END-USER CENTRED PARTICIPATORY DESIGN FOR COMMUNITY–BASED HEALTHCARE ENVIRONMENTS IN CHINA

By

QICHAO BAN

BArch, MSc, MEng

School of Architecture, University of Liverpool

Liverpool L69 3BX, United Kingdom

Thesis submitted in accordance with the requirements of the

University of Liverpool for the degree of Doctor of Philosophy in Architecture

January 2019

To my beloved family

献给我挚爱的家人

"We shape our buildings,
and afterwards our buildings shape us."

- Sire Winston Churchill, 1941

ABSTRACT

The national healthcare system in China is currently experiencing significant reform, which aims to establish a more accessible, affordable and equitable healthcare service for the whole society. One of the long-term key tasks is set to transform the allocation of medical resources in urban areas from a "centralised" pattern to a "decentralised" one. It intends to improve the capacity of delivering primary care for urban residents. In this research, attention is paid to the social sustainability and design process of healthcare environments at a community level, since the design quality has a significant impact upon the provision and delivery of healthcare service while there is a lack of specific building regulations or standards that are tailored to inform or assess the design of community-based healthcare facilities in China.

This research explores end-users' satisfaction and the design strategies related to their needs. A "multi-strategy research" strategy is applied for the research framework, which consists of desktop research and field investigations. In the desktop research, the design strategies for healthcare environments are collected with relevant evidence from regulations and previous literature. A series of social studies are conducted for the field investigations, and finally, the responses of target groups in this research are cross-compared and analysed in order to shed an in-depth insight into end-users' cognitive differences. Their preferences are used to identify the relative importance of design strategies that are related to end-users' needs for community-based healthcare environments.

It is found that a complete consensus on the needs of end-users cannot be reached for good healthcare environment design at a community level. Evidence-based design principles can improve the efficiency of knowledge exchange in the participatory design decision-making process. Information from building regulations is expected to be used as a communication platform for stakeholders with different knowledge levels. Based on the findings regarding end-users' preferences for the design of community-based healthcare environments, the suggestions on improving the existing building regulations from a social perspective are raised. Furthermore, a design aided tool, *End-user Centred Participatory Design for Community-based Healthcare Environments* Version 1.0 (ECPD), is proposed, which can be employed in conjunction with GB/T 51153 currently, in order to improve the overall design quality and social sustainability of community-based healthcare environments in China.

ACKNOWLEDGEMENTS

I, the author, am deeply indebted to a number of people who have provided amazing contributions to my PhD journey.

First and foremost, most sincere thanks are given to my supervisors, A.P. Bing Chen and Prof. Steve Sharples, for their supervision, guidance and encouragement. It could never have been possible to complete this research without their help.

My heartfelt gratitude goes to those people who gave valuable support to this research. Many thanks to all colleagues and friends at the Department of Urban Planning & Design and the School of Architecture, in particular to Prof. Xueming Chen, A.P. Sophie Sturup, Dr. Ying Chang and Ms. Jie Li for their suggestions; to Prof. Carl Hopkins for his criticism in the Architecture Annual Progress Presentations and Review Meetings; to Prof. Jian Kang from the University College London (UCL) for his comments on papers; to all participants of field investigations for feedback. I am also grateful to my viva examiners, Dr. Jiawen Han (internal) and Dr. Jun Lu (external) for their criticism, patience and constructive advices.

In addition, my appreciation goes to the Xi'an Jiaotong-Liverpool University (XJTLU) that provided financial support to this research project. It is a happy memory in my life, staying in such a beautiful campus and an excellent learning environment.

Special and forever thanks are given to my parents, parents-in-law, my wife Fangde, my son Mumu and everyone in the big family, for their love and understanding that accompany me through the past years.

This journey becomes more precious when you all stand by me.

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A

AEDET Evolution	Achieving Excellent Design Evaluation Toolkit
AIA	American Institution of Architects
AQSIQ	General Administration of Quality Supervision, Inspection, and Quarantine of The People's Republic of China
ASPECT	A Staff and Patient Evaluation Calibration Tool

B

BRE	Building Research Establishment
BREEAM	Building Research Establishment Environment Assessment Method

C

CABE	Commission for Architecture and the Built Environment
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
CDC	Centres for Disease Control and Prevention
CHA	Chinese Hospital Association
CH Centre	Community Healthcare Centre
CH Clinic	Community Healthcare Clinic
CHD	The Centre for Health Design
CHYXX	Industry Information of China
CPC	Communist Party of China

D

DH	Department of Health
DH Hong Kong	Department of Health Hong Kong

E

EBD	Evidence-based Design
EBM	Evidence-based Medicine
ECPD	End-user Centred Participatory Design for Community-based Healthcare Environments Version 1.0
EED	Eco-effective Design
EHR	Electronic Health Record
ETS	Environmental Tobacco Smoke
EUI	Energy Use Intensity

I

ICU	Intensive Care Unit
IEA	International Energy Agency

IPCC	Intergovernmental Panel on Climate Change
ISO	International Organisation for Standardisation

L

LEED	Leadership in Energy and Environmental Design

M

MBDC	McDonough Braungart Design Chemistry
MFE	Ministry of the Environment Manatu Mo Te Taiao
MOHURD	Ministry of Housing and Urban-Rural Development of the People's Republic of China

N

NEAT	National Health Service Environmental Assessment Tool
NHFPC	National Health and Family Planning Commission of the People's Republic of China
NHS	National Health Service

P

POE	Post Occupancy Evaluation
PRC	People's Republic of China

R

RIBA	Royal Institute of British Architects

S

SAC	Standardisation Administration of the People's Republic of China
SPSS	Statistical Product and Service Solutions

U

UK	United Kingdom
UN DESA	United Nations Department of Economic and Social Affairs
US	United States
USGBC	U.S. Green Building Council

W

WCED	World Commission on Environment and Development
WHO	World Health Organisation

1

Introduction

1.1 CHAPTER INTRODUCTION

This research explores end-users' satisfaction and the design process of healthcare environments at a community level in China. Based on a series of studies, this research proposes a design aided tool, which aims to improve the efficiency of end-users' participation and social sustainability in the design decision-making process of community-based healthcare environments. Chapter 1 introduces the essential content of this research project, including research background, gaps, aims, objectives, research questions, methods and the research framework.

1.2 RESEARCH BACKGROUND AND GAPS

The national healthcare system in China, founded in 1949, is currently experiencing significant reform, which aims to establish a more accessible, affordable and equitable healthcare service for the whole society (Li 2011; Yang et al. 2016). For this purpose, several long-term key tasks were launched in 2009. One of them, "improving the primary care delivery system", was set to transform the allocation of medical resources in urban areas from a "centralised" pattern to a "decentralised" one (Yang et al. 2016, p.1). It is expected that such a transformation would improve the capacity of delivering primary care and respond to the requirements of the Healthy City raised by the World Health Organisation (WHO) (Li 2011; Yang et al. 2016). Much literature demonstrates that a high-quality community-based healthcare environment, as a key performance indicator for the social development, is necessary and important to support the healthcare transformation and people's health and well-being (Xu & Huang 2010; Li 2011; Wu et al. 2015; He & Chen 2016).

However, based on the observation of the current construction market in China, it is found that there is a gap in primary care delivery systems. On one hand, a large number of community-based healthcare facilities have been built since 1990s, which intends to improve the quality of healthcare service. By 2016, the total amount of community-based healthcare facilities in the urban areas of China had reached about 34,000, and will continue growing in the following decades in order to meet the demands of the whole society (CHYXX 2016a; Ban et al. 2018). On the other hand, there is a lack of specific building regulations or standards that are tailored to inform or assess the design quality of community-based healthcare environments.

Previous research has shown that healthcare buildings should be designed as a therapeutic environment that can contribute to the process of healing rather than a place where only medical treatments take place (DH 2014, p.vi). The design quality of community-based healthcare environments has a significant impact upon the provision and delivery of primary care. To improve the overall quality of the built environment, sustainability assessment methods are widely used as information sources and design decision-making aids by architects for their design work (Lutzkendorf & Lorenz 2006; Chen et al. 2011). Nevertheless, current healthcare building regulations for sustainability assessment in China are mainly designed for general hospitals or to be used by both hospitals and community-based healthcare facilities (i.e. Community Healthcare Centres and Community Healthcare Clinics). Architects have to use these building regulations as references and identify the information relating to the design of community-based healthcare environments in a relatively short time. To some extent, it affects both design efficiency and quality of healthcare environments at a community level.

To solve the above problems, this research focuses on healthcare environments at a community level. It attempts to provide useful information to optimise the design process of community-based healthcare environments in China. This research looks at end-users' satisfaction with healthcare environments, because such information can be applied to inform healthcare environment design and thereby improve the overall quality of healthcare environments and end-users' health and well-being (Lawson & Phiri 2003; Phiri & Chen 2014; Mills et al. 2015;

CHD 2015). To explore end-users' satisfaction with healthcare environments, it is necessary to create a participatory design process that can actively engage end-users in the design decision-making to communicate directly with architects and other professionals. Based on the knowledge exchange between stakeholders with different knowledge levels, architects can explore and understand end-users' needs for the built environment, and further integrate such information into their design work by choosing appropriate design strategies.

Sustainability has been considered as a high-level standard in all development domains, especially for the built environment. As a multi-disciplinary principle, sustainability can only be achieved on the basis of a "relative balance" of social, environmental and economic aspects (Pitts 2004; Ritchie & Thomas 2009; Lutzkendorf et al. 2012). Since sustainability is acknowledged as an anthropocentric concept that concerns human values in social, ethical and cultural domains, it is necessary to use people's cognition and satisfaction to evaluate the relationship of these aspects and improve healthcare environments from a social perspective. Therefore, this research intends to gain an in-depth insight into this possibility and provide findings that can be used to inform the design of community-based healthcare environments in the process of healthcare transformation in China. As a result, a design aided tool, *End-user Centred Participatory Design for Community-based Healthcare Environments* Version 1.0 (ECPD), is finally proposed to visualise and digitalise the participatory design approach that is described in this thesis.

1.3 RESEARCH AIMS AND OBJECTIVES

This research aims to **provide an understanding of end-users' satisfaction and design strategies related to end-users' needs for community-based healthcare environments**, **and then develop an approach that can improve the efficiency of end-users' participation and social sustainability of healthcare environments at a community level**.

To achieve the aims of this research, specific objectives have been defined as below:

- Collecting design strategies for healthcare environments based on the literature and theories relating to healthcare design;
- Exploring end-users' satisfaction with healthcare environments at a community level and design strategies related to the environmental needs of these end-users;
- Identifying significant cognitive differences within end-users that may lead to the priority variances of end-users' needs and affect the efficiency of the communication

and knowledge exchange in the design decision-making process of community-based healthcare environments; and

- Testing the effectiveness of using evidence-based design principles (i.e. current best evidence) in improving the efficiency of knowledge exchange and achieving a relatively high consensus between stakeholders with different knowledge levels.

1.4 RESEARCH QUESTIONS

To achieve the above objectives, this research will answer the following questions:

- Research Question 1: What design strategies can improve the quality of community-based healthcare environments and thereby meet end-users' needs? What are end-users' preferences for these strategies?
- Research Question 2: Is there a consensus on good community-based healthcare environment design within end-user groups? If no, what are the cognitive differences?
- Research Question 3: Can evidence-based design principles be used to facilitate the knowledge exchange across different stakeholder groups in the participatory design process and achieve a win-win result?
- Research Question 4: How can the current building regulations in China be further modified to ensure end-users' satisfaction and social sustainability for community-based healthcare environments?

The research questions, including their required data and methods, will be further discussed in Chapter 3 *Research Framework and Methodology*.

1.5 RESEARCH METHODS

To answer the above questions, a "multi-strategy research" strategy has been designed for this research, which aims to generate theories that interpret people's epistemology (Bryman 2012, p.628). It consists of desktop research and field investigations.

The desktop research, including literature review and archive study, is used to collect design strategies for healthcare environments. Based on a wide spectrum of literature, the research background, boundaries, gaps and research questions are identified. A series of sustainability assessment methods and design aided tools for healthcare environments are analysed and cross-compared. By collecting relevant design strategies for healthcare environments, a conceptual framework is developed to support communication and knowledge exchange. Based on this conceptual framework, the questionnaires applied in the field investigations are designed. In addition, a national sustainability assessment method, *Evaluation Standard for Green Hospital Building* GB/T 51153 (the first official, mandatory healthcare building regulation for sustainability assessment in China), is selected to support the cross-comparative studies between end-users' needs and the requirements in legislation.

The field investigations consist of a semi-structured interview, questionnaire surveys for target groups and a follow-up focus group. The semi-structured interview is conducted first, with a small group of end-user representatives, in order to identify the design strategies that are important to a community-based healthcare environment from an end-user's perspective. Questionnaire surveys are then used to prioritise these design strategies. Preferences for design strategies are collected from target stakeholders (i.e. patients, medical staff and architects) and analysed statistically. Their relevant knowledge levels are explored as well. Based on the statistical results of questionnaire surveys, a follow-up focus group is conducted to shed an in-depth insight into the cognitive differences and priority variances between target stakeholder groups, and then recommend design approaches that can reach a relatively high consensus on the outputs of end-user centred participatory design. Suggestions relating to modifying the building regulations for healthcare environment design are proposed finally.

1.6 RESEARCH FRAMEWORK

The entire research project can be seen as a deductive process from a socio-technical perspective. To describe it, this thesis consists of eleven chapters (Figure 1.1). Chapter 2 *Literature Review and Research Scope* is to create a research scope for the topic "end-user centred participatory design for community-based healthcare environments in China", including research background, aims, objectives, boundaries, gaps and research questions, based on a comprehensive literature review. The research methodology is introduced in Chapter 3 *Research Framework and Methodology*.

Chapter 4 *Conceptual Framework for Healthcare Environment Design* concerns the archive study, which is used to collect design strategies for healthcare environments. These chapters (Chapter 2 ~ 4) describe the process and outcomes of the desktop research.

Then the field investigations begin, which can be seen as the second part of this research. Chapter 5 *Interview for End-user Groups and Questionnaire Design* demonstrates a semi-structured interview with a small group of patients and medical staff. It is a process of identifying the design strategies that are related to end-users' satisfaction and needs for community-based healthcare environments.

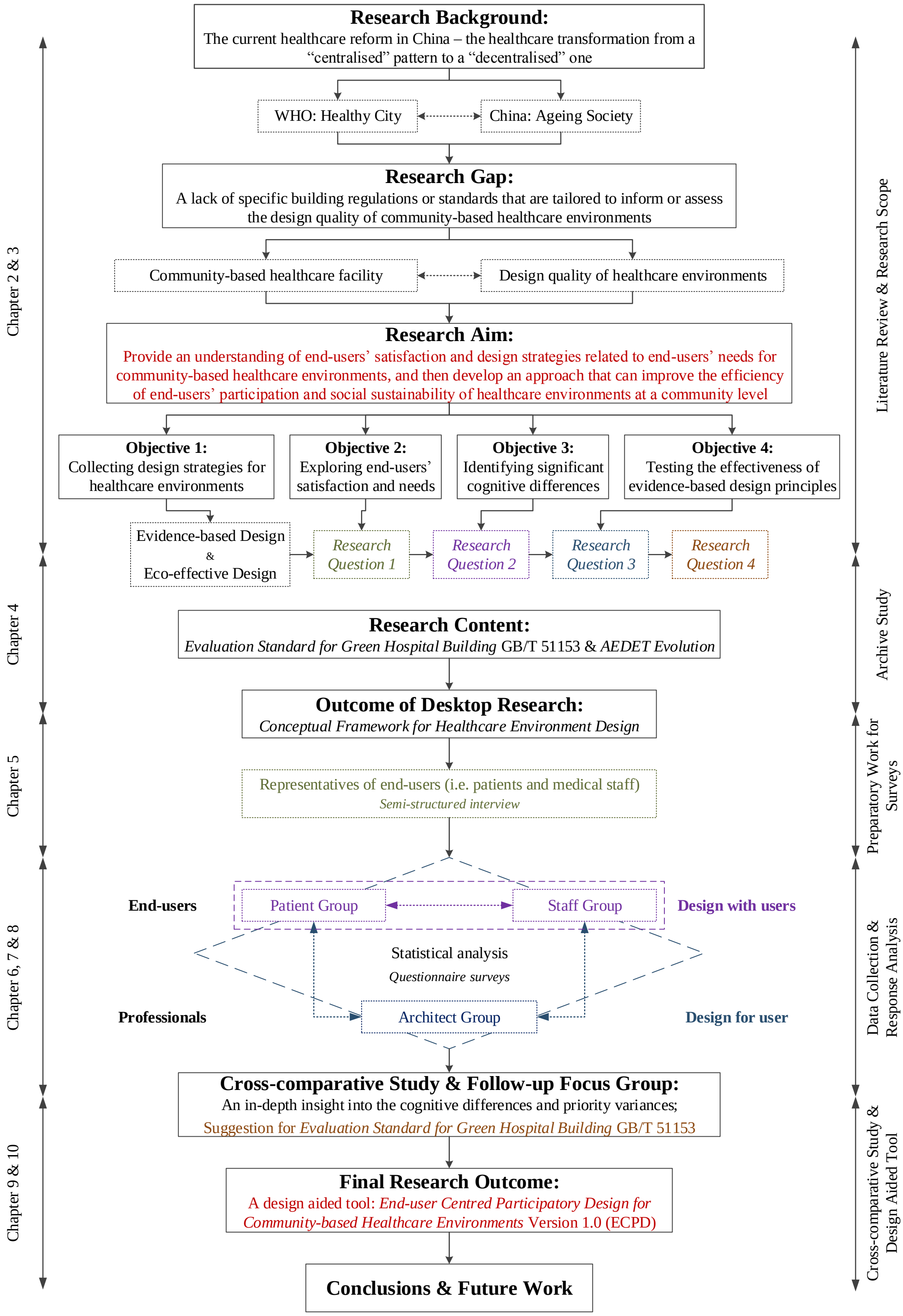


Figure 1.1 Research framework

After the questionnaires designed, data collected from target stakeholder groups is discussed in Chapter 6 *Survey and Response Analysis for Patient Group*, Chapter 7 *Survey and Response Analysis for Staff Group* and Chapter 8 *Survey and Response Analysis for Architect Group*. Basic findings about the significant cognitive differences caused by personal background are achieved according to statistical analysis.

The main research findings are summarised finally. In Chapter 9 *Cross-comparative Study and Follow-up Focus Group,* statistical results from the previous three chapters (Chapter 6 ~ 8) are cross-compared, in order to identify the significant cognitive differences between target groups that may impact upon end-users' holistic satisfaction with community-based healthcare environments and cause priority variances of their needs. Based on the results summarised from the focus group, important findings about improving the efficiency of end-users' participation and knowledge exchange are achieved and solutions relating to how to optimise the outputs of end-user centred participatory design processes are recommended. Subsequently, suggestions about optimising the capacity of building regulations in addressing social concerns (i.e. *Evaluation Standard for Green Hospital Building* GB/T 51153 in this research) are proposed. Moreover, a design aided tool ECPD, with its design rationale and comments from experienced architects, is demonstrated in Chapter 10 *End-user Centred Participatory Design for Community-based Healthcare Environments*. Finally, Chapter 11 *Conclusions and Future Work* concludes the research findings and outcomes, discusses the effectiveness of methods and relevant research limitations, and then proposes the future work.

1.7 TERMINOLOGIES

- Community-based healthcare environment: In China, there are two types of healthcare facilities at a community level, which are Community Healthcare Centres and Community Healthcare Clinics (NHFPC 2013; AQSIQ & SAC 2017). The main differences that distinguish them are total floor space and amount of service groups (for more information, see Table 2.2). In this research, community-based healthcare environments are defined as the built environments of Community Healthcare Centres and Community Healthcare Clinics.

- Sustainability imbalance: Sustainability, as a system of trinity, should be enhanced from triple dimensions – social, environmental and economic aspects, to achieve a "relative balance" of these dimensions (Ritchie & Thomas 2009; Lutzkendorf et al. 2012). "Sustainability imbalance" may be caused because the major focus is only put in certain dimensions (Lutzkendorf & Lorenz 2006; Kaatz et al. 2006; Zhou et al. 2013). For a long time, architects' attention about achieving sustainability in the built environment was mainly paid to environmental aspects at the stages of design and construction.

- Evidence-based design principle: In this research, this terminology describes a principle that uses current best evidence from research and practice to understand design strategies, including the refined design features (inputs) and measured effects (outcomes), in order to make the informed decisions about the relative importance of design strategies in a relatively short time (Hamilton & Watkins 2009).

- Socio-technical perspective: This terminology explains the method applied in this research. It identifies end-users' satisfaction and environmental needs based on their preferences (i.e. a social perspective), in order to define the relative importance of design strategies and then use the information to inform the design of community-based healthcare environments (i.e. a technical perspective).

- Design for users with users: It describes a user-centred participatory design process. In this process, the decisions on design are completed based on the collaboration between users and designers. Users express their needs for the design as explicitly as possible. In the meantime, designers should facilitate the process of knowledge exchange between stakeholders with different knowledge levels (Eason 1995). On one hand, designers choose appropriate design strategies to meet users' requirements; on the other hand, they are obligated to help users understand the links between users' needs and design strategies without the loss of any specialist knowledge that might be relevant (ibid).

- Cognitive difference: Cognitive differences are mainly caused by the differences in cognitive abilities – for example, personal characteristics, working memory, spatial ability and verbal closure (Carroll 1993; Gwizdka n.d.). In this research, "cognitive difference" is used to describe the conflicts between the different knowledge levels and opinions of target stakeholder groups (i.e. patients, medical staff and architects).

- Consensus: In this research, it is used to describe a situation that cognitive differences and priority variances of stakeholders could be reduced, and a relatively universal agreement is reached by participators on the outputs of the participatory design process – prioritising design strategies for community-based healthcare environments based on their relative importance.

- Common language: According to the Oxford English Dictionary Online, a definition of "common" is "belonging equally to more than one". A "common language" means the shared information that can be understood explicitly and efficiently by all participants or stakeholders. As indicated by Dammann and Elle (2006, p.388), "a common language for green buildings" reflects "a means of making the environmental impacts and benefits of buildings visible to relevant actors and of facilitating the communication of environmental aspects in the building process as well as the decision-making for the design, construction and operation of buildings".

1.8 CHAPTER SUMMARY

This chapter provides a general introduction about essential content of this research project, including background, gaps, aims, objectives, research questions, methods and the research framework. Based on these, the research project will be conducted step by step.

2

Literature Review and Research Scope

2.1 CHAPTER INTRODUCTION

In line with the research framework (see Figure 1.1), this chapter describes the research background based on literature review. It explores the national healthcare system in China and sustainable objectives for healthcare environments. The end-user centred participatory design principle in healthcare environment design is briefly introduced. Subsequently, research gaps and boundaries are identified. A research scope with specific objectives, research questions and the research scenario is defined and discussed, in order to guide the following of this research project.

2.2 HEALTHCARE SYSTEMS AND ENVIRONMENTS IN CHINA

It is acknowledged that a high-quality healthcare environment can contribute to the overall quality of healthcare service and people's health and well-being (Ulrich 1984; Lawson & Phiri 2003; Hamilton & Watkins 2009; Phiri 2014; DH 2014; Mills et al. 2015; CHD 2015). As architectural design can be impacted and guided by policies and relevant building regulations, it is necessary to have a general understanding of the development of national healthcare systems in China, during over 70 years with three developmental stages (i.e. 1949 ~ 1978, 1979 ~ 2008 and 2009 ~ Present).

2.2.1 Healthcare Reform in China and Healthcare Environments

The national healthcare system in China was founded in 1949, along with the establishment of the government of the People's Republic of China (PRC). To support the healthcare service in urban areas, healthcare buildings at different levels were established to form "a three-tiered, vertically organised network" of communities, districts and general hospitals, and standardised design was sequentially required for corresponding healthcare environments (Liang & Chan 2004, p.1). According to Li (2011, p.6), huge achievements had been made in the healthcare field during the first 30 years (1949 ~ 1978), including "a universal coverage healthcare system" and "a low-cost, wide-coverage primary healthcare model". With the improvement of healthcare service, life expectancy of population rose incrementally from 35 years in 1949 to 68 years in 1978, and the rate of infant mortality declined from 250 per 1000 live births per year (25%) to less than 50 per 1000 (5%) (Li 2011, p.6; Zhao & Feng 2010).

The first round of large-scale healthcare reform started from the 1980s, which was caused by the Chinese economic reform (Zhao & Feng 2010). The "old system of healthcare" was ended as this country attempted to "switch to a market-oriented healthcare system" (Li 2011, p.6). However, after 30 years' reform (1979 ~ 2008), the national healthcare system was "far behind the current level of economic development and people's demands", compared with the results of the economic reform during the same time (Li 2011, p.6; Zhao & Feng 2010). Various social problems emerged. For example, the improvement in life expectancy of population began to slow down. Total medical costs escalated rapidly. Medical resources were allocated unequally, and the relationship between patients and medical staff deteriorated (Li 2011; Yang et al. 2016). The healthcare sector became one of the areas in China's social systems which received the most complaints (Li 2011).

As indicated by Li (2011), the reasons for above problems were due to government failure. Authorities' promise that aimed to insure people's basic healthcare needs was failed, which led to breakdown of the national healthcare system. A lack of government regulations resulted in that the market-oriented healthcare system introduced excessive commercialisation models of healthcare service and competitive mechanism among healthcare facilities (Zhao & Feng 2010; Li 2011; Yang et al. 2016). It finally resulted in unequal and inefficient social resource allocation. By the end of this period, the healthcare system and healthcare environments had been hospital-based and centralised, and in urban areas general hospitals accounted for 95% of medical resources (Yang et al. 2016, p.2; Yao et al. 2011).

With these problems and reasons recognised, a new round of healthcare reform was launched on 6th April 2009 (2009 ~ Present) (Figure 2.1). It aimed to establish a more accessible, affordable and equitable healthcare service for the whole society, by launching a long-term reform plan with five key tasks (Table 2.1) (Zhao & Feng 2010; Yang et al. 2016). Among the tasks, the third one, "improving the primary care delivery system", was set to contribute to the "equity in health and healthcare, better service quality, and efficient use of health resources" (Liu et al. 2015, p.88; Yang et al. 2016, p.1; Li 2011). Zhang et al. (2011, p.182) explain that this task is to improve the access to healthcare service by strengthening primary care delivery systems and transforming community-based healthcare facilities from self-supported entities to "local government-supported community health centres". Scholars indicate that this task attempts to optimise healthcare networks and allocation of medical resources in urban areas, by changing the hospital-based healthcare service and enhancing primary care delivery at a community level (Zhao & Feng 2010; Li 2011; He 2011; Liu et al. 2015; Wu et al. 2015).

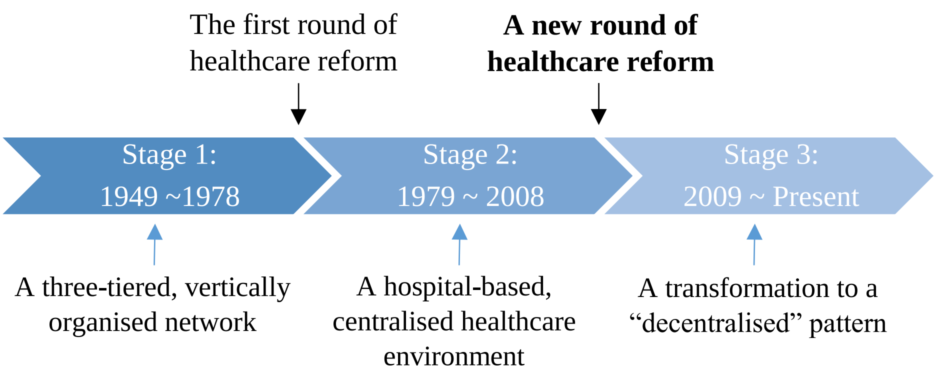


Figure 2.1 Developmental stages of the healthcare system in China and changes of healthcare environments

Table 2.1 Key tasks of the new healthcare reform in China (source: Yang et al. 2016, p.1; Li 2011)

- "Expanding the coverage of basic medical insurance to accommodate more than 90% of the population;
- Establishing a national essential medicines system to meet everyone's primary medicine needs and alleviate residents' cost burden;
- Improving the primary care delivery system to provide convenient basic health care at low cost and build a system of grading clinics and two-way referrals between primary care facilities and hospitals;
- Making public services available and equal for all; and
- Promoting pilot reforms in public hospitals."

Since 2009, vast changes have occurred to healthcare environments in urban areas. A large number of community-based healthcare facilities (i.e. Community Healthcare Centres and Community Healthcare Clinics) have been and will be built to deliver primary care to urban residents (Li 2011). Attention of authorities and the public has been paid to the healthcare transformation in urban areas from a "centralised" pattern to a "decentralised" one, to support the new healthcare reform (Yang et al. 2016, p.1).

2.2.2 Healthy City and Chinese Ageing Society

According to the World Health Organisation (hereafter referred to as WHO) (1998, p.13), a Healthy City is "one that is continually creating and improving those physical and social environments and expanding those community resources which enable people to mutually support each other in preforming all the functions of life and developing to their maximum potential" (WHO 1997; Hancock & Duhl 1988). This movement, which was issued on 4th April 1996, is considered as a long-term project, aiming to raise public awareness on health-related issues; to reduce health problems; to enhance access of primary healthcare; and to create a natural, comfortable and equitable environment (DH Hong Kong 2007).

It is indicated that the national government of China has cooperated with the WHO to use the concept of Healthy City to guide the ongoing healthcare reform (Li 2011; Yang et al. 2016). Therefore, there is an important overlap between the tasks of Chinese healthcare reform and the standards of Healthy City movement – for example, accessible primary care systems that can meet people's basic healthcare needs and high-quality community-based healthcare facilities (Yang et al. 2016). Both movements emphasise a health-supportive environment at a community level. By 2015, there were, in total, 17 areas at different administrative levels (i.e. city-level, county-level and district-level) in China that had received the certificates of Healthy City from the WHO (Figure 2.2) (WHO 2015).

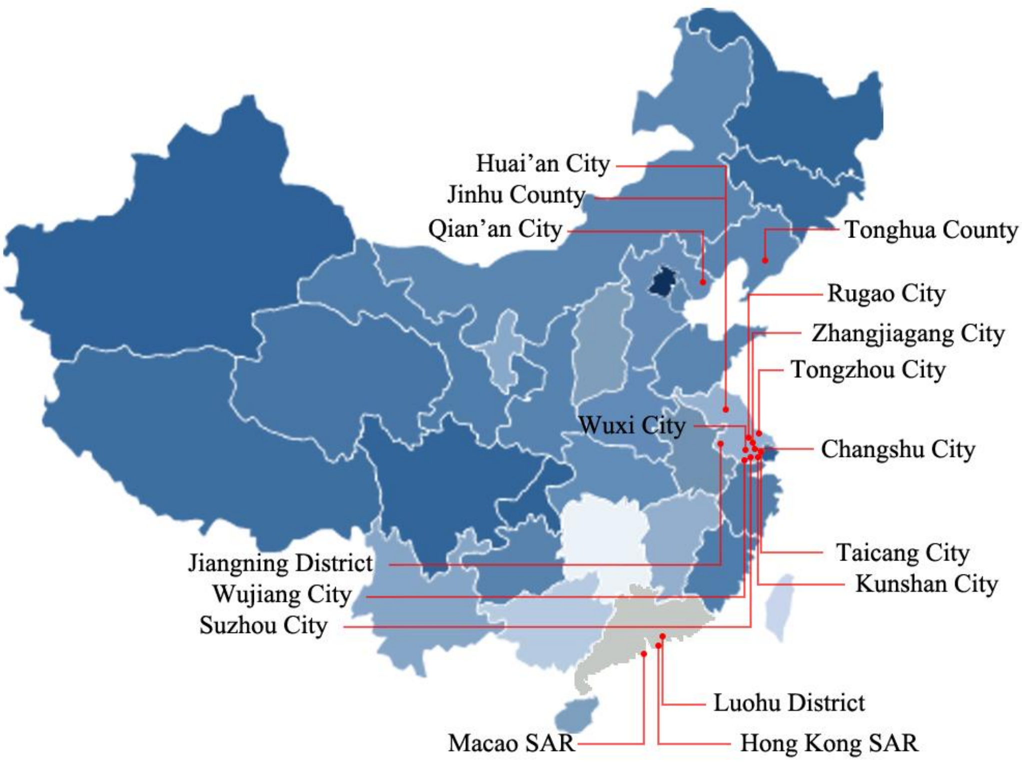


Figure 2.2 Certified Healthy City projects in China by 2015 (source: WHO 2015; WHO n.d.)

Besides the international trends for public health, this new healthcare reform also aims to respond to the requirements arising from the Chinese ageing society (Liu et al. 2010; Wang et al. 2015; WHO 2015). According to the statistical results, the percentage of the elderly (i.e. people aged 60 years or above) in China will rise from 12.4% of the total population (168 million) in 2010 to 28% (402 million) by 2040 (Figure 2.3) (UN DESA 2013; WHO 2015). By 2050, 3 of 10 Chinese people are expected to belong to the elderly. Scholars indicate that the primary care delivery system at a community level can provide effective support to the "ageing-in-place" (Gelun 2015, p.59; WHO 2015; Wang et al. 2015; Dong et al. 2016).

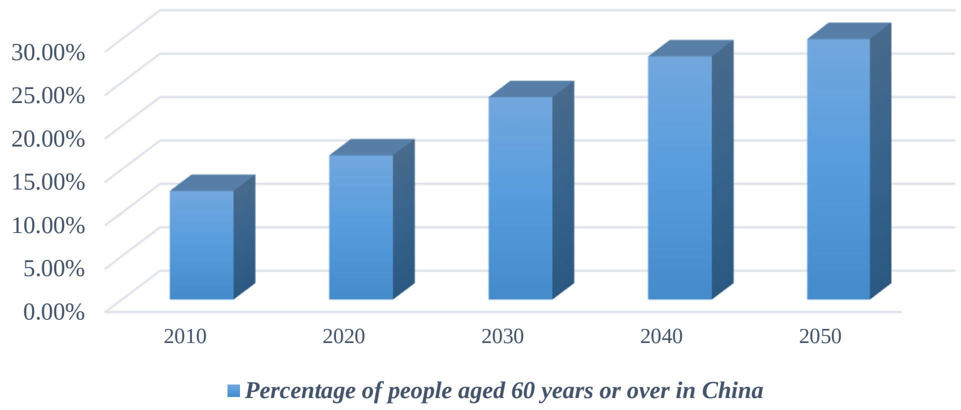


Figure 2.3 Percentage of people aged 60+ years in China from 2010 to 2050 (source: CHYXX 2016b)

According to Wang et al. (2015), a high-quality primary care delivery system provides accessible healthcare service to the elderly. Elderly residents should be able to access primary care and have convenient basic healthcare service. The current therapeutic pressure caused by the hospital-based healthcare environments can be potentially relieved. Moreover, such access encourages people to receive regular health check, which can reduce people's morbidity and further promote their health and well-being. It is believed that a health-support environment at a community level, as a key performance indicator for social development, will play a more important role of public service in the near future.

2.2.3 Community-based Healthcare Facilities in China

A primary care delivery system belongs to urban healthcare service. It was established during the process of urbanisation. This concept first appeared in developed countries around the 1930s ~ 1940s (Xu & Huang 2010). When more and more people migrated to cities, general hospitals could no longer meet residents' daily demands and there was an increased concern on the provision of healthcare service at a city level. The centralised allocation of urban medical resources (i.e. hospital-oriented healthcare environments) resulted in the imbalance of healthcare service and low efficiency of therapy (ibid). Healthcare facilities at a community level can reduce the therapeutic pressure of general hospitals and thereby solve the problems. It provides primary care to local occupants living in communities, including precautionary therapy, treatments for non-emergency ailments and psychosis recovery (Ashcroft 2015). The development of community-based healthcare environments can be viewed as an important factor in evaluating the living conditions and well-being of residents.

During the 1970s, the concept of healthcare service at a community level first entered into China, but was not applied at a large scale until the 1990s (Xu & Huang 2010). China's urbanisation had been in a stage of rapid development in the period from 1996 to 2012. In this period, the allocation of social resources became extremely unbalanced (Xu & Huang 2010; Li 2011). A series of policies were issued by authorities in China, in order to promote the development of healthcare service at a community level and encourage the relevant authorities at provincial and city levels to build community-based healthcare networks (Table 2.2).

Table 2.2 Policies for the development of healthcare service at a community level in China (source: Central Committee of CPC & State Council 1997; NHFPC 1999; NHFPC 2002; NHFPC 2006)

Time	Title	Department
1997	Decisions on Healthcare Reforms and Development by Central Committee of the Central Committee of the Communist Party of China and State Council	Central Committee of the Communist Party of China and State Council
1999	Opinions on Developing Urban Community Health Service	National Health and Family Planning Commission of the People's Republic of China (NHFPC)
2002	Opinions on Speeding up the Development of Urban Community Health Service	NHFPC
2006	Management Methods for Urban Community Healthcare Service Facilities	NHFPC

Table 2.3 Main differences between CH Centres and CH Clinics (source: NHFPC 2013, p.2)

Category	CH Centre			CH Clinic
Service group	≤50,000	50,000 ~ 70,000	≥70,000	8,000 ~ 10,000
Total floor space	1,400m^2	1,700m^2	2,000m^2	150 ~ 220m^2
Bed (*optional*)	0.3 ~ 0.6 bed/1,000 persons; ≤50 beds			None

According to the *Guidance on Developing Urban Community Health Service* issued in 2006, facilities that support healthcare service at a community level include two levels – Community Healthcare Centres and Community Healthcare Clinics (hereafter referred to as CH Centres and CH Clinics) (NHFPC 2006; AQSIQ & SAC 2017). The main differences (i.e. total floor space and amount of service groups) are detailed in Table 2.3. This content was subsequently incorporated into a building regulation, *Construction Standard for Community Healthcare Centre/Clinic* JGJ 163, which was issued by the NHFPC in 2013 (NHFPC 2013). By the end of 2007, there were approximately 1,600 CH Centres and 5,000 CH Clinics in 28 cities of

China (He & Chen 2016, p.329). Until 2009, as stated earlier, the development of primary care delivery systems at a community level was included as one of the key tasks of Chinese new healthcare reform.

By 2016, the total amount of community-based healthcare facilities, including CH Centers and CH Clinics in the urban areas of China, had reached about 34,000, and will continue growing in the following decades in order to meet the demands of the whole society and tasks of the new healthcare reform (Figure 2.4) (CHYXX 2016a; Ban et al. 2018). It can be seen that the primary care delivery system has received good background for future prospect in China. However, scholars indicate that its design quality is not equally appreciated – there have been no specific building regulations that are tailored to inform or assess the overall design quality of community-based healthcare environments (Zhang et al. 2011; Lu 2011; Gelun 2015). Table 2.4 lists all building regulations applied for healthcare environment design in the current construction market of China, including design codes and assessment methods.

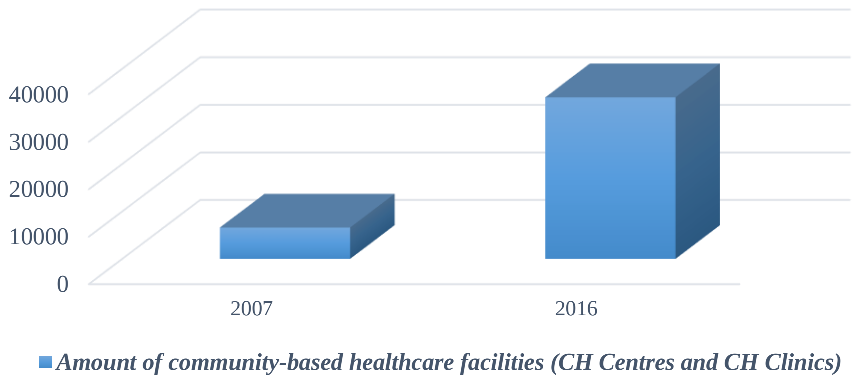


Figure 2.4 Changes of the total amount of community-based healthcare facilities in the urban areas of China (source: He & Chen 2016; CHYXX 2016a)

Table 2.4 Building regulations for the design of healthcare environments in China

Title	Code	Time
Code for Design of General Hospital	JGJ49-88	1989
Architectural and Design Code for General Hospital	Trial	2004
Technical Instruction for Green Hospital Building Assessment	Trial	2011
Assessment Standard for Healthcare Green Building	CSUS/GBC-2	2011
Construction Standard for Community Healthcare Centre/Clinic	JGJ 163	2013
Code for Design of General Hospital	GB 51039	2014
Evaluation Standard for Green Hospital Building	GB/T 51153	2015

Note: JGJ means Industrial Standard; GB (/T) means National Standard (official design regulation).

It can be found that the *Code for Design of General Hospital* has three versions, including an industrial standard version JGJ49-88 in 1989, a trial version *Architectural and Design Code for General Hospital* in 2004 and a national standard version GB 51039 in 2014. They are mandatory and have only been applied for general hospitals, as vast content concerns complex medical procedures that are not included in community-based healthcare facilities (MOHURD & AQSIQ 2014). Moreover, the *Construction Standard for Community Healthcare Centre/ Clinic* JGJ 163, which is an industrial standard for community-based healthcare facilities, is set only for constructive specification, including required medical departments, amount of service groups and total floor space for each department (NHFPC 2013).

The rest are for sustainability assessment of healthcare environment design. Among them, the *Technical Instruction for Green Hospital Building Assessment* was published by the Ministry of Housing and Urban-Rural Development of the People's Republic of China (MOHURD) and National Institute of Hospital Administration, and the *Assessment Standard for Healthcare Green Building* CSUS/GBC-2 was published by the Chinese Hospital Association (CHA) (MOHURD 2011; CHA 2011). They can be seen as two trial versions of the first official sustainability assessment method for the design of healthcare environments – *Evaluation Standard for Green Hospital Building* GB/T 51153, which was published on 3rd December 2015 and put into practice on 1st August 2016 (MOHURD & AQSIQ 2015). All of these are designed to provide information for healthcare buildings and environments, and thereby secure their overall design quality.

On one hand, the provision of primary care delivery systems has received attention from authorities and the public of China. On the other hand, there is a lack of specific regulations or standards that are tailored to inform or assess the design of community-based healthcare environments in the construction market. Current building regulations for sustainable design of healthcare environments in China are mainly designed for general hospitals or to be used by both hospitals and community-based healthcare facilities. For healthcare environment design at a community level, architects have to use these regulations as references and identify the information relating to the design of community-based healthcare facilities in a relatively short time. To a great extent, all these building regulations are still "hospital-based". As a general hospital and a community-based healthcare facility have different functions and target service groups, it is not easy to directly use existing building regulations to inform the design of healthcare environments at a community level or assess the design quality of community-based healthcare environments. There is a lack of understanding of how to improve the design quality of healthcare environments at a community level. To address healthcare environment design at a community level, this research focuses on the overall design process of community-based healthcare environments from an architect's perspective. The findings, along with general hospital design guidance, can be used to support the development of primary care delivery systems and healthcare reform in China.

2.3 SUSTAINABILITY AND HEALTHCARE DESIGN

In the modern theory of healthcare design, a healthcare environment should "provide a therapeutic environment which the overall design of the building contributes to the process of healing and reduces the risk of healthcare-associated infections rather than simply being a place where treatment takes place" (DH 2014, p.vi). In brief, the design quality of healthcare environments has a significant impact upon the provision and delivery of healthcare service. Healthcare environment design is discussed, including the trends, theories and standards.

2.3.1 Sustainability for Healthcare Environment Design

The *Our Common Future*, a report from the World Commission on Environment and Development (WCED) in 1987, for the first time, defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Bruntland 1987, p.43). As a multi-disciplinary concept, it soon gained stature in international development domains and gave all industries "a broad conceptual foundation on which to grow" (Guenther & Vittori 2013, p.7).

In 1992, at the Conference of Environment and Development of the United Nations, a blueprint for achieving global sustainability was issued as the target of sustainable development (ibid). Sustainability is acknowledged as "an anthropocentric concept from its outset", which concerns human values in social, ethical and cultural aspects (Farmer 1996, p.185; Layard et al. 2001, p.8; Flanagan et al. 1998). A large number of relevant studies describe sustainability as a system of trinity, which covers social, environmental and economic domains (also referred to as Triple Bottom Line) (Edwards & Turrent 2000; Lutzkendorf et al. 2012).

Since architecture is one of the most long-lived physical artefacts that society produces, built environments should be designed towards sustainability standards which are used to manage and evaluate the design quality of buildings (Benton 1988). According to Phiri and Chen (2014, p.7), design for sustainability is a bigger picture of sustainable development, as it has potential to improve the overall quality and efficiencies and, in the same time, to optimise the environmental performance. However, achieving sustainability for the built environment is also a challenge for society worldwide, as it should integrate social, economic, technical and healthy performance into the design of built environments (Benton 1998; Boron & Murray 2004; Ratner 2004; Lutzkendorf & Lorenz 2006; Lutzkendorf et al. 2012; Zhou et al. 2013). Based on the concept of Triple Bottom Line, the "dimensions of sustainability" (also referred to as "goals of sustainability") in the built environment are explained in Table 2.5 (Lutzkendorf et al. 2012, p.261; Hofstetter 1998; Haes & Lindeijer 2002; Guinee 2002). Environmental goals are focused on the issues regarding ecosystems, including energy-saving, resource-saving and biodiversity; social goals concern cultural values, users' needs, human health and safety; and economic goals aim to use the lifecycle principle and cost-benefit analysis to cross-compare different aspects.

Table 2.5 Dimensions / goals of sustainability in the built environment (source: Lutzkendorf et al. 2012, p.261)

"Environmental goals (e.g. energy carriers, raw materials, land and water)

- Protection of ecosystems from negative impacts from emissions and waste products on the local and global environment;
- Protection of ecosystems from risks;
- Preservation of biodiversity (flora and fauna);

Social goals

- Protection of cultural values, ensuring urban and building related design quality;
- Meeting the needs of users, providing suitable living and working conditions;
- Safeguarding health and safety of all those involved in the construction stage, providing comfort for the end-users;

Economic goals

- Optimisation / minimisation of life-cycle costs;
- Protection of capital, protection of economic value and ensuring stability of value; and
- Reducing external costs."

Moreover, to implement the idea of sustainability and manage relevant design strategies for built environments, sustainability assessment methods, as important design decision-making aids, were published by organisations and authorities in the world – for example, *Building Research Establishment Environment Assessment Method* (BREEAM) in the UK, *Leadership in Energy and Environmental Design* (LEED) in the US and *Assessment Standard for Green Building* GB/T 50378 in China (Table 2.6).

Table 2.6 Examples of sustainability assessment methods for buildings in different countries (source: China Society for Urban Studies 2013, p.277)

Nation	UK	USA	Japan	Germany	China
Name	BREEAM	LEED	CASBEE	DGNB	Assessment Standard for Green Building GB/T 50378
Date	1990	1998	2003	2008	2014
Authorities	Building Research Establishment	U.S. Green Building Council	Green Build Council / Japan Sustainable Building Consortium	German Sustainable Building Council	Ministry of Housing and Urban-Rural Development of the People's Republic of China (MOHURD) / General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ)

As stated earlier, architecture is a long-lived physical artefact which has ample records about human activities in history. It is not easy to rapidly be changed to incorporate the concept of sustainability into design practice from a comprehensive perspective. To a great extent, applying sustainability standards means re-considering the balance between socio-economic development and environmental resource consumption (Blutstein & Rodger 2001). According to Guenther and Vittori (2013), early initiatives of achieving sustainability in the design of built environments (also referred to as "sustainable design") were primarily focused on the environmental dimension – reduction of energy demand, because global resources became more scarce (also referred to as "energy crisis"). Some scholars argued that most sustainability assessment methods emphasised environmental aspects at the stages of design and construction, instead of looking at the balance with social and economic concerns, which caused the "sustainability imbalance" (Zhou et al. 2013, p.233; Lutzkendorf & Lorenz 2006; Kaatz et al. 2006). The documents listed in Table 2.6 were described as "green building assessment methods" rather than "sustainable building assessment methods", since they mainly "measured improvements in environmental building performance in relation to typical practice or requirements" (Cole 1999, cited in Kaatz et al. 2006, p.310).

In recent years, people have gradually realised that focusing only on environmental outcomes would be insufficient for the development of the whole society, since each dimension can profoundly impact upon people's daily lives. To improve the overall design quality of the built environment, "the subject matter of sustainability extends far beyond merely environmental and health aspects and requires the treatment of interrelationships between environmental, social and economic issues" (Luztkendorf et al. 2012, p.261). Sustainability of the built environment can be achieved only if the design aims to enhance buildings' performance-in-use from all dimensions. In addition, many scholars indicate that human should be in the foremost position in order to achieve a relatively balanced sustainability for the built environment (Luztkendorf & Lorenz 2006; Zhou et al. 2013).

In terms of healthcare design which also has a long history in human activities, the design of healthcare facilities was previously concentrated on the physical environment to support the medical procedures and service delivery (Guenther & Vittori 2013). However, current researchers and practitioners have become more aware of that it is much more important to achieve "a healing environment" towards the sustainability of healthcare environments (DH 2014, p.v). It can improve the overall quality of both environments and therapeutic outcomes, instead of being a place only for medical treatments (CHD 2015; Mills et al. 2015). According to the Centre for Health Design (CHD) (2015, p.20), there are ten new conceptual trends that can impact upon the modern sustainable design of healthcare environments today:

- "Trend 1 – focus on quality, safety and satisfaction;

- Trend 2 – healthcare costs and reimbursement;
- Trend 3 – environmental safety and sustainability;
- Trend 4 – healthcare worker safety and caregiver shortages;
- Trend 5 – ageing population;
- Trend 6 – healthcare information and emerging technology;
- Trend 7 – healthy living and wellness;
- Trend 8 – decentralised healthcare, ambulatory care and care at home;
- Trend 9 – disaster preparedness and emergency department saturation; and
- Trend 10 – genomics and predictive health".

It can be found that at least half trends (e.g. Trend 1, Trend 2, Trend 5, Trend 7 and Trent 8) emphasise the social aspects. As indicated by Baum et al. (2009), there are two prominent theories that significantly impact upon the sustainability of healthcare architecture today and architects' choices of design strategies in the design decision-making process, and they are "evidence-based design" and "eco-effective design". Both "achieve increased or improved positive outcomes in human and/or environmental health" in healthcare environments (Baum et al. 2009, p.2; Shepley et al. 2012, p.23). These theories can be seen as two basic principles of the modern healthcare environment design – "the very first requirement of a hospital is that it shall cause neither human nor ecological harm" (Verderber 2010, p.v).

2.3.2 Evidence-based Design

According to Hamilton and Watkins (2009, p.9), the generalised definition of evidence-based design (EBD) is:

> "Evidence-based design is a process for the conscientious, explicit and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project".

It is an architectural theory that tends to use research findings to inform the design of buildings and environments. This theory emphasises objective facts and also respects the requirements of clients and users (Hamilton & Watkins 2009; Ban et al. 2016b). Evidence-based design principles aim to help designers, clients, users and other stakeholders define their own needs for the built environment in design procedures (Hamilton & Watkins 2009).

This theory was first established for healthcare design, as it evolved from a theory applied in the medical domain – evidence-based medicine (EBM). Evidence-based medicine can be described as “medical decisions based on the evidence” (Langley 1997, p.2382). It is used to guide medical staff (e.g. doctors, nurses and pharmacists) to use appropriate information (i.e. credible research findings) to make clinical decisions throughout the care procedures for patients (ibid). The core of this theory is that “all clinical decisions should be made based on best evidence from statistical research in practice, and medical staff’s clinical experience as well” (Ban et al. 2016b, p.99; Selvaraj 2010; CHD 2015). The idea “decisions based on the best evidence” was soon embedded in architectural design and became “evidence-based design” to explore the links between healthcare environment design and the outcomes of healthcare service. It introduces interdisciplinary cooperation between the medical and architectural fields, and can be seen as a combination of evidence-based medicine and performance-based design (Chen et al. 2016).

The research relating to the potential between architectural design and healthcare outcomes can essentially be tracked back to the middle 1800s. Florence Nightingale (1820 ~ 1910), the founder of the modern nursing system, believed that the role of the built environment was a key factor in human health (Ruddock 2009). According to her theories, a healthcare environment was described as a physical, psychological, social and spiritual environment in together. Since then, attention has been paid by relevant practitioners and researchers to the concept “a therapeutic built environment for healthcare” and the links between a physical environment and patients’ well-being (CHD 2015).

In 1984, a ground-breaking EBD strategy was recorded in a journal paper, *View Through a Window May Influence Recovery from Surgery*, which was published in *Science*. The author Ulrich (1984) depicted a random parallel experiment which had, for over 10 years, explored the function of outdoor natural views on patients’ length of hospitalisation. In his experiment, the samples (surgical inpatients who had undergone cholecystectomy) in the experimental group were arranged in the wards with windows facing a natural view of trees, while the samples in the control group stayed in the wards and could only see brick walls out of windows. Wards were separated by a corridor. The statistical records finally proved that “the patients with window views of the trees spent less time in the hospital than those with views of the brick wall: 7.96 days compared with 8.70 days per patient” (ibid, p.224). This was the first time that scientific and statistical methods were employed to prove the effectiveness of the built environment on patients’ health and recovery (Hamilton & Watkins 2009). Subsequently, research groups from various fields began to conduct similar experiments for other design features (e.g. lighting, ventilation and noise). Evidence-based design enjoyed a smooth development, and later became one of the most important trends for healthcare environment design (Figure 2.5).

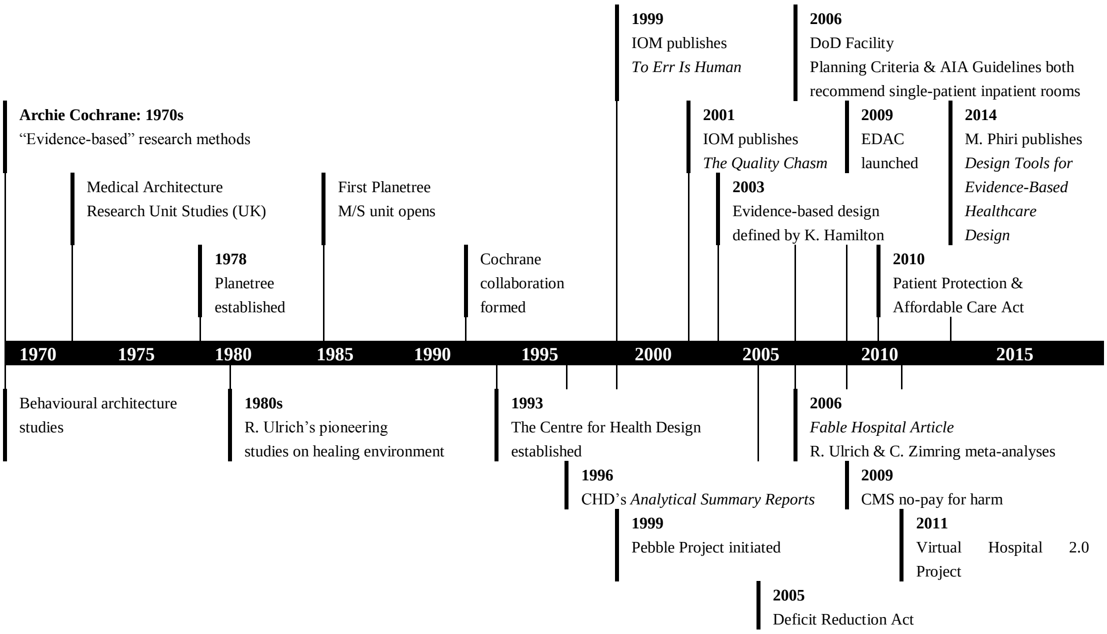


Figure 2.5 Converging efforts of evidence-based design (source: Ban et al. 2016a, p.99; Malone et al. 2007)

The evidence-based design for healthcare is mainly used to improve the built environment of healthcare facilities that can generate positive healthcare outcomes by using best evidence from research and practical knowledge (Hamilton & Watkins 2009; Hamilton & Shepley 2009). According to the WHO (1948, p.100), health is defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". Therefore, EBD strategies for healthcare environments emphasise the utilisation of design features in the physical environments that can impact upon patients' health, recovery and safety, as well as medical staff's well-being, productivity, injuries, work effectiveness and morale (CHD 2015, p.124; Hamilton & Watkins 2009).

To improve the healthcare outcomes of built environments and "monitor the success or failure for subsequent decision-making", the Centre for Health Design summarises eight steps that can guide the application of evidence-based design strategies in the processes of design and post occupancy evaluation (Malkin 2008, p.2, cited in CHD 2014b):

- "Define evidence-based goals and objectives;
- Find source for relevant evidence;
- Critically interpret relevant evidence;
- Create and innovate evidence-based design concepts;
- Develop a hypothesis;
- Collect baseline performance measures;

- Monitor implementation of design and construction; and
- Measure post-occupancy performance results".

As indicated by the Centre for Health Design (2015), the most important step of applying evidence-based design is to identify the sources for relevant best evidence from previous research, since all other steps are established based on solid and explicit data. According to Ban et al. (2016a, p.96), a complete EBD strategy (also referred to as "evidence") consists of three elements – "objective existence (factors)", "operation approach (methods)" and "behaviour & mentality (effects)". These elements constitute a "chain of logic" (Hamilton & Watkins 2009, p.10). Their contents and interrelationships are illustrated in Figure 2.6. Objective existence and operation approach independently demonstrate the environmental factors and physical features that can be designed to affect the well-being of patients and medical staff (i.e. behaviour & mentality).

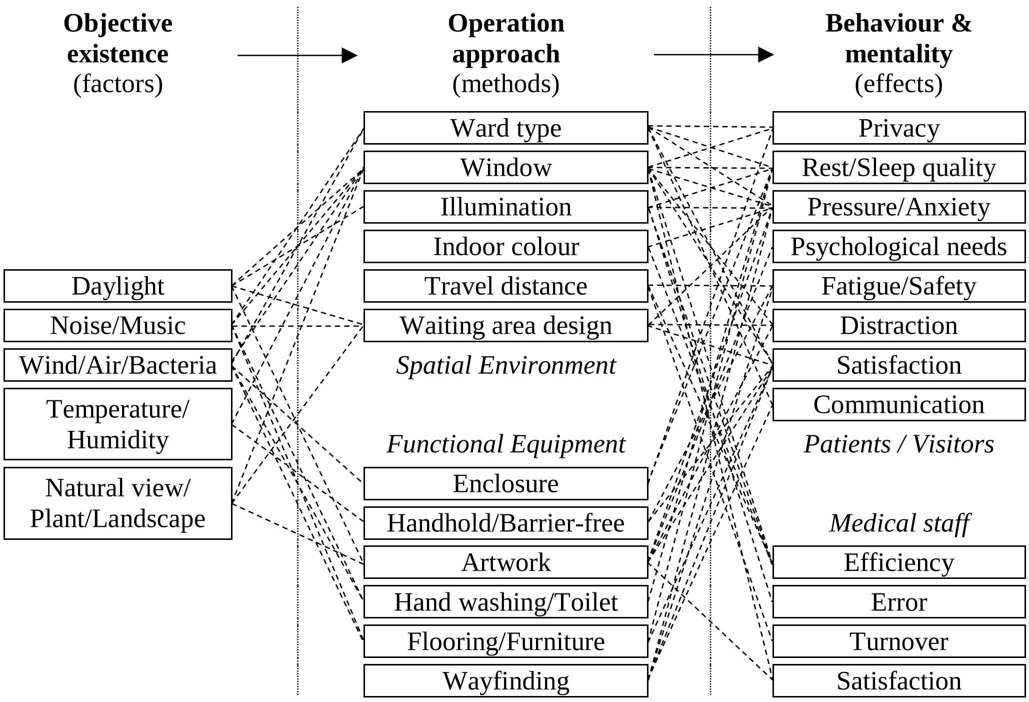


Figure 2.6 Elements of evidence-based design strategies and their logic (source: Ban et al. 2016a, p.97)

In the UK, for example, evidence-based design has been incorporated into the healthcare design guidance issued by the National Health Service (NHS). The *Sheffield Architectural Healthcare Environment and Patient Outcomes* is a database established by the University of Sheffield Healthcare Research Group in 2009, which provides almost 600 pieces of EBD strategies that are published in papers (Figure 2.7) (Phiri 2014). The elements of EBD strategies in Figure 2.6 are summarised based on the collected design strategies in this database. These strategies will be discussed in Chapter 4, in order to support the design of a conceptual framework for healthcare environment design and define the nature and functions of design strategies related to healthcare environments.

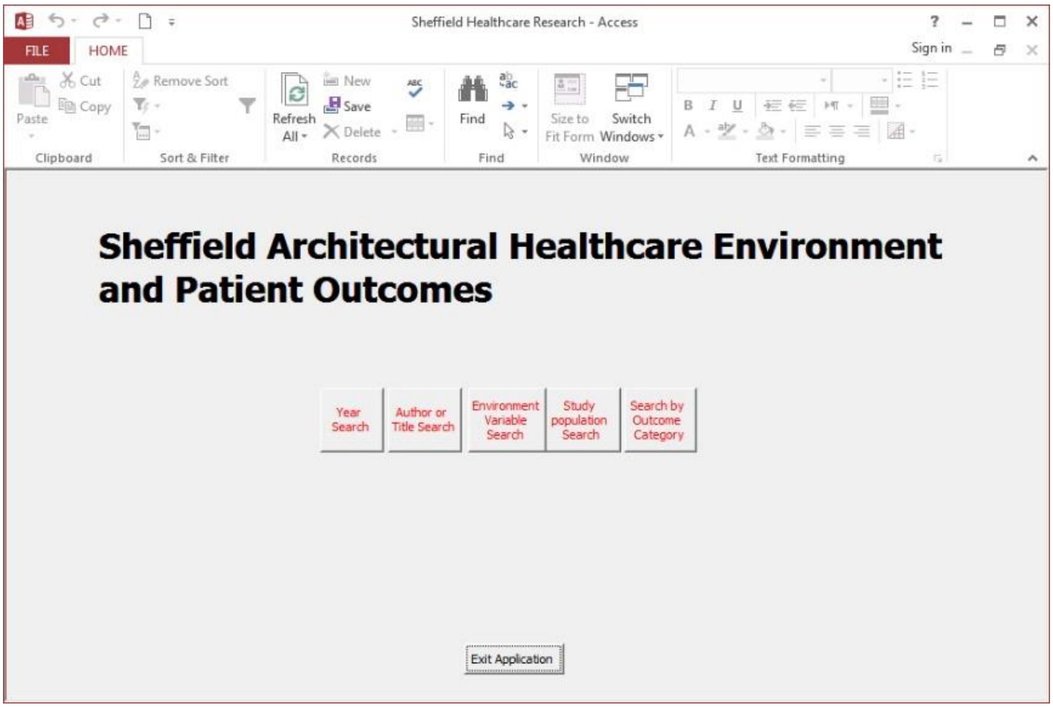


Figure 2.7 ***Sheffield Architectural Healthcare Environment and Patient Outcomes*** **(source: Phiri 2014)**

2.3.3 Eco-effective Design

According to the McDonough Braungart Design Chemistry (MBDC) (2008, cited in Baum et al. 2009, p.2), eco-effective design (EED) "gives rise to buildings that generate improved ecological health and indoor environmental quality". This design theory is also known as ecological design, green design, resource-efficient design or environment-friendly design, with the similar meaning. This theory aims to relieve two global problems – climate change and greenhouse effect caused by buildings.

Global climate change is acknowledged as the greatest threat for the natural ecosystem and human society today. As claimed by the Intergovernmental Panel on Climate Change (IPCC) (2015), the average global temperature has been rising; 0.85 ˚C (0.65 to 1.06) over the period from 1880 to 2012. The climate change issue is mainly caused by the greenhouse effect. In tackling climate change and greenhouse effect, an effective activity is to implement carbon reduction, as the atmosphere contains 32% carbon dioxide (CO_2), which is a significant contributing factor of greenhouse gases (IPCC 2015, p.35).

The reduction of CO_2 is often discussed in conjunction with secure and appropriate energy supply. Today, most energy demand in human activities still depends on traditional energy –

fossil fuels (e.g. coal, oil and gas). The rapid development has caused greater resource consumption, which results in energy crisis and huge CO_2 emission. Every 24 hours, almost 70 million tons of CO_2 are released into the atmosphere, 40% ~ 50% of which are from buildings (Phiri & Chen 2014, p.7; IPCC 2015, p.45; Hamilton & Watkins 2009). To cope with both energy crisis and environmental protection, eco-effective design provides an idea for people to re-think the balance of social development and consumption of resources and energy in a more scientific way – on one hand, improving the efficiency of energy demand; on the other hand, using renewable and clean energy to replace the traditional ones (Table 2.7).

Table 2.7 Types of energy form (source: Hamilton & Watkins 2009; IPCC 2015)

Before industrial society	Industrial society (traditional energy)	Post-industrial society (new energy)
• Human labour • Animals • Energy from rivers • Energy from wind	• Coal • Oil • Gas • Nuclear energy	• Solar energy • Geothermal energy • Wind energy • Ocean energy • Biomass energy • Nuclear fusion energy

According to Phiri and Chen (2014, p.7), healthcare facilities are key consumers of energy and resources. In return, the design of healthcare environments is “an imperative to meet global targets for sustainability”. Due to the special requirements of building functions, healthcare facilities consume much more energy than other types of buildings – for example, 24/7 operation, extra backup systems for power supply, constant indoor temperature and humidity for special rooms and medical storage, and devices and procedures for indoor cleanliness and sterilisation. Therefore, it is essential to apply eco-effective design principles in healthcare environment design. Figure 2.8 illustrates the statistical results of energy consumption in a typical hospital (Carbon Trust 2010).

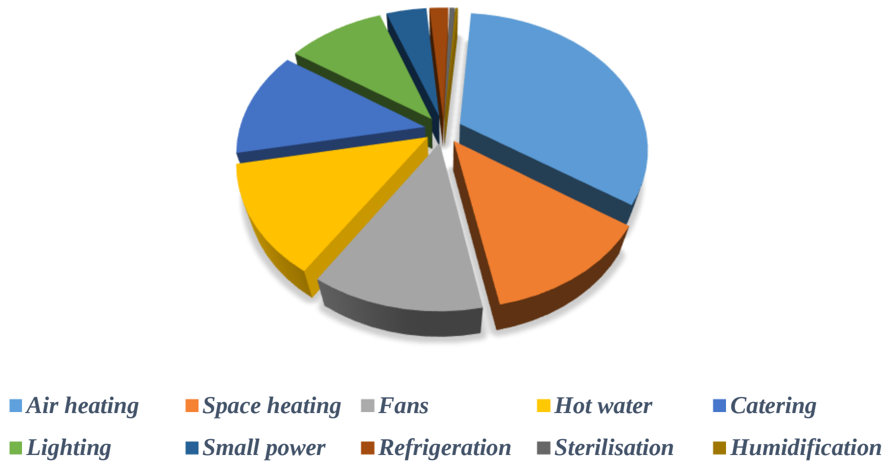


Figure 2.8 Energy consumption in a typical hospital (source: Carbon Trust 2010, p.5)

In terms of eco-effective design for healthcare environments, six patterns that can reduce energy consumption and contribute to environmental optimisation are summarised (Verderber 2010). Guenther and Vittori (2013, p.xvii) further refine 31 key indicators organised in related patterns, to measure the eco-effective performance in healthcare environments:

- "Site Planning: connection to nature; habitat restoration; innovative stormwater management; brownfield site; transit access; innovative parking;
- Form + Façade: climatic/bioregional design; narrow floor plate; energy responsive façade; green roof;
- Water: water use reduction; rainwater harvesting; reclaimed water reuse; onsite wastewater treatment;
- Energy: low energy use intensity (EUI); innovative source energy systems; innovative energy distribution systems; natural ventilation; onsite renewable energy systems; heat recovery; occupant control; energy display;
- Materials + Construction Practices: low embodied energy materials; healthy materials; prefabrication / modularity / adaptability; recycled content material; acoustics; safe construction practices; and
- Community: civic function; resilience; food production".

On the basis of these indicators, it is relatively easy to identify EED strategies for healthcare environments from previous research. Relevant strategies will be discussed in Chapter 4.

2.3.4 Balanced Sustainability for Healthcare Environment Design

Based on the above introduction of evidence-based design and eco-effective design, it can be found that both theories have significant impacts upon the design quality of healthcare environments. Evidence-based design emphasises healthcare outcomes (e.g. recovery rates, length of hospitalisation, dosage of medicine, safety and satisfaction of patients; productivity, work efficiency and satisfaction of medical staff) of the built environment (i.e. social goals), while eco-effective design pays attention to environmental protection and energy and resource saving (i.e. environmental goals). These theories were usually considered in conflicts and implemented separately in practice, because of different goals in sustainable design (Baum et al. 2009). It is necessary to understand their interrelationships since both of them can inform healthcare design and impact upon the performance of healthcare environments.

In a broad sense, it is argued by Hamilton and Watkins (2009, p.39) that "all sustainable design is founded on evidence". Design strategies that can contribute to the ecosystem and environmental protection have taken root in evidence-based design, as these strategies must "be verified to be effective for environment by findings (best evidence) from credible research" before putting into practice (Johnson 2009, cited in Hamilton & Watkins 2009, p.40). Moreover, as eco-effective design is a valid way of tackling climate change, it impacts upon the public health at a global scale. Evidence can prove other benefits of eco-effective design strategies for human values.

In 2009, a study conducted by Baum et al. (2009) showed that when EBD and EED strategies were applied in healthcare environment design at the same time, synergies and conflicts co-existed in their effects (Figure 2.9). Overall, 49 specific EBD strategies in 5 categories (i.e. "Healthy Experience", "Safety", "Operational Efficiency", "Technology" and "Life Cycle Flexibility") and 70 specific EED strategies in 6 categories (i.e. "Sustainable Sites", "Water Efficiency", "Energy & Atmosphere", "Materials & Resources", "Indoor Environmental Quality" and "Operations") were collected. The interrelationships of all design strategies were tested comprehensively. The statistical results showed that the strategies relating to "Healthy Experience" and "Indoor Environmental Quality" had the strongest correlation between evidence-based design and eco-effective design. In summary, according to the results of this study, there were, in total, 300 potential synergies and 123 conflicts between EBD and EED strategies in healthcare environment design (ibid). This circumstance, especially for the potential conflicts, affects the trade-offs in the application of these strategies during the design decision-making process. The relationship between EBD and EED strategies, which was tested in the previous study, reflects the interrelation between social and environmental dimensions, because of their corresponding goals of sustainability (Figure 2.10).

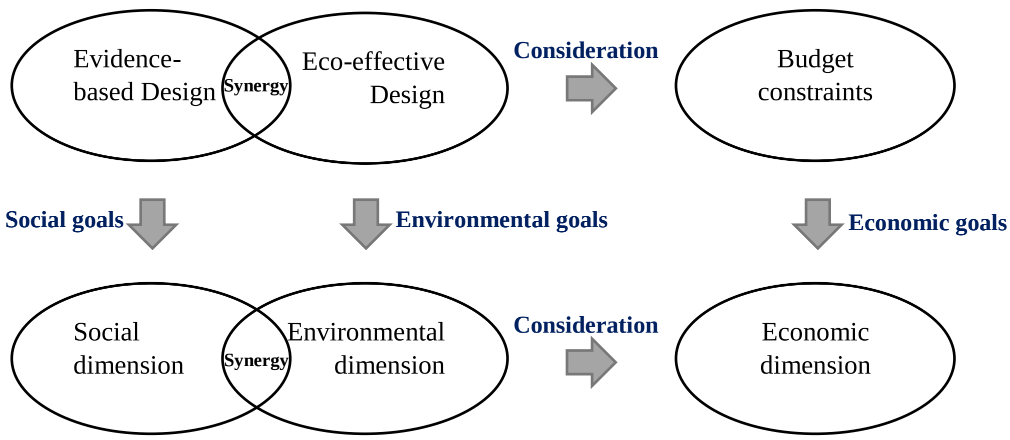
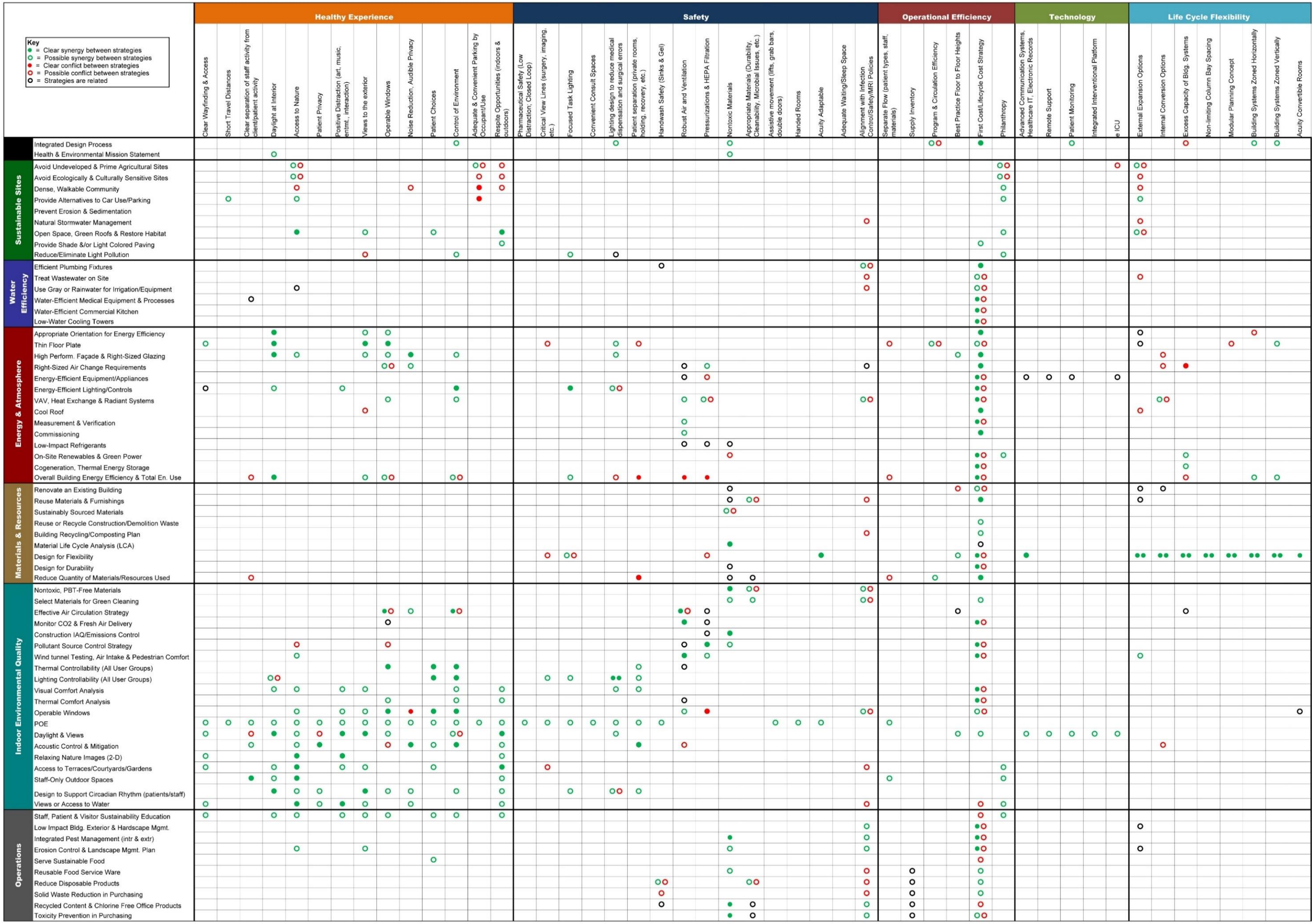


Figure 2.10 Balance between evidence-based design and eco-effective design for sustainability

Buildings are long-lived, and will exist for decades. Design should ensure to improve the buildings' overall quality and performance-in-use. A number of studies have mentioned that

Figure 2.9 A Study on the interrelationships between EBD strategies and EED strategies (source: Baum et al. 2009, p.15)



design should be well considered based on the balance among three dimensions of sustainability (i.e. social, environmental and economic aspects) (Kaatz et al. 2006). However, as sustainability will only be achieved based on a **relative balance** in the Triple Bottom Line, for now there are no explicit standards to measure the dimensions of sustainability and offer a proper trade-off for sustainable design (Ritchie & Thomas 2009). Therefore, to explore the design of community-based healthcare environments in China, as well as the methods of choosing strategies between evidence-based design and eco-effective design, this research proposes **an approach that uses end-users' satisfaction with the built environment** as a criterion to evaluate the relative balance of sustainability in healthcare environment design. The feasibility of this approach can be explained from two aspects.

- ✧ **Sustainability is an anthropocentric concept from its outset.**

The definition of sustainability clearly expresses that human values are the intrinsic purpose of design behaviour, and should be put to the first position to re-evaluate everything related to people's daily lives. In terms of healthcare environments, more and more researchers and practitioners indicate that human should be the centre of concerns for healthcare environment design and motivation of implementing sustainability (Lawson & Phiri 2003). Looking at people's satisfaction with the built environment can be seen as one of the most important conceptual trends for healthcare environment design, as information about end-users' needs can be used to secure and improve the overall design quality of healthcare environments and people's health and well-being (for more information, see Section 2.3.1) (Lawson & Phiri 2003; Phiri & Chen 2014; Mills et al. 2015; CHD 2015). As stated earlier, buildings and their impacts can last for decades, and among all people involved in the lifecycle of a building, end-users spend the longest time with buildings and are directly affected by the built environment (CHD 2015). Using their satisfaction to evaluate the overall design quality of built environments can be considered as an appropriate and effective way of implementing this anthropocentric concept in the design of healthcare environments.

- ✧ **Social sustainability should be enhanced in China.**

In recent years, practitioners have become used to applying sustainability assessment methods to assist their architectural design. However, the main attention of these "green building assessment methods" was paid to the environmental goals of sustainability (Kaatz et al. 2006, p.301). Sustainability assessment methods originated in developed countries. According to Cole (2005), the idea of creating such documents was to maintain standards of living while reducing unnecessary burden to the natural environment. It is understandable that why environmental goals are considered more important than social ones in the assessment. As argued by some scholars (Cole 2005; Kaatz et al 2006), developing countries, where social and economic concerns are far more pressing than those in developed countries, should use the documents issued by developed countries as prototypes to build their owns. However, the "inappropriate cross-cultural 'importation' of specific technical strategies" may lead to the fact that "in many cases basic human needs are not being met", as "the average standard of living in developing countries is far lower than in developed countries" (Cole 2005, p.459).

Previous research has indicated that the research and application of evidence-based design were in an extremely slow development in China, compared with its development in developed countries (e.g. UK and US) (Chao & Xie 2008; Gelun 2012; Ban et al. 2016a). It is because the development of healthcare environments in China is still at the stage of physical infrastructure. This situation impacts upon the healthcare outcomes and social aspects of healthcare buildings in China. Therefore, the aim of sustainability assessment in developing countries (e.g. China) is to **address the basic human needs and avoid negative environmental impacts**, in order to prevent the "**sustainability imbalance**" between social and environmental aspects (Gibberd 2001, cited in Cole 2005). As meeting the needs of end-users is an important social goal of sustainability, it may provide a research opportunity to use end-users' satisfaction to inform the appropriate sustainable design of a healing environment (for more information, see Table 2.4). It may also bring thoughts concerning how to address sustainable design from an integrated perspective for healthcare environments in China and then optimise the requirements in legislation and current building regulations.

Currently, sustainable design for the built environment is still under development, and there is no standard to implement architectural design towards sustainability. As such, using end-users' satisfaction and relevant needs as a criterion, which can be called end-user centred principles in this research, intends to explore approaches that can minimise harmful effects of healthcare environments on human health from a socio-technical perspective (Verderber 2010; CHD 2015). Evidence-based design principles will be used to bridge the environmental needs of end-users and healthcare environment design at a community level. The social sustainability of community-based healthcare environments is therefore chosen as the **research boundary** in this thesis.

2.4 END-USER CENTRED PRINCIPLES IN HEALTHCARE ENVIRONMENT DESIGN

To explore the end-user centred principle in healthcare environment design, previous research on "user centred design" and "participatory design" has been reviewed. The approach "*End-*

user Centred Participatory Design for Community-based Healthcare Environments" is proposed and will be analysed in detail.

2.4.1 User Centred Design

Design is essential human behaviour, and "the dominant approach to design in ergonomics" is to act on behalf of humanity (Eason 1995, p.1667). From this point of view, all design behaviour should be human-centric. Users can be seen as the end of commodity circulation, and the human-centric principle for design can be referred to as "user centred design" in practice (Uckelmann et al. 2011).

User centred design is defined as "a design philosophy that encompasses the placing of the needs, wants and desires of users at the centre of the design process, allowing these needs and desires to drive a product, system or service's development" (Uckelmann et al. 2011, p.68; Wilkinson & Angeli 2014; Dorrington et al. 2016). It allows users to customise and adapt products to their particular needs, which leads to products being able to function more efficiently and effectively. This theory originated from software development in computer science and information technology, but soon was applied to all product design fields (Uckelmann et al. 2011; Cvijikj & Michahelles 2011).

In the field of architectural design, it is believed that "the built environment exists to support the activities of users that is shelters" (Vischer 2008, p.231). To some extent, buildings can be seen as products that are created through a design process by architects. Some professionals argue that a building should be user-centric to ensure users' satisfaction, otherwise it would not be fit for its design purpose. It is because, compared with other commodities, "products of buildings" have important features – for example, high costs, complex procedures for construction and retrofitting, and long life cycles. The ideal situation for a new building is that it can perform properly once built, without any extra changes or compromises in a short period. Vischer (2008, p.3) indicates that user centred design is effective for this situation, since studying users' needs "offers a better understanding not only of how behaviour is influenced by the environment, but also how users' act on their environments and how such behaviour redefines the user-building relationship".

User centred design is suggested to be implemented at the earlier stage of a building's lifecycle, and users' satisfaction and relevant needs ought to be understood and met before the design is completed. To improve the efficiency and outputs of user centred design in ergonomics, a principle "**design for users with users**" with its application in healthcare environment design is discussed in the following (Eason 1995, p.1671).

2.4.2 "Design for Users with Users"

In the ergonomic practice of user centred design, there used to be two paradigms – "design for users" and "design by users", which were portrayed as ideologically incompatible because of their conflicting orientations (Eason 1995; Uckelmann et al. 2011). The former is based on "empirical tradition" and lets ergonomists [1] decide the best for users; while the latter emphasises "participation approach" and the idea "users decide for themselves" (Eason 1995, p.1668). The significant difference between both paradigms is that the former one represents science, precision and engineering, while the latter concerns social science and local politics.

For a long time, designers believed that the concept of "design for users" was the core of user centred design. They argued that human factors should be placed as the main drivers in the design process. Based on this standpoint, designers responded to design problems, designed on behalf of users, and then provided the products meeting users' requirements. Letting users control their future might lead to a situation where most technical knowledge would be absent – for example, users were not aware of those that might generate issues relating to safety, efficiency or comfort. However, supporters of "design by users" argued that only considering human factors in the design process could not represent human themselves or their true ideas (Eason 1995; Kujala 2010). When there were particular users of products, these people' views could effectively influence design (Eason 1995). Designers were not users, once they began to design. They were not omniscience or leaders, and they did not have the rights to make the value judgements about what was good or beneficial for other people.

With the exploration in practice, it was found that neither paradigm would perform for the maximum benefit in the absence of the other. Only "design for users" led to difficulties that design was not accepted, because the design did not completely fit the culture or ambitions of users. In the meantime, contributions from pure "design by users" might have been adopted by the users, but most of them lacked the understanding of "the human condition or new visions necessary to break out of the traditions of the organisation in a way that moves it forward" (ibid, p.1669). A mixed strategy "design for users with users" is therefore proposed by Eason (1995, p.1671) to combine the paradigms in together. It requires a design team to actively engage users in the design decision-making process, to explore their satisfaction and needs for products (visions), and finally to use the information and data gathered from users to identify design strategies (objects) and solutions (decisions) for specific problems (Figure 2.11) (MFE 2008; Vischer 2008). In this process, participation is the key of productive

[1] Ergonomist: in the design process, the designers who seek to ensure the human issues considered for a product, system or service are ergonomists (Eason 1995).

collaboration. It can also be referred to as "participatory design[2]" or "participative ergonomics[3]" (Eason 1995, p.1668; Sharma et al. 2008; Vischer 2008).

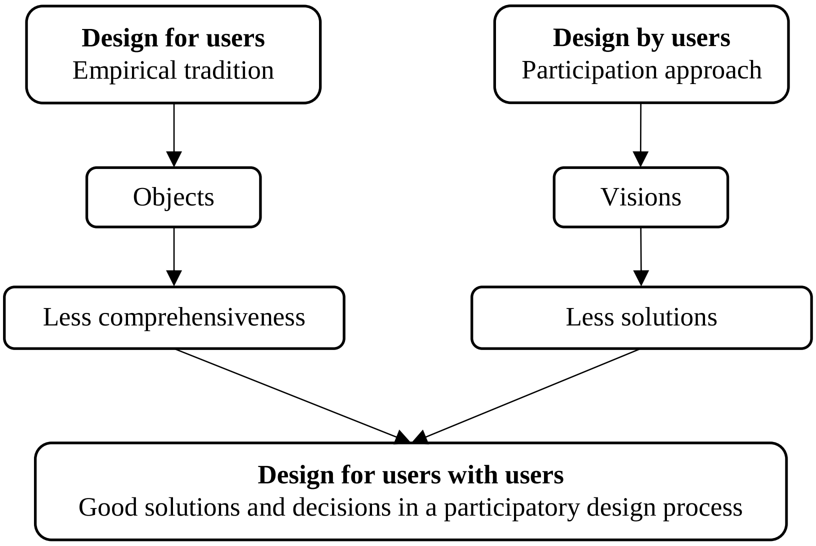


Figure 2.11 A mixed strategy of "design for users with users" (source: Eason 1995; Wever et al. 2008)

During the process of participation, the advantages of "design for users" and "design by users" can be maximised. Eason (1995, p.1671) describes this process that:

> "…the users have the opportunity to take those **decisions** that are important to them and to make sure that they do so in as informed a way as possible... The role of the ergonomist (designer) is to structure the process by which users **engage in the issue** and to **provide specific support** at each stage... The users may need to **debate** and **prioritise their requirements** but the ergonomist may be able to support this process through task analysis and other studies that reveal the context of work… The users need to be able to **identify the options available to them** and the ergonomist should be able to **introduce new visions** of technical or human alternatives of which the user may not be aware… By this overall process the users may be able to **make the value judgements** that are needed without the **loss of any specialist knowledge** that might be relevant."

The analysis of the above keywords demonstrates that improving users' satisfaction does not mean meeting all of their needs indiscriminately. It is a productive collaboration that requires

[2] Participatory design: it "aims to develop technologies with the close involvement of stakeholders and end-users through cycles of requirements gathering, prototype development, implementation and evaluation" (Sharma et al. 2008, cited in Wilkinson 2016, p.71).

[3] Participative ergonomics: it "establishes design processes in which the end-users themselves can influence the design so that it is compatible with their goals and beliefs, etc. This approach is emphasised in the 'macro-ergonomics' movement" (Hendrick 1991, cited in Eason 1995, p.1668).

communication and knowledge integration between users and designers. To embed the "design for users with users" principle into healthcare environment design, end-users should assist architects to understand their best interests and particular needs when they use healthcare environments. It is noteworthy that, because end-users have less **specialist knowledge** in the design of built environments, what they express is more like "a vision to be comfortable" instead of explicit expectation with solutions (Eason 1995, p.1668; Vischer 2008; Ban et al. 2018). On the other hand, instead of acting as the experts or authorities who represent the interests of end-users, healthcare architects become facilitators to help end-users articulate their aims and needs. They translate end-users' visions into design solutions using architectural languages – achieving a relatively balanced sustainability standard of the design work and choosing appropriate design strategies for end-users' satisfaction. The **integrated preferences** lead to a sustainable plan for healthcare environments. The process of knowledge exchange encourages end-users to describe their needs as clearly as possible, and requires architects to be sensitive and knowledgeable to the personal characteristics of people who architects hope to serve both on behalf of and alongside. An approach is therefore proposed to describe this participatory design process that supports **communication** and **knowledge exchange** between end-users and architects in healthcare environment design.

2.4.3 End-user Centred Participatory Design Approach for Community-based Healthcare Environments

Theories of architectural design today have been oriented to processes – how it is created and how it performs the work once it has come into use (Vischer 2008). According to ISO-13407 (1999), an international standard issued by the International Organisation for Standardisation (ISO), a typical user centred design process includes four activities (Figure 2.12). Based on the content of this standard, this approach is described in detail.

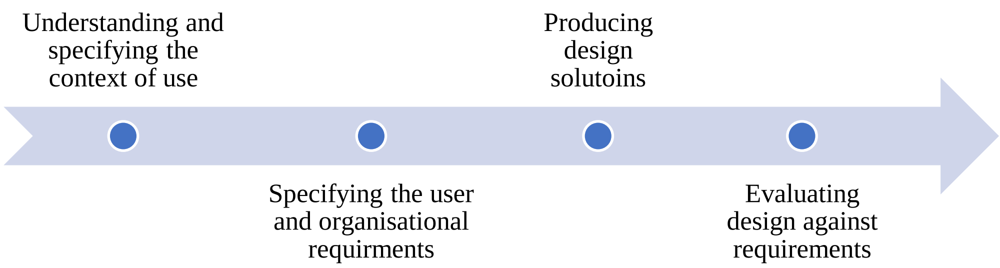


Figure 2.12 Four activities of a typical user centred design process (source: ISO 1999)

✧ **Understanding and specifying the context of use**

This end-user centred participatory design process aims to enhance the anthropocentric concept in the design of community-based healthcare environments in China. It is an approach that evaluates sustainability and design quality of healthcare environments at a community level against the satisfaction of end-users. Design can be seen as a process of exchange between areas of knowledge for the consensus of problem solving, and this approach is used in the design decision-making process (Lawson 2005, p.130). It creates a participatory environment to bridge end-users' satisfaction and architects' design intent. It also provides an opportunity of reducing the cognitive conflicts in the process of knowledge exchange and improving the efficiency of achieving a consensus on the outputs of collaboration.

✧ **Specifying the user and organisational requirements**

According to the Oxford English Dictionary Online, "user" can be defined as a person who has or makes use of a thing. Based on this generalised definition, there are various categorisations of users. Geumacs (2009, p.29) categorises the term "user" of a product into three types, including end users (i.e. direct users), indirect users and other stakeholders, which are respectively defined as:

- "End users (direct users) – people who could use directly the product;
- Indirect users – people who would not be involved in its direct use but whose inputs and decisions may have influence on the features of the product should present; and
- Other stakeholders – people and organisation who are at different levels involved in the development of the product and/or whose participation and input are needed for its development."

Table 2.8 Four different technological frames (source: Dammann & Elle 2006, p.393)

"Public-relations frame
- Professional clients;
- Administrators of buildings;
- Politicians;

Scientific frame
- Researchers;
- Consultants;

Aesthetic-holistic frame
- Architects;

Layperson-sensualist frame
- Non-professional private clients;
- Residents; and
- Users of buildings."

For the field of the built environment, Dammann and Elle (2006) suggest that stakeholder[4] (user) groups can be generally categorised into four technological frames (Table 2.8). It can

[4] Stakeholder: "a person, company, etc., with a concern or (esp. financial) interest in ensuring the success of an organisation, business, system, etc." (Oxford English Dictionary Online).

be seen that the users who spend the longest time with buildings and directly feel the continuing impacts from the built environment belong to the "end user" group or "layperson-sensualist frame" that "wants indicators to reflect their critical view of mainstream society and technology and focus directly on perceivable aspects" (ibid, p.396).

In terms of healthcare environments, the Centre for Health Design (2015, p.91) summarises that the key stakeholders of healthcare in practice – people "who have a vested interest in the success or failure of the built environment and organisational culture" can be subdivided into 9 groups, and they are:

- "Board of trustees and leadership;
- Researchers;
- Patients;
- Vendors and suppliers;
- Caregivers, family and visitors;
- Staff (physicians, nurses, housekeeping and ancillary services);
- Community partners;
- Community organisations; and
- Donors".

Among these key stakeholders, patients, caregivers, family, visitors, medical staff and community partners obtain the direct use of healthcare environments (CHD 2015). However, the Centre for Health Design (2015) indicates that **patients** and **medical staff** should be considered as the main end-users of healthcare environments, because the most of direct users belong to these groups. According to Hamilton and Watkins (2009, p.78), the key of a healing environment is the needs relating to the demonstrated outcomes that "indicate an improvement in the physical or psychological state of a group of the building's users". Only when the needs from the vast majority of end-users can be satisfied, a healing environment can be a meaningful form of therapy (ibid). Patients and medical staff are therefore chosen as the "users" of this approach to represent the end-user groups of community-based healthcare environments. In addition, in line with the principle of "design for users with users", architects who play a dominant role in healthcare environment design are also designated as the users and representatives of design professionals. In the research scope, patients, medical staff and architects are defined as the target groups. Other professionals, including stakeholders from the areas of authorities, finance, construction and research (e.g. healthcare bureau, developers, donors, constructors, assessors, manufacturers and researchers), are not chosen for this research. It is important to note that, they may also influence the quality of healthcare environment design and be qualified as approach users, and their opinions should be taken into account in the future work. Figure 2.13 demonstrates their roles and participation in the process of a building project based on the RIBA Plan of Work 2013.

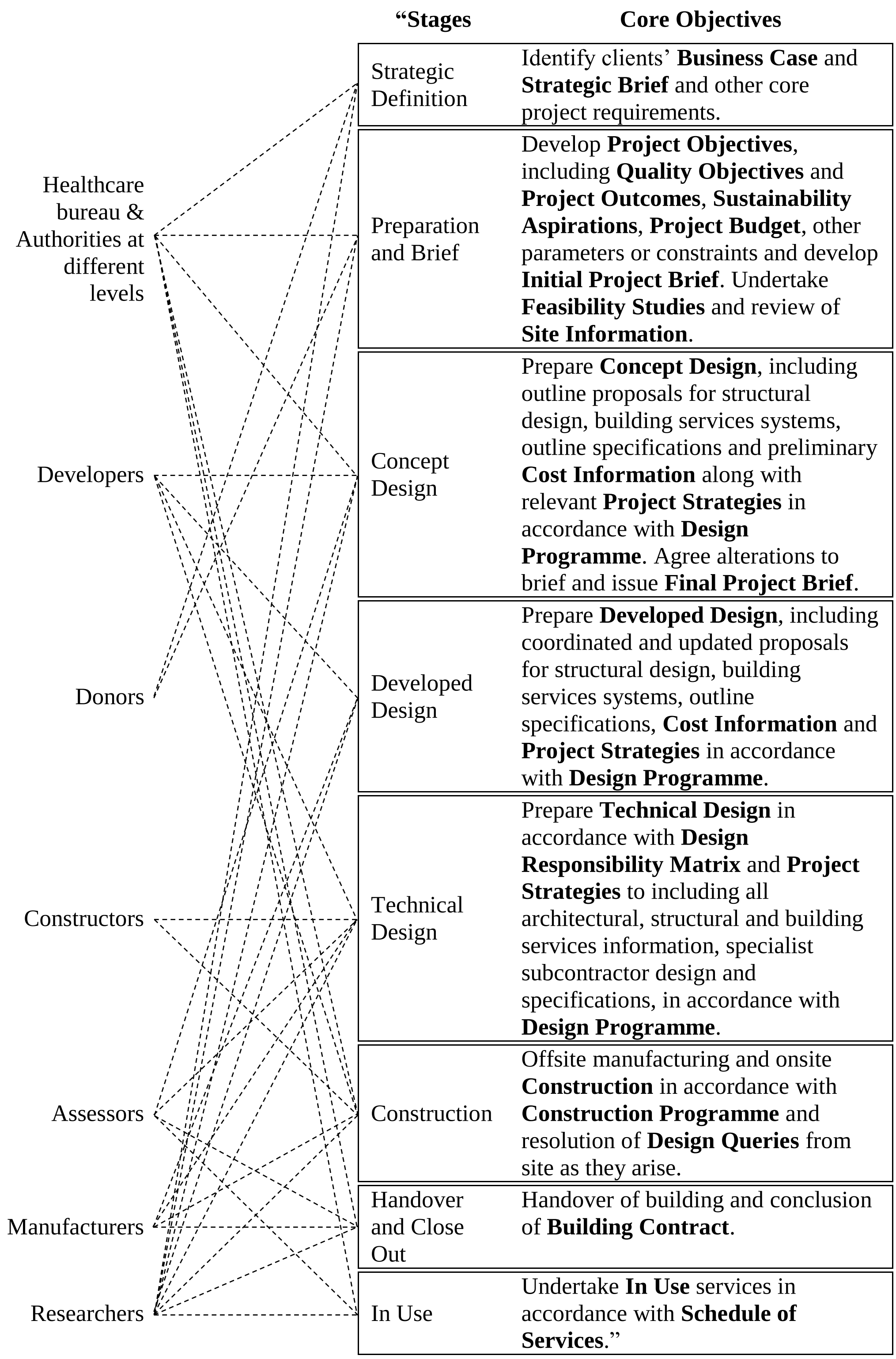


Figure 2.13 Professionals’ roles and participation in the process of architectural design based on the RIBA Plan of Work 2013 (source: RIBA 2013)

Finally, the approach users in this research can be categorised into three groups – patients, medical staff and healthcare architects. Evidence from previous research indicates that end-users expect more from healthcare environments in addition to a high-quality healthcare service – for example, privacy and company, pleasant lighting, and access to outside views (McKinley et al. 1997). Douglas and Douglas (2005) believe that a healing environment should be designed as end-user-oriented to meet their needs for the built environment. Therefore, for these stakeholders, the content relating to the design of community-based healthcare environments is provided. With its assistance, end-users can provide a relatively clear expression about what they need when they use such healthcare facilities. Based on their feedback, architects can understand what design strategies are appropriate to ensure end-users' satisfaction and optimise the overall design quality of a healing environment. These contents can be viewed as the needs of approach users.

✧ **Producing design solutions**

End-users are more qualified to speak on the performance-in-use of buildings than any other stakeholders. Every day, they enjoy or suffer the impacts from the built environment. However, end-user groups, who are expected to bring their knowledge in design, cannot be involved in design procedures in most cases. It is argued that some architects may feel uncomfortable with the compromises from users' debate (Eason 1995). They claim that the involvement of end-users may result in the work of an impractical nature, as a portion of end-users may not be in a position to offer meaningful suggestions or solutions. Such biases prevent architects from exploring end-users' satisfaction, which leads to the needs of end-user groups being misunderstood or overlooked in the decision-making process.

It is necessary to build a participatory environment to explore end-users' needs and knowledge about healthcare environment design. Such information can enhance the collective action and outputs. On one hand, direct communication helps architects understand end-users' particular needs for community-based healthcare environments at the early stage of design process. On the other hand, such knowledge exchange encourages end-users, who are the stakeholders with less specialist knowledge in the built environment, to understand architects' design intent and then provide constructive suggestions with a clear description of their visions.

However, a number of scholars declare that in the field of architecture, there will always be a distance between designers and users, as the design procedures of buildings are much more complicated than those of common commodities. They argue that users can "never be as knowledgeable about the design and construction as the architect" (Hamilton & Watkins 2009, p.11; Eason 1995; Kaatz et al. 2006). The professional restriction impacts upon the accuracy of end-users' description about visions, as well as the efficiency of communication between them and architects in the participatory design process. Moreover, the restriction also leads to different standpoints, cognitive conflicts and debates, which may affect the consensus on final decisions as well. Both situations limit the implementation of participatory design. For these, a "**common language**" is necessary to connect "visions" and "solutions" together, to explicitly explain the design intent and strategies with non-technical knowledge to those stakeholders with less specialist knowledge in the built environment, to enhance the understanding from one group to the other, and finally to improve the efficiency of participatory design and knowledge exchange (Dammann & Elle 2006).

Therefore, to implement the "design for users with users" principle, the design solution is not only to provide a participatory environment to facilitate the communication between end-users and architects, but also assist one group to understand the other based on a common language that uses shared information about healthcare environment design. Such setting can improve the efficiency of knowledge exchange.

✧ **Evaluating design against requirements**

This activity can be explained as "achieving a relatively high consensus on design decisions". Generally, each group has its own perspectives and cognitive abilities, by which cognitive conflicts may be caused. Figure 2.14 illustrates architects' preferences for healthcare environment design, according to a survey from the Commission for Architecture and the Built Environment (CABE). It shows that even in an identical group that consists of architects with similar value judgements, cognitive differences still occur (CABE 2014). It is also open to question whether the result of this survey also mirrors the situation of end-users' various needs.

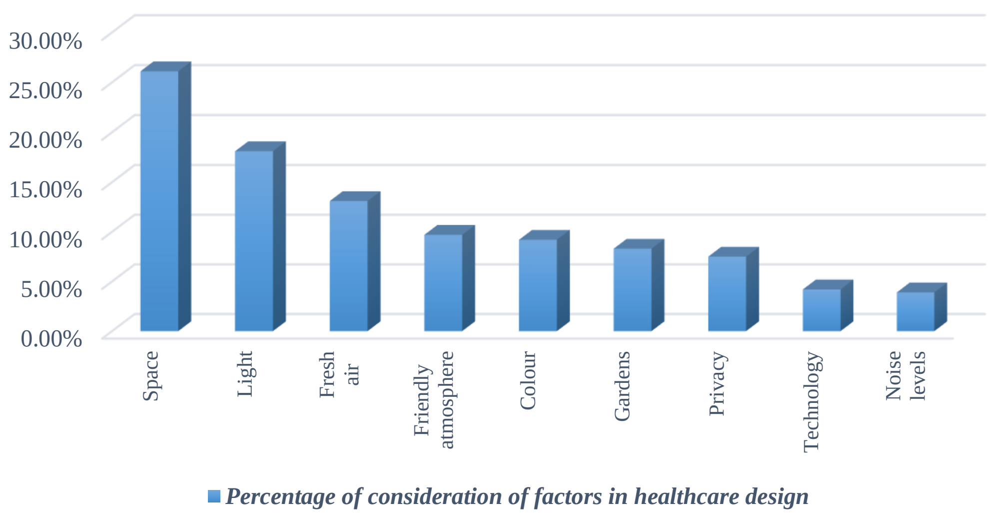


Figure 2.14 Architects' preferences for healthcare environment design (source: CABE 2014)

✧ **Discussion**

Consequently, it is necessary for the end-user centred participatory design approach not only to support communication, but also achieve a consensus on the outputs of knowledge exchange. Cognitive differences can be identified in the process of prioritising design strategies. Subsequently, a relatively high consensus on a plan of conceptual design (i.e. prioritising design strategies based on their relative importance) is expected to be achieved for the overall design quality of a healthcare facility (Figure 2.15). Only by having such information and functions that are summarised in these four activities, the approach can be used to facilitate a participatory design process of community-based healthcare environments, and thereby ensure end-users' satisfaction with the built environment.

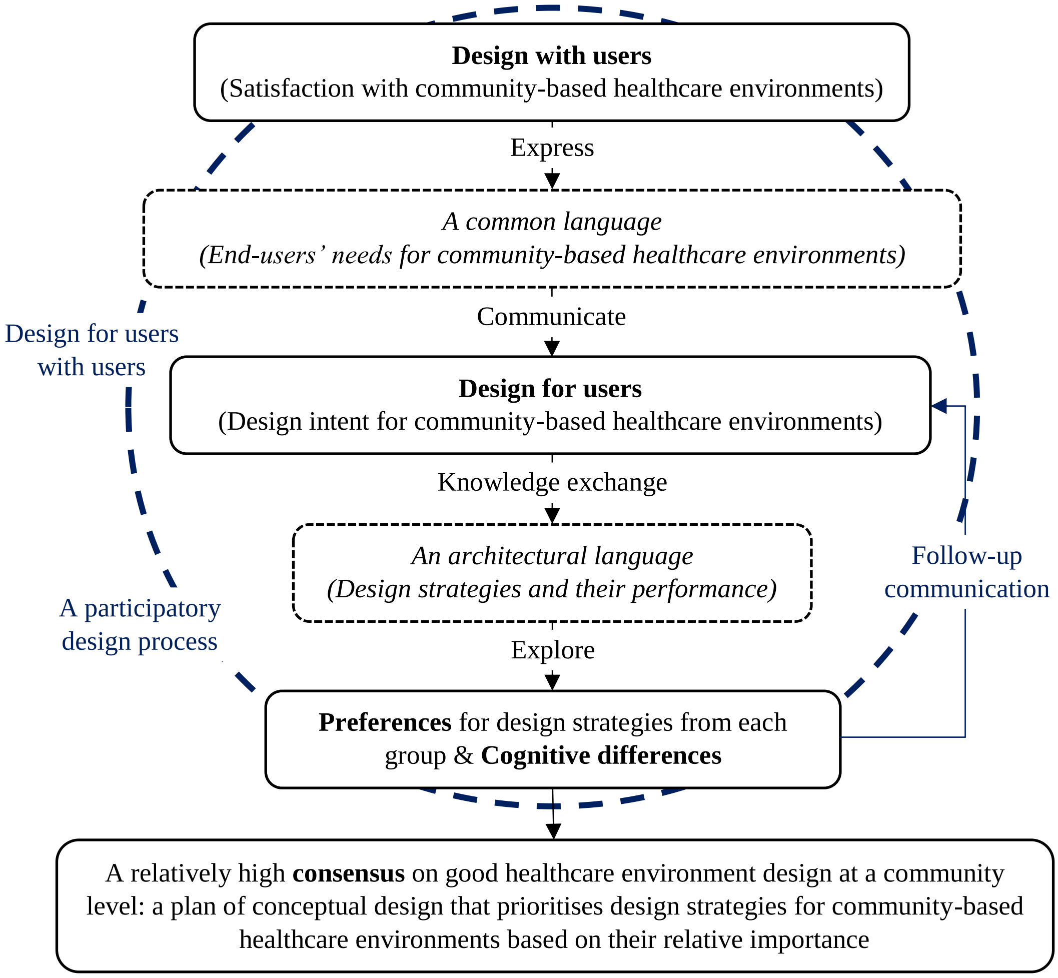


Figure 2.15 Framework of end-user centred participatory design approach for community-based healthcare environments

2.5 RESEARCH SCOPE

According to the analysis of research background (i.e. the national healthcare system in China and sustainable objectives for healthcare environment design), the **research gap** is found that there is a lack of specific building regulations or standards that are tailored to inform or assess the overall quality of healthcare environment design at a community level in the process of healthcare transformation in China. The **research boundary** is then set as the social sustainability of community-based healthcare environments. A research scope is defined based on the specific research gap and boundary. Within this scope, this research, which intends to explore the feasibility of end-user centred participatory design approach for community-based healthcare environments, can be conducted step by step.

2.5.1 Target Groups

This research aims to secure and improve the overall design quality of community-based healthcare environments in China from an architect's perspective. It pays attention to the social sustainability – end-users' satisfaction with the built environment, as only human can decide how to evaluate the social, environmental and economic concerns in sustainability (i.e. a relative balance) (Luztkendorf & Lorenz 2006; Zhou et al. 2013). Looking at end-users' satisfaction is one of the most important conceptual trends in the modern theories of healthcare environment design for public health and well-being (Lawson & Phiri 2003; CHD 2015). A participatory design approach is proposed to actively engage end-users in the decision-making process of healthcare environment design at a community level, in order to explore end-users' knowledge levels about community-based healthcare environment design and integrate multiple knowledge to achieve a relatively balanced sustainability.

It is indicated that patients and medical staff can be seen as the main end-users of healthcare environments (CHD 2015). Most studies today related to evidence-based design are focused on these groups. For many years, when talking about user centred design, most architects considered patients as the "users" of healthcare buildings. Moreover, in modern healthcare design, medical staff is valued as well. On one hand, they have to face a wide range of hazards in healthcare environments every workday (Arsand & Demiris 2008; CDC 2013; CHD 2015). Their health and well-being may be influenced by injuries, stress and fatigue (Ulrich et al. 2008). On the other hand, medical staff's performance and work efficiency significantly contribute to the quality of healthcare service delivery. Hence, a healing environment should be both "patient-centred" and "staff-supportive" (CHD 2015, p.5).

Since this research intends to explore the priority variances between different stakeholders, patients, medical staff and architects have been chosen for the further studies. Patients and medical staff can be seen as the representatives of end-users. Their needs for community-based healthcare environments are studied. According to the principle of participatory design – "design for users with users", a shared understanding of design intent between users and designers may achieve a better design solution for productive collaboration. Architects, as the designers of buildings, are chosen to represent stakeholders with specialist knowledge in the built environment. The communication and knowledge exchange among these target groups (i.e. Patient Group, Staff Group and Architect Group) are explored to test the feasibility and effectiveness of the end-users centred participatory design approach in this research.

2.5.2 Cognitive Differences

It is indicated by Dammann and Elle (2006), end-user groups have different characteristics, cognitive abilities and focuses. They may pay attention to different aspects of design. The link between patients and medical staff is the process of therapy. Patients' motivation of visiting community-based healthcare facilities is to obtain quick primary care – precautionary therapy, treatments for non-emergency ailments or psychosis recovery (Ashcroft 2015). Once they receive required information (e.g. medical advices) or recover, they do not stay for long. Medical staff needs to provide healthcare service. They use community-based healthcare facilities every workday, because of vocational requirements. Both groups have different motivations and targets for using community-based healthcare environments.

Therefore, it is assumed that the needs and preferences of patients and medical staff are varied. As both of them are main end-users of healthcare environments, it is difficult to say who can represent the entire end-user group to bespeak on healthcare environment design or whose satisfaction is more important than the other. The differences between these "short-term end-users" and "long-term end-users" significantly obstruct the communication and knowledge exchange, and then may lead to no one wanting to change their priorities to accommodate others'. During the participatory design process, knowledge exchange should be implemented. It is necessary for architects to know how to transcend differences caused by diverse cognition and knowledge levels and then achieve the holistic satisfaction between patients and medical staff. It can reduce misunderstanding and distrust, and consolidate the relationship between different end-users for the holistic satisfaction with built environments. Cognitive differences in community-based healthcare environment design between patients and medical staff will be explored and identified in this research, based on which, architects can have a comprehensive understanding of end-users' needs, make informed decisions and then optimise their design work towards a relatively high consensus on the satisfaction of end-users.

2.5.3 A Common Language

This research further focuses on how to improve the efficiency of end-users' participation and knowledge exchange for healthcare environment design at a community level. To ensure end-users' satisfaction with the built environment, their environmental needs should be explored and prioritised on the basis of their preferences. According to the principle of "design for users with users", design is no longer considered as a privilege or special skill for professionals or practitioners. Nevertheless, the professional restriction cannot be ignored. Stakeholders with less specialist knowledge in the built environment are not able to be as knowledgeable as design professionals. It is difficult for end-users to express their needs explicitly and realise their visions by using an architectural language. They should be able to provide constructive suggestions with a relatively short time during the process of communication. Design strategies related to end-users' needs for community-based healthcare environments are expected to be explored from a socio-technical perspective. To facilitate the knowledge exchange between end-users and architects, it is noteworthy to explore how to build a common language that can bridge such professional information (i.e. design strategies that can realise end-users' needs) and end-users' visions (for more information, see Section 1.7).

Retzlaff (2008, p.506) suggests that design should be "reframed to focus on **outcomes** rather than on **inputs** to buildings", when it is opening up to end-users. It is important to note that the evidence-based design principle emphasises the needs of end-users (for more information, see Section 2.3.2). It describes design strategies by using **measured effects** (e.g. duration of hospitalisation, dosage of medicine and error rates) that are established based on clinical research (Hamilton & Watkins 2009). Best evidence provides possibilities of identifying design strategies and measuring them. Stakeholders with less specialist knowledge in the built environment (e.g. patients and medical staff) can be informed with required information about the outcomes of design strategies. Compared with design inputs, the outcomes with measured effects are close to end-users' needs – "a vision to be comfortable" (Eason 1995). Moreover, based on the measured effects, architects can more easily explore the levels of impacts of environmental factors upon end-users' behaviour, understand their needs, choose appropriate design strategies (i.e. factors and methods), and then inform others about their design intent. Best evidence provides a learning process that supports a mutual understanding by translating architectural design into understandable information for end-users (Figure 2.16).

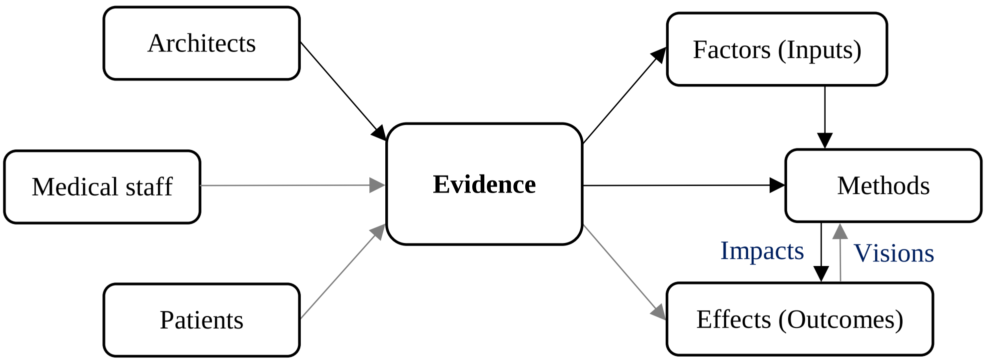


Figure 2.16 Evidence as a common language for knowledge exchange

This research will explore if evidence can be used as a common language to facilitate the knowledge exchange and productive collaboration in the design of healthcare environments, by providing essential design information about measured effects to end-users. By reviewing the relevant literature about participatory design, it is found that it is necessary to strengthen the research on the impacts of evidence upon the efficiency of knowledge exchange between different stakeholders.

2.5.4 Sustainability Imbalance in the Assessment of Built Environments

Architects normally use building regulations as a benchmark and information sources to assess their design work and thereby improve the overall design quality of the built environment. A series of aspects are included in building regulations to define building-related environmental performance, from energy efficiency to people's well-being (Cooper 1999; Ding 2005; Shiers et al. 2006; Lutzkendorf et al. 2012). In Section 2.2.3, building regulations relating to the design of healthcare environments in China were discussed, and *Evaluation Standard for Green Hospital Building* GB/T 51153 (hereafter referred to as GB/T 51153) was chosen as the most suitable building regulation of informing the design of community-based healthcare environments. It is because that:

- As an official sustainability assessment method, it is designed to secure and improve the overall design quality and sustainability of healthcare environments;
- It aims to offer information to fit "all single healthcare buildings and building clusters", including general hospitals, special hospitals and community-based healthcare facilities (MOHURD & AQSIQ 2015, p.3); and
- Other building regulations in China have only been tailored for general hospitals (Ban et al. 2018).

It is argued by some scholars that sustainability imbalance may exist in the sustainability assessment methods launched in developing countries, because they may pay insufficient attention to social goals – "in many cases basic human needs are not being met" (Cole 2005, p.450; Kaatz et al. 2006). One objective of GB/T 51153 is to inform healthcare environment design at different levels towards a healing environment for end-users (MOHURD & AQSIQ 2015). This research intends to explore the social concerns of GB/T 51153 – securing and improving end-users' satisfaction with healthcare environments at a community level.

To a great extent, the sustainability of community-based healthcare environments in China will be influenced by GB/T 51153. It is expected that there may be little sustainability imbalance that impacts upon the effectiveness of assessment of GB/T 51153 in healthcare environment design. The distance between end-users' needs and the value judgement of GB/T 51153 will be further explored in this research, in order to understand:

- Does GB/T 51153 have sustainability imbalance? If yes, what human needs are overlooked by GB/T 51153 during the process of sustainability assessment for the design of community-based healthcare environments?

Findings from the cross-comparative studies intend to provide suggestions to legislation from a social perspective, which can be used to modify and optimise the capacity of GB/T 51153 in addressing social concerns.

2.5.5 Research Objectives and Questions

To explore the preferences and cognitive differences of target groups, an approach, *End-user Centred Participatory Design for Community-based Healthcare Environments*, is proposed to fill in the research gap from an architect's perspective. Then the research aims are broken down into specific objectives to demonstrate the research process:

- Collecting design strategies for healthcare environments based on the literature and theories relating to healthcare design;
- Exploring end-users' satisfaction with healthcare environments at a community level and design strategies related to the environmental needs of these end-users;
- Identifying significant cognitive differences within end-users that may lead to the priority variances of end-users' needs and affect the efficiency of the communication and knowledge exchange in the design decision-making process of community-based healthcare environments; and
- Testing the effectiveness of using evidence-based design principles (i.e. current best evidence) in improving the efficiency of knowledge exchange and achieving a relatively high consensus between stakeholders with different knowledge levels.

Research questions are designed to further explain the above objectives (for more information, see Section 1.4 & Figure 1.1). It can be seen as a deductive process to answer those questions, in order to achieve important research findings for the participatory design approach of community-based healthcare environments. Research questions will be discussed and analysed in detail in the next chapter, together with the introduction of research methods and the required data that are applied to this research project.

2.5.6 Research Scenario

To answer all research questions, a research scenario is defined. This research aims to explore end-users' epistemology (i.e. satisfaction, environmental needs and cognitive differences of stakeholders with different knowledge levels), in terms of healthcare environment design at a community level. The Suzhou Industrial Park (hereafter referred to as SIP)[5] has been chosen as the research area (Figure 2.17).

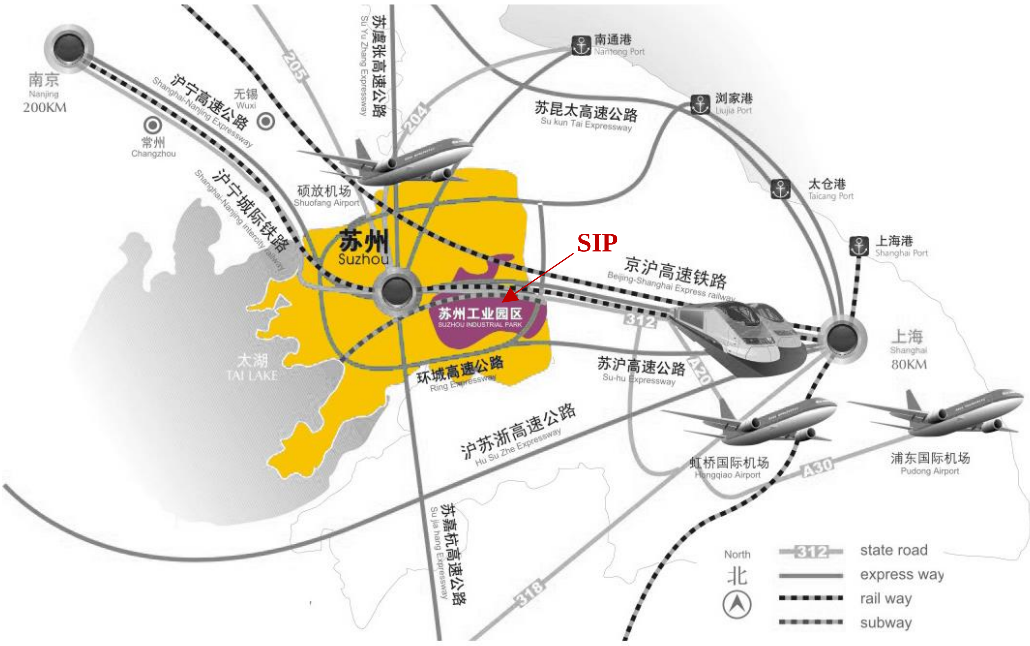


Figure 2.17 Suzhou Industrial Park (source: SIPAC n.d.a)

This is because that SIP applies a **neighbourhood planning** principle for resource allocation and spatial design. This principle attempts to allocate basic public service (e.g. **medical resources**, shopping, catering and preschool education) in neighbourhood centres which can serve residents of surrounding communities with a considerable service circle – about 400m (service radius) for around 20,000 local residents (Chen & Shu 2014, p.56; Wang 2009).

For public health, SIP uses hierarchical healthcare systems which include community-based healthcare facilities, secondary (district-level) hospitals and general (city-level) hospitals (Chen & Shu 2014; Tan 2018; Zhang et al. 2018). Figure 2.18 shows the distribution of medical resources in SIP. A survey indicates that, when residents in SIP have common diseases, 43% of them would like to choose community-based healthcare facilitates for medical

[5] SIP: China-Singapore Suzhou Industrial Park, launched in 1994, is a county-level administrative district located in Suzhou, Jiangsu Province of China. It has a total jurisdiction area of 278km^2, of which, the China-Singapore cooperation area covers 80km^2 (SIPAC n.d.b).

treatments, compared with 36% of residents who choose general hospitals, 15% who choose secondary hospitals, and 5% who choose self-diagnosis and pharmacies (Zhang et al. 2018, p.6). As a result, it is believed that residents of SIP, who have relatively long-term experience of using hierarchical healthcare systems and community-based healthcare facilities, can provide representative opinions on environmental needs for healthcare environments at a community level. "Data" collected in the field investigations from SIP will be used to explore the preferences and cognitive differences of end-users (i.e. patients and medical staff), in terms of the design of community-based healthcare environments in China.

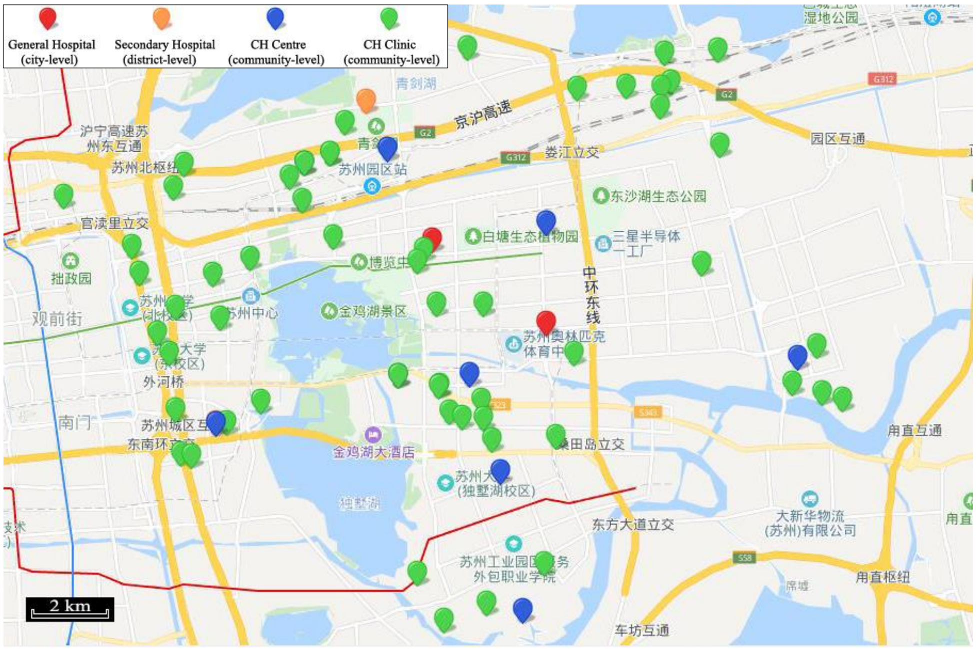


Figure 2.18 Distribution of medical resources in SIP (source: SIPAC n.d.c)

2.6 CHAPTER SUMMARY

Based on a comprehensive literature review, community-based healthcare environments, as an integral part of urban healthcare systems, have been chosen as the scope of this research. It has a significant impact upon the provision and delivery of healthcare service in urban areas. However, proper attention has not been paid to the design quality of community-based healthcare environments in China. A research gap in the primary care delivery system in urban areas is found that there is a lack of specific and appropriate building regulations that can be used to manage the overall design quality of community-based healthcare facilities in the transformation of urban medical resources from a "centralised" pattern to a "decentralised" one. Architects have to use building regulations for general hospitals as references and identify the information relating to the design of community-based healthcare environments in a relatively short time.

Design theories for healthcare environments are reviewed to provide a general understanding of sustainability for healthcare design and strategies for healthcare environments. It shows that there are two main types of design strategies that can significantly contribute to today's healthcare environments – evidence-based design and eco-effective design, though they impact upon healthcare environment design from different perspectives and concerns. Making decisions between EBD and EED strategies is similar to a trade-off between the social and environmental dimensions of sustainability in the design process. This research proposes an idea that uses end-users' satisfaction and needs for the built environment as a criterion to inform the sustainable design of community-based healthcare environments. Findings can be used to fill in the research gap and improve the efficiency of end-users' participation in healthcare environment design at a community level.

By reviewing the theories of "user centred design" and "participatory design", it shows that improving end-users' satisfaction with the built environment should be established on a productive collaboration between end-users and architects in a participatory design decision-making process. Therefore, this research proposes an approach, *End-user Centred Participatory Design for Community-based Healthcare Environments*, in order to create a participatory environment to support the communication and knowledge exchange between patients, medical staff and architects.

The analysis demonstrates that the links between end-users and architects need to be enhanced, because a lack of effective communication may result in that end-users' needs cannot be completely understood or satisfied. Moreover, cognitive abilities and professional restrictions lead to cognitive differences. To a great extent, cognitive differences can affect the efficiency of collaboration and knowledge exchange. To solve the problem, a research scope is defined, aiming to explore if evidence can be used as a common language and learning tool to facilitate the participatory design process for community-based healthcare environments. It is important to note that, as the Chinese primary care delivery system is newly-developed, there are relatively few studies on healthcare environment design at a community level currently in China. Therefore, it is believed that the outcomes and findings of this research project can be fed back into the development of policies and research for healthcare environment design and healthcare service. In the next chapter, the main methods applied in this research are described, which explain the research framework in greater detail.

New strategy always implies change, and the potential of a new strategy is often threatening to the existing success formula.

- Peter Schwartz

3

Research Framework and Methodology

3.1 CHAPTER INTRODUCTION

Chapter 3 introduces the research strategies and research designs that are applied to the desktop research and field investigations of this research, in order to achieve the expected outcomes and findings that can contribute to the overall design quality and social sustainability of community-based healthcare environments in China.

3.2 RESEARCH STRATEGIES AND RESEARCH DEISGNS

This research aims to gain an understanding of end-users' satisfaction and design strategies related to end-users' needs for community-based healthcare environments. As a social research project, it concentrates on "problems and issues of direct relevance to people's lives, to help find ways of dealing with the problem or of better understanding the issue" (Robson 2011, p.4). Methodology[6] consists of both research strategies and research designs (Bryman 2012). In general, there are two types of research strategies of social research – quantitative research

[6] Methodology: "a way of thinking about and studying social reality", and the systematic and theoretical analysis of the methods applied to a field of study (Strauss & Corbin 2007, p.3).

and qualitative research (Robson 2011; Bryman 2012). As indicated by Bryman (2012, p.35), these research strategies can be defined as:

> Quantitative research – “a research strategy that emphasises quantification in the collection and analysis of data and that
>
> - Entails a deductive approach to the relationship between theory and research, in which the accent is placed on the testing of theories;
> - Has incorporated the practices and norms of the natural scientific model and of positivism in particular; and
> - Embodies a view of social reality as an external, objective reality”.
>
> Qualitative research – “a research strategy that usually emphasises words rather than quantification in the collection and analysis of data and that
>
> - Predominantly emphasises an inductive approach to the relationship between theory and research, in which the emphasis is placed on the generation of theories;
> - Has rejected the practices and norms of the natural scientific model and of positivism in particular in preference for an emphasis on the ways in which individuals interpret their social world; and
> - Embodies a view of social reality as a constantly shifting emergent property of individuals’ creation”.

Table 3.1 Fundamental differences between quantitative research and qualitative research (source: Bryman 2012, p.36)

“Category	**Quantitative**	**Qualitative**
Principal orientation to the role of theory in relation to research	Deductive; testing of theory	Inductive; generation of theory
Epistemological orientation	Natural science model, in particular positivism	Interpretivism
Ontological orientation	Objectivism	Constructionism”

Fundamental differences between the strategies of quantitative research and qualitative research are summarised in Table 3.1. It is necessary to distinguish between quantitative and qualitative research (Bryman 2012). However, because each of them has exclusive advantages of dealing with problems and issues, “there is a growing recognition of the value of combining elements of both quantitative and qualitative research styles” (Robson 2011, p.21). The type of research where quantitative and qualitative strategies are combined in a project is referred to as “mixed methods research”, and the combining strategy is called a “multi-strategy research” strategy (Bryman 2012, p.628).

The purpose of research designs[7] is "to structure the research, to show how all of the major parts of the research project – the samples or groups, measures, treatments or programmes, and methods of assignment – work together to address the central research questions" (Trochim 2001, p.171). There are five types of research designs: experimental design and its variants, cross-sectional or survey design, longitudinal design, case study design and comparative design (Bryman 2012, p.46; Robson 2011). A choice of these research designs can reflect researchers' decisions on the priority that is given to the research process with a range of dimensions (Bryman 2012).

Table 3.2 Relationship between research strategies and research designs (source: Bryman 2012, p.76)

"Research design	**Research strategy**	
	Quantitative	Qualitative
Experimental	*Typical form*. Most researchers using an experimental design employ quantitative comparisons between experimental and control groups with regards to the dependent variable.	*No typical form*. However, Bryman (1988) notes a study in which qualitative data on schoolchildren were collected within a quasi-experimental research design.
Cross-sectional (Survey design)	*Typical form*. Survey research or structured observation on a sample at a single point in time. Content analysis on a sample of documents.	*Typical form*. Qualitative interviews or focus groups at a single point in time. Qualitative content analysis of a set of documents relating to a single period.
Longitudinal	*Typical form*. Survey research on a sample on more than one occasion, as in panel and cohort studies. Content analysis of documents relating to different time periods.	*Typical form*. Ethnographic research over a long period, qualitative interviewing on more than one occasion, or qualitative content analysis of documents relating to different time periods. Such research warrants being dubbed longitudinal when there is a concern to map change.
Case study	*Typical form*. Survey research on a single case with a view to revealing important features about its nature.	*Typical form*. The intensive study by ethnography or qualitative interviewing of a single case, which may be an organisation, life, family, or community.
Comparative	*Typical form*. Survey research in which there is a direct comparison between two or more cares, as in cross-cultural research.	*Typical form*. Ethnographic or qualitative interview research on two or more cases."

Table 3.2 summarises the research designs, as well as their relationship with research strategies of both quantitative research and qualitative research. Each of them has different forms and nature. It is essential to select appropriate research designs, according to the specific **required data** that can be used to answer the research questions.

[7] Research design: "a general plan that provides a framework for the collection and analysis of data" (Bryman 2012, p.46).

3.3 RESEARCH QUESTIONS AND METHODS

This section designs research questions for data collection. The required data for all research questions is analysed in detail. Based on this, relevant and appropriate methods are selected, which can be used to structure the whole research and address the central research questions (Trochim 2001).

- ✧ **Research Question 1: What design strategies can improve the quality of community-based healthcare environments and thereby meet end-users' needs? What are end-users' preferences for these strategies?**

This question can be answered by doing the following (Figure 3.1):

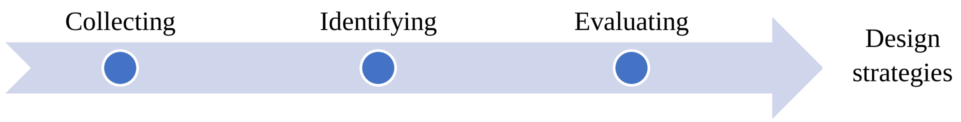


Figure 3.1 Three steps for Research Question 1

The first is to collect the design strategies that are related to healthcare environments based on literature review and archive study. The official, mandatory sustainability assessment method for healthcare environments in China (i.e. *Evaluation Standard for Green Hospital Building* GB/T 51153) and a design aided tool for healthcare buildings (i.e. *Achieving Excellent Design Evaluation Toolkit*) are used as the benchmarking standards to underpin the proposed new design aided tool. For this step, a qualitative cross-sectional design ("qualitative content analysis of a set of documents relating to a single period") is applied (Bryman 2012, p.76). Design strategies for healthcare environments are collected from *Evaluation Standard for Green Hospital Building* GB/T 51153 and *Achieving Excellent Design Evaluation Toolkit*, based on which, the *Conceptual Framework for Healthcare Environment Design* is developed to collect relevant design strategies and, as a communication platform, explore the end-users' attitudes and preferences.

The second step is to understand the relationship between end-users' needs and the design strategies for healthcare environments. The required data is end-users' satisfaction and cognition that can affect the design of community-based healthcare environments. An interview is conducted with a small group of end-user representatives from community-based healthcare facilities (i.e. CH Centres and CH Clinics), including patients and medical staff. They are asked to identify the design strategies related to their needs based on the *Conceptual Framework for Healthcare Environment Design*. To conduct the interviews and analysis of interviewees' feedback, a qualitative cross-sectional design is applied, and face-to-face interview methods (e.g. semi-structured interviews at a single point in time) are selected as well. In this step, the design strategies related to end-users' needs for community-based healthcare environments in China can be identified.

Finally, the relative importance of these design strategies is evaluated in questionnaire surveys, in order to understand end-users' various needs and transfer their preferences into a measureable way. Based on the quantitative data, relevant design strategies can be prioritised, which directly reflects the end-users' preferences for these design strategies in the healthcare environment design at a community level. The research designs – a survey design and a case study design – are used in this step. Three surveys are conducted independently for each target group (i.e. Patient Group, Staff Group and Architect Group) (Figure 3.2).

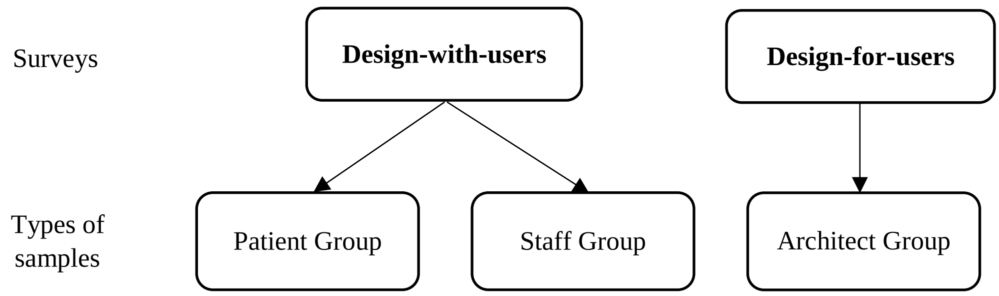


Figure 3.2 Survey types and sample cases

The convenience sampling method[8], which is a type of non-probability sampling methods, is adopted in the data collection process for all target groups. Patient samples in this research are selected from people who seek medical treatments from community-based healthcare facilities in SIP, and the samples of medical staff are selected from medical workers (i.e. doctors, nurses and administrators) who are hired by these healthcare facilities. Architect Group is sampled from architects who have previous experience in the design of community-based healthcare buildings and environments. Self-completion questionnaires are designed to explore samples' preferences. In the surveys, questionnaires for Patient Group and Staff Group are completed under the researcher's supervision, since they have relatively less specialist knowledge in participatory design or healthcare environment design. Unlike a face-to-face semi-structured interview process for End-user Groups (including Patient Group and Staff Group), the questionnaires for Architect Group are distributed and collected by email. There is no supervision for this procedure. Finally, statistical analysis is conducted to quantify end-users'

[8] Convenience sampling: it "involves choosing the nearest and most convenient persons to act as respondents. The process is continued until the required sample size has been reached" (Robson 2011, p.275).

preferences for relevant needs into a measureable way and rank these environmental needs in order, based on a five-point Likert scale and median values.

- ✧ **Research Question 2: Is there a consensus on good community-based healthcare environment design within end-user groups? If no, what are the cognitive differences?**

To answer this question, it is necessary to test if cognitive differences exist in the end-users' needs for community-based healthcare environments. Statistical analysis is conducted between Patient Group and Staff Group to explore significant differences. A quantitative comparative research design is used to conduct the cross-comparative studies within target groups to identify cognitive conflicts. A statistical analysis programme *Statistical Product and Service Solutions* (SPSS) is adopted for the statistical analysis. In terms of test methods, there are two types – parametric statistical techniques and nonparametric statistical techniques (Walsh 1962; Sheskin 2011; Hoskin n.d.). Hoskin (n.d., p.2) summarises that:

> "Parametric statistical procedures (parametric techniques) rely on assumptions about the shape of the distribution (i.e. assume a normal distribution) in the underlying population and about the form or parameters (i.e. means and standard deviations) of the assumed distribution. Nonparametric statistical procedures (nonparametric techniques) rely on no or few assumptions about the shape or parameters of the population distribution from which the sample was drawn".

As each test method has unique characteristics and requirements for data analysis, they should be applied according to the nature of data. The selection between these statistical techniques is discussed before their application. Finally, with the statistically significant results of the cross-comparative studies, this research question can be answered.

- ✧ **Research Question 3: Can evidence-based design principles be used to facilitate the knowledge exchange across different stakeholder groups in the participatory design process and achieve a win-win result?**

To answer this question, it is essential to understand the change of end-users' cognition when they acquire relevant knowledge about healthcare environment design and evidence-based design. The comparative research design – qualitative interview is applied. With the results from the cross-comparative studies, a follow-up focus group is conducted to further explore the cognitive differences that may cause priority variances of end-users' needs. Participants of this group interview include representatives of patients, medical staff and architects. Their feedback can be used to test if evidence-based design principles can provide information required by end-users and architects, and then facilitate the knowledge exchange between stakeholders with different background and knowledge levels. It is expected that all design strategies related to end-users' needs can be prioritised with a relatively high consensus, in order to mitigate the priority variances of end-users' needs for community-based healthcare environments. To have an in-depth insight into architects' roles in the participatory design process, their knowledge levels about evidence-based design are explored and cross-compared with those of patients and medical staff.

- ✧ **Research Question 4: How can the current building regulations in China be further modified to ensure end-users' satisfaction and social sustainability for community-based healthcare environments?**

For the answers of this question, the differences between the value judgements of end-users and legislation (i.e. current building regulations) are explored. Another cross-comparative study is conducted between end-users' preferences and the evaluation content of GB/T 51153 to identify the information that has been previously overlooked in legislation. Based on the comparison, suggestions that can enhance the capacity of GB/T 51153 in addressing social concerns and informing healthcare environment design at a community level towards social sustainability are proposed.

Based on the findings of comparisons, a computer programme (ECPD) is designed to visualise and digitalise the end-user centred participatory design approach in this research. It can be seen as a new design aided tool that adopts end-user centred principles in the design decision-making process of community-based healthcare environments. This tool attempts to have a more efficient way of aiding the application of GB/T 51153, in order to create a platform that can support the public participation in healthcare environment design.

3.4 CHAPTER SUMMARY

In this chapter, research strategies and research designs are discussed. This research project aims not only to generate theories that interpret people's epistemology (qualitative research), but also deduct the distances between the cognitive abilities of relevant stakeholder groups (quantitative research). It creates a deductive process to explore the relationship between theories and people's interpretation of their social world. Consequently, the multi-strategy research strategy is better suited in exploring the research objectives and answering the research questions.

The very first requirement of a hospital is that it shall cause neither human nor ecological harm.

- Stephen Verderber

4

Conceptual Framework for Healthcare Environment Design

4.1 CHAPTER INTRODUCTION

Chapter 4 describes the desktop research that explores sustainability assessment methods and design aided tools for healthcare buildings. It intends to collect design strategies that can be applied to secure and improve the overall design quality of healthcare environments. This chapter aims to answer the first research question. Based on cross-comparative studies between sustainability assessment methods and design aided tools, some strengths and weaknesses of GB/T 51153 are preliminarily explored.

Moreover, the *Conceptual Framework for Healthcare Environment Design* is set up, which has several functions in this research. It can be used as a communication platform for knowledge exchange between different stakeholders – for example, end-users and architects. Design strategies for healthcare environments are explained in the form of design outcomes, based on the findings (i.e. best evidence) collected from previous research. Then on the basis of this conceptual framework, interview questions and questionnaires used in the field investigations are designed to explore end-users' satisfaction and needs for community-based healthcare environments.

4.2 SUSTAINABILITY ASSESSMENT METHODS FOR HEALTHCARE BUILDINGS

In order to collect the design strategies for healthcare environments, relevant sustainability assessment methods for healthcare environment design (i.e. *Evaluation Standard for Green Hospital Building* GB/T 51153, *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare*) are reviewed. Comparative studies are conducted to explore issues that may affect the effectiveness of using GB/T 51153 to inform the design of community-based healthcare environments in practice.

4.2.1 Sustainability Assessment Methods for the Built Environment

It is always a challenge to achieve sustainability. There is an increased demand for suitable methods that can enhance social, environmental and economic performance of the built environment holistically (Lutzkendorf et al. 2012; Zhou et al. 2013). A series of sustainability assessment methods are designed to assess the built environment, in order to mitigate environmental impacts, to increase economic viability of the construction market, and to improve the building-related performance and users' satisfaction with the quality of built products (Kaatz et al. 2006; Lutzkendorf et al. 2012; Zhou et al. 2013). Cole (2005, p.455) indicates that these documents can "provide an objective evaluation of resource use, ecological loading and indoor environment quality within a much broader 'culture of performance measurement' that seeks greater accountability in sectors such as education and healthcare as well as building construction".

Moreover, sustainability assessment methods are established as information sources and decision-making aids to provide users (e.g. designers, planners, customers, administrators and end-users) with **required information** so that they can address issues appropriately (Lutzkendorf et al. 2012). These documents can be used as checklists for all stakeholders to identify valuable information that can be used to support decision-making in a participatory design process. It is necessary to conduct a process of **knowledge exchange** to achieve **consensus-building** between the general public and professionals (Kaatz et al. 2006; Lutzkendorf et al. 2012). As sustainability assessment methods can "produce and transfer knowledge; improve the quality of building design, construction and management; and enhance communication between building stakeholders", they are considered and used as an important approach for improving buildings' design quality in practice (Cole 2005, cited in Kaatz et al. 2006, p.309; Lutzkendorf et al. 2012). Some representative, important sustainability assessment methods available worldwide were reviewed in Chapter 2 (for more information, see Table 2.5).

However, some issues of current sustainability assessment methods may affect their impacts upon the knowledge exchange between end-users (e.g. patients and medical staff) and architects in the participatory design process. On one hand, these documents are considered by some scholars as "green assessment methods" (i.e. main attention is paid to environmental aspects of sustainability, which causes "sustainability imbalance") (Zhou et al. 2013, p.233; Kaatz et al. 2006). It means that, to some extent, some information required by end-users may be overlooked – "end-users of information have neither fully recognised nor appropriately formulated their particular requirements for assessment results" (Lutzkendorf & Lorenz 2006, p.337; Lutzkendorf et al. 2012). Some scholars indicate that sustainability assessment methods may not "validate a single building's construction to sustainable development" or their social, environmental and economic advantages currently (Lutzkendorf & Lorenz 2006, p.337; Kaatz et al. 2006; Lutzkendorf et al. 2012; Zhou et al. 2013; Ye et al. 2015). It is necessary to test if a sustainability assessment method, especially for those newly issued, is able to **serve today's information required by end-users**. Additionally, it is also questionable whether social aspects have been well addressed in the process of sustainability assessment.

On the other hand, end-users and architects talk about environmental issues and concerns in "different languages" (Dammann & Elle 2006, p.397; Lutzkendorf et al. 2012). The contents of these sustainability assessment methods – description of design strategies, are too difficult for the stakeholders with less specialist knowledge in the built environment to understand. It results in a predicament where end-users may **misunderstand the design** and cannot directly use an architectural language to express their "visions to be comfortable". This professional restriction keeps stakeholders from measuring the "absolute values and distance to target" (Lutzkendorf et al. 2012, p.260). Therefore, it is essential to find a **common language** to help end-users understand design strategies in those documents and thereby improve the efficiency of knowledge acquisition in a participatory design process.

In the field of healthcare environment design, some sustainability assessment methods have been developed – for example, *BREEAM Healthcare 2008*, *LEED 2009 for Healthcare* and *Evaluation Standard for Green Hospital Building* GB/T 51153. *BREEAM Healthcare 2008* is the first commercialised building assessment and measurement method in the world, which was developed by the Building Research Establishment (BRE) of the UK in 2008 (BRE 2012; Phiri & Chen 2014). After one year, *LEED 2009 for Healthcare* was established by the US Green Building Council (USGBC) in the US (USGBC 2014). As stated earlier in Chapter 2, the first official sustainability assessment method for healthcare buildings in China, *Evaluation Standard for Green Hospital Building* GB/T 51153, was published in 2015. As a national building regulation, GB/T 51153 has been used as one of mandatory design standards for

Chinese healthcare buildings since 1st August 2016 (MOHURD & AQSIQ 2015). To study the social sustainability of community-based healthcare environments in China, this document is chosen as the main information source for the collection of design strategies in this research. Furthermore, as *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare* have been widely used in their countries and internationally, they are chosen for a comparative study. Some weaknesses that may affect the effectiveness of GB/T 51153 in the sustainability assessment of healthcare environments can be explored based on this comparative study.

4.2.2 *Evaluation Standard for Green Hospital Building* GB/T 51153

The first national sustainability assessment method for healthcare environment design in China, *Evaluation Standard for Green Hospital Building* GB/T 51153, was issued by the Ministry of Housing and Urban-Rural Development of the People's Republic of China (MOHURD) and General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ) in 2015. It "represents the first sustainable architectural healthcare design guidance customised for healthcare facilities to best meet the need of 'green hospital' in China" (Phiri & Chen 2014, p.53). According to GB/T 51153, "a green hospital" is defined as "a healthcare building that saves resources (e.g. land, energy, water and materials) maximally, protects environments and reduces pollution; **provides patients and medical staff with healthy**, **suitable and effective space**; and coexists with nature in harmony, during its lifecycle and under the condition of securing healthcare procedures" (MOHURD & AQSIQ 2015, p.2). This definition shows that a green hospital has been targeted at enhancing the performance from triple dimensions of sustainability (i.e. environmental, social and economic aspects) (Ban et al. 2016b).

To achieve the target of "sustainability", GB/T 51153 uses a hierarchical system to conduct the assessment from seven technical aspects, including "Site optimisation utilisation and land resource utilisation", "Energy saving and energy utilisation", "Water saving and water resource utilisation", "Material saving and material resource utilisation", "Indoor environment quality", "Operation management" and "Innovation" (an added aspect) for "**all single healthcare buildings and building clusters**" (Table 4.1) (MOHURD & AQSIQ 2015, p.3). GB/T 51153 can be applied at two stages in the process of a project before certificates are issued: one at the design stage and the other at the operational stage (after the hospital is completed and occupied for at least one year) (ibid). Among the technical aspects, "Operation management" is only for the operational stage.

Based on this classification, 112 design items, in total, are categorised into two groups – "prerequisite items" (27, 24.1%) with compulsory requirements for any healthcare facility and “scoring items” (85, 75.9%) with optional requirements and available credits (MOHURD & AQSIQ 2015, p.4; Phiri & Chen 2014). There are three certificate levels of assessment results which are listed in Table 4.2. It is important to note that all new buildings are required to achieve “One Star” rating under the corresponding building regulations from Chinese State Council (China Society for Urban Studies 2014). Therefore, GB/T 51153 can be seen as **one of the mandatory standards for the design of healthcare facilities in China** since its official launch. The comparisons of GB/T 51153, *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare* are discussed in detail in Section 4.2.5.

Table 4.1 Weighting systems in GB/T 51153 (source: MOHURD & AQSIQ 2015, p.4)

“Weighting / Evaluation stage	Site optimisation utilisation and land resource utilisation w_1	Energy saving and energy utilisation w_2	Water saving and water resource utilisation w_3	Material saving and material resource utilisation w_4	Indoor environment quality w_5	Operation management w_6
Design stage	0.15	0.3	0.15	0.15	0.25	-
Operational stage	0.1	0.25	0.15	0.1	0.2	0.2”

Table 4.2 Certificate levels in GB/T 51153 (source: MOHURD & AQSIQ 2015, p.5)

“Certificate rating	Credits
One Star ☆	≥ 50
Two Star ☆☆	≥ 60
Three Star ☆☆☆	≥ 80

Note: total credits of each aspect should be not less than 40”

4.2.3 *BREEAM Healthcare 2008*

In 1990, *Building Research Establishment Environmental Assessment Method* (BREEAM) was developed in the UK, aiming to set a benchmark for best practice to support sustainable design and evaluate a building’s environmental performance (BRE 2012; Phiri & Chen 2014). So far, it has been widely implemented in the UK and other European countries. BREEAM covers a wide range of building types: homes, offices, commercial buildings, healthcare buildings, industrial buildings and residential communities (BRE 2012).

Commissioned by the UK Department of Health (DH) and Welsh Health Estates in 2008, *BREEAM Healthcare 2008* was developed as an environmental sustainability assessment method and certification scheme for healthcare buildings in the UK (BRE 2012; Phiri & Chen 2014). It is defined to represent “an important government strategy for meeting the challenges posed by the sustainability agenda, the need for improved environmental performance of National Health Service (NHS) buildings as well as meeting its targets for energy, generation of energy from renewable and waste management" (Phiri & Chen 2014, p.44). The Department of Health (DH) requires all new healthcare buildings to achieve an "Excellent" rating and all refurbished projects a "Very Good" rating under *BREEAM Healthcare 2008* (Table 4.3) (ibid). According to this requirement, *BREEAM Healthcare 2008* is used as a mandatory standard in the construction market of the UK since 2009 (Phiri & Chen 2014).

Table 4.3 *BREEAM Healthcare 2008* rating benchmarks (source: BRE 2012, p.27)

"BREEAM Rating	% score
Unclassified	< 30
Pass	≥ 30
Good	≥ 45
Very Good	≥ 55
Excellent	≥ 70
Outstanding	≥ 85"

BREEAM Healthcare 2008 can be used to assess at both design and post-construction stages from 10 main sections and 74 design items, of which there are 14 items of minimum performance standards and 60 optional ones (Table 4.4) (BRE 2012). Credits can be awarded according to the performance and corresponding weightings to produce a single overall score for final ratings. There is no minimum score requirement for each section of *BREEAM Healthcare 2008,* which leads to more flexibility for sustainability assessment.

Table 4.4 *BREEAM Healthcare 2008* assessment sections and weightings (source: BRE 2012, p.27)

"BREEAM Section	Weighting (%)	
	New builds, extensions & major refurbishments	Building fit-out only (where applicable to scheme)
Management (10)	12	13
Health & Wellbeing (15)	15	17
Energy (8)	19	21
Transport (8)	8	9
Water (6)	6	7
Materials (7)	12.5	14
Waste (5)	7.5	8
Land Use & Ecology (6)	10	N/A
Pollution (8)	10	11
Innovation (1)	10	10"

The scope of *BREEAM Healthcare 2008* covers most types of healthcare facilities "which are designed to be accessed by patients", including "teaching/specialist hospitals; general acute hospitals; community and mental health hospitals; GP surgeries; and health centres and clinics" (BRE 2012, p.23).

4.2.4 *LEED 2009 for Healthcare*

In 1998, *Leadership in Energy and Environmental Design* (LEED) was developed by the US Green Building Council (USGBC), aiming to provide all stakeholders a concise framework to identify and implement the measureable solutions of green building design, construction, operation and maintenance for a series of buildings (USGBC 2014; Phiri & Chen 2014). After 11 year practice, *LEED 2009 for Healthcare* was published for designated uses – "inpatient and outpatient care facilities and licensed long term care facilities", including medical offices, assisted living facilities, and medical education and research centres (USGBC 2014, p.xiv). It represents "a joint initiative between the Green Guide for Health Care and US Green Building Council" (Phiri & Chen 2014, p.48; USGBC 2014).

LEED 2009 for Healthcare is defined as "a set of performance standards for certifying health care facilities" with the purpose of "promoting healthful, durable, affordable and environmentally sound practices in building design and construction" (USGBC 2014, p.xiii). It can be used for the design and construction of "both new build premises and major renovations of existing healthcare facilities" (USGBC 2014, p.xiv; Phiri & Chen 2014). Unlike GB/T 51153 or *BREEAM Healthcare 2008*, *LEED 2009 for Healthcare* is a voluntary environmental assessment system with a suite of evaluation topics in the US.

All design items (65 in total: 13 prerequisites and 52 optional items) in *LEED 2009 for Healthcare* address 7 topics for sustainability assessment (i.e. "Sustainable Sites (18%)", "Water Efficiency (9%)", "Energy and Atmosphere (39%)", "Materials and Resources (16%)", "Indoor Environmental Quality (18%)", "Innovation in Design (6%)" and "Regional Priority (10%)"), which add up to 110%. Each topic has both prerequisites and available credits. Finally, based on the evaluation of performance, three certifications in *LEED 2009 for Healthcare* can be awarded (Table 4.5).

Table 4.5 Certifications in *LEED 2009 for Healthcare* (source: USGBC 2014, p.xiv)

"LEED rating	Point
Certified	40 – 49 points
Silver	50 – 59 points
Gold	60 – 79 points
Platinum	80 points and above"

4.2.5 Comparative Studies of GB/T 51153, *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare*

GB/T 51153, *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare* were initially designed for assessing the sustainability performance of healthcare environments under different circumstances. A comparative study between these documents is conducted to explore the weakness of GB/T 51153 in sustainability assessment of healthcare environments. Based on the comparative study, it is found that similarities and differences between them coexist. Moreover, all documents used in the research are the latest versions: GB/T 51153 (only version, 2015), *BREEAM Healthcare 2008* (Version 4.1, 2012) and *LEED 2009 for Healthcare* (Version 2014, 2014).

For similarities, first, all documents are designed to assess the sustainability of healthcare environment design, focusing on environmental, social and economic aspects. They aim to support healthcare environment design towards sustainability standards, and a number of design strategies are overlapped and categorised into similar sections – for example, energy saving, indoor illumination, water saving and noise control. Figure 4.1 shows that the classifications in GB/T 51153 and *LEED 2009 for Healthcare* are alike, while *BREEAM Healthcare 2008*'s is more complex than others.

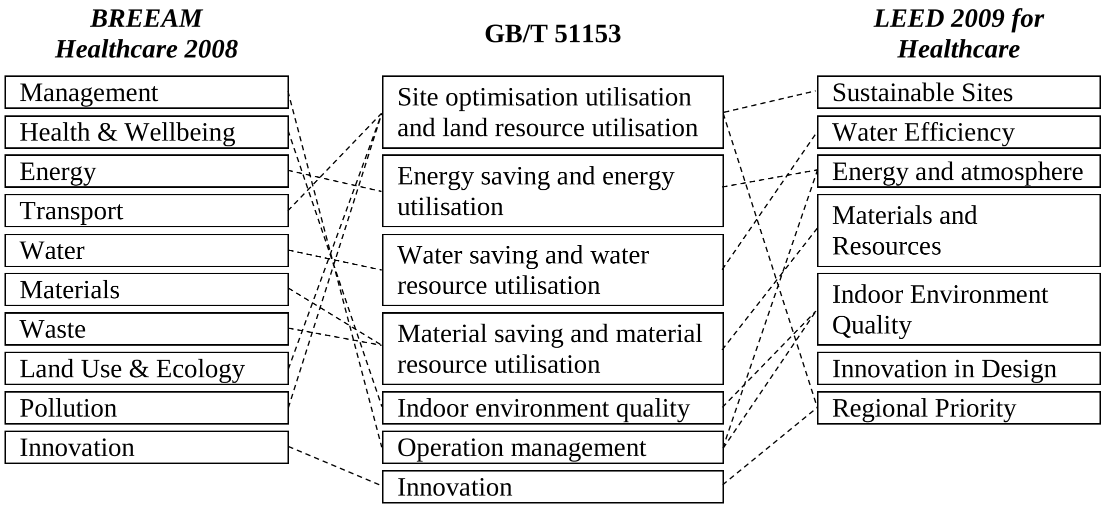


Figure 4.1 Relationship between GB/T 51153 and *BREEAM Healthcare 2008*/*LEED 2009 for Healthcare*

Second, they have similar calculation models (i.e. available credits that reflect the **relative importance** of design items) and certificate rating systems (i.e. three certificate ratings for GB/T 51153, five ratings for *BREEAM Healthcare 2008*, and four ratings for *LEED 2009 for Healthcare*) (for more information, see Table 4.2, 4.3 & 4.5). All design items (i.e. design strategies), with clear requirements, credits and terminologies, are divided as compulsory and optional ones. In terms of evaluation procedures and assessment scopes of building types, all documents can be used at both design and operation stages for a range of healthcare buildings (Table 4.6) (BRE 2012; USGBC 2014; MOHURD & AQSIQ 2015).

Differences also exist. GB/T 51153 was officially launched by authorities – the Ministry of Housing and Urban-Rural Development of the People's Republic of China and the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China, as a mandatory building regulation in the construction market of China. Working closely with the national government of the UK, the Building Research Establishment (BRE) was commissioned to develop *BREEAM Healthcare 2008*, which soon replaced the *National Health Service Environmental Assessment Tool* (NEAT – a self-assessment tool for sustainability of healthcare environments issued by the NHS in 2002) and became a mandatory regulation later (Chen et al. 2011; BRE 2012). *LEED 2009 for Healthcare* was designed by an organisation, US Green Building Council, and applied as a voluntary design aid for healthcare buildings in the US (USGBC 2014; Phiri & Chen 2014). The requirement of "mandatory standards" for sustainability assessment can lead to a good drive for the development of sustainable design, including standardisation, transparency and legal certainty. However, a voluntary way may provide flexibility and proximity that work for the collective interest of industries (Scholtz et al. 2014). Each way has its own advantages.

Table 4.6 Types of healthcare buildings for sustainability assessment (source: BRE 2012, p.23; USGBC 2014, p.xiv; MOHURD & AQSIQ 2015, p.3)

GB/T 51153
• "All single healthcare buildings and building clusters";
BREEAM Healthcare 2008
• "Teaching/specialist hospitals, general acute hospitals, community and mental health hospitals, GP surgeries, and health centres and clinics";
LEED 2009 for Healthcare
• "Inpatient and outpatient care facilities and licensed long term care facilities, including medical offices, assisted living facilities, and medical education and research centres".

Since this research focuses on the social sustainability of community-based healthcare environments, more attention has been paid to this aspect in the following comparisons. *BREEAM Healthcare 2008* has a more complicated classification. It separately sets a section "Health & Wellbeing", which consists of a range of design strategies that contribute to users' health and well-being (BRE 2012). In return, *BREEAM Healthcare 2008* has a better support for healthcare environment design from a social perspective. Compared with *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare,* there are some design strategies that are overlooked by GB/T 51153 (Table 4.7) (Ban et al. 2016b). According to previous research, most of them are evidence-based design strategies that are related to end-users' healing, well-being and environmental satisfaction – for example, user guide (Man 4), participation (Man 6 & Man 13), safety (Man 8 & Tra 4), glare control (Hea 3), high frequency lighting (Hea 4) and arts in health (Hea 19) (Mann et al. 1986; Ulrich et al. 1993; Beauchemin & Hays 1998a & 1998b; Altimier 2004; Macnaughton 2007).

As argued by Cole (2005), social and economic concerns in developing countries are far more pressing than those in developed countries, and the aims of sustainability assessment in developing countries should address the basic human needs and avoid negative environmental impacts. But the comparative study shows that the capacity of GB/T 51153 in addressing social concerns should be further enhanced in order to meet end-users' satisfaction and needs. This is because that GB/T 51153 has been put into practice for a relatively short term. Long-term practice enhances the holistic qualities of *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare* from various aspects step by step. Taking *BREEAM Healthcare 2008* as an example, it has been revised in the process of development. On one hand, it applies new standards to refine and optimise the strategies related to environmental aspects – for example, the change of "Ene 3 Sub-metering of high energy load and tenancy areas" in Version 4.0: "a definition of Energy Supply, and therefore what should be metered, has been added to the Additional Information section") (BRE 2012, p.334). On the other hand, the NHS cooperates with research institutes and collects evidence-based design strategies from previous research to enhance the social concerns in this sustainability assessment method (e.g. The University of Sheffield Healthcare Research Group – *Sheffield Architectural Healthcare Environment and Patient Outcomes*; for more information, see Section 2.3.2) (Phiri 2014; Phiri & Chen 2014). For example, to secure patients' recovery rates by controlling noise, the requirement of "Hea 13 Acoustic performance" was raised to be in accordance with evidence, which was also included in a design code in the UK – *Health Technical Memorandum 08-01 Acoustics* (BRE 2012). The changes to *BREEAM Healthcare 2008* are an optimised process of approaches, standards and scopes of sustainability assessment from both social and environmental dimensions, based on research and practice.

Table 4.7 Design strategies related to end-users' healing, well-being and environmental satisfaction only in *BREEAM Healthcare 2008* or *LEED 2009 for Healthcare*

BREEAM Healthcare 2008	**Credits**
• Man 4: Building user guide (Minimum standard)	1
• Man 6: Consultation	2
• Man 7: Shared facilities	2
• Man 8: Security	1
• Man 11: Ease of maintenance	1
• Man 13: Good cooperate citizen	1
• Hea 3: Glare control	1
• Hea 4: High frequency lighting (Minimum standard)	1
• Hea 19: Arts in health	1
• Tra 2: Proximity to amenities	1
• Tra 3: Cyclist facilities	2
• Tra 4: Pedestrian and cyclist safety	1-2
• Tra 7: Travel information point	1
LEED 2009 for Healthcare	**Points**
• SS 4.2: Alternative transportation – bicycle storage and changing rooms	1
• IEQ Prerequisite 2: Environmental tobacco smoke (ETS) control	0
• ID Prerequisite 1: Integrated project planning and design	0
• ID 3: Intergard project planning and design	1

Although GB/T 51153, *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare* have a series of assessment scopes that cover many types of healthcare buildings, the diversity can be clearly found from *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare*. Both of them have explicit and various requirements in the environmental assessment for healthcare facilities at different scales. The solutions reflect in the variety of weights (i.e. credits) and assessment standards in an identical strategy, according to the types of healthcare buildings (Table 4.8; for more information, see *BREEAM Healthcare 2008* & *LEED 2009 for Healthcare*). The framework improves the diversity and effectiveness of sustainability assessment. However, almost all items in GB/T 51153 have only one standard for all types of healthcare buildings (only "4.2.12 Green routes for ambulances" indicates that this strategy is appropriate for medium and large healthcare buildings with more than 500 beds). It results in a query whether this sustainability assessment method is able to inform the design of healthcare environments at both large and small scales.

Table 4.8 Design items that have different contents in *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare* (source: BRE 2012, p.73; USGBC 2014)

BREEAM Healthcare 2008	
• Hea 2 View out;	• Ene 3 Sub-metering of high energy load and tenancy areas;
• Tra 3 Cyclist facilities;	• Tra 4 Pedestrian and cyclist safety;
• Tra 6 Maximum car parking capacity;	• Tra 7 Travel information point.
LEED 2009 for Healthcare	
• SS Credit 4.4: Alternative transportation – parking capacity;	
• IEQ Credit 8.2: Daylighting and view – view.	

The comparative study of GB/T 51153, *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare* indicates some differences between these documents. First, GB/T 51153 has a lack of diversity in sustainability assessment – having identical standards and technical requirements for healthcare buildings with different scales, functions and service groups. It may decrease the efficiency of identifying required information for healthcare environment design by stakeholders. Moreover, compared with *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare*, the content related to evidence-based design strategies (e.g. arts, privacy protection, user guide and participation) in GB/T 51153 is relatively less. It brings negative impacts upon its capacity of informing healthcare environment design for end-users' satisfaction and needs. It is indicated that, in developing countries, sustainability should be approached by addressing the basic human needs and avoiding negative environmental impacts in the meantime (Cole 2005). Sustainability assessment methods have responsibility for securing the design quality of the built environment. These differences identified from the comparisons reflect some weaknesses of GB/T 51153, which may affect the social concerns for healthcare environment design. Since the social sustainability of community-based healthcare environments is chosen as the research boundary, findings of this research can be used to provide suggestions to modify such weaknesses of GB/T 51153.

4.3 DESIGN AIDED TOOLS FOR HEALTHCARE

Besides the sustainability assessment methods in the current construction market, there are design aided tools that have been applied as information sources in the fields of healthcare environment design and research – for example, *Achieving Excellence Design Evaluation Toolkit* (AEDET Evolution) and *A Staff and Patient Environment Calibration Tool* (ASPECT) (Ghazali & Abbas 2012; Bajunid et al. 2014; Phiri & Chen 2014; Phiri 2014).

4.3.1 *Achieving Excellence Design Evaluation Toolkit*

To measure and evaluate complex concepts that are frequently involved in healthcare design, in 2004, *Achieving Excellence Design Evaluation Toolkit* (AEDET Evolution) was developed by The University of Sheffield Healthcare Research Group under a commission from the NHS Estates (DH 2004a). It is designed to reflect the strengths and weaknesses of a design or an existing building during the design-build-occupy cycle (DH 2004a; Phiri & Chen 2014). For this target, AEDET Evolution designs 58 "clear, non-technical statements" that encompass three key areas (i.e. "Impact", "Build Quality" and "Functionality"), and then splits these design issues into 10 "assessment criteria" (Figure 4.2) (DH 2004a, p.3). These assessment criteria and statements are used to summarise "how well a healthcare building complies with best practice" (ibid, p.2).

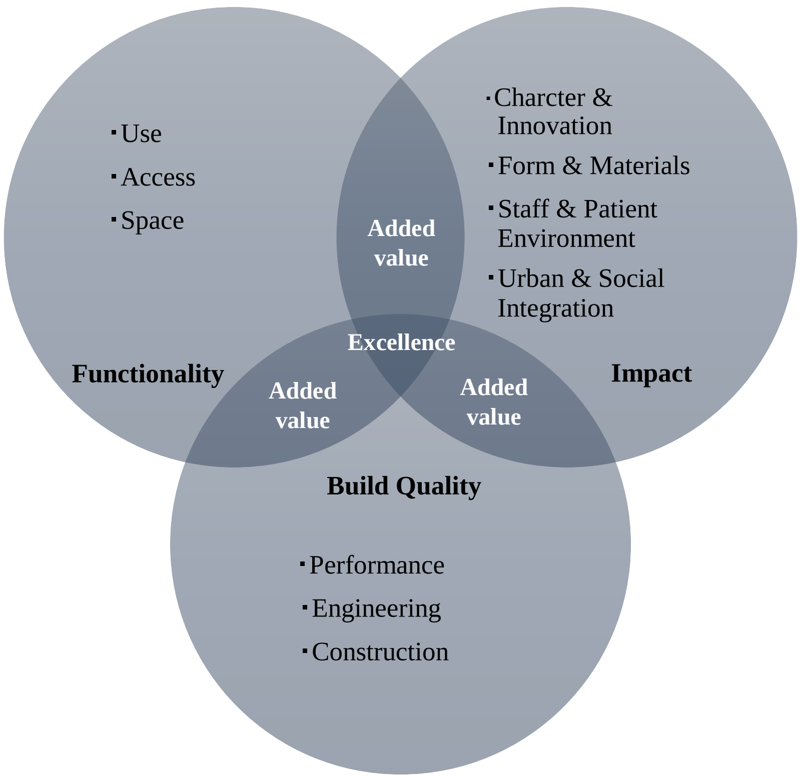


Figure 4.2 Main sections and assessment criteria in AEDET Evolution (source: DH 2004a, p.2)

By using non-technical statements instead of professional terminologies to express assessment consideration, AEDET Evolution provides a "**common language**" that identifies the needs and other information required by the stakeholders who are engaged in the design, construction and occupancy of healthcare buildings (DH 2004a, p.4; Phiri & Chen 2014). It can be used as a benchmarking tool or communication platform for all stakeholders, including "public and private sector commissioning clients, developers, design teams, project managers, estates/facilities managers, design champions and user clients (e.g. patient representatives and medical staff)" (DH 2004a, p.5; Phiri & Chen 2014).

Table 4.9 Weighting and 6 point scoring scale (source: DH 2004a, p.9)

"**Weighting** (weighting)	**6 point scoring scale** (score)
• High (2): Statements weighted High (2) have their score added in twice • Normal (1): Statements weighted Normal (1) have their score added in once • Zero (0): Statements weighted Zero (0) are excluded from the calculations	Virtually complete agreement (6) Strong agreement (5) Fair agreement (4) Little agreement (3) Hardly any agreement (2) Virtually no agreement (1) Unable to score (0)"

$$average\ score = \frac{\sum_{i=1}^{n}(weighing_1 \times score_1 + \cdots + weighing_n \times score_n)}{\sum_{i=1}^{n}(weighing_1 + \cdots + weighting_n)}$$

To facilitate the communication and knowledge exchange between different user groups, this hierarchical tool designs 3 layers – "scoring layer", "guidance layer" and "evidence layer" (DH 2004a, p.7; Phiri & Chen 2014, p.57; Phiri 2014). On scoring layer, users express their opinions on the statements by using a "weighting" and a "six-point scoring scale" (Table 4.9 & the formula as above). It is important to note that this tool intends to explore the **preferences** from different stakeholder groups and thereby identify their **cognitive differences** and **priority variances**. No predefined points are provided to reflect the importance of statements. All points are created from the value judgements and calculations. The guidance layer gives more detailed help and explanations about the statements. It provides a link between the outcomes and inputs of environmental design. For example, the statement C.04 is "there are high levels both of comfort and control of comfort". If users would like to get more detailed and professional knowledge about this design outcome, clear design strategies related to this statement are provided on the corresponding guidance layer (DH 2004a, p.17):

> "Consider using double weighting. This item may be particularly important for space where patients and/or staff spend significant amounts of time. Patients and staff should be comfortable. The temperature should be comfortable all year round and be capable of easy local control. Patients and staff should be able to exclude sunlight and darken

spaces when patients wish to sleep. Artificial light should be easily controllable offering patterns suitable for day and night and for winter and summer. Patients and staff should be able to open windows and doors easily for fresh air. The places where staff work or patients spend time should be quite and free from unwanted levels of background noise. Stress and heart rates have been proved to rise in noise hospitals."

The evidence layer is an innovative part which points to available research evidence and supports the links between design outcomes and inputs (DH 2004a). It can be seen as an evidence database, which collects previous successful studies that have identified evidence-based design strategies and their contributions to the built environment, health or efficiency. The setting of this layer results in that AEDET Evolution is considered as an important evidence-based design tool (O'Keeffe 2008; Phiri & Chen 2014; Phiri 2014). Moreover, AEDET Evolution is designed as "a tool specifically directed towards achieving excellence in design rather than ensuring compliance with legislation, regulation and guidance" (Phiri & Chen 2014, p.57). Therefore, in the UK, this tool is applied in conjunction with *BREEAM Healthcare 2008*, AEDET Evolution for social aspects while *BREEAM Healthcare 2008* for "evaluation of designs for environmental considerations and energy consumption" (Phiri & Chen 2014, p.57; DH 2004a; BRE 2012; Phiri 2014; Ban et al. 2016b). Both contribute to the excellence of healthcare environments from different dimensions of sustainability.

4.3.2 *A Staff and Patient Environment Calibration Tool*

A Staff and Patient Environment Calibration Tool (ASPECT), also developed in 2004, is used as "a plug-in or Section C (Staff and Patient Environment) of AEDET Evolution" that provides "a more comprehensive evaluation" of the "impact of design on patient and staff satisfaction and patient health outcomes" (DH 2004b, p.3; Phiri & Chen 2014, p.58). It can be seen as a standalone tool to amplify a part of AEDET Evolution – the environment of medical staff and patients in a more detailed and accurate way, based on over 600 pieces of research available by 2004 (DH 2004b; Phiri & Chen 2014). Therefore, ASPECT has the same system (i.e. non-technical statements, user scopes and triple-layer evaluation systems) as AEDET Evolution. The main differences are the evaluation contents and application stages. As the Staff and Patient Environment section of AEDET Evolution, ASPECT implements the evaluation under eight headings, including "Privacy, company and dignity", "Views", "Nature and outdoors", "Comfort and control", "Legibility of place", "Interior appearance", "Facilities" and "Staff", by collecting evidence from relevant studies (DH 2004b). These headings correspond to the statements in Section C of AEDET Evolution – Staff and Patient Environment. The statements in ASPECT explain those in AEDET Evolution in further detail. Taking C.04 "there are high levels both of comfort and control of comfort" in AEDET Evolution as an example, the corresponding heading in ASPECT is "Comfort and control". There are six statements in this heading to explain the item C.04 (ibid, p.15):

- "4.01 There is a variety of artificial lighting patterns appropriate for day and night and for summer and winter;
- 4.02 Patients and staff can easily control the artificial lighting;
- 4.03 Patients and staff can easily exclude sun light and day light;
- 4.04 Patients and staff can easily control the temperature;
- 4.05 Patients and staff can easily open windows/doors; and
- 4.06 The design layout minimises unwanted noise in staff and patient areas."

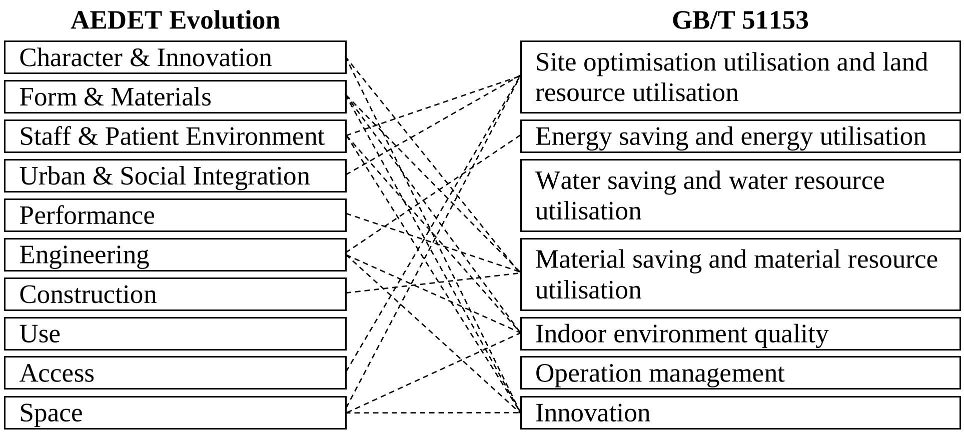
It is obvious that all items listed above have been summarised in the explanation of C.04 of AEDET Evolution, which can be found on its guidance layer. ASPECT is designed to further emphasise the impacts of healthcare environment design upon the satisfaction of medical staff and patients. As indicated in ASPECT, this tool can be used to evaluate existing and new healthcare buildings during the design process (ibid). However, the studies from The Sheffield University Healthcare Research Group indicate that ASPECT produces more accurate results for a post-occupancy evaluation environment for medical staff and patients (Phiri & Chen 2014; Phiri 2014). ASPECT is therefore more frequently used for post-project or post-occupancy stages (Phiri 2014).

4.4 *CONCEPTUAL FRAMEWORK FOR HEALTHCARE ENVIRONMENT DESIGN*

Based on the above discussion about sustainability assessment methods and design aided tools for healthcare environments, it can be found that they have been designed to inform healthcare environment design from different perspectives. Another cross-comparative study is conducted between AEDET Evolution and GB/T 51153, to further explore the capacity of GB/T 51153 in addressing social concerns. On one hand, GB/T 51153 is designed as a mandatory building regulation by authorities to set compulsory standards and secure the overall quality of healthcare environments in China; on the other hand, AEDET Evolution has some characteristics that GB/T 51153 may not own – for example, a common language for communication between different stakeholders. The reason of choosing AEDET Evolution rather than ASPECT is that AEDET Evolution has more holistic and comprehensive content than that in ASPECT. In addition, it is noteworthy that there are no such design aided tools developed for healthcare environments in China (Ban et al. 2016b). Although these tools have been developed and applied worldwide for decades, the research and application of design aided tools for healthcare environments in China are still limited (ibid). Then based on the results of cross-comparisons, the *Conceptual Framework for Healthcare Environment Design* can be established to collect relevant design strategies for communication and knowledge exchange between different stakeholder groups.

4.4.1 A Cross-comparative Study between GB/T 51153 and AEDET Evolution

AEDET Evolution and GB/T 51153 have many differences in terms of contents and structures. First, the most significant difference is their focuses. Although both of them assess healthcare buildings from triple dimensions of sustainability (i.e. environmental, social and economic aspects) and have a part of overlapping contents for assessment, their main focuses are different (Figure 4.3). Based on the cross-comparisons, it can be found that AEDET Evolution emphasises "atmosphere (e.g. a caring and reassuring atmosphere, welcoming feeling, interesting and attractive appearance, home-like design, and on-site security), efficiency (e.g. obvious and logical entrances, standardisation and prefabrication for engineering systems and construction, transportation at peak times, and optimally arranged workflows and circulation) and humanity (e.g. privacy protection, staff-only space, and sex segregation)" (Ban et al. 2016b, p.101). It focuses on a **user-centred perspective** and **consensus-building** between different stakeholder groups.



Note: the links mean there are overlapping but not completely consistent contents between assessment criteria of AEDET Evolution and aspects of GB/T 51153.

Figure 4.3 Overlapping contents between AEDET Evolution and GB/T 51153

However, it is found that GB/T 51153 pays more attention to ecosystem and resource utilisation – for example, energy saving, water saving, land saving, material saving and pollution control, which reflects in the quantity and available credits of design items. It can be seen that there are 88 design items (23 prerequisite items and 65 scoring items with 102.25 available credits) for the design stage in GB/T 51153. While, according to the content of

AEDET Evolution's evidence layer, only 21 design items of 88 (5 prerequisite items and 16 scoring items with 21.9 available credits) belong to evidence-based design strategies. Many evidence-based design strategies that have been proved in previous clinical studies are not included in GB/T 51153 – for example, privacy protection, artwork and workflow design for medical staff's work efficiency. Such information that is overlooked by GB/T 51153 may impact upon its objective for a green hospital – "providing patients and medical staff with healthy, suitable and effective space" (MOHURD & AQSIQ 2015, p.2).

Second, in AEDET Evolution, design strategies, which are collected on the guidance layer, have been described with "clear, non-technical statements" in order to ensure that it can be used by different users, especially for those stakeholders with less specialist knowledge in the built environment (e.g. patients and medical staff). The intentions and outcomes of design strategies have been explained in an understandable and readable way. It builds a communication platform for all stakeholders who are "involved in the commissioning, production and use of healthcare buildings" (DH 2004a, p.4). In contrary, all design strategies in GB/T 51153 are technical. It provides detailed techniques and requirements about design inputs which are mainly for the professional stakeholders (e.g. architects). The professional restriction hinders end-users from expressing their needs or preferences by directly using GB/T 51153 as a decision-making aid.

It is shown that AEDET Evolution has better capacity to address social concerns, including healthcare outcomes (e.g. abundant evidence-based design strategies for end-users' health, well-being, satisfaction and medical staff's work efficiency) and public participation (e.g. a common language in non-technical statements for communication and knowledge exchange between different stakeholders). These help architects understand end-users' needs effectively and thereby implement end-user centred participatory design specifically. To implement end-user centred participatory design for community-based healthcare environments, the capacity of GB/T 51153 for social aspects (e.g. healing, well-being and environmental satisfaction for end-users) should be improved. To identify the information that can be added to improve the social sustainability of GB/T 51153, an integrated approach, *Conceptual Framework for Healthcare Environment Design,* is proposed. It integrates AEDET Evolution and GB/T 51153 in together, including two parts – contents and structures.

It is important to note that a series of evidence-based design strategies collected in AEDET Evolution are important for end-users' healing and well-being, but they are overlooked by GB/T 51153. The content integration may bring more information to GB/T 51153 and thereby enhance its capacity from a social perspective. Moreover, the structure integration gives GB/T

51153 potential of facilitating the communication and knowledge exchange between end-users and architects. A common language can be created to help end-users express their needs and preferences for design strategies in a participatory design process. In the next section, the integrated approach is described, including its content and structure.

4.4.2 *Conceptual Framework for Healthcare Environment Design*

As seen in the *Conceptual Framework for Healthcare Environment Design*, in terms of contents, there are three levels – **design issues** (Level 1), **design strategies** (Level 2) and **design items** (Level 3) that are categorised into ten assessment criteria (Figure 4.4 & Table 4.10). This structure (i.e. classification) is designed based on the "outcome-input" system used by AEDET Evolution. In total, 60 design issues on Level 1 (highlighted in grey in Table 4.10) describe the outcomes of design strategies in non-technical statements for stakeholders with less specialist knowledge in the built environment (e.g. patients and medical staff). Most of design issues are abstracted directly from AEDET Evolution (E.05 "the location of building is appropriate and land-saving" and F.06 "the building has resource-saving design and facilities" are created by summarising the particular design strategies and items from GB/T 51153).

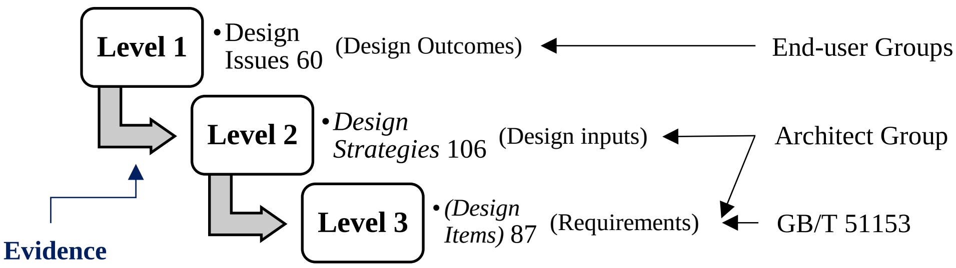


Figure 4.4 Structure of *Conceptual Framework for Healthcare Environment Design*

Table 4.10 Content of *Conceptual Framework for Healthcare Environment Design*

A: CHARACTER & INNOVATION ← e.g. assessment criterion	
A.01 There are clear ideas behind the design of the building. ← e.g. design issue	
• *A clear and coherent vision about its function and aspirations* ← e.g. design strategy	▲
A.02 The building is interesting to look at and move around in.	
• *Plain form without extra decoration for elevation (7.1.3)* ← e.g. design item	♦
• *Artwork for decoration*	▲/*
A.03 The building projects a caring and reassuring atmosphere.	
• *A civic presence for a caring and reassuring atmosphere*	▲/*
A.04 The building appropriately expresses the value of the health services.	
• *Design for inspiration of patients and staff*	▲/*
A.05 The building is likely to influence future healthcare designs.	
• *Current best practice to reflect healthcare provision*	▲/*
• *Building Information Modelling (10.2.3)*	♦
B: FORM & MATERIALS	
B.01 The building has a human scale and feels welcoming.	
• *Welcoming appearance to staff, patients and visitors*	▲/*
• *A human scale for windows, indoor heights, doors and entrances*	▲

B.02 The building is well orientated on the site.

- *Daylighting level (8.2.3/10.2.9)* ■/*/#
- *Daylighting level for underground space (8.2.5)* ♦/#

B.03 Entrances are obvious and logically positioned in relation to likely points of arrival on site.

- *Obvious entrances and routes onto the site* ▲/*

B.04 The external materials and detailing appear to be of high quality.

- *Graceful image without staining or weathering* ▲
- *No prohibited materials (7.1.1)* ♦
- *Concrete structure (7.1.2)* ♦/#
- *Premixed concrete (7.2.2)* ♦/#
- *Premixed mortar (7.2.3)* ♦/#
- *Robust materials (7.2.4)* ♦
- *Innovative materials (10.2.8)* ♦

B.05 The external colours and textures seem appropriate and attractive.

- *Colours and textures related to adjacent buildings and environment* ▲

C: STAFF & PATIENT ENVIRONMENT

C.01 The building respects the dignity of patients and allows for appropriate levels of privacy and company.

- *Design for privacy protection* ▲/*
- *Design for patient company* ▲/*

C.02 There are good views inside and out of the building.

- *Good views in wards and consulting rooms (8.2.4)* ■/*

C.03 Patients and staff have good easy access to outdoors.

- *Land use for greening (4.2.2)* ■/*/#
- *Greening and vegetation diversity (4.2.16)* ♦/*/#
- *Open spaces and access to nature for all-weather design (8.2.13)* ■/*/#

C.04 There are high levels both of comfort and control of comfort.

- *Light pollution control (4.2.5)* ♦
- *On-site acoustic environment (4.2.6)* ■/*/#
- *On-site wind environment (outdoor walking in winter / ventilation in summer) (4.2.7)* ■/#
- *Heat island control (4.2.8)* ■
- *Indoor noise level (8.1.1/8.2.1/8.2.2)* ■/*/#
- *Indoor glare control (8.1.2)* ♦
- *Indoor temperature (8.1.4/8.2.6)* ■/*
- *Indoor ventilation and fresh air volume (8.1.5)* ■/*/#
- *Shading system in summer (8.2.7)* ■/#
- *Air quality monitoring (8.2.11/10.2.10)* ♦/*/#

C.05 The building is clearly understandable.

- *Signposting system and humanistic factors (8.1.7)* ■/*

C.06 The interior of the building is attractive in appearance.

- *Home-like design for interior (light, airy, tidy and texture-appropriate)* ▲/*

C.07 There are good bath/toilet and safety facilities for patients.

- *Safety facilities (non-slip flooring, seats, handrails and shelves) for bath/toilet* ▲/*

C.08 There are good facilities for staff including convenient places to work and relax without being on demand.

- *Staff-only space for work and relax* ▲

D: URBAN & SOCIAL INTEGRATION

D.01 The height, volume and skyline of the building relate well to the surrounding environment.

- *Sunshine spacing for surrounding residential buildings (4.1.4)* ■

D.02 The building contributes positively to its locality.

- *A landmark or locality* ▲/#
- *Pleasant spaces outside the building* ▲/*/#

D.03 The hard and soft landscape around the building contribute positively to the locality.

- *Therapeutic function for hard and soft landscape* ▲/*

• *Safe and clear ground materials*	▲
D.04 The building is sensitive to neighbours and passers-by.	
• *Attractive form and elevation for neighbours and passers-by*	▲/#

E: PERFORMANCE	
E.01 The building is easy to operate.	
• *Straightforward management of facilities*	▲/#
E.02 The building is easy to clean.	
• *Easy clean for building and materials*	▲
• *Easy access to windows for cleaning externally and internally*	▲
E.03 The building has appropriately durable finishes.	
• *Robust and washable finishes for walls, ceiling and floor for predicted lifespans (7.2.6)*	■
• *Control of moisture and mildew on the surface of walls (8.1.3)*	♦
E.04 The building will weather and age well.	
• *Graceful image with material junctions after ageing*	▲
E.05 The location of the building is appropriate and land-saving.	○
• *No protection areas for heritage or ecosystem (4.1.1/4.2.13)*	♦
• *Location safety (4.1.2/4.1.3)*	♦
• *Land-saving design (4.2.1)*	♦/#
• *Usage of underground spaces (4.2.3)*	♦
• *Contaminated land recovery (10.2.2)*	♦/#

F: ENGINEERING	
F.01 The engineering systems are well designed, flexible and effective.	
• *Commissioning (5.1.5)*	■
F.02 The engineering systems exploit any benefits from standardisation and prefabrication where relevant.	
• *Standardisation and prefabrication for engineering systems*	▲/#
F.03 The engineering systems are energy efficient.	
• *Energy-saving plan for power consumption (5.1.1/5.1.2/5.1.3/5.1.4/5.2.1/5.2.2/5.2.3/ 5.2.4/5.2.5/ 5.2.6/5.2.8)*	■/#
• *Renewable energy (5.2.7/10.2.1)*	■/#
• *Energy-efficient air conditioning and air purifier (8.2.8/8.2.9/8.2.10/10.2.4)*	■/#
F.04 There are emergency backup systems that are designed to minimise disruption.	
• *Emergency backup requirements for the design*	▲
F.05 During construction disruption to essential services is minimised.	
• *Continuity of essential services during construction disruption*	▲
F.06 The building has resource-saving design and facilities (water and materials).	○
• *Recyclable materials (7.2.9)*	♦/#
• *Water-saving plan and facilities (6.1.1/6.1.2/6.1.3/6.2.2/6.2.3/6.2.4/6.2.5/6.2.6/6.2.7/ 6.2.8/6.2.9/10.2.6)*	♦/#
• *Rainwater recycling (4.2.14/4.2.15/6.2.10/6.2.11/10.2.7)*	♦/#

G: CONSTRUCTION	
G.01 If phased planning and construction are necessary the various stages are well organised.	
• *Organisation of phased planning and construction*	▲
G.02 Temporary construction is minimised.	
• *Minimal temporary construction*	▲
• *Simultaneous works for construction and decoration (7.2.7)*	♦
G.03 The impact of the construction process on continuing healthcare provision is minimised.	
• *Segregation between operational areas and contractor's area*	▲/#
G.04 The building can be readily maintained.	
• *Minimal maintenance for components in the construction*	▲
• *Clear life-cycles of components*	▲
• *Easy replacement for components*	▲
G.05 The construction is robust.	
• *Detailed junctions between materials and components*	▲/#

- *Sufficient strength and integrity for functions and locations of components and finishes (7.2.5)* ■
- *Resource-saving types of construction (7.2.12)* ♦/#

G.06 The construction allows easy access to engineering systems for maintenance, replacement and expansion.

- *Integration between construction design and engineering systems* ▲
- *Easy maintenance and replacement for engineering components* ▲

G.07 The construction exploits any benefits from standardisation and prefabrication where relevant.

- *Standardisation and prefabrication for construction* ▲/#

H: USE

H.01 The prime functional requirements of the brief and satisfied.

- *Considerations of core purposes of healthcare service* ▲/#

H.02 The design facilitates the care model of the Trust.

- *Reflection of Trust's healthcare philosophy and delivery in the design* ▲

H.03 Overall the building is capable of handing the projected throughput.

- *Demands at peak times on spaces, circulation and access* ▲

H.04 Workflows and logistics are arranged optimally.

- *Layout design to minimise distances travelled and lines crossed* ▲/*

H.05 The building is sufficiently adaptable to respond to change and to enable expansion.

- *Recyclable partition for multifunctional and alterable rooms (7.2.8)* ■/#
- *Flexibility for future change and expansion* ▲/#

H.06 Where possible spaces are standardised and flexible in use patterns.

- *Capability of changing spaces' use as needs change* ▲/#

H.07 The layout facilitates both security and supervision.

- *Layout design for security and passive supervision* ▲

I: ACCESS

I.01 There is good access from available public transport including any on-site roads.

- *Connection with public transport (4.2.9)* ■/#
- *Clear pedestrian routes from public transport points* ▲/#

I.02 There is adequate parking for visitors and staff cars with appropriate provision for disabled people.

- *Design for parking (cycles and vehicles) (4.2.11)* ■/#

I.03 The approach and access for ambulances is appropriately provided.

- *Adequate segregation and demarcation of ambulance access and drop off points* ▲
- *Access and entrance for ambulances (4.2.12)* ■

I.04 Goods and waste disposal vehicle circulation is good and segregated from public and staff access where appropriate.

- *Segregation between large or noisy vehicles and pedestrian areas* ▲/#

I.05 Pedestrian access routes are obvious, pleasant and suitable for wheelchair users and people with other disabilities/impaired sight.

- *Barrier-free design for site and sidewalk (4.2.10)* ■

I.06 Outdoor spaces are provided with appropriate and safe lighting indicating path, ramps steps.

- *Safety lighting for landscape at night* ▲

I.07 The fire planning strategy allows for ready access and egress.

- *Integration between fire planning strategy and the design* ▲

J: SPACE

J.01 The design achieves appropriate space standards.

- *Normal demand and peak demand for technical spaces* ▲/#
- *Uncluttered and spacious entrance areas* ▲
- *Consideration for special areas for children* ▲

J.02 The ratio of usable space to the total area is good.

- *Maximise utilisation for possible spaces* ▲/#
- *Effectiveness for dual use of circulation space* ▲/#

J.03 The circulation distances travelled by staff, patients and visitors are minimised by the layout.	
• *Layout design to reduce the congestion and circulation (8.2.12)*	■/#
J.04 Any necessary isolation and segregation of spaces is achieved.	
• *Layout and greenbelt design for infectious segregation (4.2.4)*	■
J.05 The design makes appropriate provision for gender segregation.	
• *Design for gender segregation*	▲/*
J.06 There is adequate storage space.	
• *Adequate storage space in the building*	▲

Note: ○ *Design issues that are created by summarising the content of GB/T 51153 (2);*
■ *Design strategies collected in both AEDET Evolution and GB/T 51153 (26);*
▲ *Design strategies only collected in AEDET Evolution (56);*
♦ *Design strategies only collected in GB/T 51153 (24);*
* *EBD strategies with evidence (24)* (see Appendix 2.1)*;*
# *EED strategies* (see Appendix 2.2)*;*
Numbers in bracket behind the design strategies are the design items' codes in GB/T 51153.

On Level 2, design strategies (106) addressed from both AEDET Evolution and GB/T 51153 are mixed (highlighted in italic in Table 4.10). It can be seen as the content integration. It is important to note that the design strategies that are abstracted from GB/T 51153 are the ones applied for the design stage, as this research focuses on the design quality of new healthcare buildings. The content only applied for the operational stage of healthcare buildings is not included. According to the content of the evidence layer in AEDET Evolution, all evidence-based design strategies in the *Conceptual Framework for Healthcare Environment Design* are highlighted with "*" (25, 23.6%). The eco-effective design strategies are highlighted with "#" (41, 38.7%). **The links between design issues (outcomes) and design strategies (inputs) are built based on the evidence from previous research**, which can identify the nature of design strategies – EBD or EED (see Appendix 2.1 & 2.2). Moreover, the design items on Level 3 (87) (highlighted in italic and brackets in Table 4.10, behind design strategies) present the requirements of corresponding items in GB/T 51153. It helps professional stakeholders (e.g. architects, constructors, assessors and manufacturers) allocate the required information (i.e. detailed requirements of relevant design items) from this sustainability assessment method in a relatively short time.

4.4.3 Discussion

The *Conceptual Framework for Healthcare Environment Design* is designed by integrating structures and contents from GB/T 51153 and AEDET Evolution. This integration further demonstrates that GB/T 51153 and AEDET Evolution have different focuses: there are 106 design strategies in total, 24 of which (22.6%) are only collected in GB/T 51153. Most of them emphasise the environmental dimension of sustainability, including ecosystem protection and resource utilisation; 56 design strategies (52.8%) can be only found in AEDET Evolution, and they are mainly focused on social concerns – for example, a caring atmosphere, welcoming feeling, privacy protection and home-like design (see Table 4.10).

Therefore, it can be used in conjunction with GB/T 51153 currently to identify the information for an enhancement of GB/T 51153 on its social sustainability. It can facilitate the knowledge exchange between different stakeholders (including design professionals and stakeholders with less specialist knowledge in the built environment) for healthcare environment design in a participatory design process. Along with the design issues that describe the outcomes of design strategies in non-technical statements, the *Conceptual Framework for Healthcare Environment Design* can be used as a communication platform. Knowledge exchange can be implemented based on the evidence-based design principle that links end-users' needs and the intentions and decisions of architects together (Figure 4.5). End-users can use design issues to express their desires. Their environmental needs can be understood by architects, based on the links between design issues and design strategies.

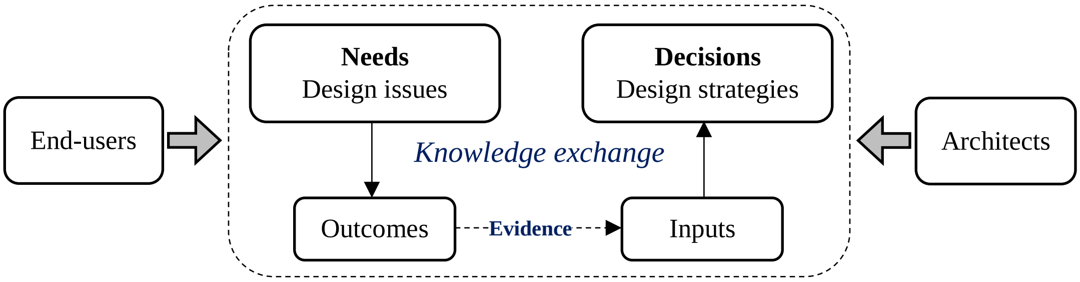


Figure 4.5 Knowledge exchange based on evidence

Evidence-based design emphasises the connection between the stakeholders with different knowledge levels (for more information, see Section 2.5.1) (Hamilton & Watkins 2009). Based on its definition, an evidence-based design strategy can be seen as a "chain of logic" that bridges the detailed design inputs and measurable healing effects together. Since stakeholders with less specialist knowledge do not understand how to design healthcare buildings, they just express their desires about general needs for healthcare environments – for example, a comfortable indoor environment, quick recovery, understandability of buildings and safety. This kind of needs can be explained in the form of the outcomes of design strategies which belong to the information required by end-users. Design strategies that have the intentions related to end-users' general needs can be considered as architects' required information about end-users' environmental satisfaction.

Moreover, the solid **evidence** verified by successful studies validates the links between the inputs and outcomes – for example, postoperative patients with window views of trees spend less time in the hospital than those with views of brick walls: "7.96 days compared with 8.70 days per patient" for patients' recovery after cholecystectomy (Ulrich 1984, p.224). With the help of evidence, architects can collect and identify design strategies that can contribute to end-users' needs and quickly make **informed decisions** for their design work (Mills et al. 2015). On the basis of evidence, the information required by end-users can be transferred to architects, and knowledge exchange can be facilitated.

Therefore, in the *Conceptual Framework for Healthcare Environment Design*, three levels of contents are designed (see Figure 4.4). The first level functions to describe design strategies' outcomes in non-technical statements. End-users can use this information to express their preferences for needs and understand the outcomes of relevant design strategies for healthcare environments. Long-term practical experience of AEDET Evolution has proved that these design issues cover the **vast majority of end-users' needs** and describe them explicitly (Phiri 2014). Using the second and third levels, architects are able to identify the design strategies related to end-users' needs on one hand. On the other hand, they can understand the corresponding requirements in GB/T 51153. All information helps architects improve the quality of their design work, which accommodates end-users' satisfaction with healthcare environments and legislation standards in the meantime. Moreover, architects can also evaluate design strategies, and find which strategies have more effectiveness for healthcare environment design based on current best evidence. This process has an additional function, which engages end-users in the development of building regulations (e.g. sustainability assessment methods). The preferences of end-users and architects can be used as references in practice to inform and modify the relative importance of design strategies in legislation.

4.5 CHAPTER SUMMARY

In this chapter, a series of environmental sustainability assessment methods and design aided tools for healthcare buildings have been analysed and cross-compared. All comparative studies were conducted around GB/T 51153, as it had been studied in this research as the most suitable sustainability assessment method for the design of community-based healthcare environments in China. According to the "One Star" requirement from authorities, GB/T 51153 can be seen as a mandatory building regulation for healthcare environment design in China, and foreign sustainability assessment methods (e.g. *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare*) are all voluntary (for more information, see Section 4.2.2).

Based on the comparative study between sustainability assessment methods, it was found that GB/T 51153 covered a comprehensive scope for evaluation of environmental aspects – for example, land, energy, water and materials. The comparisons between GB/T 51153 and *BREEAM Healthcare 2008*/*LEED 2009 for Healthcare* showed some weaknesses of GB/T 51153 that might have impacts upon its holistic performance in the sustainability assessment of healthcare environments at a community level. Improving the capacity to address social concerns is important for the future development of GB/T 51153.

The analysis of AEDET Evolution and ASPECT provided an idea about enhancing the communication-supportive and participation-supportive capacity of GB/T 51153. With an integration of contents and structures between GB/T 51153 and AEDET Evolution, design issues and strategies addressed from them were collected to form the *Conceptual Framework for Healthcare Environment Design* (see Figure 4.4 & Table 4.10). Some benefits were created by this integration:

- Based on the comparison between GB/T 51153 and AEDET Evolution, it was found that a number of design strategies that were related to end-users' needs for healthcare environments were not collected currently in GB/T 51153. A part of these strategies belonged to evidence-based design strategies that had been verified by previous research (see Table 4.10 & Appendix 2.1). These design strategies could be used to improve the capacity of GB/T 51153 in addressing social concerns and facilitate its future development. The *Conceptual Framework for Healthcare Environment Design* could be seen as an approach that integrated the contents of GB/T 51153 and AEDET Evolution towards achieving excellence in healthcare environment design and the compliance with legislation and building regulations.

- A function that end-users could be engaged in the design decision-making process was provided. Since GB/T 51153 was considered as a mandatory standard and important information source for healthcare environment design in China, architects should use it as guidance. The *Conceptual Framework for Healthcare Environment Design* could be seen as an approach that was applied in conjunction with GB/T 51153 in practice. It provided an opportunity for architects to identify end-users' needs and use such information for decision-making. It could be viewed as a communication platform that applied the "outcome-input" system for knowledge exchange between stakeholders with different knowledge levels in a participatory design process of community-based healthcare environments. It is important to note that the "outcome" part – design issues were addressed from AEDET Evolution, as this design aided tool covered the vast majority of end-users' needs. The links between the design issues and strategies were established based on the evidence from previous successful studies.

In the next chapter, the *Conceptual Framework for Healthcare Environment Design* will be applied to identify the design issues and design strategies that are related to end-users' needs for community-based healthcare environments, and then guide the design of questions and questionnaires for target groups (i.e. Patient Group, Staff Group and Architect Group) in the field investigations (including interviews and surveys). Based on the links between design issues and design strategies in the *Conceptual Framework for Healthcare Environment Design*, cross-comparative studies between the target groups (i.e. Patient Group, Staff Group and Architect Group) can be conducted to explore the cognitive differences and priority variances relating to the design of community-based healthcare environments.

5

Interview for End-user Groups and Questionnaire Design

5.1 CHAPTER INTRODUCTION

The field investigations of this research are described from this chapter, including a semi-structured interview (Chapter 5), questionnaire surveys for target groups (Chapter 6 ~ 8) and a follow-up focus group (Chapter 9). Social research methods are applied to have a comprehensive understanding of end-users' satisfaction and needs for community-based healthcare environments. Findings from investigations can be used to support the end-user centred participatory design. It is important to note that the ethical approvals for all social studies were achieved on 30th March 2016 before conducting the field investigations (see Appendix 3.1 ~ 3.4).

Chapter 5 presents an interview with a small group of end-users (i.e. patients and medical staff), which intends to answer the research questions: 1) "What design strategies can improve the quality of community-based healthcare environments and thereby meet end-users' needs?" and 2) "Is there a consensus on good community-based healthcare environment design within end-user groups?". To answer the first question, the design strategies related to end-users' needs for community-based healthcare environments should be identified based on those addressed in the *Conceptual Framework for Healthcare Environment Design*. For the second question, this interview serves as a pilot study that explores end-users' cognitive abilities about healthcare environment design at a community level. Moreover, cross-comparative analysis of the feedback is conducted to explore the cognitive differences in end-users' needs and knowledge regarding the design of community-based healthcare environments across different stakeholder groups.

Self-completion questionnaires applied in the surveys for target groups (i.e. Patient Group, Staff Group and Architect Group) are designed. They are used to explore the preferences of end-users and architects, to evaluate the relative importance of design strategies related to end-users' needs for community-based healthcare environments, and to support cross-comparative studies between these stakeholder groups.

5.2 INTERVIEWS FOR END-USER GROUPS

As stated earlier in Chapter 2, the main end-users of healthcare environments are patients who are the beneficiaries of healthcare service and medical staff who should also be paid attention to because they face a wide range of hazards on the job every day (Arsand & Demiris 2008; CDC 2013; CHD 2015). A small group of patients and medical staff are randomly recruited to participate in this interview. Their feedback can be used to identify the design issues and design strategies related to end-users' needs for community-based healthcare environments. Based on the results of cross-comparative analysis, surveys for end-users groups can be designed and conducted (Figure 5.1).

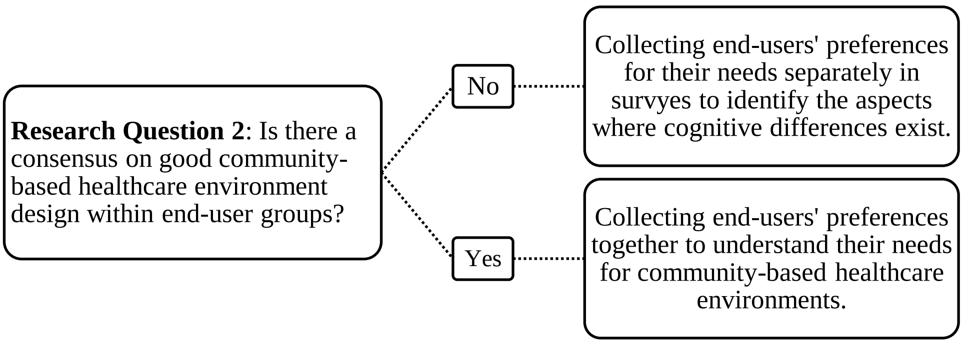


Figure 5.1 Survey Procedures for Research Question 2

5.2.1 Semi-structured Interviews and Grounded Theory

In this interview, qualitative methods are applied to explore people's cognition. This is because that qualitative methods can "emphasise multiple participant views and theory generation" with the goal of "understanding the complexity of the topics under study from personal perspectives, experiences and interactions" (CHD 2014a, p.10; Lincoln & Guba 1985; Leedy & Ormrod 2001; Creswell 2003; Bryman 2012). In contrast to quantitative research, raw data in qualitative research is typically transferred to narratives. This way is "more flexible in terms of procedure, design and measurement methods, which may consistently change and develop along the research process" (CHD 2014a, p.23).

Of qualitative methods, a face-to-face interview is considered as a useful tool of examining the attitudes, feelings and opinions regarding complex topics from target groups and providing accurate information compared with other tools (Bryman 2012; CHD 2014a). Of the major types of interviews, a semi-structured interview method "typically refers to a context in which the interviewer has a series of questions that are in the general form of an interview schedule but is able to vary the sequence of questions" (Bryman 2012, p.212; CHD 2014a). It is selected to keep the validity of data in this research. Predefined but open-ended questions are used to explore the end-users' cognition. On one hand, strict standards may limit interviewees' imagination for answers. On the other hand, predefined questions can keep interviewees focusing on the topic and the answers will not be too diverse (Bryman 2012).

The grounded theory is used to analyse the data collected from the semi-structured interview in order to generate "the theory out of data" (Thomson 2011, cited in Bryman 2012, p.378). It is defined as "a theory that was derived from data, systematically gathered and analysed through the research process… in this method, data collection, analysis and eventual theory stand in close relationship to one another" (Strauss & Corbin 1998, cited in Bryman 2012, p.387). The ground theory is considered as a most commonly used qualitative method that is applied in connection with different types of data (Strauss & Corbin 1990; Creswell 1998).

5.2.2 Sample Size and Interview Schedule

In general, sample size of qualitative research should "not be so small as to make it difficult to achieve data saturation, theoretical saturation or informational redundancy… at the same time, the sample should not be so large that it is difficult to undertake a deep, case-oriented analysis" (Onwuegbuzie & Collins 2007, p.289; Bryman 2012, p.425). Previous research of 100 academic articles from various disciplines that used the grounded theory from 2002 to 2008 indicated that the average of sample size in all studies was 25 and the range of sample quantity was from 5 to 114 (Thomson 2011, p.49).

As indicated by Thomson (2011), when using the grounded theory, the size of sampling can be affected by the quality of data. By choosing participants who "**have experienced or are experiencing the phenomenon under study**", "the researcher has chosen '**experts**' in the phenomenon and thus able to provide the **best data**" (Strauss & Corbin 2007, cited in Thomson 2011, p.48; Glaser & Strauss 1967).

The interviewees were randomly recruited from patients who sought medical treatments from community-based healthcare facilities in SIP and medical staff who worked there, since the samples had been defined as patients and medical staff who should have the experience of using community-based healthcare environments. Purposive sampling[9] was chosen for this interview. All samples could be seen as "experts" who were able to provide the "best data". Therefore, the sample size was set as 20, 10 from patients and 10 from medical staff. Due to ethical concerns, all interviewees' names were abbreviated to codes. Based on the schedule of this research, the interview was conducted from June to July in 2016 (Table 5.1 & 5.2).

5.3 DATA ANALYSIS AND DISCUSSION

There were three questions with relevant documents (i.e. information sheet of the research project and participant consent form) for all interviewees (see Appendix 3.5 & 4.1):

- Interview Question 1: What is your personal background, including genders, ages, visiting purpose, education background, work experience and positions?
- Interview Question 2: Based on your understanding, what design factors are necessary for a community-based healthcare environment, and why?
- Interview Question 3: What design issues can meet your needs for a community-based healthcare environment, based on those addressed in the *Conceptual Framework for Healthcare Environment Design*?

Based on the data of feedback, cross-comparative studies between the interviewees of patients and medical staff are conducted to build a fundamental understanding of end-users' needs for community-based healthcare environments and explore potential cognitive differences in these needs. Hypotheses and findings are discussed in this section.

5.3.1 Interview Question 1

Interview Question 1 is designed to categorise interviewees. Patients are categorised under the following variables: gender, age, visiting purpose and education background (Table 5.1).

[9] Purposive sampling: "a non-probability form of sampling. The researcher does not seek to sample research participants on a random basis. The goal of purposive sampling is to sample cases/participants in a strategic way, so that those sampled are relevant to the research questions that are being posed" (Bryman 2012, p.418).

Medical staff is categorised under the following variables: gender, work experience and position (Table 5.2).

Table 5.1 Patient interviewees' personal background and interview schedule

Code	Personal Background	Interview Time
P1	Male; age 31; for medicine purchase; master degree, Economics;	9:00 ~ 10:00, 26th June 2016
P2	Male; age 47; for treatment (dressing change); bachelor degree, Tourism management;	10:00 ~ 11:00, 26th June 2016
P3	Female; age 20; for treatment (tetanus injection); vocational degree, Secretary major ;	14:00 ~ 15:00, 26th June 2016
P4	Female; age 59; for treatment (keep coughing); master degree, Physics;	15:00 ~ 16:00, 26th June 2016
P5	Female; age 35; for her baby's vaccine injection; bachelor degree, IT;	9:00 ~ 10:00, 27th June 2016
P6	Male; age 22; for medicine purchase; undergraduate student, IT;	15:00 ~ 16:00, 27th June 2016
P7	Male; age 23; for medicine purchase; vocational degree, Civil engineering;	9:00 ~ 10:00, 3rd July 2016
P8	Male; age 61; for medicine purchase; vocational degree, n/a;	10:00 ~ 11:00, 13th July 2016
P9	Female; age 45; for treatment (headache); master degree, Arts;	14:00 ~ 15:00, 18th July 2016
P10	Female; age 67; for treatment; n/a;	15:00 ~ 16:00, 18th July 2016

Note: To keep the information representative, interviewees with architecture-related careers or education background (e.g. architecture, construction, environment assessment and healthcare estate) were excluded for the data analysis.

Table 5.2 Staff interviewees' personal background and interview schedule

Code	Personal Background	Interview Time
S1	Male; 4-year work experience; doctor; a Community Healthcare Centre;	16:00 ~ 17:00, 27th June 2016
S2	Male; intern; nurse; a Community Healthcare Clinic;	8:30 ~ 9:30, 29th June 2016
S3	Female; 24-year work experience; director; a Community Healthcare Clinic;	10:00 ~ 11:00, 29th June 2016
S4	Female; 20-year work experience; doctor; a Community Healthcare Clinic;	15:00 ~ 16:00, 29th June 2016
S5	Female; 14-year work experience; head nurse; a Community Healthcare Centre;	14:00 ~ 15:00, 3rd July 2016
S6	Male; 13-year work experience; administrator; a Community Healthcare Centre;	14:00 ~ 15:00, 13th July 2016
S7	Female; 2-year work experience; doctor; a Community Healthcare Centre;	14:00 ~ 15:00, 15th July 2016
S8	Male; 9-year work experience; doctor; a Community Healthcare Clinic;	10:00 ~ 11:00, 16th July 2016
S9	Female; 28-year work experience; doctor; a Community Healthcare Clinic;	14:00 ~ 15:00, 16th July 2016
S10	Female; 8-year work experience; nurse; a Community Healthcare Clinic.	15:00 ~ 16:00, 16th July 2016

It is indicated that people's personal characteristics may affect their common sense and thereby impact upon their cognition (Cardoso & Clarkson 2012; Pratt & Nunes 2015). The data collection about interviewees' personal background can provide an opportunity to check if different characteristics may affect end-users' cognition and needs for community-based healthcare environments. It is important to note that the information about patients' education background is used to exclude the people with architecture-related careers for this interview, as most patients have limited specialist knowledge in the built environment.

5.3.2 Interview Question 2

The second question intends to explore end-users' understanding and cognition about healthcare environment design at a community level. All interviewees were asked to answer the question "Based on your understanding, what design factors are necessary for a community-based healthcare environment, and why?". As this question is open-ended, the feedback from interviewees is various. The key words (i.e. design factors) are addressed and highlighted from their answers (Table 5.3).

Table 5.3 Feedback analysis from interviewees

Design factor (25)	Patient										Medical staff									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
Open space	•	•		•	•		•	•	•	•	•	•	•		•	•	•			•
Walking convenience				•		•		•	•		•		•	•			•			•
Public transport		•		•		•					•	•	•	•			•	•		
Pedestrian-only roads		•		•	•												•			
Parking space			•						•				•		•	•		•	•	•
Separate roads for delivery vehicles															•	•				
Landscape	•		•						•		•	•	•	•	•	•		•		•
Ecosystem and plants		•	•		•	•			•	•	•	•	•	•	•	•		•	•	
Energy-saving appliances											•		•			•				
Wayfinding maps and signs		•	•	•	•		•	•	•		•	•	•	•	•	•			•	•
Layout for footprint reduction											•	•	•	•	•					
Barrier-free devices for stairs		•		•				•			•		•		•	•	•		•	
An external view									•		•		•	•			•		•	•
Sunshine	•	•	•	•	•				•			•								•
Shading				•		•	•		•						•	•	•			
Natural ventilation		•		•					•		•	•	•	•		•	•			•
Indoor temperature	•		•		•	•	•	•	•	•	•		•	•	•	•	•	•	•	•
Local features for communities													•		•	•				
Environment-friendly materials																•	•			•
Handhold for safety								•	•		•		•	•	•	•			•	•
Slip-anti flooring								•	•		•		•				•	•		
Home-like decoration	•								•						•	•				•
Artwork			•				•										•			•
Interior lighting level									•		•	•	•			•	•			
Noise-anti equipment															•				•	•

Note: Highlighted as the design factors that are only mentioned by staff interviewees.

Finally, 19 design factors, in total, are mentioned by patients, and another 25 design factors are mentioned by medical staff. It is important to note that interviewees answered this question independently, without any consultation from others in the interview process. All feedback about their understanding of the necessity and importance of design factors was based on their common sense. As patients and medical staff are two types of main end-users of healthcare environments, it is ideal that there is a complete consensus on the good design of community-based healthcare environments between them. If so, architects and other professionals can save time and efforts from making a balance between the needs of different end-users during the design decision-making process. However, the cross-comparative studies between the patients and medical staff show that, when there is no hints, the needs of interviewees are various. It can be seen that patients and medical staff have different understanding of healthcare environment design at a community level. Priority variances exist in some environmental needs of end-users (Table 5.4 & Figure 5.2).

Table 5.4 Cross-comparisons between design factors mentioned by patients and medical staff

Design factor mentioned in the interview	Patient	Rate	Staff	Variance	Total
Open space	8/10	8:7	7/10	1	15
Walking convenience	4/10	4:5	5/10	1	9
Public transport	3/10	3:6	6/10	3	9
Pedestrian-only roads	3/10	3:1	1/10	2	4
Parking space	2/10	2:6	6/10	4	8
Separate roads for delivery vehicles	0/10	0:2	2/10	2	2
Landscape (e.g. fountain, pool and sculpture)	3/10	3:8	8/10	5	11
Ecosystem and plants (e.g. trees, flowers, shrubs and grass)	8/10	8:8	8/10	0	16
Energy-saving appliances (lights and air conditionings)	0/10	0:3	3/10	3	3
Wayfinding maps and signs	7/10	7:8	8/10	1	15
Layout for footprint reduction (Short distance between different therapy rooms)	0/10	0:5	5/10	5	5
Barrier-free devices (e.g. entrances and stairs)	4/10	4:6	6/10	2	10
An external view from buildings (e.g. viewing windows)	1/10	1:6	6/10	5	7
Sunshine (sufficient access to daylight)	6/10	6:2	2/10	4	8
Shading (controllable shading system against strong sunshine)	4/10	4:1	1/10	3	5
Natural ventilation	3/10	3:7	7/10	4	10
Indoor temperature	8/10	8:9	9/10	1	17
Local features for communities	0/10	0:3	3/10	3	3
Environment-friendly materials	0/10	0:3	3/10	3	3
Handhold for safety	2/10	2:7	7/10	5	9
Slip-anti flooring	2/10	2:4	4/10	2	6
Home-like interior design and decoration	2/10	2:3	3/10	1	5
Artwork for decoration	2/10	2:2	2/10	0	4
Lighting levels	1/10	1:5	5/10	4	6
Noise-anti equipment	0/10	0:3	3/10	3	3

Note: Highlighted as the design factors that are only mentioned by staff interviewees.

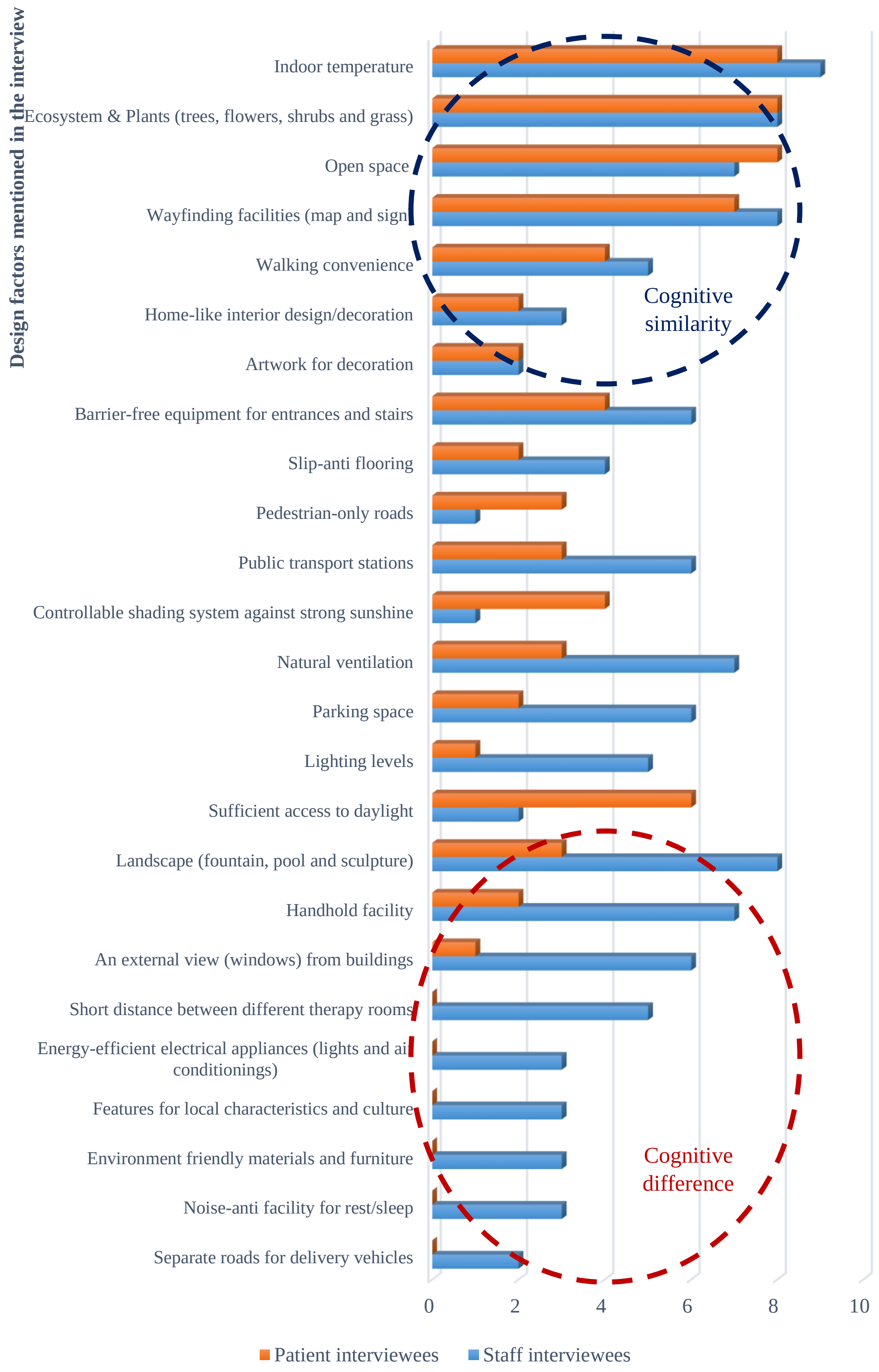


Figure 5.2 Cross-comparisons between design factors mentioned by interviewees

There are 19 design factors being mentioned by both groups of interviewees. Among them, some factors have similar rates – for example, "indoor temperature" (8:9), "ecosystem and plants" (8:8), "open space" (8:7), "wayfinding equipment (e.g. map, sign)" (7:8), "barrier-free equipment for entrances and stairs" (4:6), "home-like interior design and decoration" (2:3) and "artwork for decoration" (2:2) (see Figure 5.2). The factors, including "indoor temperature", "ecosystem and plants", "open space" and "wayfinding equipment", are the top four factors that are considered necessary by all interviewees. It is important to note that these factors can be used to constitute evidence-based design strategies for health, recovery and work efficiency (for more information, see Appendix 2.1). AEDET Evolution uses "consider using double weighting" to describe the design issues that are related to these factors (DH 2004a). On the guidance layer, it indicates that "the temperature should be comfortable all year round and be capable of easy local control" (ibid, p.17). Moreover, "(for patients and staff) to go outside easily and have access to well landscaped gardens" can "reduce blood pressure, relieve stress, encourage healing and restore hope" (ibid, p.17). In terms of wayfinding, AEDET Evolution shows that this strategy makes buildings easily understandable by implementing obvious entrances, indicating the public and private domains, and telling where to find medical staff (ibid). Although end-users may not be clear with the academic studies that have proved the importance of these design factors, their experience gives these "experts" a relatively high cognitive consensus on these factors.

In addition, cognitive differences exist in some design factors – for example, "landscape (fountain, pool and sculpture)" (3:8), "handhold equipment" (2:7), "parking space" (2:6), "sufficient access to daylight" (6:2), "an external view (window) from building" (1:6), "lighting levels" (1:5), "short distance between different therapy rooms" (0:5), "energy-efficient electrical appliances" (0:3), "features for local characteristics and culture" (0:3), "environment friendly materials and furniture" (0:3) and "noise-anti equipment for rest sleep" (0:3) (see Figure 5.2). These conflicts show that different nature of end-users leads to different needs for community-based healthcare environments between the interviewees of patients and medical staff. It can be concluded from some representative feedback with high frequency in the interview:

- Public transport stations around community-based healthcare facilities

Patients: "The centre is not far away from my department"; "When I feel tired, public transport is not helpful"; "A walking distance is important";

Medical staff: "I wish there is a bus from my apartment to the healthcare facility, so I can use public transport instead of a private car"; "I prefer a through bus. I don't need to change one to another"; "There is not enough parking space, so I have to take a bus everyday";

- Parking space

Patients: “I come here on foot. I do not use parking space”; “I would like to go to a hospital that is designed with a consideration of parking space”; “A convenient parking process may improve the medical efficiency and patients’ moods”;

Medical staff: “I wish I would not need to search a parking bay every day”; “The parking space here is not big enough for all doctors and nurses”; “I have to find a parking bay in competition with the customers of the supermarket”;

- Ecosystem and Plants (e.g. trees, flowers, shrubs and grass)

Patients: “It is not a necessary factor, but better than nothing”; “We are here for treatments. I do not have enough time to admire vegetation. But better than nothing”;

Medical staff: “Trees can be used for shading”; “Plants make the indoor healthcare environment vivifying”; “It decorates the space”;

- Artwork for decoration

Patients: “Better than nothing. It makes the indoor environment a good taste”; “I would like to admire something when I am in a queue”;

Medical staff: “Some flowers may make a comfortable, agreeable environment”; “Some painting can distract patients’ attention”;

Taking transport as an example, most patients go to community-based healthcare facilities on foot. It is because that this kind of healthcare facilities is designed for neighbourhoods. These patients live in the surrounding neighbourhoods, which results in that parking space is not much necessary for most of them. However, some of medical staff has to use vehicles for commuting, since they usually do not live in the neighbourhoods where they work. They consider public transport and parking space much more important than patients do. Moreover, the original motive that patients visit community-based healthcare facilities is to seek for medical treatments. The uncomfortableness may make them focus mainly on their illness. To some extent, these people hardly care about the natural environments or landscape. This idea can be found from some responses of patients:

“It (e.g. trees, flowers and grass) is not a necessary factor, but **better than nothing**”;
“We are here for treatments. I do not have enough time to admire vegetation. But **better than nothing**”;

> "It is **better than nothing**. Landscape is a connection between buildings and nature. It makes environments friendly";
> "**Better than nothing**. It (artwork) makes the indoor environment a good taste".

"Better than nothing" means these design factors do not draw proper attention from patients. But the factors related to surrounding natural environments (e.g. plants, landscape and artwork) can effectively contribute to end-users' health (i.e. recovery, stress reducing and social support) on the basis of evidence from a number of clinical studies (Rice et al. 1980; Ulrich 1984; Schroeder 1991; Baron 2006; Rashid 2010; Neducin et al. 2010). Based on the researcher's observation, it can be explained that, on one hand, most patients, who are with less specialist knowledge in the built environment, cannot realise the correlations between their original motives (i.e. medical treatments and healing) and these evidence-based design strategies. On the other hand, illness makes them care less about the surrounding environment. Once they get treatments, they do not need to stay in these community-based healthcare facilities. It is because that these community-based healthcare facilities are designed towards the primary care for non-emergency aliments and no needs for recovery in bed. Compared with patients who only spend relatively short time in community-based healthcare facilities, medical staff belongs to long-stay end-users. They follow the responsibility and eight-hour working systems. They pay more attention to interior and exterior environments and design details. The different length of stay leads to the cognitive differences and priority variances.

There are 6 design factors that are only considered important by medical staff, including "short distance between different therapy rooms" (0:5), "energy-efficient electrical appliances" (0:3), "features for local characteristics and culture" (0:3), "environment friendly materials and furniture" (0:3), "noise-anti equipment for rest/sleep" (0:3) and "separate roads for delivery vehicles" (0:2). On one hand, medical staff has longer experience, which makes them care more about design details and impacts from the built environments upon their work efficiency. On the other hand, patients care about those factors that have direct correlations with their needs and original motives. It means the above factors can hardly draw patients' attention based on their experience. Based on the results, it can be assumed that a complete consensus is unlikely to be reached, as patients and medical staff have different cognition.

5.3.3 Interview Question 3

The third interview question is set to identify the design strategies that can contribute to end-users' satisfaction with community-based healthcare environments. As the stakeholders with less specialist knowledge in the built environment "can never be as knowledgeable about design and construction as the architect", a bridge should be built between their cognition and professional knowledge to facilitate the knowledge exchange and productive collaboration (Hamilton & Watkins 2009, p.11). End-users can use non-technical statements about design outcomes to claim their needs, and architects use evidence to identify the design inputs (i.e. design strategies) that can contribute to these outcomes (DH 2004a; Phiri & Chen 2014; Phiri 2014). For this, the *Conceptual Framework for Healthcare Environment Design* was provided to the interviewees. Based on the design issues addressed in it, interviewees were asked to identify the design issues that could contribute to their needs for a community-based healthcare environment in their opinions.

As stated earlier in Chapter 4, there were 60 design issues in the *Conceptual Framework for Healthcare Environment Design* (for more information, see Table 4.12). Finally, 27 design issues (27/60, 45.0%) are identified by both interviewees of patients and medical staff:

- A.02 The building is interesting to look at and move around in;
- A.03 The building projects a caring and reassuring atmosphere;
- A.04 The building appropriately expresses the values of the health service;
- B.01 The building has a human scale and feels welcome;
- B.02 The building is well orientated on the site;
- B.03 Entrances are obvious and logically positioned in relation to likely points of arrival on site;
- B.05 The external colours and textures seem appropriate and attractive;
- C.01 The building respects the dignity of patients and allows for appropriate levels of privacy and company;
- C.02 There are good views inside and out of the building;
- C.03 Patients and staff have good easy access to outdoors;
- C.04 There are high levels both of comfort and control of comfort;
- C.05 The building is clearly understandable;
- C.07 There are good bath/toilet and safety facilities for patients;
- C.08 There are good facilities for staff including convenient places to work and relax without being on demand;
- D.01 The height, volume and skyline of the building relate well to the surrounding environment;
- D.04 The building is sensitive to neighbours and passers-by;
- H.04 Workflows and logistics are arranged optimally;
- H.05 The building is sufficiently adaptable to respond to change and to enable expansion;

- H.07 The layout facilitates both security and supervision;
- I.01 There is good access from available public transport including any on-site roads;
- I.02 There is adequate parking for visitors and staff cars with appropriate provision for disabled people;
- I.05 Pedestrian access routes are obvious, pleasant and suitable for wheelchair users and people with other disabilities/impaired sight;
- I.06 Outdoor spaces are provided with appropriate and safe lighting indicating paths, ramps and steps;
- J.03 The circulation distances travelled by staff, patients and visitors are minimised by the layout;
- J.04 Any necessary isolation and segregation of spaces is achieved;
- J.05 The design makes appropriate provision for gender segregation;
- J.06 There is adequate storage space.

Table 5.5 Design issues related to end-users' needs for community-based healthcare environments

Code	Quantity of patient interviewees	Quantity of staff interviewees	Rate	Total	Rank
A.02	6/10	10/10	6:10	16	14
A.03	10/10	10/10	10:10	20	1
A.04	10/10	10/10	10:10	20	1
B.01	9/10	10/10	9:10	19	6
B.02	8/10	9/10	8:9	17	11
B.03	8/10	8/10	8:8	16	14
B.05	5/10	8/10	5:8	13	21
C.01	10/10	10/10	10:10	20	1
C.02	8/10	10/10	8:10	18	8
C.03	7/10	10/10	7:10	17	11
C.04	10/10	10/10	10:10	20	1
C.05	9/10	9/10	9:9	18	8
C.07	9/10	10/10	9:10	19	6
C.08	4/10	9/10	4:9	13	21
D.01	4/10	8/10	4:8	12	24
D.04	5/10	6/10	5:6	11	25
H.04	0/10	10/10	0:10	10	26
H.05	6/10	9/10	6:9	15	19
H.07	10/10	8/10	10:8	18	8
I.01	7/10	10/10	7:10	17	11
I.02	5/10	8/10	5:8	13	21
I.05	8/10	8/10	8:8	16	14
I.06	7/10	9/10	7:9	16	14
J.03	10/10	10/10	10:10	20	1
J.04	7/10	8/10	7:8	15	19
J.05	8/10	8/10	8:8	16	14
J.06	0/10	10/10	0:10	10	26

Note: Highlighted as the design factors that are only mentioned by staff interviewees.

A cross-comparative study is conducted to explore the results of feedback between patient and medical staff (Table 5.5 & Figure 5.3). There are 2 design issues that are only selected by medical staff, which are H.04 ("workflows and logistics") and J.06 ("storage space"). These design issues have obvious relationship with the work efficiency of medical staff.

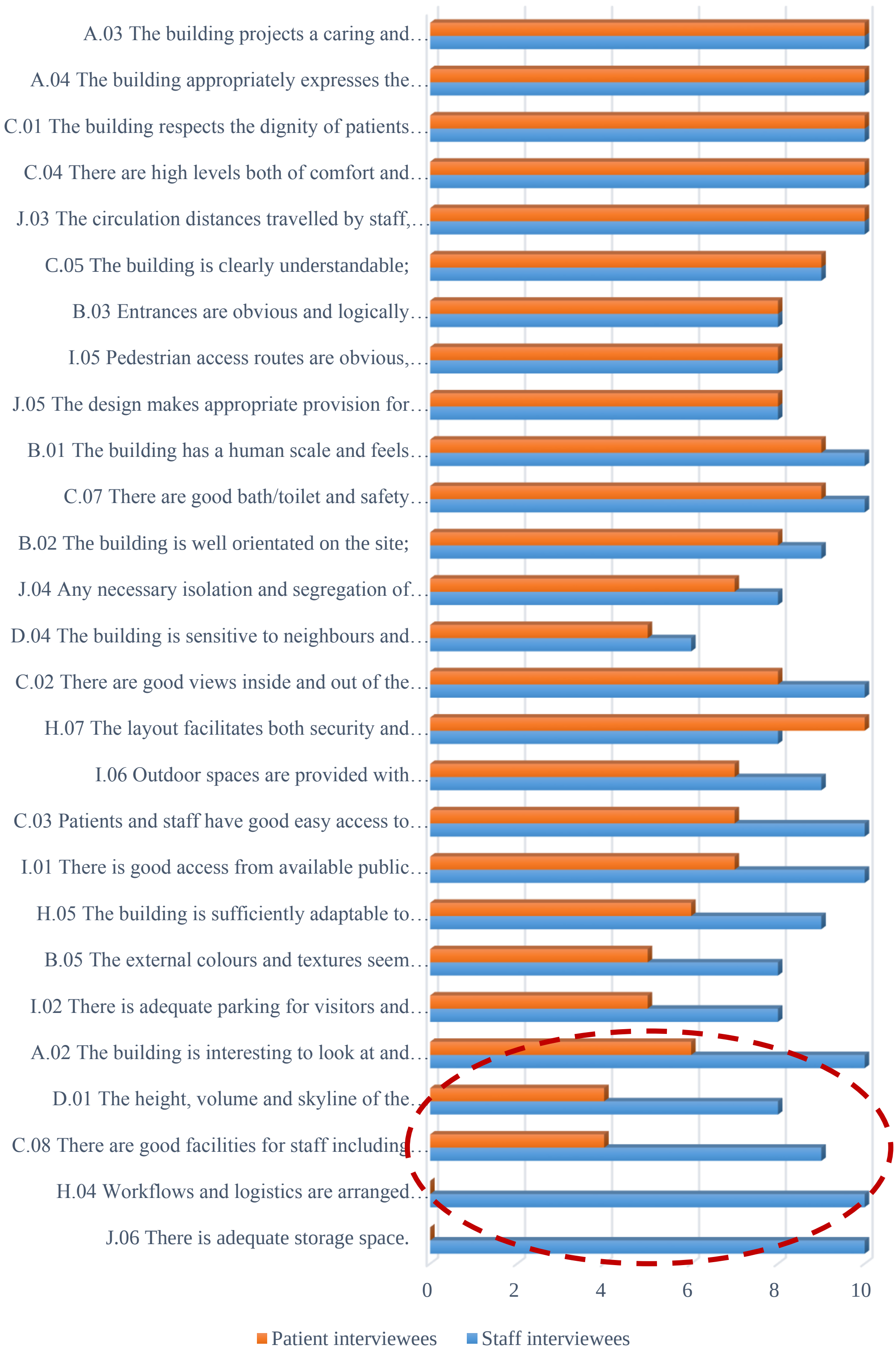


Figure 5.3 Cross-comparisons between design issues selected by interviewees

Moreover, the results show that the percentages of design issues that are selected by medical staff are more intensive than those selected by patients. It further implies that, even when there are hints, the needs of patients and medical staff are different – for example, A.02 (6:10), D.01 (4:8), C.08 (4:9), H.04 (0:10) and J.06 (0:10) (see Figure 5.3).

5.3.4 Findings and Hypotheses

This interview provides an opportunity of exploring end-users' needs for community-based healthcare environments and relevant knowledge levels. As stated earlier, this interview acts as a pilot study, which attempts to answer two research questions. According to the results, findings and hypotheses are summarised as follows:

- ✧ **Research Question 1: What design strategies can improve the quality of community-based healthcare environments and thereby meet end-users' needs?**

As indicated by Hamilton and Watkins (2009, p.12), "it is impossible for the architect to be as knowledgeable about the business as the clients… similarly, the client can never be as knowledgeable about the design and construction as the architects". To understand end-users' needs for community-based healthcare environments, it is unlikely to ask end-users to directly provide relevant design strategies or solutions. To achieve a win-win result in the end-user centred participatory design, it is important to have a productive communication and knowledge exchange between end-users and architects.

It is hard for end-users to express their satisfaction or environmental needs explicitly. The feedback from the second interview question (i.e. "Based on your understanding, what design factors are necessary for a community-based healthcare environment, and why?") shows that, due to the lack of a common language, a productive communication and knowledge exchange are difficult to achieve. To solve this problem, design outcomes, rather than design inputs to buildings, should be provided to end-users, because of their limited specialist knowledge in architectural design (Retzlaff 2008). It is relatively easy for end-users to identify their needs from the design outcomes and effects instead of choosing the design factors to express their needs in the participatory design process (Figure 5.4).

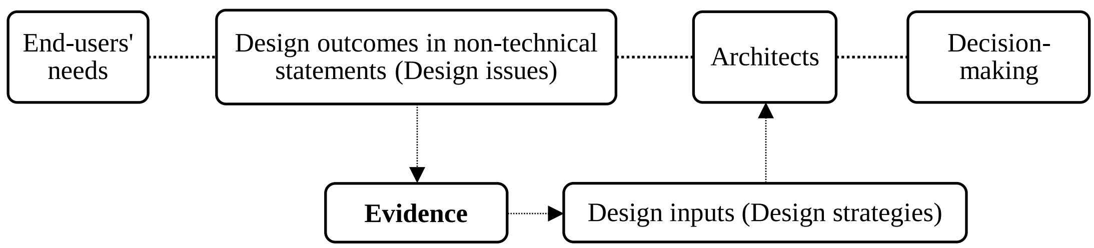


Figure 5.4 Collaboration and knowledge exchange between end-users and architects

It is important to note that AEDET Evolution is designed based on evidence-based design principles where all these design issues are related to both healthcare outcomes and design inputs (DH 2004a). In the *Conceptual Framework of Healthcare Environment Design* (an approach that integrates AEDET Evolution and GB/T 51153), all design issues are described as design outcomes in non-technical statements. They can be used as "a common language" to help end-users express themselves more easily. These design issues, which are addressed from AEDET Evolution, can effectively support the translation from an architectural language to a common language between architects and end-users. After end-users express their needs by using design issues, architects can use the links to identify relevant design strategies.

For Interview Question 3 (i.e. "What design issues can meet your needs for a community-based healthcare environment, based on those addressed in the *Conceptual Framework for Healthcare Environment Design*?"), all interviewees choose 27 design issues based on those addressed in the *Conceptual Framework for Healthcare Environment Design*, and these can be identified as **design issues related to end-users' needs for community-based healthcare environments** in this research. This information can be seen as the design issues that can contribute to end-users' satisfaction and social sustainability of community-based healthcare environments. By using the design issues that describe design outcomes and effects in non-technical statements, these stakeholders can express their needs in a better way. Their choices focus on the content about the social aspects – for example, indoor environments, atmosphere, efficiency, convenience and safety. They would like to choose the design issues that have direct and obvious connections with their needs for health and well-being. Moreover, relevant design strategies, which have relationship with these design issues based on evidence, can be identified as **design strategies related to end-users' needs** (Figure 5.5). These design strategies are the ones that can contribute to end-users' needs for community-based healthcare environments, and can be seen as the answer to Research Question 1.

In the questionnaire surveys for target groups, these design issues and design strategies will be applied to further explore target samples' preferences and cognitive differences. The design issues related to end-users' needs are suitable to the surveys for Patient Group and Staff Group, in order to understand their preferences for these design issues. The design strategies related to end-users' needs are suitable to Architect Group.

- ✧ **Research Question 2: Is there a consensus on good community-based healthcare environment design within end-user groups?**

All results of the comparative analysis show that the interviewees of patients and medical staff have different cognition about the design of community-based healthcare environments. They

Figure 5.5 Design issues and design strategies related to end-users' needs for community-based healthcare environments

Code	Design issues related to end-users' needs (27)	Code	Design strategies related to end-users' needs (44)
A.02	The building is interesting to look at and move around in.	A.021	Plain form without extra decoration for elevation (7.1.3)
		A.022	Artwork for decoration (-)
A.03	The building projects a caring and reassuring atmosphere.	A.031	A civic presence for a caring and reassuring atmosphere (evidence-based design) (-)
A.04	The building appropriately expresses the values of the health service.	A.041	Design for inspiration of patients and staff (evidence-based design) (-)
B.01	The building has a human scale and feels welcome.	B.011	Welcoming appear to staff, patients and visitors (-)
		B.012	A human scale for windows, indoor heights, doors and entrances (-)
B.02	The building is well orientated on the site.	B.021	Daylighting level (8.2.3/10.2.9)
		B.022	Daylighting level for underground space (8.2.5)
B.03	Entrances are obvious and logically positioned in relation to likely points of arrival on site.	B.031	Obvious entrances and routes onto the site (-)
B.05	The external colours and textures seem appropriate and attractive.	B.051	Colours and textures related to adjacent buildings and environment (-)
C.01	The building respects the dignity of patients and allows for appropriate levels of privacy and company.	C.011	Design for privacy protection (-)
		C.012	Design for patient company (-)
C.02	There are good views inside and out of the building.	C.021	Good views for wards and consulting rooms (8.2.4)
C.03	Patients and staff have good easy access to outdoors.	C.031	Land use for greening (4.2.2)
		C.032	Greening and vegetation diversity (4.2.16)
		C.033	Open space and access to nature for all-weather design (8.2.13)
C.04	There are high levels both of comfort and control of comfort.	C.041	Light pollution control (4.2.5)
		C.042	On-site acoustic environment (4.2.6)
		C.043	On-site wind environment (outdoor walking in winter; ventilation in summer) (4.2.7)
		C.044	Heat island control (4.2.8)
		C.045	Indoor noise level (8.1.1/8.2.1/8.2.2)
		C.046	Indoor glare control (8.1.2)
		C.047	Indoor temperature (8.1.4/8.2.6)
		C.048	Indoor ventilation and fresh air volume (8.1.5)
		C.049	Shading system in summer (8.2.7)
		C.04X	Air quality monitoring (8.211/10.2.10)
C.05	The building is clearly understandable.	C.051	Signposting system and humanistic factors (8.1.7)
C.07	There are good bath/toilet and safety facilities for patients.	C.071	Safety facilities (non-slip flooring, seats, handrails and shelves) for bath/toilet (-)
C.08	There are good facilities for staff including convenient places to work and relax without being on demand.	C.081	Staff-only spaces for work and relax (-)
D.01	The height, volume and skyline of the building relate well to the surrounding environment.	D.011	Sunshine spacing for surrounding residential buildings (4.1.4)
D.04	The building is sensitive to neighbours and passers-by.	D.041	Attractive form and elevation for neighbours and passers-by (-)
H.04	Workflows and logistics are arranged optimally.	H.041	Layout design to minimise distances travelled and lines crossed (-)
H.05	The building is sufficiently adaptable to respond to change and to enable expansion.	H.051	Recyclable partition for multifunctional and alterable rooms (7.2.8)
		H.052	Flexibility for future change and expansion (-)
H.07	The layout facilitates both security and supervision.	H.071	Layout design for security and passive supervision (-)
I.01	There is good access from available public transport including any on-site roads.	I.011	Connection with public transport (4.2.9)
		I.012	Clear pedestrian routes from public transport points (-)
I.02	There is adequate parking for visitors and staff cars with appropriate provision for disabled people.	I.021	Design for parking (cycles and vehicles) (4.2.11)
I.05	Pedestrian access routes are obvious, pleasant and suitable for wheelchair users and people with other disabilities/impaired sight.	I.051	Barrier-free design for site and sidewalk (4.2.10)
I.06	Outdoor spaces are provided with appropriate and safe lighting indicating paths, ramps and steps.	I.061	Safety lighting for landscape at night (-)
J.03	The circulation distances travelled by staff, patients and visitors are minimised by the layout.	J.031	Layout design to reduce the congestion and circulation (8.2.12)
J.04	Any necessary isolation and segregation of spaces is achieved.	J.041	Layout and greenbelt design for infectious segregation (4.2.4)
J.05	The design makes appropriate provision for gender segregation.	J.051	Design for gender segregation (-)
J.06	There is adequate storage space.	J.061	Adequate storage space in the building (-)

Note: highlighted as the design issues that are only chosen by staff interviewees.

have conflictive needs for some design strategies, based on the analysis of feedback. Attention of patients is mainly focused on the efficiency of medical treatments. Compared with medical staff, patients care less about environmental quality or indoor design details – for example, plants, landscape or artwork. They also show less concerns for the design of parking space or staff-only places. Based on the grounded theory, it is assumed that a complete consensus on good community-based healthcare environment design is unlikely to be reached between patients and medical staff. Cognitive differences and priority variances may exist between patients and medical staff because of their different nature and characteristics. Therefore, architects and other professional stakeholders should consider the needs of patients and medical staff separately in the processes of integrating their needs into design work and making decisions (see Figure 5.1).

The feedback implies that cognitive differences exist within an identical stakeholder group as well. Of patients, there were two elderly people. They showed more concerns about barrier-free, human-scale and accident-anti design (e.g. handhold and slip-anti flooring). Female patients were more sensitive to safety and vegetation. In terms of medical staff, it was found that only two interviewees mentioned indoor daylighting and they were both nurses. Based on the researcher's observation, doctors had bright offices with large windows, which were designed to create good indoor illumination and provide better quality and efficiency of healthcare service. However, in order to provide high-quality nursing service and quick responses, nurse stations were often designed in a corner or surrounded by injection rooms and wards. It led to mediocre indoor illumination. The consciousness for the need of lighting was derived from nurses' dissatisfaction with the reality of their working environments. Based on the above analysis, it is assumed that end-users' personal background – for example, genders, ages and work experience, may lead to cognitive differences and priority variances with regard to the design of community-based healthcare environments.

Moreover, it is assumed, based on the analysis of interviewees' opinions on the importance of design factors, that they misunderstood some of design factors (for more information, see Section 5.3.2). For instance, patients would like to recover as soon as possible, but they considered some evidence-based design factors (e.g. landscape, artwork and lighting levels) less important. They evaluated design factors based on their common sense or current experience, instead of realising the correlation between design factors and potential healthcare outcomes, including well-being, recovery and other environmental benefits. In the interview, the feedback about some design factors' importance contained complaints about the situation of these factors in reality. The needs and preferences of end-users might be affected by the current situation of existing healthcare environments. It is necessary to have **a unified**

standard that can manage the design of community-based healthcare facilities, which can help researchers and practitioners explore end-users' satisfaction with the built environment relatively easily and explicitly.

A hypothesis is therefore set for the second research question – **a complete consensus on good healthcare environment design is unlikely to be reached within end-user groups**. As the sample size of this interview is relatively small (i.e. 20 samples), it cannot produce statistically significant results to identify the aspects that have significant cognitive differences between patients and medical staff. It is necessary to conduct statistical analysis with a large-scale group of samples to distinguish end-users' preferences for the design of community-based healthcare environments in the participatory design process. In the surveys for target groups (i.e. Patient Group, Staff Group and Architect Group), the preferences for relevant design strategies will be collected separately from target end-user groups, and then cross-comparative studies will be implemented to explore cognitive differences.

- **Summary**

All above establishes an understanding of end-users' needs and knowledge levels related to healthcare environment design at a community level. Since it is assumed that cognitive differences may exist between patients and medical staff in terms of some environmental needs, their preferences for the design of community-based healthcare environments will be explored separately. To measure the relative importance of design strategies and identify the significant cognitive differences and priority variances of end-users, quantitative methods are applied (Pallant 2005a & 2016; Bryman 2012). A series of surveys with larger sample size will be therefore conducted to allow the research findings to be generated beyond the cases.

5.4 QUESTIONNAIRE DESIGN PROCEDURES

Based on the comparative analysis in the interview, the design issues and design strategies related to end-users' needs have been identified. To further explore the cognitive differences between target groups, self-completion questionnaires are designed. Surveys are conducted from a social-technical perspective with relatively large sample size in order to allow for statistical analysis. The design procedures are separately described in detail.

5.4.1 *Questionnaire for Patient Group* and *Questionnaire for Staff Group*

As patients and medical staff are both end-users of community-based healthcare environments, the contents of questionnaires for these groups are similar. They share an identical evaluation criterion. Both questionnaires have same sections and only several questions are different. After the pre-test procedures, the final versions of *Questionnaire for Patient Group* and *Questionnaire for Staff Group* can be found in Appendix 3.6 and 3.7. After an introductory statement that explains the research title, aims and brief ethical concerns to participants, questions are divided into four sections: Section A for personal background, Section B for relative importance of design issues, Section C for knowledge about healthcare environment design at a community level and Section D for open-ended questions.

Based on the results of the semi-structured interview, it was assumed that personal background, including genders, ages and work experience might affect end-users' understanding and needs for community-based healthcare environments. It is important to further explore whether significant differences within each group exist because of their different personal background. Therefore, Section A is designed to explore respondents' general information (in *Questionnaire for Patient Group*, QPA-1 for gender, QPA-2 for age and QPA-3 for residence; in *Questionnaire for Staff Group*, QSA-1 for gender, QSA-2 for job title and QSA-3 for work experience). It is used to categorise variables. Moreover, QSA-3 in *Questionnaire for Patient Group* is used to calculate the distances between patients' residence and community-based healthcare facilities, and then mapping these facilities.

Section B intends to evaluate the relative importance of design issues related to end-users' needs. It can be seen as the core of these surveys. Questions of this section are the design issues related to end-users' needs that were summarised in the interview. According to the results of the interview, it has been assumed that a complete consensus on the preferences for healthcare environment design at a community level cannot be reached within end-user groups. Therefore, end-users' preferences for design issues should be transferred into a measurable way to facilitate statistical analysis and cross-comparative studies between patients and medical staff.

The Likert scale is used in the questionnaire. It is a frequently used rating scale, by which "people express judgements (e.g. importance, agreement and frequency) about a phenomenon" on a continuous line (from low to high or from poor to good) (CHD 2014a, p.22; DeVellis 2003; Pallant 2005b; Bryman 2012). As indicated by Berdie (1994, cited in Wu 2003), of the multiple-item scales, the five-point scale is more creditable to explore respondents' attitudes in most cases, compared with other types of scales (e.g. three-point, four-point, six-point and seven-point). Compared with three-point and four-point scales, the five-point scale can differentiate the strong and moderate attitudes more effectively; compared with six-point or seven-point scales, the five-point scale can support the reliability more directly. Therefore, the five-point Likert scale is applied for respondents to evaluate the relative importance of all design issues from “not at all important” to “extremely important” (Figure 5.6) (Brown 2010, p.1; Vagias 2006).

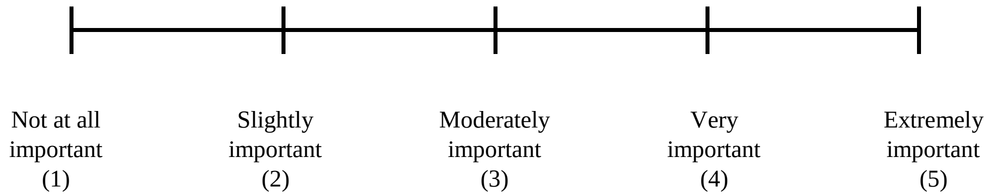


Figure 5.6 Five-point Likert scale for the rating of importance (source: Brown 2010, p.2)

Section C is set to explore the knowledge levels of patients and medical staff about healthcare environment design at a community level. QPC-1 in *Questionnaire for Patient Group* and QSC-1 in *Questionnaire for Staff Group* are designed to separately investigate the approaches that can help patients and medical staff learn about the design of community-based healthcare facilities. They attempt to find useful approaches that can help end-users acquire information about the design of healthcare environments.

It is indicated that end-user centred principles focus on end-users’ satisfaction. It includes not only the design for space and equipment, but also the desires for health and safety. Patients’ desires for health and safety are their original motive of visiting healthcare facilities. In terms of medical staff, it shows that they are “at risk to various occupational hazards on a daily basis” as they “are exposed to airborne infections in the hospital as well as those acquired through direct contact with patients” (CHD 2014a, p.36). Therefore, the desires for safety should be considered when medical staff offers medical treatments. It is believed that their status may affect the delivery of healthcare service and thereby further impact upon patients’ satisfaction. Based on the given phenomena, QPC-2 and QSC-2 are designed to explore if end-users have been aware of that their desires can be satisfied by some design strategies for healthcare environments. They will be asked to choose the options that they think have connections with healthcare environment design from options “healthcare-associated infection”, “recovery rate”, “dosage of medication”, “accidental falls”, “mood and emotion”, “staff’s health”, “staff’s service quality and efficiency” and “staff’s satisfaction”. All these options are the healthcare outcomes of evidence-based design strategies that are addressed by AEDET Evolution (DH 2004a; CHD 2015). QPC-3, QSC-3, QPC-4 and QSC-4 are designed to find if this kind of surveys related to community-based healthcare environments or service quality has been conducted for end-users previously.

Section D provides five open-ended questions. All of them are optional. QPD-1, QSD-1, QPD-2 and QSD-2 intend to ask participants to describe their understanding of community-based healthcare service and community-based healthcare environment design, while QPD-3 and QSD-3 explore their opinions on end-user centred principles in the design of community-based healthcare environments. QPD-4, QSD-4, QPD-5 and QSD-5 allow them to provide contact information for the follow-up focus group and comments on this research project.

5.4.2 *Questionnaire for Architect Group*

The end-user centred principle requires design professionals to understand end-users' satisfaction with the built environment and then integrate end-users' needs into design. The knowledge about end-users' needs would be transferred by using an architectural language. To meet end-users' needs, it is important for architects to understand end-users and have the capability of realising their needs through proper strategies.

Therefore, *Questionnaire for Architect Group* is designed to explore architects' cognition about the design strategies related to end-users' needs for healthcare environments at a community level (see Appendix 3.8). An introductory statement is set first to help architects understand the research title, survey aims and brief ethical concerns. After that, Section A is designed to investigate architects' personal background, including work experience (QAA-1) and relevant projects (QAA-2). It attempts to explore if work experience may affect architects' preferences for healthcare environment design.

In Section B, architects' knowledge levels about design strategies for healthcare environments are tested. QAB-1 explores the information sources that are frequently used by architects in the design decision-making process. QAB-2 investigates architects' knowledge about prevalent sustainability assessment methods for healthcare environment design, including *Evaluation Standard for Green Hospital Building* GB/T 51153 (China), *BREEAM Healthcare 2008* (UK) and *LEED 2009 for Healthcare* (US). QAB-3 and QAB-4 are designed to explore architects' knowledge levels about evidence-based design principles.

Section C intends to explore architects' preferences for the design strategies that are related to end-users' needs for community-based healthcare environments. The design strategies identified in the interview (i.e. the design strategies related to end-users' needs) are used as a checklist. Architect respondents will be asked to evaluate the relative importance by using the five-point Likert scale (see Figure 5.6).

Section D, with three questions, is designed to investigate the knowledge about the development of healthcare environment design at a community level from an architect's perspective. QAD-1 explores the top drivers that can improve the design quality of community-based healthcare facilities, while QAD-2 explores the top barriers that may hinder such development. QAD-3 attempts to understand the approaches that can be used to improve architects' design skills for healthcare buildings and environments.

Section E consists of three open-ended questions which are optional. QAE-1 is designed to investigate architects' opinions on end-user centred principles. QAE-2 and QAE-3 are designed to allow them to provide contact information for the follow-up focus group study and comments on this research project.

5.4.3 Questionnaire Pre-test Procedures

To achieve a high quality of questionnaires, three rounds of questionnaire pre-tests have been conducted before the questionnaire surveys are implemented. Questionnaires in Appendix 3.6 ~ 3.8 are the final versions. The drafts 1.0 of questionnaires (English version) were revised based on the feedback about wording, contents and layouts from supervisors and academics who had relevant experience about healthcare environment design or social research. Since all respondents were Chinese people, the drafts 2.0, a version in Chinese, were sent to several end-user representatives and architects for suggestions. It intended to make the questionnaires understandable and readable.

After questionnaire pre-tests, the questionnaires were delivered to the target groups according to the requirements of convenience sampling. The response analysis (including descriptive and statistical analysis) and findings from the surveys for target groups (i.e. Patient Group, Staff Group and Architect Group) are demonstrated correspondingly in the next chapters.

5.5 CHAPTER SUMMARY

This chapter describes a pilot study for questionnaire surveys. A semi-structured interview was conducted first to explore end-users' fundamental understanding of healthcare environment design at a community level. A small-size group, including patients and medical staff, was randomly recruited for the interview, as they had been defined as main end-users of community-based healthcare facilities. According to the feedback and comparative analysis, two research questions were answered (Figure 5.7).

According to the comparative analysis, it was found that it was better to use design outcomes (i.e. design issues) instead of design inputs (i.e. design strategies) to identify end-users' needs (for more information, see Table 4.12). Without any assistance of specialist knowledge in the built environment, end-users could not express their environmental needs explicitly. By using a series of design issues in “clear, non-technical statements” as a common language that described the design outcomes and performance-in-use, the needs of patients and medical staff were relatively easy to be communicated. It showed that end-users’ needs mainly focused on social aspects, including well-being, recovery, safety and medical efficiency. Moreover, since end-users had relatively less specialist knowledge in the built environment, they cared less about the environmental benefits – for example, resource-saving (e.g. land, energy, water and materials) or environmental protection (e.g. waste control, noise control, gas control and construction pollution control). To achieve a relatively balanced sustainability of community-based healthcare environments from triple dimensions – social, environmental and economic aspects, architects should make a good trade-off between end-users’ satisfaction and environmental benefits for design decision-making.

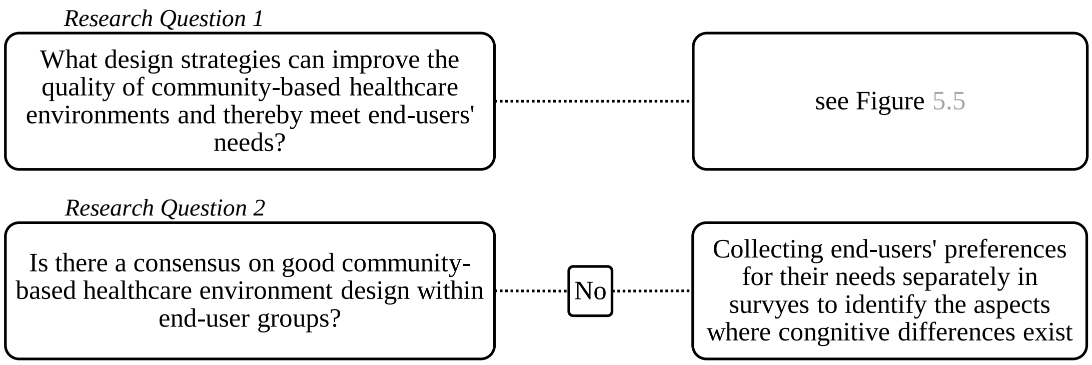


Figure 5.7 Answers to Research Question 1 and Research Question 2

Based on the interview, it was assumed that cognitive differences between patients and medical staff existed in healthcare environment design at a community level. End-users had priority variances of needs for community-based healthcare environments and different preferences for relevant design strategies. A complete consensus was unlikely to be reached. Generally, patients mainly focus on medical efficiency and convenience, since their original motives of visiting community-based healthcare facilities are receiving primary care and healing. When their desires are fulfilled, they will not continue staying in community-based healthcare facilities. However, medical staff’s situation is different. They follow the eight-hour working system and spend much more time in such facilities. Compared with patients who are defined as short-stay end-users, medical staff pays more attention to design quality and details, which can effectively ensure their satisfaction with working environments.

Moreover, cognitive differences may exist within an identical group as well, because of end-users’ different personal background – for example, genders, ages, job positions and work experience. As the sample size of this pilot study was relatively small, it was difficult to identify the significant differences that existed in end-users' cognition. It is necessary to conduct surveys with enough data to explore end-users' priority variances of their needs. Based on the outputs of the semi-structured interview, three self-completion questionnaires were designed respectively. *Questionnaire for Patient Group* and *Questionnaire for Staff Group* would be used to explore the preferences for design issues from patients and medical staff, and *Questionnaire for Architect Group* would be used to explore the preferences for design strategies from architects. After the data collection, statistical analysis will be conducted to explore the hypotheses about cognitive differences and priority variances between stakeholder groups with different knowledge levels.

He who has health, has hope; and he who has hope, has everything.

- Arabian proverb

6

Survey and Response Analysis for Patient Group

6.1 CHAPTER INTRODUCTION

Chapter 6, together with Chapter 7, explores the end-users' preferences for their needs in the design of community-based healthcare environments. This chapter describes the response analysis based on the data collected from Patient Group. According to the aggregated results, Research Question 1 (i.e. "What are end-users' preferences for these design strategies (related to their needs)?") can be answered from a patient's perspective. A statistical analysis programme SPSS (*Statistical Product and Service Solutions*, Version 21) is used to identify the significant differences in the preferences within Patient Group. A verification study is designed to explore the generalisation of findings summarised in the Survey for Patient Group. Finally, an understanding of patients' needs can be achieved.

6.2 SURVEY METHODS AND SAMPLE SIZE

As stated earlier in Chapter 2, the end-user centred participatory design approach aims to actively engage end-users in the design decision-making process and use their satisfaction to evaluate design. For healthcare environments, patients are the most important end-users, since they are the direct beneficiaries for who healthcare buildings are designed. Research on evidence-based design has proved that end-users' satisfaction with the built environment can improve their health and well-being (CHD 2015). Therefore, an understanding of patients' needs is essential for "design with users". Based on the semi-structured interview, patients' needs for community-based healthcare environments were identified. It was found that their needs were different, and therefore it was assumed that a complete consensus was unlikely to be reached. To further explore patients' cognition and environmental needs, the investigations explore their preferences for the design issues related to their needs.

The convenience sampling method was used to recruit respondents. In the procedure of Survey for Patient Group (October 2016 ~ February 2017), target samples were randomly selected from people who sought medical treatments from community-based healthcare facilities in SIP. These people can be seen as the **experts** who provide the **best data** about the specific environmental needs and knowledge levels of patients (Glaser & Strauss 1967; Strauss & Corbin 2007; Thomson 2011). It is representative for regional research if the sample size is designed between 500 and 1000 (Wu 2003, p.4; Sudman 1976). Therefore, 750 copies of self-completion *Questionnaires for Patient Group* (see Appendix 3.6), in total, were sent to 11 community-based healthcare facilities in SIP, and 550 questionnaires were collected equally from these target sites (see Appendix 4.1). It is important to note that all names of these healthcare facilities are abbreviated to codes in the thesis.

Based on the response rate formula, the response rate of this survey is 73.3% (Bryman 2012, p.199). These samples can be seen as the **Patient Group**. To ensure the quality, this questionnaire survey was completed under the researcher's supervision in a face-to-face process, and only those with all compulsory questions completed were taken into account as valid responses (i.e. usable questionnaires).

$$\frac{number\ of\ usable\ questionnaires}{total\ sample - unsuitable\ or\ uncontactable\ members\ of\ the\ sample} \times 100\%$$

After the statistical analysis of Patient Group, the second round of data collection was conducted in March 2017. Additional 55 questionnaires were randomly and equally collected from patients in the target sites (Patient Group II). The test-retest method was applied. The comparison between the responses of both groups intends to test the generalisation of the findings related to patients' preferences for the design of community-based healthcare environments (for more information, see Section 6.5).

6.3 RESPONSE ANALYSIS – DESCRIPTIVE STATISTICS

The response analysis from Patient Group, including the quantitative and qualitative data, is described in this section. As the sample size (550 usable questionnaires) and response rate (73.3%) are relatively large, the results summarised in this regional research can represent the preferences and knowledge levels of patients in SIP.

6.3.1 Personal Background (Section A)

This section aims to get respondents' personal background (i.e. genders, ages and locations of their residential communities) which can be used as variables for statistical analysis. Figure 6.1 shows that there are 252 males (45.8%) and 298 females (54.2%) of the respondents (QPA-1). Moreover, 232 of them (42.2%) are young people (ages: 18-35), 214 (38.9%) are mid-aged (ages: 36-59), and the rest (104, 18.9%) belongs to the elderly (ages: ≥ 60) (QPA-2) (Figure 6.2). A breakdown of respondents' genders and ages is shown in Table 6.1.

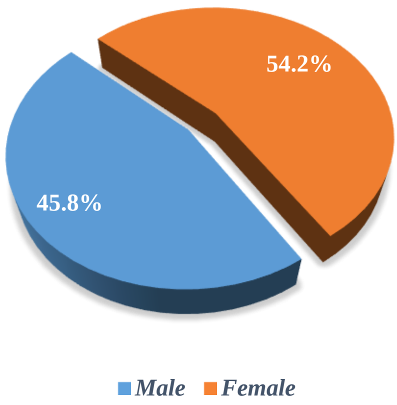


Figure 6.1 Respondents' genders from Patient Group

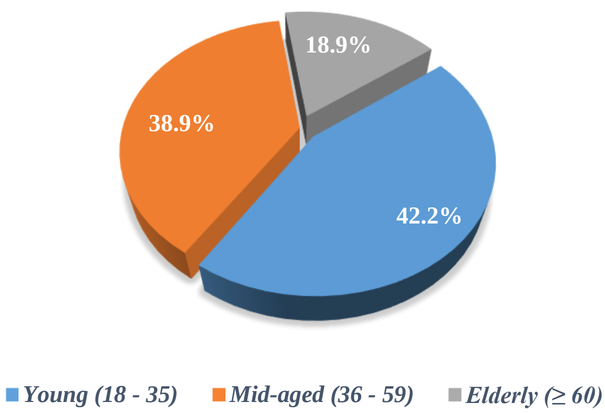


Figure 6.2 Respondents' ages from Patient Group

Table 6.1 A breakdown of respondents' genders and ages from Patient Group

Age / Gender	18 - 35	36 - 59	≥ 60	Total
Male	112	98	42	252
Female	120	116	62	298
Total	232	214	104	550

Figure 6.3 illustrates the distances between respondents' residential communities and the corresponding target sites (QPA-3). The service circles of community-based healthcare facilities in SIP can be concluded. It shows that the range of distances is approximately between 0.02km and 4.2km. The results of this question will be discussed in Section 6.6.

Figure 6.3 Service circles of community-based healthcare facilities in SIP (red dots highlight the residential communities of respondents)

6.3.2 Relative Importance of Design Issues (Section B)

This section explores patients' preferences for their needs and then transfers them into a measurable way for statistical analysis and cross-comparative studies. In the survey, respondents were asked to evaluate the relative importance of design issues related to end-users' needs, using the five-point Likert scale.

The Likert scale is a multiple-indicator rating scale that is used to "measure intensity of feelings about the area in question" with a range of statements (known as "items"), and it is creditable for exploring respondents' attitudes by using the five-point Likert scale (for more information, see Section 5.4.1) (CHD 2014a, p.22; Berdie 1994; Wu 2003; DeVellis 2003; Bryman 2012). Therefore, the importance of design issues is categorised into five levels in this research, from "not at all important" to "extremely important" (Figure 6.4).

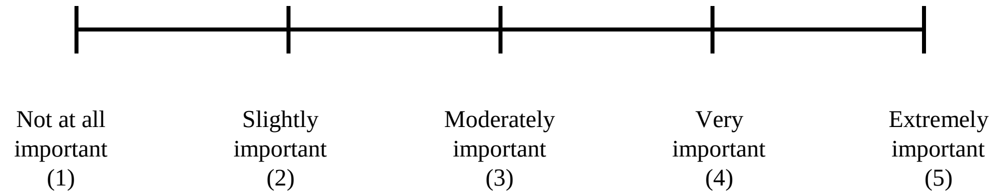


Figure 6.4 Five-point Likert scale for the rating of importance (source: Brown 2010, p.2)

According to previous research, it is necessary to decide the measurement level of the data produced by Likert scale – ordinal variables[10] or interval/ratio variables[11] (Carifio & Perla 2008; Murray 2013). Gardner and Martin (2007, cited in Murray 2013, p.259) contend that the Likert data belongs to an ordinal or rank order nature, and Bryman (2012) also argues that the multiple-indicator measures produce ordinal variables absolutely. However, Carifio and Perla (2007, cited in Murray 2013, p.259) believe that scholars who accept "ordinalist view" of Likert scale overlook the empirical research that supports the interval view. According to Creswell (2014), Likert data should be treated as interval data when there are multiple categories within a scale. It is also agreed by Norman (2010, p.631) that Likert scale can be used as interval data without "fear of coming to the wrong conclusion".

Since this research intends to explore the end-users' preferences for design issues related to their needs, **ordinal variables** are suitable to measure the relative importance of these design issues and then prioritise them (Bryman 2012). It means that two adjacent items are ranked in order, but the distances are not identical. Figure 6.5 illustrates the responses about the relative importance of design issues from Patient Group. The aggregate results show that all choices of the respondents concentrate on three items – "moderately important" (the grey bar in Figure 6.5), "very important" (the yellow bar in Figure 6.5) and "extremely important" (the dark blue bar in Figure 6.5). The graphic description further implies that a complete consensus may not be reached on the needs for community-based healthcare environments within patients. As ordinal variables are used in this research, the results are calculated based on **median values**[12]. All design issues are evaluated in Table 6.2.

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[10] Ordinal variable: "these are variables whose categories can be rank ordered (as in the case of interval and ratio variables), but the distances between the categories are not equal across the range" (Bryman 2012, p.335).

[11] Interval/ratio variable: "these are variables where distances between the categories are identical across the range of categories… it requires arithmetic mean values for measures of central tendency" (Bryman 2012, p.335).

[12] Median: "the median is the mid-point in a distribution of values… It derived by arraying all the values in a distribution from the smallest to the largest and then finding the middle point… If there is an even number of values, the median is calculated by taking the mean of the two middle numbers of the distribution" (Bryman 2012, p.338). It can be employed "in relation to both interval/ratio and ordinal variables" (ibid, p.339).

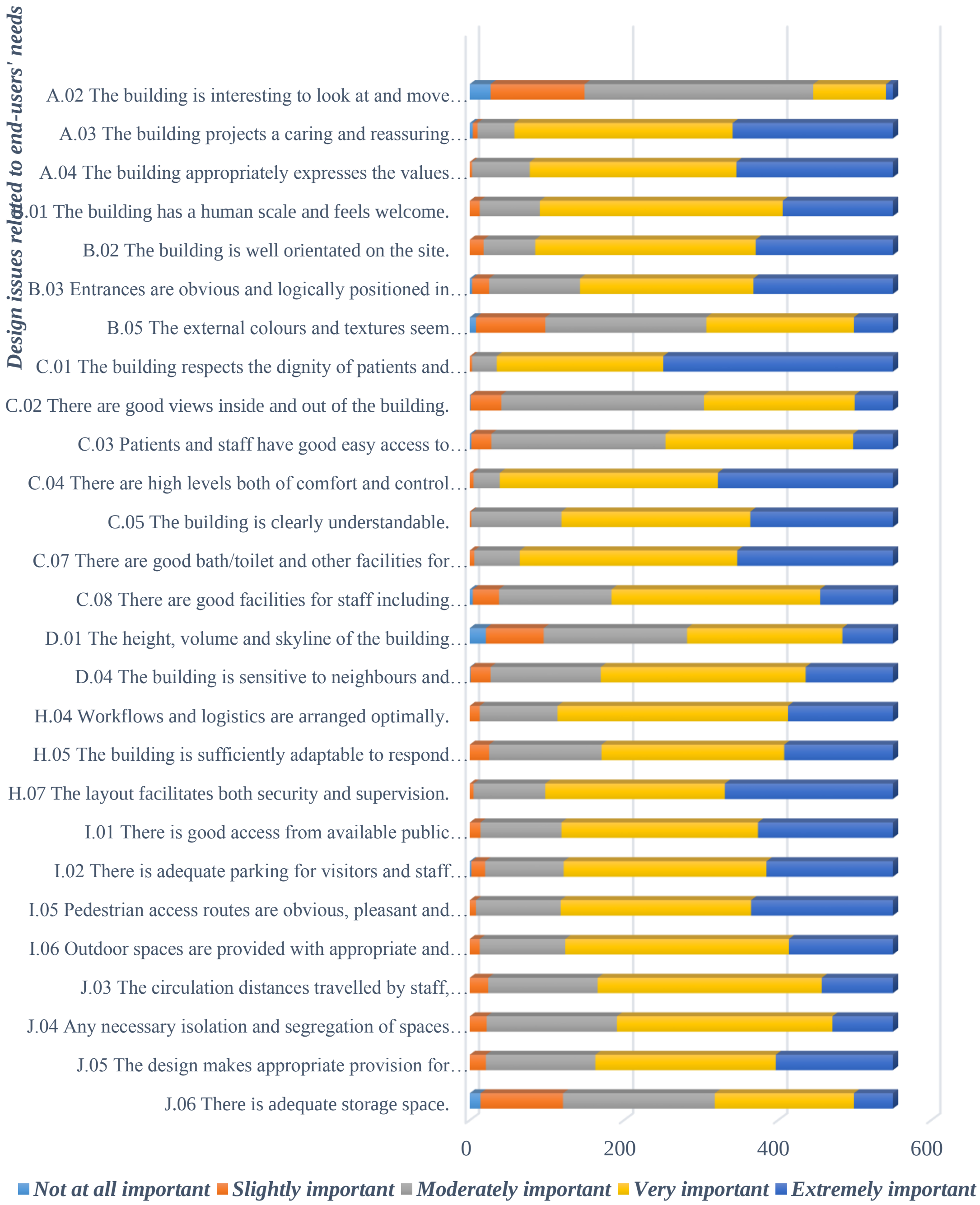

Figure 6.5 Relative importance of design issues related to end-users' needs from Patient Group

All results in Table 6.2 show the relative importance of design issues related to end-users' needs for community-based healthcare environments (27). It can be seen that 1 design issue (3.7%) is defined as "extremely important" (L-5), 21 design issues (77.8%) are defined as "very important" (L-4), and 5 design issues (18.5%) are defined as "moderately important" (L-3). Moreover, the design issues about indoor environments and convenience are easy to get high values – for example, C.01 ("dignity of patients": L-5), C.04 ("high-level comfort": L-4), A.03 ("a caring and reassuring atmosphere": L-4) and C.07 ("safety facilities": L-4).

Table 6.2 Relative importance (median values and levels of relative importance) of design issues related to end-users' needs from Patient Group

Design issue related to end-users' needs (27)		Patient		GB/T 51153		
		MV	L	PI	CSI	R
A.02	The building is interesting to look at and move around in.	3.0000	3	Yes	0	-
A.03	The building projects a caring and reassuring atmosphere.	4.0000	4	-	-	-
A.04	The building appropriately expresses the values of the health service.	4.0000	4	-	-	-
B.01	The building has a human scale and feels welcome.	4.0000	4	-	-	-
B.02	The building is well orientated on the site.	4.0000	4	No	4.5	2
B.03	Entrances are obvious and logically positioned in relation to likely points of arrival on site.	4.0000	4	-	-	-
B.05	The external colours and textures seem appropriate and attractive.	3.0000	3	-	-	-
C.01	The building respects the dignity of patients and allows for appropriate levels of privacy and company.	5.0000	5	-	-	-
C.02	There are good views inside and out of the building.	3.0000	3	No	2	4
C.03	Patients and staff have good easy access to outdoors.	4.0000	4	No	3.35	3
C.04	There are high levels both of comfort and control of comfort.	4.0000	4	Yes	15.25	1
C.05	The building is clearly understandable.	4.0000	4	Yes	0	-
C.07	There are good bath/toilet and safety facilities for patients.	4.0000	4	-	-	-
C.08	There are good facilities for staff including convenient places to work and relax without being on demand.	4.0000	4	-	-	-
D.01	The height, volume and skyline of the building relate well to the surrounding environment.	3.0000	3	Yes	0	-
D.04	The building is sensitive to neighbours and passers-by.	4.0000	4	-	-	-
H.04	Workflows and logistics are arranged optimally.	4.0000	4	-	-	-
H.05	The building is sufficiently adaptable to respond to change and to enable expansion.	4.0000	4	No	0.75	8
H.07	The layout facilitates both security and supervision.	4.0000	4	-	-	-
I.01	There is good access from available public transport including any on-site roads.	4.0000	4	No	1.05	6
I.02	There is adequate parking for visitors and staff cars with appropriate provision for disabled people.	4.0000	4	No	0.75	8
I.05	Pedestrian access routes are obvious, pleasant and suitable for wheelchair users and people with other disabilities/impaired.	4.0000	4	No	0.3	10
I.06	Outdoor spaces are provided with appropriate and safe lighting indicating paths, ramps and steps.	4.0000	4	-	-	-
J.03	The circulation distances travelled by staff, patients and visitors are minimised by the layout.	4.0000	4	No	1.75	5
J.04	Any necessary isolation and segregation of spaces is achieved.	4.0000	4	No	1.05	6
J.05	The design makes appropriate provision for gender segregation.	4.0000	4	-	-	-
J.06	There is adequate storage space.	3.0000	3	-	-	-

Note: MV – median value; L – level of relative importance; PI – prerequisite item; CSI – credit of scoring items; R – rank.

However, the comparison between the preferences of Patient Group and the evaluation content of GB/T 51153 shows that synergies and conflicts co-exist (see Table 6.2). For synergies, 13 design issues (48.1%) are involved in GB/T 51153, 4 of which (A.02, C.04, C.05 and D.01) have prerequisite items. Some design issues are evaluated similarly by Patient Group and GB/T 51153 – for example, B.02, C.03, H.05 and J.03.

In terms of conflicts, there are still 14 design issues (51.9%) that are overlooked by GB/T 51153, some of which are considered as "extremely important" or "very important" by Patient Group – for example, C.01 (L-5), A.03 (L-4), A.04 (L-4), C.07 (L-4) and H.07 (L-4). In addition, some design issues that have prerequisite items in GB/T 51153 receive relatively low values from Patient Group, including A.02 (L-3) and D.01 (L-3). Some design issues that are highly ranked in GB/T 51153 are low-evaluated by Patient Group – for example, C.02 (Patient Group: L-3; GB/T 51153: R-4). These results can be used to optimise GB/T 51153, and findings will be discussed in detail in the cross-comparative studies in Chapter 9.

6.3.3 Knowledge about Healthcare Environment Design (Section C)

In Section C, four questions are designed to explore patients' knowledge levels about healthcare environment design. The first question (QPC-1) is to prioritise the approaches that can help patients acquire relevant knowledge. As illustrated in Figure 6.6, the ranks of these approaches are "internet" (339 respondents out of 550, 61.6%), "TV media" (322, 58.5%), "information from friends/relatives/neighbours" (294, 53.5%), "brochures from healthcare facilities" (286, 52.0%), "newspaper" (247, 44.9%) and "visit and direct observation" (204, 37.1%).

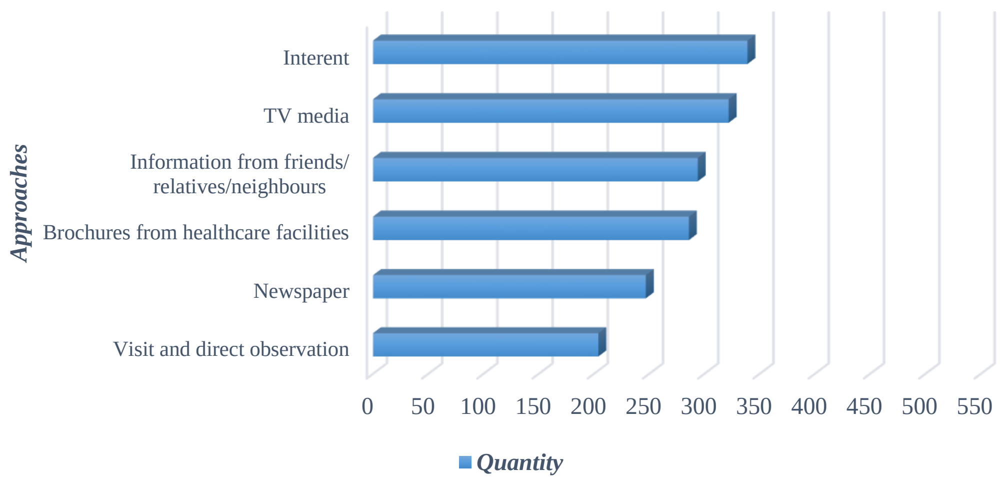

Figure 6.6 Approaches of acquiring knowledge about healthcare environment design from Patient Group

With regard to the knowledge about evidence-based design (QPC-2), respondents express their cognition (Figure 6.7). It is important to note that all options listed in this question can be improved by healthcare environment design according to previous research on evidence-based design (for more information, see Appendix 2.1). The aggregated results show that they are not well understood by patients. Respondents believe design can mostly affect "staff's service quality and efficiency" (405 respondents out of 550, 73.6%). Subsequently, "mood and emotion" and "staff's satisfaction" are ranked at 2 (341, 62.0%) and 3 (292, 53.1%). Less half of them believe that "staff's health" (216, 39.3%), "accidental falls" (216, 39.3%) or "dosage of medication" (136, 24.7%) can be affected by relevant design strategies. As expected, patients' knowledge about evidence-based design is relatively limited.

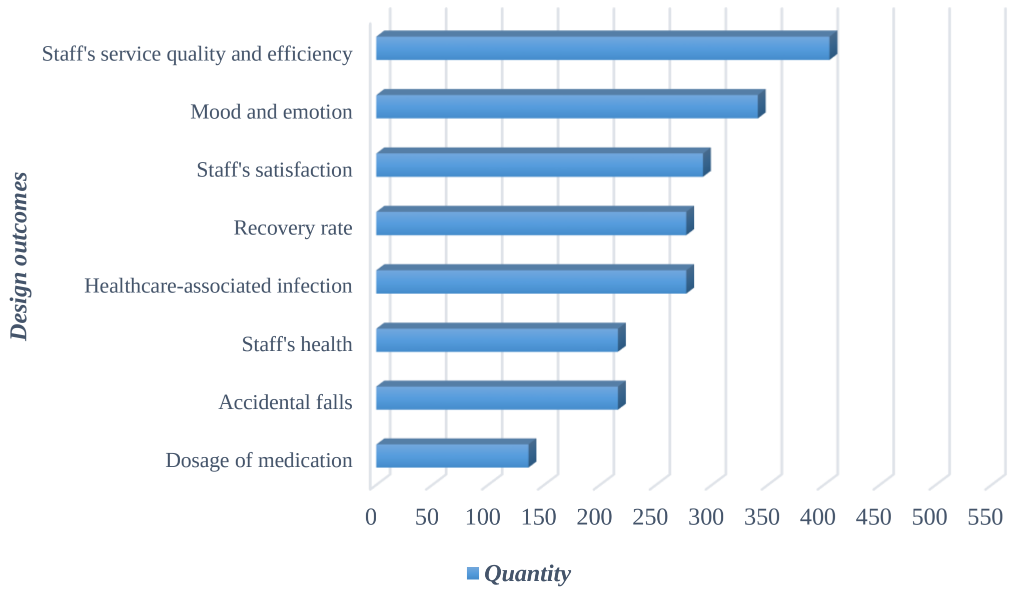

Figure 6.7 Knowledge about evidence-based design from Patient Group

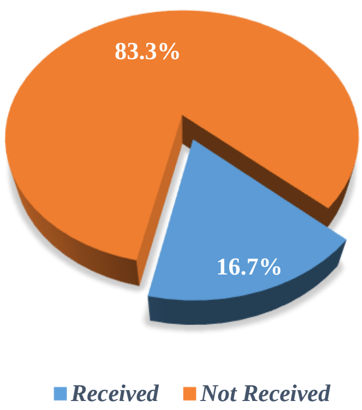

Figure 6.8 Respondents' experience of being involved in surveys about patients' satisfaction with community-based healthcare environments

Figure 6.8 illustrates that only 16.7% of respondents (92 out of 550) have previously received surveys about their satisfaction with community-based healthcare environments (QPC-3).

Moreover, 17.6% of respondents (97) have previously received surveys about their satisfaction with healthcare service at a community level (QPC-4) (Figure 6.9). Generally, a survey is a chance of learning patients' opinions and helping them approach the areas they have not approached ever (Bryman 2012). The survey results show that the frequency and scope of surveys about healthcare environments at a community level should be enhanced, in order to increase the possibility of helping patients acquire knowledge about healthcare environment design and medical procedures.

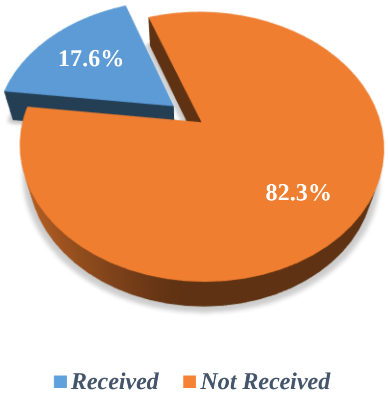

Figure 6.9 Respondents' experience of being involved in surveys about patients' satisfaction with healthcare service at a community level

6.3.4 Open-ended Questions (Section D)

Section D is set up for qualitative data collection. Three open-ended questions are asked to explore patients' knowledge about healthcare service at a community level (QPD-1), design quality of community-based healthcare environments (QPD-2), and end-user centred principles for healthcare environments (QPD-3). Other than the questions in the previous sections, all questions here are optional. A number of respondents therefore chose to leave these open-ended questions empty, and only a small group of respondents (82 out of 550, 14.9%) answered them. Some representative responses, which have high frequencies in the survey, are listed as follows:

- **QPD-1**

S-P66 (a mid-aged male): "…For healthcare service at a community level, its purpose is to serve the **nearby residents** who require medical treatments for ailments. Its existence is to **provide convenience and reduce the pressure for general hospitals**…"

S-P220 (a young male): "…Community-based healthcare service means a healthcare support with **basic medical treatments**, mainly for urban residents…"

S-P245 (a young female): "…I wish it could be **on call at all time**, 24 hours. I know it is an ideal situation, but it is really helpful for local residents, especially for the elderly…"

S-P382 (an elderly male): "…A doctor door-to-door-service is necessary..."

S-P475 (a young male): "…For now, **the quality and efficiency of healthcare service** at a community level should be improved. It should be more humanised…"

The feedback reflects patients' cognition about healthcare service at a community level. It meets the requirements of the primary care delivery system in urban areas. In terms of the design of community-based healthcare environments, respondents indicated that:

- ✧ **QPD-2**

S-P66 (a mid-aged male): "…The design of a Community Healthcare Centre should be focused on traditional and local culture. Methods for environmental protection, such as PV systems, are important. More plants, patients like **a good natural environment**…"

S-P152 (a young female): "…It should be clean, warm, sweet, bright and home-like. A good design is to **make patients less stressful**…"

S-P181 (a young male): "…Plants are necessary for environmental decoration. They can relieve patients' **psychological pressure**…"

However, some respondents believed that healthcare environment design was not that important, and the focuses of designers and administrators should be centralised upon the development of medical technologies.

S-P218 (a mid-aged male): "…A good environmental quality is **an added value**. Medical technologies and service attitudes are the core…"

S-P241 (an elderly male): "…In my opinion, the end-user centred principle should emphasise medical service. **I think the environmental quality is not as important as medical service**. Patients need treatments, including quality and efficiency…"

- ✧ **QPD-3**

Furthermore, for end-user centred principles, respondents emphasised the humanistic concerns for the elderly. However, none of them brought forward any opinions about their participation in design or opportunities of sharing a voice for the design of local community-based healthcare facilities.

> S-P64 (a mid-aged female): "…Patients are users. The end-user centred principle means healthcare environments should be designed as a part of residential environments. It should bring **convenience** to patients at all ages, **especially for the elderly**…"

> S-P74 (a young female): "…End-user centred principles mean the **design for humanisation**…"

> S-P154 (a mid-aged female): "…It is necessary to establish archives for local residents at all ages. It is a good approach to implement this principle. The end-user centred principle means **a high-quality healthcare service**…"

> S-P156 (a mid-aged female): "…The facilities should have the systemic records of patients, such as contacts, house number and health situation…"

The qualitative responses reflect patients' knowledge levels about healthcare service and healthcare environment design at a community level. It shows that patients mainly care about healthcare service quality, environmental atmosphere and circulation convenience. Their knowledge about healthcare environment design is limited. Most of them did not realise the importance of their participation in healthcare environment design. Statistical analysis will be conducted to further explore the cognitive differences caused by the variables, including patients' personal background and relevant survey experience about the design of community-based healthcare environments.

6.4 RESPONSE ANALYSIS – STATISTICAL ANALYSIS

The results from the semi-structured interview have preliminarily come up with a hypothesis that a complete consensus on end-users' needs is unlikely to be reached whether between different end-user groups or within an identical group. This section uses statistical methods to further explore the significant cognitive differences that may affect the preferences and knowledge levels of patients. Features used as variables are set as patients' personal background (i.e. QPA-1, QPA-2 and QPA-3). The interrelationship between these features and patients' preferences is tested based on SPSS. Finally, the statistical results provide an understanding of patients' cognitive differences and priority variances of their environmental needs, and can be used to inform healthcare environment design at a community level from a patient's perspective.

6.4.1 Statistical Analysis Procedures

To implement the statistical analysis, respondents are categorised according to their features (i.e. genders, ages and target sites). The significant cognitive differences of Patient Group will be identified based on these variables. The relative importance of design issues has been evaluated based on the five-point Likert scale, from "not at all important" to "extremely important" with ordinal variables. Median values are used to transfer the relative importance measurable to conduct the correlational analysis. The comparative research design for the quantitative research strategy is selected to define the suitable statistical test methods from parametric or nonparametric statistical techniques (for more information, see Table 3.2). Prominent methods applied for statistical analysis in different scenarios are summarised in Table 6.3. According to Pallant (2005a; 2005b; 2016), there are three determinants that affect the application of these methods:

- Quantity of sample groups (two or more than three);
- Nature of samples (independent samples or related samples[13]); and
- A parametric technique or a nonparametric technique.

Table 6.3 Parametric and nonparametric techniques (source: Hoskin n.d.; Pallant 2005b & 2016; Field 2009)

Analysis type	Parametric technique	Nonparametric technique
Compare means between two distinct/independent groups	Independent-samples t-test	Mann-Whitney U Test
Compare two quantitative measurements taken from the same individual	Paired-samples t-test	Wilcoxon Signed Rank Test
Compare means between three or more distinct/independent groups	One-way between-groups ANOVA	Kruskal-Wallis Test
Estimate the degree of association between two quantitative variables	Pearson's product-moment correlation	Spearman's Rank Order Correlation
Explore the relationship between two categorical variables	-	Chi-square for independence

The most important determinant of identifying significant differences between samples is to decide whether a parametric or nonparametric statistical technique is appropriate (Bryman 2012; Pallant 2016). It is noteworthy that a parametric technique tends to be more sensitive and powerful than a nonparametric technique (Robson 2011; Bryman 2012; Pallant 2016). Pallant (2016) indicates that a nonparametric technique tends to be less sensitive in detecting

[13] Related sample: related samples are those where the same people would be tested each time for two sets (Pallant 2005a).

relationship or a difference among target groups in the analysis process. In previous statistical tests, both techniques were applied in parallel, while results from parametric techniques were taken into account as main findings and results from nonparametric techniques were used to verify the findings from parametric techniques. However, a parametric technique makes assumptions about the data that is more careful and stringent (Bryman 2012). To choose a parametric technique to conduct statistical analyse, additional assumptions should be met, which are summarised as follows (Bryman 2012; Pallant 2016):

- The samples approximate to a normal distribution[14];
- There is homogeneity of variance[15] within groups;
- The level of measurements is interval and independent.

Only the data from samples that meets all assumptions above can use parametric techniques for tests. As a nonparametric technique does not depend on these assumptions, it is normally used as the alternative when any of assumptions is not met (Bryman 2012). However, Pallant (2016, p.103) also puts forward a statement: when attributes measured are not normally distributed, parametric techniques can be used anyway. But it means that it might seriously invalidate the findings of studies. Therefore, according to the discussion, the procedure of statistical analysis is designed with three steps in this research as follows:

- First step – testing the normal distribution or homogeneity of variance. As stated earlier, the measurement of items of the design issues related to end-users' needs is designed with ordinal variables. Therefore, a normal distribution and homogeneity of variance will be tested first for each analysis.
- Second step – selecting suitable test methods. The suitable techniques (parametric or nonparametric) are applied based on the results of the first step.
- Third step – using the alternative technique for verification. The alternative technique is used to verify the results summarised from the second step.

The statistical analysis in SPSS about "cognitive differences in the relative importance of design issues related to end-users' needs for community-based healthcare environments" and "cognitive differences in the knowledge levels about healthcare environment design at a

[14] Normal distribution: "the populations from which the samples are taken are normally distributed" (Pallant 2005, p.198).

[15] Homogeneity of variance: "the samples are obtained from populations of equal variance" (Pallant 2005, p.198).

community level" are described in the following sections. It is noteworthy that asterisks "*" and "**" are used separately in the statistical analysis to indicate the extreme points (i.e. significant differences), when correlations are significant at the $p<.05$ level and $p<.01$ level[16] (Pallant 2005b & 2016).

As indicated by Field (2009, p.56), significant differences of a test statistic do not completely mean that the effect is meaningful or important. Pallant (2005, p.201) also mentions that, when sample size is large, small differences between variables can become statistically significant. To have an in-depth insight into the cognitive differences identified from statistical analysis, the effect size of all significant differences for evaluation of design issues' relative importance should be explored after test statistics. The effect size (also known as "strength of association") is "simply an objective and (usually) standardised measure of the magnitude of observed effect" (Filed 2009, p.56). Pallant (2016, p.247) indicates that effect size statistics can be used to "provide an indication of the magnitude of the differences" between variables. This method describes "the amount of the total variance in the dependent variable that is predictable from knowledge of the levels of the independent variable" (Tabachnick & Fidell 2001, p.52). There are a number of effect size statistics for the statistical techniques – for example, eta square (the most commonly used effect size statistics for t-test), eta square η^2 (for one-way independent ANOVA) and Z-score (for Mann-Whitney U Test) (Field 2009; Pallant 2005b & 2016). Standards that are widely used to distinguish a large or small effect are also summarised as follows (Cohen 1988 & 1992, cited in Field 2009, p.57):

- "r = .10 (small effect): In this case the effect explains 1% of the total variance;
- r = .30 (medium effect): The effect accounts for 9% of the total variance; and
- r = .50 (large effect): The effect accounts for 25% of the variance".

6.4.2 Cognitive Differences in the Relative Importance of Design Issues related to End-users' Needs for Community-based Healthcare Environments

The impacts upon the relative importance of design issues from the variables of genders, ages and target sites are tested in SPSS separately. The aggregated results can be used to identify the significant cognitive differences in the patients' preferences for end-users' needs that are caused by their different nature.

[16] *P* value: when the *p* value is less than .05, the variable makes "a significant unique contribution to the prediction of the dependent variable" (Pallant 2005, p.153). "$p<.05$ level" implies that "there are up to 5 chances in 100 that we might be falsely concluding that there is a relationship when there is not one in the population from which the sample was taken"; while "$p<.01$ level" implies that the quantity of chances is 1 (1 out of 100 when $p<.01$) (Bryman 2012, p.348).

✧ **Gender (QPA-1) * Relative importance of design issues (QPB-A02 ~ QPB-J06)**

The median values are compared, on the evaluation of relative importance of design issues (from QPB-A02 to QPB-J06) for males and females in Patient Group.

Table 6.4 Tests of normality – (Gender * Relative importance)

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
A.02	Male	.253	252	.000	.880	252	.000**
	Female	.310	298	.000	.833	298	.000**
A.03	Male	.277	252	.000	.742	252	.000**
	Female	.253	298	.000	.784	298	.000**
A.04	Male	.265	252	.000	.786	252	.000**
	Female	.248	298	.000	.802	298	.000**
B.01	Male	.298	252	.000	.811	252	.000**
	Female	.289	298	.000	.799	298	.000**
B.02	Male	.285	252	.000	.804	252	.000**
	Female	.260	298	.000	.804	298	.000**
B.03	Male	.225	252	.000	839	252	.000**
	Female	.250	298	.000	.845	298	.000**
B.05	Male	.216	252	.000	.900	252	.000**
	Female	.233	298	.000	.883	298	.000**
C.01	Male	.330	252	.000	.734	252	.000**
	Female	.349	298	.000	.715	298	.000**
C.02	Male	.253	252	.000	.861	252	.000**
	Female	.303	298	.000	.823	298	.000**
C.03	Male	.275	252	.000	.846	252	.000**
	Female	.271	298	.000	.838	298	.000**
C.04	Male	.313	252	.000	.754	252	.000**
	Female	.278	298	.000	.744	298	.000**
C.05	Male	.226	252	.000	.818	252	.000**
	Female	.224	298	.000	.805	298	.000**
C.07	Male	.274	252	.000	.791	252	.000**
	Female	.264	298	.000	.786	298	.000**
C.08	Male	.274	252	.000	.867	252	.000**
	Female	.281	298	.000	.854	298	.000**
D.01	Male	.212	252	.000	.896	252	.000**
	Female	.220	298	.000	.900	298	.000**
D.04	Male	.272	252	.000	.857	252	.000**
	Female	.261	298	.000	.852	298	.000**
H.04	Male	.273	252	.000	.834	252	.000**
	Female	.278	298	.000	.820	298	.000**
H.05	Male	.222	252	.000	.854	252	.000**
	Female	.248	298	.000	.857	298	.000**
H.07	Male	.235	252	.000	.842	252	.000**
	Female	.328	298	.000	.738	298	.000**
I.01	Male	.243	252	.000	.834	252	.000**
	Female	.244	298	.000	.826	298	.000**
I.02	Male	.236	252	.000	.839	252	.000**
	Female	.279	298	.000	.825	298	.000**
I.05	Male	.236	252	.000	.828	252	.000**
	Female	.229	298	.000	.821	298	.000**
I.06	Male	.273	252	.000	.834	252	.000**
	Female	.278	298	.000	.820	298	.000**
J.03	Male	.298	252	.000	.829	252	.000**
	Female	.285	298	.000	.849	298	.000**
J.04	Male	.277	252	.000	.839	252	.000**
	Female	.285	298	.000	.843	298	.000**
J.05	Male	.231	252	.000	.862	252	.000**
	Female	.229	298	.000	.831	298	.000**
J.06	Male	.216	252	.000	.900	252	.000**
	Female	.233	298	.000	.883	298	.000**

[a.] Lilliefors Significance Correction

Generally in SPSS, the typical test methods of assessing the normality are Kolmogorov-Smirnov and Shapiro-Wilk (SPSS: *Analyse – Descriptive Statistics – Explore*) (Pallant 2016). When the sample size exceeds 2000, Kolmogorov-Smirnov is more accurate for calculation;

when the size is less than or equals to 2000, Shapiro-Wilk is more accurate (ibid). As the sample size of Patient Group is 550, Shapiro-Wilk statistic is applied and relevant results are taken into account in this research. In Table 6.4, significant results (Sig. values in Shapiro-Wilk less than .01) indicate that there is non-normality for the evaluation between males and females of the respondents. A nonparametric statistical technique Mann-Whitney U Test (SPSS: *Analyse – Non-parametric Tests – 2 Independent Samples*) is therefore used to compare the median values, and the results are listed in Table 6.5.

Table 6.5 Test statistics [a] – (Gender * Relative importance)

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
A.02	33573.000	65451.000	-2.355	.019*
A.03	37433.500	81984.500	-.069	.945
A.04	37071.000	81622.000	-.282	.778
B.01	35741.500	67619.500	-1.094	.274
B.02	36325.000	68203.000	-.726	.468
B.03	36101.500	80652.500	-.828	.408
B.05	33653.500	65531.500	-.2.214	.027*
C.01	36148.500	68026.500	-.854	.393
C.02	35992.500	67870.500	-.912	.362
C.03	33213.000	77764.000	-2.544	.011*
C.04	35250.500	67128.500	-1.390	.165
C.05	36988.000	81539.000	-.325	.746
C.07	36634.500	68512.500	-.545	.586
C.08	34397.500	66275.500	-1.833	.067
D.01	36725.500	81276.500	-.465	.642
D.04	36850.500	81401.500	-.405	.685
H.04	34101.500	80352.500	-.828	.407
H.05	36993.500	81544.500	-.318	.751
H.07	34685.000	56563.000	-7.487	.000**
I.01	35611.000	67489.000	-1.124	.261
I.02	37087.000	68965.000	-.268	.789
I.05	35208.000	67086.000	-1.356	.175
I.06	33381.000	65259.000	-2.463	.014*
J.03	37007.000	68885.000	-.320	.749
J.04	34313.500	66191.500	-1.905	.057
J.05	29357.500	61253.500	-4.680	.000**
J.06	37097.000	68765.000	-.268	.781

[a.] Grouping Variable: Gender

The results show that male and female patients have a certain degree of consensus on the relative importance of most design issues (21 out of 27, 77.8%). Of all design issues, only 6 ones (22.2%) have significant differences of evaluation between males and females, which are A.02, B.05, C.03, H.07, I.06 and J.05 (highlighted in Table 6.5). Of them, H.07 and J.05 have the significant differences of evaluation at the $p<.01$ level (Asymp. Sig. (2-tailed) value less than .01) and the rest is at the $p<.05$ level (Asymp. Sig. (2-tailed) value less than .05). It means that males and females may have different preferences for the aspects of "interesting look" (A.02), "attractive colours and textures" (B.05), "easy access to outdoors" (C.03), "security and supervision" (H.07), "lighting for outdoor spaces" (I.06) and "gender segregation" (J.05).

When the data measured is not normally distributed, nonparametric techniques are more suitable and will not seriously invalidate the findings (Pallant 2016). However, the non-normality does not strictly mean that parametric techniques cannot be used anyway (ibid, p.103). In this research, the alternative parametric technique Independent-samples t-test (SPSS: *Analyse – Compare Means – Independent Samples T-test*) is used in parallel to verify the findings from Mann-Whitney U Test (Table 6.6 & 6.7). It is important to note that arithmetic mean values are required to be employed when parametric techniques are applied.

Table 6.6 Group statistics – (Gender * Relative importance)

	Gender	N	Mean Value	Std. Deviation	Std. Error Mean
A.02	Male	252	2.7976	.84843	.05345
	Female	298	2.9597	.75549	.04376
A.03	Male	252	4.2460	.73269	.04616
	Female	298	4.2517	.70621	.04091
A.04	Male	252	4.2381	.67309	.04240
	Female	298	4.2114	.70991	.04112
B.01	Male	252	4.0357	.71601	.04510
	Female	298	4.1040	.69091	.04002
B.02	Male	252	4.1032	.78155	.04923
	Female	298	4.1678	.71917	.04166
B.03	Male	252	4.0397	.91817	.05784
	Female	298	4.0034	.82673	.04789
B.05	Male	252	3.2500	.93887	.05914
	Female	298	3.4195	.87726	.05082
C.01	Male	252	4.4524	.63255	.03985
	Female	298	4.4933	.63162	.03659
C.02	Male	252	3.4203	.79694	.05020
	Female	298	3.4966	.73968	.04285
C.03	Male	252	3.6587	.74857	.04716
	Female	298	3.5101	.73046	.04231
C.04	Male	252	4.3056	.60368	.03803
	Female	298	4.3591	.65798	.03812
C.05	Male	252	4.1270	.74667	.04704
	Female	298	4.1107	.74161	.04296
C.07	Male	252	4.2262	.67425	.04247
	Female	298	4.2517	.68688	.03979
C.08	Male	252	3.6905	.84650	.05332
	Female	298	3.8221	.81974	.04749
D.01	Male	252	3.4206	.97256	.06127
	Female	298	3.3725	1.00781	.05838
D.04	Male	252	3.8532	.83157	.05238
	Female	298	3.8423	.78622	.04554
H.04	Male	252	4.0357	.80010	.05040
	Female	298	4.0403	.81136	.04700
H.05	Male	252	3.9167	.84034	.05294
	Female	298	3.8893	.83150	.04817
H.07	Male	252	3.9444	.78131	.04922
	Female	298	4.4362	.63905	.03702
I.01	Male	252	4.0437	.76923	.04846
	Female	298	4.1074	.78831	.04567
I.02	Male	252	4.0357	.80010	.05040
	Female	298	4.0403	.81136	.04700
I.05	Male	252	4.0635	.75476	.04755
	Female	298	4.1443	.77154	.04469
I.06	Male	252	3.9206	.73178	.04610
	Female	298	4.0638	.73807	.04276
J.03	Male	252	3.8214	.71122	.04480
	Female	298	3.8255	.79334	.04596
J.04	Male	252	3.6944	.72922	.04594
	Female	298	3.8087	.75232	.04358
J.05	Male	252	3.7659	.82584	.05202
	Female	298	4.0940	.80271	.04650
J.06	Male	252	3.2500	.93887	.05914
	Female	298	3.4195	.87726	.05082

It is noteworthy that the results from Independent-samples t-test are exactly as same as those from Mann-Whitney U Test (highlighted in Table 6.7). Table 6.7 demonstrates that significant differences of evaluation of H.07 and J.05 between males and females are at the $p<.01$ level (Sig. (2-tailed) value less than .01), while the evaluation of A.02, B.05, C.03 and I.06 is significantly different at the $p<.05$ level (Sig. (2-tailed) value less than .05). As the normal distribution cannot be achieved in this test, results from the nonparametric technique are taken into account as the main findings of statistical analysis.

Table 6.7 Independent samples t-test – (Gender * Relative importance)

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
	Equal variances	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
A.02	assumed	16.374	.000	-2.370	548	.018	-.16211	.06841	-.29650	-.02773
	not assumed			-2.347	507.585	.019*	-.16211	.06908	-.29783	-.02640
A.03	assumed	.164	.686	-.092	548	.927	-.00565	.06149	-.12642	.11513
	not assumed			-.092	525.956	.927	-.00565	.06168	-.12681	.11552
A.04	assumed	.175	.676	.450	548	.653	.02669	.05933	-.08986	.14323
	not assumed			.452	540.860	.652	.02669	.05907	-.08934	.14272
B.01	assumed	.183	.669	-1.136	548	.256	-.06831	.06012	-.18641	.04978
	not assumed			-1.133	526.187	.258	-.06831	.06030	-.18677	.05015
B.02	assumed	.008	.929	-1.009	548	.314	-.06461	.06405	-.19042	.06120
	not assumed			-1.002	515.691	.317	-.06461	.06449	-.19131	.06209
B.03	assumed	6.715	.010	.488	548	.626	.03633	.07444	-.10989	.18255
	not assumed			.484	510.399	.629	.03633	.07509	-.11120	.18386
B.05	assumed	.095	.758	-2.186	548	.029*	-.16946	.07754	-.32177	-.01716
	not assumed			-2.173	519.246	.030	-.16946	.07798	-.32265	-.01627
C.01	assumed	.063	.803	-.756	548	.450	-.04091	.05409	-.14716	.06534
	not assumed			-.756	532.673	.450	-.04091	.05410	-.14718	.06536
C.02	assumed	1.682	.195	-1.159	548	.247	-.07601	.06559	-.20485	.05283
	not assumed			-1.152	517.712	.250	-.07601	.06600	-.20567	.05366
C.03	assumed	.043	.836	2.351	548	.019*	.14866	.06323	.02447	.27286
	not assumed			2.346	528.413	.019	.14866	.06336	.02420	.27313
C.04	assumed	2.099	.148	-.987	548	.324	-.05350	.05423	-.16003	.05302
	not assumed			-.994	544.345	.321	-.05350	.05384	-.15927	.05226
C.05	assumed	.001	.980	.255	548	.799	.01625	.06367	-.10881	.14130
	not assumed			.255	531.726	.799	.01625	.06370	-.10889	.14138
C.07	assumed	.202	.654	-.437	548	.662	-.02549	.05829	-.13999	.08901
	not assumed			-.438	535.996	.662	-.02549	.05820	-.13982	.08884
C.08	assumed	2.082	.150	-1.849	548	.065	-.13167	.07121	-.27155	.00821
	not assumed			-1.844	526.904	.066	-.13167	.07140	-.27194	.00860
D.01	assumed	.540	.463	.567	548	.571	.04815	.08488	-.11858	.21488
	not assumed			.569	538.531	.570	.04815	.08463	-.11809	.21439
D.04	assumed	.157	.692	.158	548	.875	.01089	.06909	-.12482	.14661
	not assumed			.157	521.876	.875	.01089	.06941	-.12547	.14726
H.04	assumed	.579	.447	-.066	548	.947	-.00455	.06900	-.14008	.13098
	not assumed			-.066	535.269	.947	-.00455	.06892	-.13993	.13082
H.05	assumed	.156	.693	.383	548	.702	.02740	.07151	-.11306	.16787
	not assumed			.383	531.042	.702	.02740	.07157	-.11319	.16800
H.07	assumed	.121	.728	-8.119	548	.000**	-.49180	.06057	-.61078	-.37282
	not assumed			-7.986	484.325	.000	-.49180	.06159	-.61281	-.37079
I.01	assumed	.674	.412	-.955	548	.340	-.06373	.06672	-.19479	.06733
	not assumed			-.957	536.911	.339	-.06373	.06658	-.19453	.06706
I.02	assumed	.579	.447	-.066	548	.947	-.00455	.06900	-.14008	.13098
	not assumed			-.066	535.269	.947	-.00455	.06892	-.13993	.13082
I.05	assumed	1.402	.237	-1.236	548	.217	-.08080	.06537	-.20922	.04761
	not assumed			-1.238	536.529	.216	-.08080	.06525	-.20899	.04738
I.06	assumed	.118	.731	-2.275	548	.023*	-.14312	.06292	-.26671	-.01953
	not assumed			-2.276	534.380	.023	-.14312	.06287	-.26663	-.01961
J.03	assumed	2.270	.133	-.063	548	.950	-.00407	.06477	-.13130	.12315
	not assumed			-.063	546.117	.949	-.00407	.06418	-.13015	.12200
J.04	assumed	.394	.531	-1.800	548	.072	-.11428	.06349	-.23899	.01042
	not assumed			-1.805	537.901	.072	-.11428	.06332	-.23867	.01010
J.05	assumed	2.150	.143	-4.713	548	.000**	-.32809	.06961	-.46482	-.19135
	not assumed			-4.702	527.645	.000	-.32809	.06978	-.46516	-.19101
J.06	assumed	.095	.758	-2.186	548	.029*	-.16946	.07754	-.32177	-.01716
	not assumed			-2.173	519.246	.030	-.16946	.07798	-.32265	-.01627

Since the results taken into account were from nonparametric techniques (i.e. Mann-Whitney U Test), Z-score is applied for the test of effect size. The formula is illustrated as follows (Field 2009, p.550):

$$r = \frac{Z}{\sqrt{N}}$$

According to the formula and standards, the effect size of the significant differences identified by the nonparametric technique Mann-Whitney U Test (i.e. gender * relative importance) is calculated and listed in Table 6.8. It shows that the evaluation of some design issues (i.e. A.02, B.05, C.03 and I.06) has significant differences with the small effect (r around .10), which indicates that the impacts of genders are small upon the consensus on relevant needs between male and female patients. Only the design issue H.07 ("security and supervision") has the medium effect ($r = 0.32$) of the significant difference between males and females. It means that the effect accounts for approximate 9% of the total variance.

Table 6.8 Effect size of significant differences – (Gender * Relative importance)

	Issue	r	Issue	r	Issue	r
Gender	A.02	-0.10	B.05	-0.09	C.03	-0.11
	H.07	-0.32	I.06	-0.11	J.05	-0.20

The results of this test show that male and female patients may have cognitive differences in the aspects of **building images**, **safety** and **privacy** (e.g. A.02, B.05, H.07, I.06 and J.05), while the degrees of most differences are small.

- ✧ **Age (QPA-2) * Relative importance of design issues (QPB-A02 ~ QPB-J06)**

The median values are compared, on the evaluation of relative importance of design issues (from QPB-A02 to QPB-J06) for patients at different ages in the group. The normal distribution is tested first. Significant results show that the normal distribution cannot be achieved, and the nonparametric technique is more suitable to explore the correlation between the ages and the relative importance of design issues. Kruskal-Wallis Test (SPSS: *Analyse – Nonparametric Tests – K Independent Samples*) is therefore used, and the aggregated results are demonstrated in Table 6.9.

Respondents at different ages have significantly different preferences for B.01 ("a human scale"), B.03 ("obvious entrances"), I.01 ("available public transport"), I.02 ("parking"), I.05 ("pedestrian access routes"), I.06 ("lighting for outdoor space") and J.03 ("minimised circulation distances") (20 out of 27, 74.1%) (highlighted in Table 6.9). All significant differences of evaluation of these design issues are at the $p<.05$ level (Asymp. Sig. value less than .05). It is important to note that I.01, I.02, I.05 and I.06 were all drawn from the assessment criterion "Access" in the *Conceptual Framework for Healthcare Environment Design*. It means that it is relatively easy to cause conflictive opinions on the aspects of access and transport between patients at different ages.

Table 6.9 Test statistics [a, b] – (Age * Relative importance)

	Chi-Square	df	Asymp. Sig.
A.02	.796	2	.672
A.03	1.100	2	.577
A.04	1.152	2	.562
B.01	6.379	2	.041*
B.02	1.236	2	.539
B.03	7.636	2	.022*
B.05	.562	2	.755
C.01	2.677	2	.262
C.02	1.183	2	.553
C.03	.387	2	.824
C.04	4.323	2	.115
C.05	3.697	2	.157
C.07	3.998	2	.135
C.08	2.620	2	.270
D.01	.090	2	.956
D.04	1.575	2	.455
H.04	.355	2	.837
H.05	.630	2	.730
H.07	3.919	2	.141
I.01	6.032	2	.049*
I.02	7.144	2	.028*
I.05	7.251	2	.027*
I.06	6.247	2	.044*
J.03	6.155	2	.046*
J.04	1.567	2	.457
J.05	.355	2	.837
J.06	.562	2	.755

[a.] Kruskal Wallis Test

[b.] Grouping Variable: Age

The alternative parametric technique, one-way between-groups ANOVA (SPSS: *Analyse – Compare Means – One-way ANOVA*), is applied to verify the findings from Kruskal-Wallis Test. The results are slightly different. Only 5 design issues have the significant results of their evaluation: B.01, B.03, I.05 and I.06 at the $p<0.5$ level, while I.02 at the $p<.01$ level. I.01 and J.03 are not included. As none of design issues have the homogeneity of variance, the results from the nonparametric technique Kruskal-Wallis Test are taken into account as the main findings of this test.

In terms of the effect size of significant differences that are calculated by Kruskal-Wallis Test, Field (2009, p.570) indicates that it is not easy to "convert a chi-square statistic that has more than 1 degree of freedom to an effect size r". It means that there is no direct formula to calculate the effect size for the results from Kruskal-Wallis Test. A suggestion is to transfer the effect size for a focused comparison that compares two things every time (Field 2009; Pallant 2005b & 2016). Therefore, the variables of different ages are compared in pairs by using Mann-

Whitney U Test, and the effect size of significant differences is calculated by Z-score and demonstrated in Table 6.10.

Table 6.10 Effect size of significant differences (impacts from ages) calculated by Kruskal-Wallis Test

	Issue		r	Issue		r
Age	B.01	18 ~ 35 vs. 36 ~59	0.01	B.03	18 ~ 35 vs. 36 ~59	0.12
		36 ~59 vs. ≥ 60	0.14		36 ~59 vs. ≥ 60	0.03
		18 ~ 35 vs. ≥ 60	0.14		18 ~ 35 vs. ≥ 60	0.14
	I.01	18 ~ 35 vs. 36 ~59	0.05	I.02	18 ~ 35 vs. 36 ~59	0.08
		36 ~59 vs. ≥ 60	0.13		36 ~59 vs. ≥ 60	0.15
		18 ~ 35 vs. ≥ 60	0.08		18 ~ 35 vs. ≥ 60	0.08
	I.05	18 ~ 35 vs. 36 ~59	0.07	I.06	18 ~ 35 vs. 36 ~59	0.04
		36 ~59 vs. ≥ 60	0.35		36 ~59 vs. ≥ 60	0.29
		18 ~ 35 vs. ≥ 60	0.31		18 ~ 35 vs. ≥ 60	0.32
	J.03	18 ~ 35 vs. 36 ~59	0.00			
		36 ~59 vs. ≥ 60	0.33			
		18 ~ 35 vs. ≥ 60	0.33			

It shows that respondents' evaluation about I.05, I.06 and J.03 is affected by ages with the medium effect (r = .30). Respondents in the "≥ 60" group have significantly high requirements for these issues, compared with respondents in the groups of "18 ~ 35" and "36 ~59". However, the significant differences of evaluation of these design issues between young people and mid-aged people are with the small effect (r = .10). Other design issues (i.e. B.01, B.03, I.01 and I.02) have the significant differences with the small effect (r = .10).

Based on the results of this test, patients at different ages have cognitive differences in the aspects of **building forms**, **access** and **safety** (e.g. B.01, B.03, I.01, I.02, I.05 and I.06). The degrees of these differences are with small or medium effects (see Table 6.10).

- ✧ **Target site (QPA-301 ~ QPA-311) * Relative importance of design issues (QPB-A02 ~ QPB-J06)**

As argued by Pratt and Nunes (2015), people's cognition will be affected by the dissatisfaction from reality. Such phenomenon may happen: some respondents from a certain community-based healthcare facility feel terrible about a part of aspects, and they emphasise their dissatisfaction with these design issues and then give high values of relative importance in the process of filling questionnaires. A test is designed to explore this hypothesis. Conventionally, the normal distribution and homogeneity of variance are analysed. The results show that the normal distribution is absent and the nonparametric technique Kruskal-Wallis Test is suitable for this test.

The results in Table 6.11 show that there are 14 design issues (14 out of 27, 51.9%), including A.02, B.01, B.03, B.05, C.02, C.03, C.05, C.07, C.08, D.01, D.04, H.07, I.02 and I.06

(highlighted in Table 6.11), that have significant differences in their relative importance. Of these design issues, B.03 ("obvious entrances"), C.03 ("access to outdoors") and H.07 ("security and supervision") are evaluated with significant differences at the $p<.01$ level (Asymp. Sig. value less than .01) and others are at the $p<.05$ level (Asymp. Sig. value less than .05). In terms of the results from the parametric technique – one-way between-groups ANOVA that is used in parallel, it can be seen that the results are very similar. There are also 14 design issues (i.e. B.01, B.03, B.05, C.02, C.03, C.04, C.05, C.07, C.08, D.01, D.04, H.07, I.02 and I.06) that have significant differences in the evaluation among the target sites. Moreover, of the design issues identified by the parametric technique, 10 design issues are evaluated with significant differences at the $p<.01$ level (Sig. value less than .01), which are B.03, B.05, C.02, C.03, C.07, C.08, D.01, H.07, I.02 and I.06. The others are evaluated at the $p<.05$ level (Sig. value less than .05).

Table 6.11 Test statistics [a, b] – (Target site * Relative importance)

	Chi-Square	df	Asymp. Sig.
A.02	17.742	9	.038*
A.03	5.998	9	.740
A.04	11.010	9	.275
B.01	19.773	9	.019*
B.02	11.825	9	.223
B.03	32.763	9	.000**
B.05	22.357	9	.008**
C.01	16.257	9	.062
C.02	27.243	9	.001**
C.03	34.002	9	.000**
C.04	11.787	9	.226
C.05	17.893	9	.036*
C.07	23.732	9	.005**
C.08	29.339	9	.001**
D.01	27.864	9	.001**
D.04	19.394	9	.022*
H.04	12.684	9	.177
H.05	7.492	9	.586
H.07	33.458	9	.000**
I.01	5.693	9	.770
I.02	24.152	9	.004**
I.05	7.326	9	.603
I.06	31.903	9	.000**
J.03	8.065	9	.528
J.04	11.422	9	.248
J.05	12.684	9	.177
J.06	11.825	9	.223

[a.] Kruskal Wallis Test

[b.] Grouping Variable: Site

Because of the absence of normal distribution, the results from the nonparametric technique (i.e. Kruskal-Wallis Test) are used to explore patients' preferences. The results show that, to a great extent, all healthcare facilities selected as the target sites were not designed based on an identical standard, which led to cognitive differences in patients' needs and the difficulties of understanding their satisfaction with community-based healthcare environments. For the significant differences in the evaluation of design issues among the target sites, it is found that respondents from different sites have significantly different evaluation about the design issues

B.03, C.03, C.07, H.07, I.06 (at the *p*<.01 level), A.02, B.01, C.05 and D.04 (at the *p*<.05 level). Taking C.07 ("good bath/toilet and safety facilities") as an example, based on the field experience of the researcher, the toilet of Site 11 is in the worst situation, while Site 4 has the best situation of a toilet (Figure 6.10). According to the calculation of Mann-Whitney U Test and Z-score, the significant difference of evaluation of relative importance between respondents from these two target sites is with an effect (0.42), approximately close to the large effect (r = .50).

Figure 6.10 Toilet situation of Site 11 (left) and Site 4 (right)

The comparisons and statistical test above show that the environmental differences can lead to cognitive differences in end-users' needs, and it is necessary to implement a standardised design that is tailored for community-based healthcare environments. It means that the current guidance, when intending to ensure end-users' satisfaction with the built environment, should not only involve the design strategies related to end-users' needs, but also provide detailed standards and cases for the design of both indoor and outdoor environments.

✧ **Summary**

A series of statistical techniques were applied to explore the impacts of patients' personal background (i.e. genders, ages and target site) upon their preferences for the design issues related to end-users' needs for community-based healthcare environments. All design issues that have significant differences of evaluation within Patient Group are summarised and highlighted in Table 6.12.

There are 9 design issues that have no significant differences of evaluation caused by genders, ages or target sites. They are A.03 ("a caring and reassuring atmosphere"), A.04 ("values of the health service"), B.02 ("building orientation"), C.01 ("dignity of patients"), C.04 ("high-level comfort"), H.04 ("workflow and logistic"), H.05 ("change and expansion"), J.04 ("isolation and segregation") and J.06 ("storage space"). The others (18) have different evaluation between different sub-groups of patients. The inherent attributes (i.e. genders and ages) and non-inherent ones (i.e. surrounding environments) impact upon the consensus on patients' preferences for their needs, which increases difficulties of making decisions to secure end-users' holistic environmental satisfaction. Architects should pay more attention to the design issues that may lead to end-users' needs at different levels in the design of community-based healthcare environments. Findings from the statistical tests can be used to help architects identify the different needs within patients in the design decision-making process in an effective way.

Table 6.12 Design issues with significant differences from Patient Group

	Design issue related to end-users' needs	Gender	Age	Target Site
A.02	The building is interesting to look at and move around in.	*		*
A.03	The building projects a caring and reassuring atmosphere.			
A.04	The building appropriately expresses the values of the health service.			
B.01	The building has a human scale and feels welcome.		*	*
B.02	The building is well oriented on the site.			
B.03	Entrances are obvious and logically positioned in relation to likely points of arrival on site.		*	*
B.05	The external colours and textures seem appropriate and attractive.	*		**
C.01	The building respects the dignity of patients and allows for appropriate levels of privacy and company			
C.02	There are good views inside and out of the building.			**
C.03	Patients and staff have good easy access to outdoors.	*		**
C.04	There are high levels both of comfort and control of comfort.			
C.05	The building is clearly understandable.			*
C.07	There are good bath/toilet and safety facilities for patients.			**
C.08	There are good facilities for staff including convenient places to work and relax without being on demand.			**
D.01	The height, volume and skyline of the building relate well to the surrounding environment.			**
D.04	The building is sensitive to neighbours and passers-by.			*
H.04	Workflows and logistics are arranged optimally.			
H.05	The building is sufficiently adaptable to respond to change and to enable expansion.			
H.07	The layout facilities both security and supervision.	**		**
I.01	There is good access from available public transport including any on-site roads.		*	
I.02	There is adequate parking for visitors and staff cars with appropriate provision for disabled people.		*	**
I.05	Pedestrian access routes are obvious, pleasant and suitable for wheelchair users and people with other disabilities/impaired sight.		*	
I.06	Outdoor spaces are provided with appropriate and safe lighting indicating paths, ramps and steps.	*	*	**
J.03	The circulation distances travelled by staff, patients and visitors are minimised by the layout.		*	
J.04	Any necessary isolation and segregation of spaces is achieved.			
J.05	The design makes appropriate provision for gender segregation.	**		
J.06	There is adequate storage space			

"*": significant difference at the $p<.05$ level; "**": significant difference at the $p<.01$ level.

6.4.3 Cognitive Differences in the Knowledge about Healthcare Environment Design at A Community Level between Patients at Different Ages

A community-based healthcare facility is an essential approach of delivering primary care and responding to the requirements arising from the ageing society. Based on the feedback summarised from the open-ended questions, it is concluded that respondents believe end-user centred principles mean providing a convenient healing environment for patients at all ages, especially for the elderly. In this section, the statistical analysis explores if age differences may cause cognitive differences in patients' knowledge levels about healthcare environment design.

✧ **Age (QPA-2) * Approach of acquiring knowledge about healthcare environment design (QPC-11 ~ QPC-16)**

End-users with essential knowledge about healthcare environment design may have more objective evaluation about their needs. It is necessary to understand how patients access such knowledge, especially for the elderly. Their opinions are important for the ageing-friendly design of healthcare environments. Chi-square test for independence[17] (SPSS: *Analyse – Descriptive Statistics – Crosstabs*), as shown in Table 6.13 and 6.15, is suitable to explore the significant association between the categorical variables (i.e. age * learning approach). It is mainly to "compare the frequency of cases found in the various categories of one variable across the different categories of another variable" (Pallant 2005, p.287). It belongs to nonparametric techniques, because it is used for nominal (categorical) variables (Bryman 2012). In this analysis process, this test method is applied to determine if the variables are related. It has two important assumptions – "it is imperative that each person, item or entity contributes to only one cell of the contingency table" and "the expected frequencies should be greater than 5 (≥ 5)" (Field 2009, p.691). As both assumptions have been met, the results from the chi-square test for independence are taken into account for the test of relationship between ages and learning approaches. The results show that, of all approaches listed in QPC-1, "newspaper" and "internet" have significant association with different ages of respondents.

Table 6.13 Age * Newspaper crosstabulation

			Newspaper		Total
			Not selected	Selected	
Age	18 – 35	Count	142	90	232
		Expected Count	127.8	104.2	232.0
		% within Age	61.2%	38.8%	100.0%
		% within Newspaper	46.9%	36.4%	42.2%
		% of Total	25.8%	16.4%	42.2%
	36 – 59	Count	118	96	214
		Expected Count	117.9	96.1	214.0
		% within Age	55.1%	44.9%	100.0%
		% within Newspaper	38.9%	38.9%	38.9%
		% of Total	21.5%	17.5%	38.9%
	60 +	Count	43	61	104
		Expected Count	57.3	46.7	104.0
		% within Age	41.3%	58.7%	100.0%
		% within Newspaper	14.2%	24.7%	18.9%
		% of Total	7.8%	11.1%	18.9%
Total		Count	303	247	550
		Expected Count	303.0	247.0	550.0
		% within Age	55.1%	44.9%	100.0%
		% within Newspaper	100.0%	100.0%	100.0%
		% of Total	55.1%	44.9%	100.0%

In Table 6.14 and 6.16, the Asymp. Sig. (2-sided) values in Pearson Chi-Square are both less than .01, which are .003 and .000 at the $p<.01$ level. The results show that the proportion of

[17] Chi-square test for independence: it is applied when researchers wish to "explore the relationship between two categorical variables. Each of these variables can have two or more categories" (Pallant 2005, p.288).

elderly people (≥ 60) who would like to use "newspaper" to learn knowledge about healthcare environment design (58.7%) is higher than the proportions of mid-aged people (44.9%) and young people (38.8%). Contrarily, the results show that only 25.0% of elderly people are willing to use "internet" (65.0% for mid-aged and 75.0% for young), although "internet" is ranked at first by the whole Patient Group (see Figure 6.6). In terms of other approaches (i.e. "brochures from healthcare facilities", "TV media", "information from friends/relatives/ neighbours", and "visit and direct observation"), the proportions of elderly people that would like to use these approaches are not significantly different from the proportions of mid-aged people or young people.

Table 6.14 Chi-square tests – (Age * Newspaper)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.449[a]	2	.003**
Likelihood Ratio	11.440	2	.003
Linear-by-Linear Association	10.690	1	.001
N of Valid Cases	550		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 46.71.

Table 6.15 Age * Internet crosstabulation

			Internet		Total
			Not selected	Selected	
Age	18 – 35	Count	58	174	232
		Expected Count	89.0	143.0	232.0
		% within Age	25.0%	75.0%	100.0%
		% within Internet	27.5%	51.3%	42.2%
		% of Total	10.5%	31.6%	42.2%
	36 – 59	Count	75	139	214
		Expected Count	82.1	131.9	214.0
		% within Age	35.0%	65.0%	100.0%
		% within Internet	35.0%	41.0%	38.9%
		% of Total	13.6%	25.3%	38.9%
	60 +	Count	78	26	104
		Expected Count	39.9	64.1	104.0
		% within Age	75.0%	25.0%	100.0%
		% within Internet	37.0%	7.7%	18.9%
		% of Total	14.2%	4.7%	18.9%
Total		Count	211	339	550
		Expected Count	211.0	339.0	550.0
		% within Age	38.4%	61.6%	100.0%
		% within Internet	100.0%	100.0%	100.0%
		% of Total	38.4%	61.6%	100.0%

Table 6.16 Chi-square tests – (Age * Internet)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	77.551[a]	2	.000**
Likelihood Ratio	77.278	2	.000
Linear-by-Linear Association	65.835	1	.000
N of Valid Cases	550		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 39.90.

✧ Age (QPA-2) * Knowledge about evidence-based design (QPC-21 ~ QPC-28)

The results from chi-square test for independence show that there is significant association between ages and patients' knowledge about "accidental falls" and "staff's satisfaction", as the Asymp. Sig. (2-sided) values in Pearson Chi-Square are less than .05. ($p<.05$ level) (Table 6.17 ~ 6.20). The proportion of elderly people that believe design can avoid "accidental falls" (48.1%) is different from others (34.1% for mid-aged and 40.7% for young). Moreover, the proportion of mid-aged people who think design can improve the "staff's satisfaction" (59.3%) is higher than others (52.9% for elderly and 47.7% for young).

Table 6.17 Age * Accidental falls crosstabulation

			Accidental falls		Total
			Not selected	Selected	
Age	18 – 35	Count	153	79	232
		Expected Count	140.9	91.1	232.0
		% within Age	65.9%	34.1%	100.0%
		% within Accidental falls	45.8%	36.6%	42.2%
		% of Total	27.8%	14.4%	42.2%
	36 – 59	Count	127	87	214
		Expected Count	130.0	84.0	214.0
		% within Age	59.3%	40.7%	100.0%
		% within Accidental falls	38.0%	40.3%	38.9%
		% of Total	23.1%	15.8%	38.9%
	60 +	Count	54	50	104
		Expected Count	63.2	40.8	104.0
		% within Age	51.9%	48.1%	100.0%
		% within Accidental falls	16.2%	23.1%	18.9%
		% of Total	9.8%	9.1%	18.9%
Total		Count	334	216	550
		Expected Count	334.0	216.0	550.0
		% within Age	60.7%	39.3%	100.0%
		% within Accidental falls	100.0%	100.0%	100.0%
		% of Total	60.7%	39.3%	100.0%

Table 6.18 Chi-square tests – (Age * Accidental falls)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.203[a]	2	.045*
Likelihood Ratio	6.181	2	.045
Linear-by-Linear Association	6.183	1	.013
N of Valid Cases	550		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 40.84.

Table 6.19 Age * Staff's satisfaction crosstabulation

			Satisfaction		Total
			Not selected	Selected	
Age	18 – 35	Count	122	110	232
		Expected Count	108.8	123.2	232.0
		% within Age	52.6%	47.4%	100.0%
		% within Staff's satisfaction	47.3%	37.7%	42.2%
		% of Total	22.2%	20.0%	42.2%
	36 – 59	Count	87	127	214
		Expected Count	100.4	113.6	214.0
		% within Age	40.7%	59.3%	100.0%
		% within Staff's satisfaction	33.7%	43.5%	38.9%
		% of Total	15.8%	23.1%	38.9%
	60 +	Count	49	55	104
		Expected Count	48.8	55.2	104.0
		% within Age	47.1%	52.9%	100.0%
		% within Staff's satisfaction	19.0%	18.8%	18.9%
		% of Total	8.9%	10.0%	18.9%
Total		Count	258	292	550
		Expected Count	258.0	292.0	550.0
		% within Age	46.9%	53.1%	100.0%
		% within Staff's satisfaction	100.0%	100.0%	100.0%
		% of Total	46.9%	53.1%	100.0%

Table 6.20 Chi-square tests – (Age * Staff's satisfaction)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.366[a]	2	.041*
Likelihood Ratio	6.385	2	.041
Linear-by-Linear Association	2.197	1	.138
N of Valid Cases	550		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 48.79.

In terms of other design outcomes (i.e. "healthcare-associated infection", "recovery rate", "dosage of medication", "mood and emotion", "staff's health" and "staff's service quality and efficiency"), there are no significant differences between the viewpoints of respondents at different ages. The results achieved in the test are representative for patients' knowledge levels about evidence-based design.

✧ **Summary**

According to the results of chi-square test for independence, it can be seen that it was appropriate to use newspaper to help elderly people acquire knowledge about healthcare environment design at a community level, although it was not fully suitable for the groups of mid-aged and young people (Table 6.21). Moreover, internet was considered as the most popular approach for Patient Group to learn about healthcare environment design, but it was only appropriate for mid-aged and young people. Elderly people were not able to use internet to acquire relevant knowledge.

Cognitive differences also existed in patients' knowledge levels about evidence-based design between patients at different ages. Compared with the mid-aged and young people, more elderly people believed that healthcare environment design could avoid accidental falls. This finding means that elderly people pay more attention to safety and convenience. It is necessary for architects to consult with the elderly, when they would like to ensure patients' satisfaction with the safety and convenience of community-based healthcare environments.

Table 6.21 Knowledge situation impacted from ages within Patient Group

Option		Age	Suitable Group
Approaches of acquiring knowledge about healthcare environment design	Newspaper	**	Elderly (≥ 60)
	Brochures from healthcare facilities		
	TV media		
	Internet	**	Mid-aged (36 – 59); Young (18 – 35)
	Information from friends/relatives/neighbours		
	Visit and direct observation		
Outcomes of evidence-based design	Healthcare-associated infection		
	Recovery rate		
	Dosage of medication		
	Accidental falls	*	Elderly (≥ 60)
	Mood and emotion		
	Staff's health		
	Staff's service quality and efficiency		
	Staff's satisfaction	*	Mid-aged (36 – 59)

"*": significant association at the $p<.05$ level; "**": significant association at the $p<.01$ level.

6.5 A VERIFICATION STUDY

A verification study is conducted to explore the generalisation of findings achieved in the Survey for Patient Group (i.e. 550 respondents were recruited from the patents who sought medical treatments from community-based healthcare facilities in SIP) (Figure 6.11). This study intends to generate the idea that can reflect patients' preferences for the design of community-based healthcare environments.

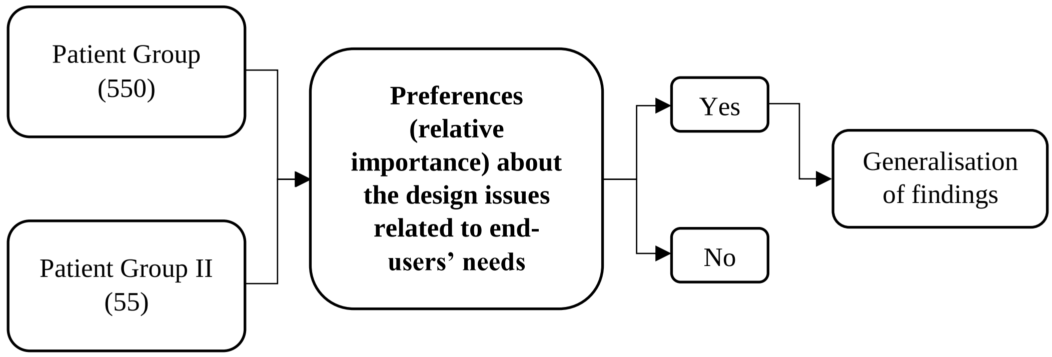

Figure 6.11 Generalisation of findings

Using the convenience sampling method, the second round of questionnaire collection from patients in SIP was conducted, and 55 respondents were recruited randomly and equally from the target sites (March 2017). They can be seen as the **Patient Group II**, and a breakdown of their personal background is demonstrated in Table 6.22. Under the researcher's supervision, these respondents were asked to only complete the questions in Section B of *Questionnaire for Patient Group* and evaluate the relative importance of design issues.

Table 6.22 A breakdown of genders and ages from Patient Group II

Gender \ Age	18 - 35	36 - 59	≥ 60	Total
Male	12	10	5	27
Female	15	9	4	28
Total	27	19	9	55

Another statistical analysis is conducted to compare the responses of Patient Group and Patient Group II (QPB-A02 ~ QPB-J06). It attempts to test if there are significant differences in the respondents' evaluation of the relative importance of design issues related to end-users' needs. The results calculated in Shapiro-Wilk (SPSS: *Analyse – Descriptive Statistics – Explore*) show that the normality of distribution of data cannot be achieved. The nonparametric technique Mann-Whitney U test is used to compare the median values of design issues. Table 6.23 shows that Asymp. Sig. (2-tailed) values of A.03 ("values of the health service"), C.04 ("high-level comfort"), H.07 ("security and supervision") and I.06 (lighting for outdoor space") do not exceed .05 (*p*<.05 level), which means that these design issues cause significant cognitive differences of relative importance between both groups of patients (4 out of 27, 14.8%; highlighted in Table 6.23).

Table 6.23 Test statistics [a] – (Group * Relative importance)

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
A.02	13586.000	14861.000	-.154	.878
A.03	12556.000	164081.000	-1.131	.025*
A.04	13290.500	164815.500	-.429	.668
B.01	13283.000	164808.000	-.448	.654
B.02	13412.000	164937.000	-.317	.751
B.03	13324.000	164849.000	-.386	.699
B.05	13030.000	164555.000	-.648	.517
C.01	13014.500	164539.500	-.711	.477
C.02	13351.500	14626.500	-.369	.712
C.03	13030.000	164555.000	-.668	.504
C.04	11576.500	163101.500	-2.083	.037*
C.05	12563.000	164088.000	-1.089	.276
C.07	13445.000	164970.000	-.288	.773
C.08	13746.000	15021.000	-.004	.997
D.01	13599.500	165124.500	-.135	.893
D.04	13524.500	14799.500	-.207	.836
H.04	12417.000	13692.000	-1.224	.221
H.05	13603.000	165128.000	-.133	.894
H.07	12562.000	13837.000	-1.093	.011*
I.01	13302.500	14577.500	-.411	.681
I.02	12417.000	13692.000	-1.224	.221
I.05	13442.500	14717.500	-.281	.778
I.06	12386.500	13661.500	-1.274	.023*
J.03	13070.000	164595.000	-.638	.524
J.04	13291.000	164816.000	-.429	.668
J.05	13468.500	164993.500	-.225	.799
J.06	13030.000	164555.000	-.648	.517

[a.] Grouping Variable: Patient Group

Moreover, the calculation from the alternative parametric technique Independent-samples t-test (SPSS: *Analyse – Compare Means – Independent Samples T-test*) shows the same results: A.03, C.04, H.07 and I.06 that have significant differences of relative importance between two patient groups. All of them are at the *p*<.05 level. For other design issues (23), there are no significant differences. The effect size of these significant differences is calculated by Z-score. The results listed in Table 6.24 show that the degrees of these significant differences are between the small and medium effects (r: .10 ~ .30).

Table 6.24 Effect size of significant differences – (Group * Relative importance)

	Issue	r	Issue	r	Issue	r	Issue	r
Group	A.03	-0.19	C.04	-0.09	H.07	-0.13	I.06	-0.21

Based on the results of this statistical test, it means that a relatively high consensus is reached between two rounds of surveys from patients, about their preferences for end-users' needs in the design of community-based healthcare environments. It proves that, to a great extent, the findings achieved in the statistical analysis for Patient Group can be generalised to the whole population – the patients of community-based healthcare environments in SIP.

6.6 DISCUSSION AND FINDINGS

Based on the calculation from a series of statistical techniques, the design issues with significant differences of evaluation within Patient Group have been identified. All aggregated results can be used to generalise the important findings for the Survey for Patient Group, which are discussed in detail.

✧ **Patients' preferences for the design of community-based healthcare environments**

Based on the aggregated results regarding the relative importance of design issues related to end-users' needs for community-based healthcare environments, patients' preferences for the design of healthcare environments at a community level are identified and transferred into a measureable way (i.e. the five-point Likert scale and median values) (see Table 6.2). Among the design issues identified in the semi-structured interview (27), there are 1 design issue at the level of "extremely important" (Level 5), 21 at the level of "very important" (Level 4) and 5 at the level of "moderately important" (Level 3).

According to the relationship between design issues and design strategies in the *Conceptual Framework for Healthcare Environment Design*, the design strategies related to end-users' needs can be prioritised at the different levels of relative importance (Table 6.25). It is noteworthy that some design issues correspond to several design strategies (e.g. a design issue A.02 has two design strategies A.021 & A.022). Among all design strategies (44), 2 of them (4.5%) are categorised into Level 5, 36 (81.8%) are categorised into Level 4 and 6 (13.6%) are categorised into Level 3 (Figure 6.12). Based on the levels of relative importance, these design strategies can be prioritised. Architects can use the ranks to choose appropriate design strategies and ensure patients' satisfaction with the built environment.

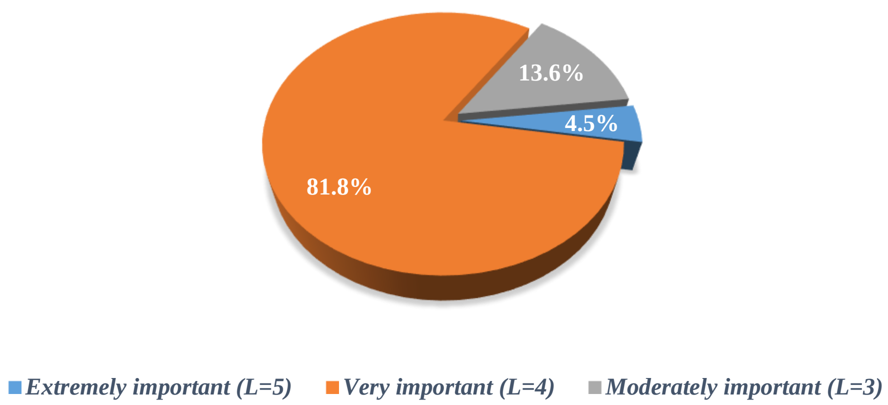

Figure 6.12 Design strategies at different levels of relative impotence from Patient Group

Table 6.25 Relative importance of design strategies related to end-users' needs from Patient Group

Design issue (27)			Design strategy (44)	
Code	MV	L	Code	
C.01	5.0000	Extremely	C.011	Design for privacy protection
			C.012	Design for patient company
A.03	4.0000	Very	A.031	A civic presence for a caring and reassuring atmosphere
A.04	4.0000	Very	A.041	Design for inspiration of patients and staff
B.01	4.0000	Very	B.011	Welcoming appear to staff, patients and visitors
			B.012	A human scale for windows, indoor heights, doors and entrances
B.02	4.0000	Very	B.021	Daylighting level
			B.022	Daylighting level for underground space
B.03	4.0000	Very	B.031	Obvious entrances and routes onto the site
C.03	4.0000	Very	C.031	Land use for greening
			C.032	Greening and vegetation diversity
			C.033	Open space and access to nature for all-weather design
C.04	4.0000	Very	C.041	Light pollution control
			C.042	On-site acoustic environment
			C.043	On-site wind environment (for outdoor walking in winter and ventilation in summer)
			C.044	Heat island control
			C.045	Indoor noise level
			C.046	Indoor glare control
			C.047	Indoor temperature
			C.048	Indoor ventilation and fresh air volume
			C.049	Shading system in summer
			C.04X	Air quality monitoring
C.05	4.0000	Very	C.051	Signposting system and humanistic factors
C.07	4.0000	Very	C.071	Safety facilities (non-slip flooring, seats, handrails and shelves) for bath/toilet
C.08	4.0000	Very	C.081	Staff-only spaces for work and relax
D.04	4.0000	Very	D.041	Attractive form and elevation for neighbours and passers-by
H.04	4.0000	Very	H.041	Layout design to minimise distances travelled and lines crossed
H.05	4.0000	Very	H.051	Recyclable partition for multifunctional and alterable rooms
			H.052	Flexibility for future change and expansion
H.07	4.0000	Very	H.071	Layout design for security and passive supervision
I.01	4.0000	Very	I.011	Connection with public transport
			I.012	Clear pedestrian routes from public transport points
I.02	4.0000	Very	I.021	Design for parking (cycles and vehicles)
I.05	4.0000	Very	I.051	Barrier-free design for site and sidewalk
I.06	4.0000	Very	I.061	Safety lighting for landscape at night
J.03	4.0000	Very	J.031	Layout design to reduce the congestion and circulation
J.04	4.0000	Very	J.041	Layout and greenbelt design for infectious segregation
J.05	4.0000	Very	J.051	Design for gender segregation
A.02	3.0000	Moderately	A.021	Plain form without extra decoration for elevation
			A.022	Artwork for decoration
B.05	3.0000	Moderately	B.051	Colours and textures related to adjacent buildings and environment
C.02	3.0000	Moderately	C.021	Good views for wards and consulting rooms
D.01	3.0000	Moderately	D.011	Sunshine spacing for surrounding residential buildings
J.06	3.0000	Moderately	J.061	Adequate storage space in the building

Note: MV – median value; L – level of relative importance

The results are representative for patients' preferences for the design of community-based healthcare environments. It can be seen that patients' attention is mainly focused on the design strategies that are related to **patients' dignity**, **indoor comfort** and **circulation convenience**. According to the feedback of open-ended questions (i.e. QPD-1 ~ QPD-3), it is found that respondents believe that healthcare environment design should support the healthcare service and therapeutic efficiency – for example, "patients need treatments, including quality and efficiency" and "the end-user centred principle should emphasise medical service". However, no proper attention has been paid to some important evidence-based design strategies that can contribute to patients' recovery (i.e. some evidence-based design strategies are evaluated at the level of "moderately important") – for example, "artwork for decoration" and "good views for wards and consulting rooms". It can be therefore assumed that the limited specialist knowledge in the built environment affects patients' value judgements. On one hand, patients desire the quality and efficiency of medical treatments; on the other hand, they overlook the healthcare outcomes of some evidence-based design strategies. Previous studies in medical psychology and medical sociology have indicated that good natural environments (including greening and views) and decoration are useful techniques for patients' satisfaction. But there is an obvious difference between patients' preferences and their desires for health.

- **Patients' cognition and knowledge about healthcare environment design at a community level**

Based on the situation that respondents evaluated some evidence-based design strategies (i.e. "artwork for decoration" and "good views for wards and consulting rooms") as "moderately important", it can be inferred that patients' knowledge about healthcare environment design is limited. It may affect patients to express their satisfaction and needs for community-based healthcare environments objectively. The results of QPC-2 further verify this assumption. With regard to the outcomes of evidence-based design strategies, 73.6% of respondents believe that design can improve "staff's service quality and efficiency", but only 50.4% of them realise that design can contribute to their "recovery rate" (see Figure 6.7). Limited knowledge leads to that respondents evaluated some evidence-based design strategies at relatively low levels of importance and had opinions such as "better than nothing". They need help to find the links between their environmental needs and the desires for health. It is necessary to choose appropriate approaches of disseminating relevant information to patients. According to the survey results, internet is the most popular approach for patients (61.6% of respondents in the survey chose it as the top learning approach) (see Figure 6.6). However, for the elderly, they would like to use traditional media – newspaper to acquire information. It is noteworthy that it is a long-term process to acquire relevant knowledge about healthcare environment design from all these approaches, as these approaches may not provide information intensively or quickly. Some new approaches should be created to provide brief but effective information to help patients improve knowledge levels efficiently.

Moreover, the impacts of patients' personal background (i.e. genders, ages and target sites), upon their evaluation of relative importance of design issues, were explored (see Table 6.12). A series of design issues with significant cognitive differences were identified on the basis of SPSS. This information can help architects better understand the preferences of patients with different characteristics, and then ensure their holistic environmental satisfaction during the decision-making process of healthcare environment design at a community level. The analysis of effect size shows that the magnitudes of significant differences were small or medium. It means that these differences relatively little impacted upon the consensus on their preferences (see Table 6.8 & 6.10). In summary, it is found that patients of males and females may have different cognition and needs in the aspects of **building images** (i.e. "interesting look" and "attractive colours and textures"), **safety** (i.e. "security and supervision" and "lighting for outdoor space") and **privacy** (i.e. "gender segregation"). Cognitive differences between patients at different ages mainly exist in the aspects of **building forms** (i.e. "a human scale" and "obvious entrances"), **access** (i.e. "available public transport", "parking" and "pedestrian access routes") and **safety** ("lighting for outdoor space"). Architects should pay attention to these priority variances of environmental needs and choose appropriate design strategies for their design work, in order to meet the satisfaction of patients with different attributes and characteristics. Based on the comprehensive consideration, patients' satisfaction with the built environment of healthcare at a community level can be improved holistically.

The study also explores the impacts of patients' ages upon the design of community-based healthcare environments. It is found that the elderly has higher requirements for safety and access. These people have different demands for acquiring knowledge about healthcare environment design (i.e. newspaper). Such information should be taken into account in healthcare environment design, in order to create an ageing-friendly healing environment to mitigate some problems caused by the ageing society.

- ✧ **Differences between patients' needs and the requirements in legislation**

Moreover, the preferences for design strategies based on the responses of Patient Group did not correspond with the evaluation content of GB/T 51153 (see Table 6.2). Obvious differences can be found between both value judgements. These differences can be used to modify GB/T 51153 in the near future and improve its capacity to address social concerns. The cross-comparative study will be discussed in greater detail in Chapter 9, together with the comparison between medical staff's preferences and GB/T 51153.

Moreover, it is found the longest distance between respondents' residential communities and corresponding target sites is 4.2km. It, to some extent, reflects that the amount of community-based healthcare facilities is not enough for residents in SIP (a suggestion of neighbourhood planning principles in SIP – a 400m service radius of basic public resources for around 20,000 local residents; for more information, see Section 2.5.6). As stated earlier in Chapter 2, the *Construction Standard for Community Healthcare Centre/Clinic* JGJ 163 demonstrates the constructive specification of community-based healthcare facilities, including the required medical departments, amount of service groups and total floor spaces for each department (for more information, see Section 2.2.3) (see Table 2.2). However, this building regulation does not indicate the requirements of service circles, which may result in that people have to travel a relatively long distance from their residence to community-based healthcare facilities – for example, 4.2km in this survey. It is necessary to design standards that include both amount of service groups and service circles. In the follow-up studies, the ideal distance between people's residence and a community-based healthcare facility will be explored based on end-users' response analysis.

6.7 CHAPTER SUMMARY

This chapter describes the response analysis from Patient Group (i.e. 550 respondents who were randomly recruited from the patients of community-based healthcare facilities in SIP), including both quantitative and qualitative data. Of the responses, quantitative data was used as the main source for statistical analysis. Finally, a comprehensive understanding of end-users' preferences and knowledge levels about healthcare environment design at a community level was achieved from a patient's perspective.

Design issues related to end-users' needs were categorised in order, based on the relative importance (i.e. median values calculated by the five-point Likert scale) (see Figure 6.5 & Table 6.2). According to the links between design issues and design strategies in the *Conceptual Framework for Healthcare Environment Design*, relevant design strategies were prioritised (see Table 6.25). It was found that patients paid more attention to design strategies that were related to people's dignity, indoor comfort and circulation convenience. A verification study that was conducted subsequently validated the generalisation of findings in this study. Moreover, patients' knowledge about evidence-based design was explored. It was found that limited knowledge levels about evidence-based design might keep patients from expressing their needs objectively and explicitly.

A relatively higher response rate may reduce the risk of bias in the findings. However, it was found that only 16.7% of respondents had previously participated in surveys related to their satisfaction with the design of healthcare environments (see Table 6.7). For a comprehensive understanding of patients' cognition and knowledge levels which can be used for the optimisation of current building regulations, it is necessary for relevant authorities to conduct more surveys to explore the satisfaction and needs of stakeholders with less specialist knowledge in the built environment. It may also provide an opportunity of raising patients' awareness about public participation in healthcare environment design. According to the qualitative data, it was found that respondents had not realised the importance of participation in the design decision-making process for healthcare environments. This information should also be taken into account in healthcare environment design.

To support the end-user centred participatory design and improve the social sustainability of community-based healthcare environments, patients' satisfaction and needs should be well understood by architects. The results of the Survey for Patient Group will be further discussed, together with the results of the Survey for Staff Group which are described in the next chapter, in order to identify the cognitive differences within end-users in the design of community-based healthcare environments.

Man is not on earth solely for his own happiness. He is there to realise great things for humanity.

- Vincent Van Gogh

7

Survey and Response Analysis for Staff Group

7.1 CHAPTER INTRODUCTION

This chapter describes the response analysis from Staff Group, based on both quantitative and qualitative data. An understating of medical staff's needs for community-based healthcare environments, including their preferences for the design issues related to their needs and knowledge levels, can be achieved. The significant cognitive differences within Staff Group are explored statistically on the basis of SPSS. Finally, the relevant design strategies are prioritised based on their levels of relative importance, and the Research Question 1 (i.e. "What are end-users' preferences for these design strategies (related to their needs for community-based healthcare environments)?") can be answered from a medical staff's perspective.

7.2 SURVEY METHODS AND SAMPLE SIZE

Medical staff is another group of important end-users of healthcare environments. Following the career responsibility, they spend much more time in healthcare facilities than patients. Every workday, they have to face a wide range of hazards that affect their health and well-being – for example, injuries, stress and fatigue (Arsand & Demiris 2008; CDC 2013; CHD

2015). Their environmental needs play an important role in the efficiency of healthcare service delivery, which further contributes to the overall quality of a healing environment (CHD 2015). It is meaningful to understand their needs, as well as their priority variances, for the design of community-based healthcare environments. This study explores medical staff's preferences for the design issues related to end-users' needs for community-based healthcare environments, together with their knowledge levels about healthcare environment design.

The non-probability sampling method, convenience sampling, was used for respondent recruitment. During the Survey for Staff Group (October 2016 ~ March 2017), all medical staff members who worked in the target community-based healthcare facilitates in SIP (i.e. the CH Centres and CH Clinics that were chosen as the target sites in the Survey for Patient Group) were invited (for more information, see Figure 6.3). They can be seen as **expects** with **best data** about healthcare environment design at a community level from a medical staff's perspective. There were, in total, 296 employees of these facilities, and 296 copies of *Questionnaire for Staff Group* (see Appendix 3.7) were distributed in line with the quantity (see Appendix 4.1). Finally, 117 of them accepted the invitations. Under the supervision of the researcher, all questionnaires were finished individually by the respondents, and 114 usable questionnaires were taken into account as valid responses (the requirement for usable questionnaires in this research: all compulsory questions should be completed). Based on the response rate formula, the response rate of this survey is 38.5% (for more information, see Section 6.2). A breakdown of the questionnaire responses is shown in Table 7.1.

Table 7.1 A breakdown of questionnaire responses from Staff Group

Survey site	Usable questionnaire	Respondent	Employee	Rate
Site 1	12	12	16	75.0%
Site 2	5	6	11	54.5%
Site 3	19	19	41	46.3%
Site 4	9	9	16	56.3%
Site 5	31	31	103	30.1%
Site 6	6	6	11	54.5%
Site 7	4	4	18	22.2%
Site 8	19	19	39	48.7%
Site 9	3	3	13	23.1%
Site 10	2	4	13	30.8%
Site 11	4	4	15	26.7%
Total	114	117	296	39.5%

7.3 RESPONSE ANALYSIS – DESCRIPTIVE STATISTICS

The response analysis from Staff Group is described, including the quantitative and qualitative data. Based on the feedback, medical staff's preferences for the design issues and knowledge levels about healthcare environment design are explored. The results are representative, as the sample size (296) and response rate (38.5%) are appropriate.

7.3.1 Personal Background (Section A)

Section A intends to explore respondents' personal background (i.e. genders and working fields). The data obtained in this section is used as variables to conduct statistical analysis and explore medical staff's cognitive differences that are caused by genders (QSA-1) and working fields (QSA-2). A breakdown of their personal background is given in Table 7.2.

Table 7.2 A breakdown of respondents' genders and working fields from Staff Group

Gender \ Working field	Treatment	Nursing	Administration	Other	Total
Male	19	0	6	3	28
Female	29	44	3	7	86
Total	48	44	12	10	114

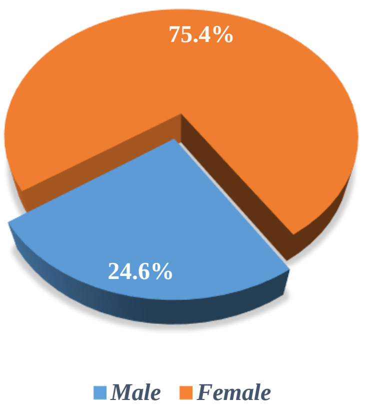

Figure 7.1 Respondents' genders from Staff Group

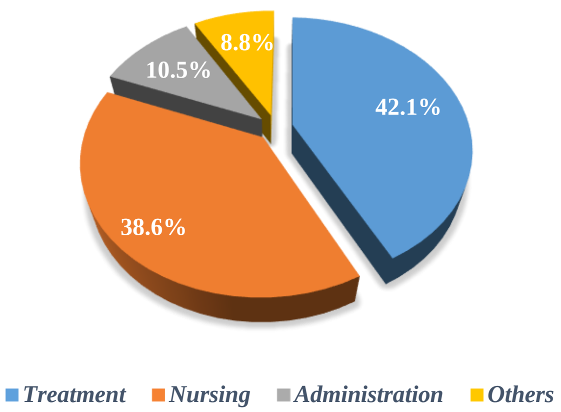

Figure 7.2 Respondents' working fields from Staff Group

Of the respondents, there are 28 males (24.6%) and 86 females (75.4%) (Figure 7.1). Moreover, 48 respondents (42.1%) are from the working field of treatments (i.e. doctors), 44 respondents (38.6%) are nurses, 12 (10.5%) are administrators, and the rest (10, 8.8%) is from the staff who works in the auxiliary departments (Figure 7.2). The third question (QSA-3) is to explore respondents' work experience. Of the respondents, there are only 2 interns (1.8%). The rest are all regular employees (112) with the work experience between 2 and 25 years.

7.3.2 Relative Importance of Design Issues (Section B)

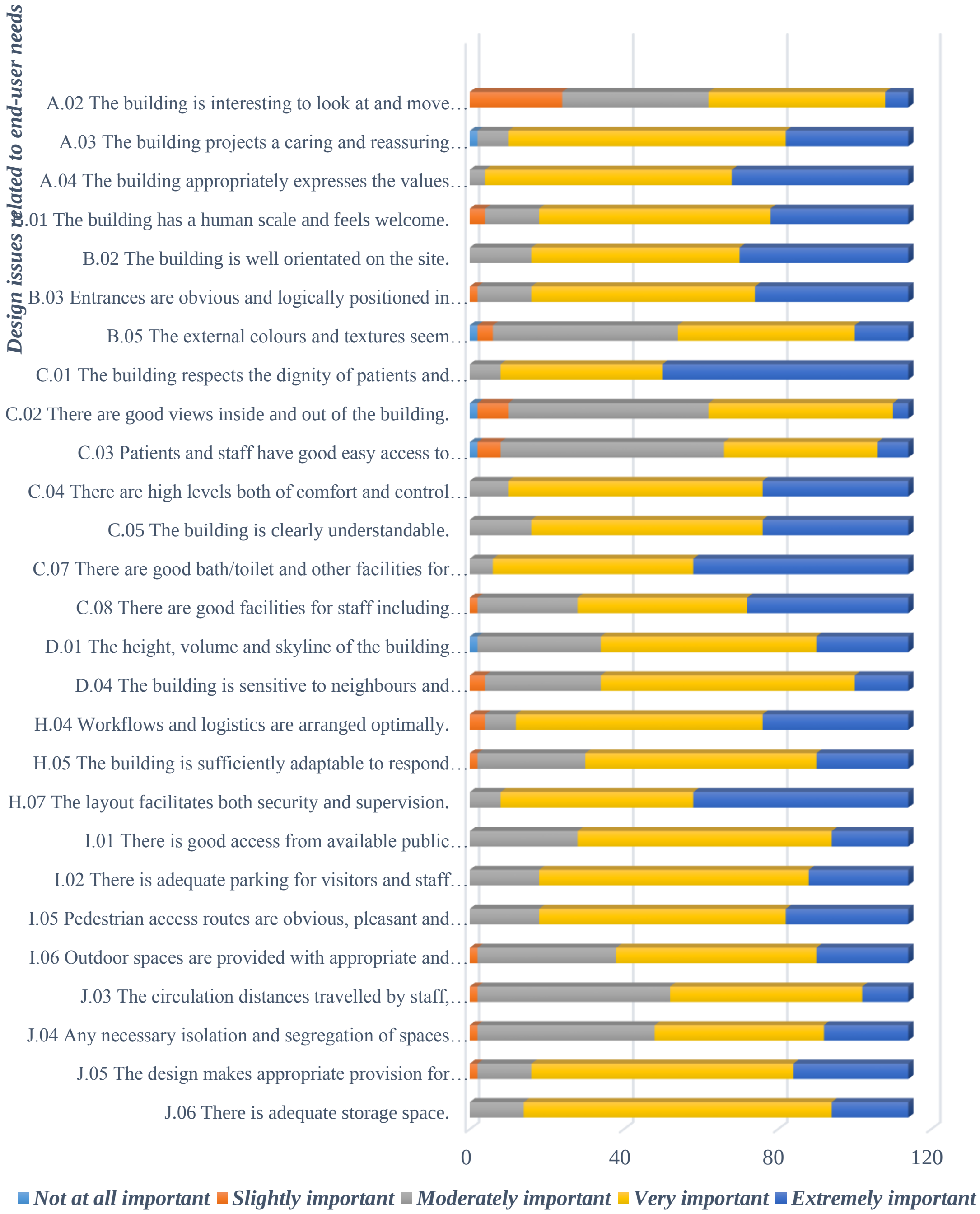

Figure 7.3 Relative importance of design issues related to end-users' needs from Staff Group

Table 7.3 Relative importance (median values and levels of relative importance) of design issues related to end-users' needs from Staff Group

	Design issue related to end-users' needs (27)	Staff		GB/T 51153		
		MV	L	PI	CSI	R
A.02	The building is interesting to look at and move around in.	3.0000	3	Yes	0	-
A.03	The building projects a caring and reassuring atmosphere.	4.0000	4	-	-	-
A.04	The building appropriately expresses the values of the health service.	4.0000	4	-	-	-
B.01	The building has a human scale and feels welcome.	4.0000	4	-	-	-
B.02	The building is well orientated on the site.	4.0000	4	No	4.5	2
B.03	Entrances are obvious and logically positioned in relation to likely points of arrival on site.	4.0000	4	-	-	-
B.05	The external colours and textures seem appropriate and attractive.	4.0000	4	-	-	-
C.01	The building respects the dignity of patients and allows for appropriate levels of privacy and company.	5.0000	5	-	-	-
C.02	There are good views inside and out of the building.	3.0000	3	No	2	4
C.03	Patients and staff have good easy access to outdoors.	3.0000	3	No	3.35	3
C.04	There are high levels both of comfort and control of comfort.	4.0000	4	Yes	15.25	1
C.05	The building is clearly understandable.	4.0000	4	Yes	0	-
C.07	There are good bath/toilet and safety facilities for patients.	4.0000	4	-	-	-
C.08	There are good facilities for staff including convenient places to work and relax without being on demand.	4.0000	4	-	-	-
D.01	The height, volume and skyline of the building relate well to the surrounding environment.	4.0000	4	Yes	0	-
D.04	The building is sensitive to neighbours and passers-by.	4.0000	4	-	-	-
H.04	Workflows and logistics are arranged optimally.	4.0000	4	-	-	-
H.05	The building is sufficiently adaptable to respond to change and to enable expansion.	4.0000	4	No	0.75	8
H.07	The layout facilitates both security and supervision.	4.0000	4	-	-	-
I.01	There is good access from available public transport including any on-site roads.	4.0000	4	No	1.05	6
I.02	There is adequate parking for visitors and staff cars with appropriate provision for disabled people.	4.0000	4	No	0.75	8
I.05	Pedestrian access routes are obvious, pleasant and suitable for wheelchair users and people with other disabilities/impaired.	4.0000	4	No	0.3	10
I.06	Outdoor spaces are provided with appropriate and safe lighting indicating paths, ramps and steps.	4.0000	4	-	-	-
J.03	The circulation distances travelled by staff, patients and visitors are minimised by the layout.	4.0000	4	No	1.75	5
J.04	Any necessary isolation and segregation of spaces is achieved.	4.0000	4	No	1.05	6
J.05	The design makes appropriate provision for gender segregation.	4.0000	4	-	-	-
J.06	There is adequate storage space.	4.0000	4	-	-	-

Note: MV – median value; L – level of relative importance; PI – prerequisite item; CSI – credit of scoring items; R – rank.

This section explores the preferences for the design issues related to end-users' needs from a medical staff's perspective. The relative importance of design issues is transferred into a measureable way, using the five-point Likert scale with ordinal variables, from "not at all important” to “extremely important” (for more information, see Section 5.4.1). The aggregate results, which are calculated and evaluated based on median values, are illustrated in Figure 7.3 and Table 7.3.

All design issues related to end-users’ needs for community-based healthcare environments (27 in total) are categorised into three levels of relative importance. As shown in Table 7.3, 1 design issue (3.7%) is defined as “extremely important” (L-5), 23 (85.2%) are defined as “very important” (L-4), and 3 (11.1%) are defined as “moderately important” (L-3). It can be seen that some design issues that are “extremely important” or “very important” are focused on **patients’ benefits** – for example, C.01 (“dignity of patients”), C.07 (“safety facilities”) and A.04 (“values of the health service”). It, to a great extent, reflects medical staff’s career responsibility and humanistic concerns. Moreover, some design issues do not draw proper attention from respondents – for example, A.02 (“interesting look”), C.02 (“good views”) and C.03 (“access to outdoors”).

On the basis of the comparison between the preferences of Staff Group and the evaluation content of GB/T 51153, it is found that there are both synergies and conflicts (see Table 7.3). Of the 13 design issues (13 out of 27, 48.1%) that are involved in GB/T 51153, 10 (i.e. B.02, C.04, C.05, D.01, H.05, I.01, I.02, I.05, J.03 and J.04) are defined as “very important” by medical staff. However, some design issues that are overlooked by GB/T 51153 are evaluated as “extremely important” or “very important” by medical staff, and they are C.01 (L-5), A.03 (L-4), A.04 (L-4), B.01 (L-4), B.03 (L-4), B.05 (L-4), C.07 (L-4), C.08 (L-4), D.04 (L-4), H.04 (L-4), H.07 (L-4), I.06 (L-4), J.05 (L-4) and J.06 (L-4). Moreover, some design issues that are highly ranked in GB/T 51153 (prerequisite items) are low-valued by Staff Group – for example, A.02 (L-3). The comparison between the preferences of Staff Group and the evaluation content of GB/T 51153 will be further discussed in Chapter 9, to explore the information that can be used to modify the capacity of GB/T 51153 in addressing social concerns.

7.3.3 Knowledge about Healthcare Environment Design (Section C)

This section aims to have a general understanding of medical staff’s knowledge levels about healthcare environment design. There are four questions (i.e. QSC-1, QSC-2, QSC-3 and QSC-4). QSC-1 asks medical staff to indicate the approaches that can help them acquire relevant knowledge. It shows in Figure 7.4 that the ranks of these learning approaches are “brochures from healthcare facilities” (110 respondents out of 114, 96.5%), “TV media” (94, 82.5%), “newspaper” (93, 81.6%), “internet” (85, 74.6%), “information from friends/ relatives/neighbours” (81, 71.1%) and “visit and direct observation” (48, 43.1%).

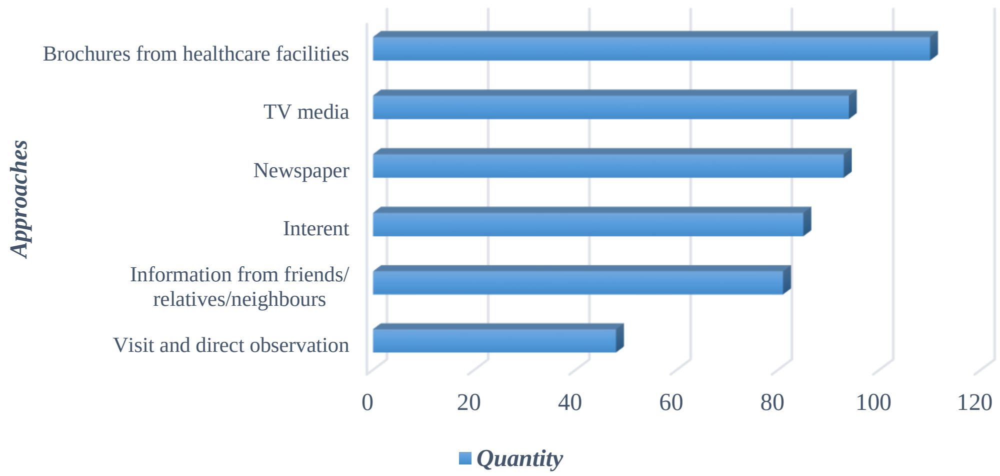

Figure 7.4 Approaches of acquiring knowledge about healthcare environment design from Staff Group

Medical staff's knowledge levels about evidence-based design strategies are illustrated in Figure 7.5 (QSC-2). For these options that can be contributed to by healthcare environment design, respondents believe that design can optimise "healthcare-associated infection" (110 out of 114, 97.4%). They also consider that "accidental falls" (94, 82.5%), "staff's health" (92, 80.7%) and "mood and emotion" (91, 79.8%) can be effectively affected based on the design of healthcare environments. Moreover, "staff's service quality and efficiency", "staff's satisfaction" and "recovery rate" are ranked at 5 (82, 71.9%), 6 (76, 66.7%) and 7 (67, 58.8%) accordingly. These options draw proper attention from Staff Group. Only the option "dosage of medication" is chosen by less half of respondents (38, 33.3%).

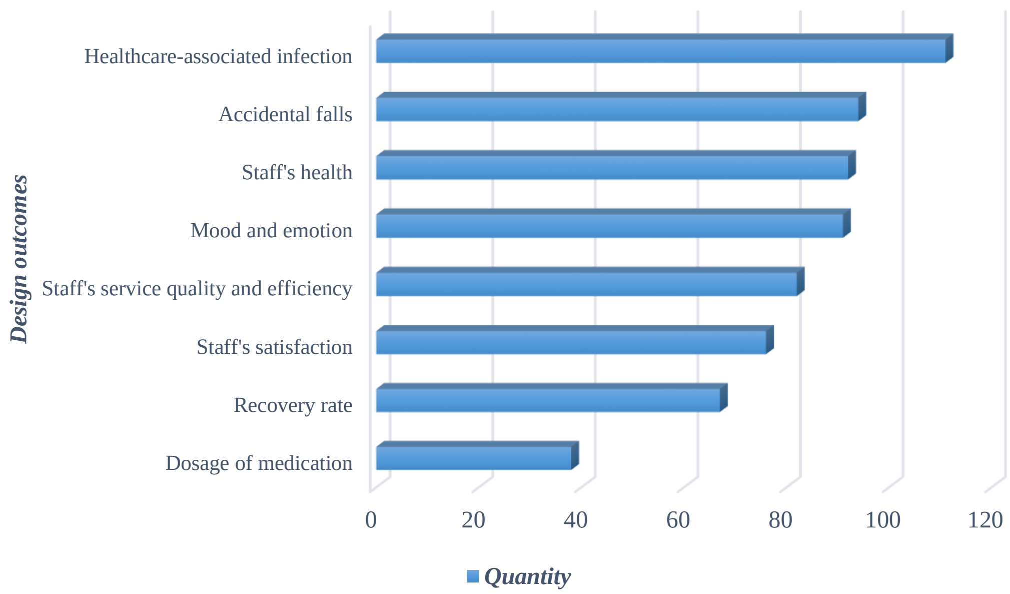

Figure 7.5 Knowledge about evidence-based design from Staff Group

The last two questions in this section are designed to learn about survey situation. QSC-3 intends to ask if medical staff has previously received any surveys about their satisfaction with community-based healthcare environments, while QSC-4 asks if they have previously conducted any surveys to explore patients' opinions on the healthcare service quality at a community level. Figure 7.6 shows that only 28.1% of respondents (32 out of 114) have the experience of surveys about healthcare environment design. Moreover, 61.4% of them (70) have conducted surveys to learn about patients' satisfaction and suggestions about healthcare service at a community level (Figure 7.7).

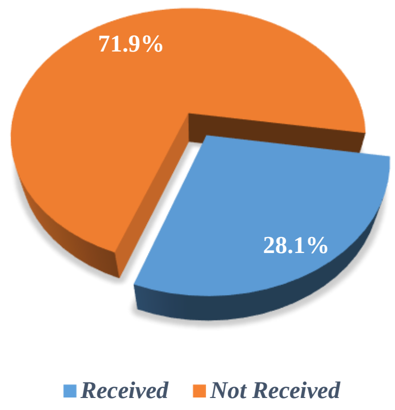

Figure 7.6 Respondents' experience of being involved in surveys about medical staff's satisfaction with community-based healthcare environments

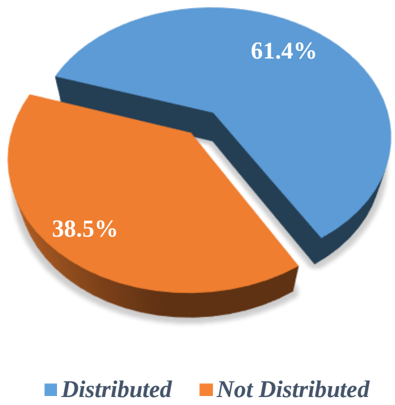

Figure 7.7 Respondents' experience of conducting surveys about patients' satisfaction with healthcare service at a community level

7.3.4 Open-ended Questions (Section D)

In this section, qualitative data is collected based on three open-ended questions. These questions are designed to acquire information from Staff Group, about their understanding of healthcare service at a community level (QSD-1), community-based healthcare environment design (QSD-2) and end-user centred principles for healthcare environments (QSD-3). All questions in this section are not compulsory for respondents. Representative responses from Staff Group are summarised as follows:

- ✧ **QSD-1**

S-S8 (a male doctor with 9-year work experience): "…For patients, primary care means **therapeutic convenience**. It provides basic medical treatments for local residents, and it also aims to **release the pressure of general and special hospitals**…"

S-S92 (a male doctor with 3-year work experience) "…It is mainly for the **common and chronic diseases**, and **disease prevention** as well. But it is a very important segment of modern urban healthcare service. Such facilities should **exist in every community**…"

S-S72 (a female administrator with 7-year work experience):"…It is necessary to build **a file system** for all local residents and their periodic physical examination. The core of healthcare service at a community level is to provide full **physical examination** and **follow-up care** for nearby residents. **Convenience** is important…"

S-S105 (a female doctor with 5-year work experience): "…It is important to provide **convenience** for residents. It only provides **basic medical treatments**, such as injection and prescription for fever…"

"Convenience" is a key word of responses with the highest frequency, and it basically explains the target of primary care delivery systems. For the design of community-based healthcare environments, the respondents indicate that:

- ✧ **QSD-2**

S-S94 (a male doctor with 10-year work experience): "…**Humanisation**. Special convenience for aged people, children, the pregnant and the disabled… It is the core of community-based healthcare environment design…"

S-S8 (a male doctor with 9-year work experience): "…Roomy, bright, clean, elegant, warm and home-like. These elements may benefit patients' **recovery** and **satisfaction** with indoor environments…"

S-S107 (a female nurse with 2-year work experience): "…**Convenient transport** is very important, for both vehicles and pedestrians…"

S-S74 (a female administrator with 2-year work experience): "…It is very important to be **understandable** about the layout for patients…"

S-S34 (a female nurse with 4-year work experience): "…Indoor comfort for both patients and medical staff…"

It is important to note that most of concerns are focused on patients' benefits. Some respondents clearly express that the focus of healthcare environment design should also be located for medical staff. Moreover, some of them have realised the specific functions of community-based healthcare facilities for the ageing society. In terms of end-user centred principles, some respondents emphasise the functions for patients, such as:

✧ **QSD-3**

S-S52 (a male doctor with 11-year work experience): "…End-user centred principles mean protecting **patients' privacy** and **safety**, emphasising the **communication** between end-users and designers, and creating **a home-like healing environment**…"

S-S39 (a female nurse with 15-year work experience): "…This principle can make the patients feel **respected**. Very important…"

S-S6 (a female administrator with 6-year work experience): "…All for patients, and for patients' all. It is the core of this principle…"

S-S24 (a female nurse with 6-year work experience): "…Warm and sweet. It is very important to reduce patients' **psychological pressure**…"

S-S50 (a female nurse with 3-year work experience): "…Easy to find. Convenience for medical treatments, way-finding signs, home-like atmosphere, friendly service, good service attitude and reasonable charges…"

S-S49 (a female nurse with 6-year work experience): "…It is necessary to make clear the end-user centred principles for the design of community-based healthcare facilities. It can provide more characteristic and flexible design details. The environment can be designed with attractive and **home-like features**…"

Some of them claim that this principle also means a participatory design process of healthcare facilities and environments – for example:

S-S94 (a male doctor with 10-year work experience): "…For end-user centred principles, it is necessary to conduct **investigations** – for example, questionnaires and interviews, to collect the information from patients in communities and then use this information to design community-based healthcare facilities…"

S-S107 (a female nurse with 2-year work experience): "…It means that various needs from various end-users – for example, patients and medical staff, should be met…"

Moreover, for this question, several respondents indicate that, currently, the design of community-based healthcare environments should be enhanced from perspectives of both patients and medical staff:

S-S91 (a female nurse with 4-year work experience): "…End-user centred principles mean **human-centred concerns** for both patients and medical staff…"

S-S109 (a female doctor with 10-year work experience): "…End-user centred principles can be interpreted as that healthcare facilities should be designed **from the perspectives of both patients and medical staff**, not only for patients…"

According to the qualitative data of open-ended questions, the opinions of Staff Group are summarised. It can be seen that a close consensus can be reached on the functions of community-based healthcare service. Most of medical staff realises the phenomenon that they also belong to end-users of healthcare environments and their participation is important for the design quality of healthcare environments. It is a good sign of implementing the end-user centred participatory design. The next section explores the cognitive differences of Staff Group, using statistical techniques in SPSS.

7.4 RESPONSE ANALYSIS – STATISTICAL ANALYSIS

In Chapter 5, a pilot study (i.e. a semi-structured interview) was discussed. According to the results, it was assumed that some cognitive differences might exist in the needs for design issues existed between medical staff with different working fields (e.g. doctors and nurses). For example, they had different requirements for the design of windows and indoor illumination (for more information, see Section 5.3.4). Therefore, since the sample size (114) and response rate (38.5%) of this survey are relatively large, statistical methods can be implemented in SPSS to further identify the significant cognitive differences of medical staff. However, statistical analysis should be carefully organised. As indicated by Wu (2003, p.18), the appropriate sample size of conducting correlational studies[18] is no less than 30 for each group or variable. With relatively small samples, "a result that does not generalise (cannot be repeated) with other samples" may be obtained, and then lead to "little scientific value" (Pallant 2005a, p.142). Pallant (2005a, p.210) indicates that "with sample sizes of 30+, violation of the assumption (the difference between the two scores obtained for each subject should be normally distributed) is unlikely to cause any serious problems".

Therefore, to ensure the power of tests, the standard of sample size is defined. Only the working field (QSA-2) can be chosen as a variable. It is found that the cognitive differences can be tested only between the doctor group (sample size: 48) and nurse group (sample size: 44). The results calculated from appropriate statistical techniques are demonstrated in this section. The statistical analysis procedure follows the "three-step standard" applied in the analysis procedure for Patient Group (for more information, see Section 6.4.1).

7.4.1 Cognitive Differences within Staff Group

The impacts upon the preferences for design issues and knowledge levels about evidence-based design, from the variable of working fields, are tested in SPSS separately. The aggregated results identify the significant cognitive differences in medical staff' preferences and knowledge for the design of community-based healthcare environments.

- ✧ **Working field (QSA-2) * Relative importance of design issues (QSB-A02 ~ QSB-J06)**

The median values are compared, on the evaluation of relative importance of design issues (from QSB-A02 to QSB-J06) for doctors and nurses in Staff Group. The normal distribution cannot be achieved for any of design issues, according to the significant results (Sig. values in Shapiro-Wilk less than .01) of Shapiro-Wilk statistic (SPSS: *Analyse – Descriptive Statistics – Explore*). Therefore, a nonparametric statistical technique Mann-Whitney U Test (SPSS: *Analyse – Non-parametric Tests – 2 Independent Samples*) is more appropriate to apply, and the results are demonstrated in Table 7.4.

It can be seen that the significant differences only exist in 4 design issues (4 out of 27, 14.8%), which are A.03, C.01, C.04 and J.06 (highlighted in Table 7.4). Their significant differences are all at the $p<.05$ level (Asymp. Sig. (2-tailed) less than .05). It means that doctors and nurses

[18] Correlational study: "a form of research in which you observe what naturally goes on in the world without directly interfering with it. This term implies that data will be analysed so as to look at relationships between naturally-occurring variables rather than making statements about cause and effect" (Field 2009, p.783).

are easy to have different preferences for “a caring and reassuring atmosphere”, “dignity of patients”, “high-level comfort” and “storage space”. Moreover, based on the calculation from the alternative parametric technique Independent-samples t-test (SPSS: *Analysis – Compare Means – Independent Samples T-test*), it shows that the results from the parametric technique are slightly different. Only C.01, C.04 and J.06 have significant differences at the $p<.05$ level (Sig. (2-tailed) value less than .05). Finally, the results from Mann-Whitney U Test are taken into account.

Table 7.4 Test statistics [a] – (Working field * Relative importance)

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
A.02	852.000	2028.000	-1.683	.092
A.03	834.000	1824.000	-2.062	.039*
A.04	1028.000	2018.000	-.255	.799
B.01	966.000	1956.000	-.766	.444
B.02	980.000	2156.000	-.643	.520
B.03	1048.000	2224.000	-.068	.946
B.05	860.000	2036.000	-1.665	.096
C.01	778.000	1768.000	-2.461	.014*
C.02	1010.000	2186.000	-.395	.693
C.03	1048.000	2224.000	-.069	.945
C.04	792.000	1782.000	-2.341	.019*
C.05	986.000	1976.000	-.604	.546
C.07	880.000	1870.000	-1.562	.118
C.08	1016.000	2006.000	-.333	.739
D.01	890.000	1880.000	-1.434	.152
D.04	916.000	2092.000	-1.212	.225
H.04	1010.000	2186.000	-.412	.681
H.05	1032.000	2022.000	-.204	.839
H.07	1008.000	1998.000	-.420	.674
I.01	1054.000	2044.000	-.017	.986
I.02	1026.000	2202.000	-.274	.784
I.05	1050.000	2226.000	-.053	.958
I.06	912.000	2088.000	-1.205	.228
J.03	924.000	2100.000	-1.148	.251
J.04	1026.000	2016.000	-.253	.801
J.05	932.000	2108.000	-1.102	.271
J.06	820.000	1996.000	-2.278	.023*

a. Grouping Variable: Working field

Since the results from the nonparametric technique are taken into account as main findings, Z-score is appropriate to apply for the test of effect size (for more informant, see Section 6.4.1). The results in Table 7.5 show that the effects of significant differences are all between the suggested standards of .01 (small effect) and .03 (medium effect)[19]. As indicated by Field (2005, p.57), the r value of effect size is not “measured on a liner scale”, which means “an effect with r = .6 isn’t twice as big as one with r =.3”. Therefore, it can be concluded that less than 9% of total variance is caused by the effects of the significantly different opinions. It reflects that medical staff’s cognition may not be affected to a great extent. It can be

[19] Suggested standards of effects: Cohen (1988 & 1992, cited in Field 2009, p.57) suggests the standards about “what constitutes a large or small effect:

- r = .10 (small effect): In this case the effect explains 1% of the total variance;
- r = .30 (medium effect): The effect accounts for 9% of the total variance; and
- r = .50 (large effect): The effect accounts for 25% of the variance”.

summarised that a certain degree of consensus on the relative importance of most design issues is reached between the preferences of doctors and nurses.

Table 7.5 Effect size of significant differences – (Working field * Relative importance)

	Issue	r	Issue	r	Issue	r	Issue	r
Working field	A.03	-0.21	C.01	-0.26	C.04	-0.24	J.06	-0.23

- ✧ **Working field (QSA-2) * Knowledge about evidence-based design (QSC-21 ~ QSC-28)**

Medical staff can be considered as the bridge between patients and design professionals. It is expected that they have much more knowledge about healthcare environment design than other end-users. To explore the significant association between working fields and knowledge levels about evidence-based design strategies, chi-square test for independence (SPSS: *Analysis – Descriptive Statistics – Crosstabs*) is applied. The results demonstrate that there is significant relationship between the working fields and "recovery rate".

Table 7.6 Working field * Recovery rate crosstabulation

			Recovery rate		Total
			Not selected	Selected	
Working field	Treatment	Count	28	20	48
		Expected Count	19.8	28.2	48.0
		% within Working field	58.3%	41.7%	100.0%
		% within Recovery rate	73.7%	37.0%	52.2%
		% of Total	30.4%	21.7%	52.2%
	Nursing	Count	10	34	44
		Expected Count	18.2	25.8	44.0
		% within Working field	22.7%	77.3%	100.0%
		% within Recovery rate	26.3%	63.0%	47.8%
		% of Total	10.9%	37.0%	47.8%
Total		Count	38	54	92
		Expected Count	38.0	54.0	92.0
		% within Working field	41.3%	58.7%	100.0%
		% within Recovery rate	100.0%	100.0%	100.0%
		% of Total	41.3%	58.7%	100.0%

Table 7.7 Chi-square tests – (Working field * Recovery rate)

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.512[a]	1	.001		
Continuity Correction [b]	10.581	1	.001		
Likelihood Ratio	12.375	1	.000		
Fisher's Exact Test				.001	.000
Linear-by-Linear Association	11.874	1	.001		
N of Valid Cases	92				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.17.

b. Computed only for a 2x2 table

In Table 7.6 and 7.7, the Asymp. Sig. (2-tailed) value in Continuity Correction is .001 at the p<.01 level. It means that doctors and nurses have significantly different opinions on design's impacts upon patients' recovery. The proportion of doctors who believe design can increase patients' recovery rates (41.7%, 20 out of 48) is much less than the proportion of nurses who have this opinion (77.3%, 34 out of 44). In terms of other options (i.e. "healthcare-associated infection", "dosage of medication", "accidental falls", "mood and emotion", "staff's health", "staff's service quality and efficiency" and "staff's satisfaction"), the results from chi-square test for independent show that there is a close consensus on the knowledge levels about healthcare environment design between doctors and nurses.

✧ **Summary**

In the procedure of statistical analysis, cognitive differences were explored within Staff Group. As only the groups of doctors and nurses had 30+ samples, the significant differences between doctors and nurses were tested. Based on the results from Mann-Whitney U Test, the design issues with significant cognitive differences were identified. It shows that, doctors and nurses in Staff Group had different preferences for the design issues related to **indoor atmosphere** (i.e. "a caring and reassuring atmosphere", "high-level comfort" and "storage space") and **dignity** (i.e. "dignity of patients: privacy and company"). Moreover, the results from chi-square test for independence show that doctors and nurses had different knowledge levels about the relationship between evidence-based design and patients' recovery rates. Nurses considered this option more positive than doctors. For other significant differences that were caused by personal background (e.g. genders, target sites and working fields about administration/auxiliary work), statistical analysis was not conducted to test the impacts upon medical staff's cognition or knowledge levels. It is because that the sample size related to these variables is not appropriate (i.e. less than 30). It can be seen as a research limitation, and should be enhanced in the future work.

7.5 DISCUSSION AND FINDINGS

Based on the calculation of Mann-Whitney U Test and chi-square test for independence, medical staff's preferences, cognitive differences and knowledge levels about healthcare environment design at a community level were explored. The aggregated results, including both quantitative and qualitative data from descriptive and statistical analysis, are used to generalise findings from the Survey for Staff Group.

✧ **Medical staff's preferences for the design of community-based healthcare environments**

Based on the aggregated results, medical staff's preferences for the design of healthcare environments at a community level are identified. As calculated by the five-point Likert scale, the median values of design issues indicate their relative importance into a measurable way (median values) (see Table 7.3). The responses from Staff Group show that there are 1 design issue at the level of "extremely important" (Level 5), 23 at the level of "very important" and 3 at "moderately important" (Level 3).

Table 7.8 Relative importance of design strategies related to end-users' needs from Staff Group

Design issue (27)			Design strategy (44)	
Code	MV	L	Code	
C.01	5.0000	Extremely	C.011	Design for privacy protection
			C.012	Design for patient company
A.03	4.0000	Very	A.031	A civic presence for a caring and reassuring atmosphere
A.04	4.0000	Very	A.041	Design for inspiration of patients and staff
B.01	4.0000	Very	B.011	Welcoming appear to staff, patients and visitors
			B.012	A human scale for windows, indoor heights, doors and entrances
B.02	4.0000	Very	B.021	Daylighting level
			B.022	Daylighting level for underground space
B.03	4.0000	Very	B.031	Obvious entrances and routes onto the site
B.05	3.0000	Very	B.051	Colours and textures related to adjacent buildings and environment
C.04	4.0000	Very	C.041	Light pollution control
			C.042	On-site acoustic environment
			C.043	On-site wind environment (for outdoor walking in winter and ventilation in summer)
			C.044	Heat island control
			C.045	Indoor noise level
			C.046	Indoor glare control
			C.047	Indoor temperature
			C.048	Indoor ventilation and fresh air volume
			C.049	Shading system in summer
			C.04X	Air quality monitoring
C.05	4.0000	Very	C.051	Signposting system and humanistic factors
C.07	4.0000	Very	C.071	Safety facilities (non-slip flooring, seats, handrails and shelves) for bath/toilet
C.08	4.0000	Very	C.081	Staff-only spaces for work and relax
D.01	3.0000	Very	D.011	Sunshine spacing for surrounding residential buildings
D.04	4.0000	Very	D.041	Attractive form and elevation for neighbours and passers-by
H.04	4.0000	Very	H.041	Layout design to minimise distances travelled and lines crossed
H.05	4.0000	Very	H.051	Recyclable partition for multifunctional and alterable rooms
			H.052	Flexibility for future change and expansion
H.07	4.0000	Very	H.071	Layout design for security and passive supervision
I.01	4.0000	Very	I.011	Connection with public transport
			I.012	Clear pedestrian routes from public transport points
I.02	4.0000	Very	I.021	Design for parking (cycles and vehicles)
I.05	4.0000	Very	I.051	Barrier-free design for site and sidewalk
I.06	4.0000	Very	I.061	Safety lighting for landscape at night
J.03	4.0000	Very	J.031	Layout design to reduce the congestion and circulation
J.04	4.0000	Very	J.041	Layout and greenbelt design for infectious segregation
J.05	4.0000	Very	J.051	Design for gender segregation
J.06	4.0000	Very	J.061	Adequate storage space in the building
A.02	3.0000	Moderately	A.021	Plain form without extra decoration for elevation
			A.022	Artwork for decoration
C.02	3.0000	Moderately	C.021	Good views for wards and consulting rooms
C.03	3.0000	Moderately	C.031	Land use for greening
			C.032	Greening and vegetation diversity
			C.033	Open space and access to nature for all-weather design

Note: MV – median value; L – level of relative importance

Based on the relationship between design issues and design strategies in the *Conceptual Framework for Healthcare Environment Design*, the design strategies related to end-users' needs can be prioritised at the different levels of relative importance from a medical staff's perspective (Table 7.8). Among the relevant design strategies, 2 out of 44 (4.5%) are categorised into Level 5, 36 (81.8%) are categorised into Level 4 and 6 (13.6%) are categorised into Level 3 (Figure 7.8). These design strategies can be prioritised based on their levels of relative importance. Architects can have a comprehensive understanding of medical staffs' needs and preferences, and then choose appropriate design strategies to optimise their design work for better satisfaction of medical staff with the built environment of community-based healthcare buildings.

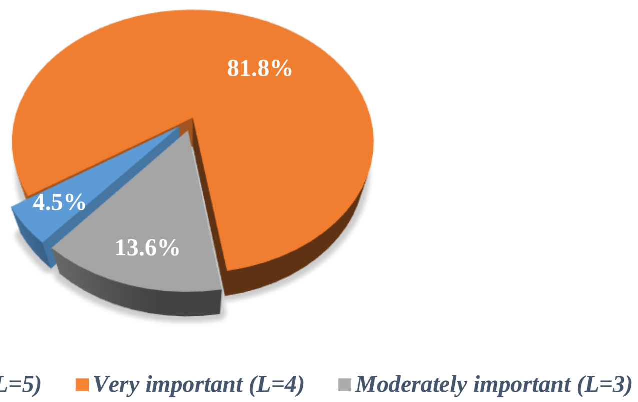

Figure 7.8 Design strategies at different levels of relative impotence from Staff Group

The results are representative for the preferences of medical staff for the design of community-based healthcare environments. It shows that medical staff pays more attention to the design of **indoor equipment** and **decoration**, instead of outdoor environment design. They also emphasise the design for **patients' benefits**. It reflects medical staff's career responsibility and humanistic concerns. It is found that, in the participatory design process, medical staff would like to provide an integrated consideration for the benefits of both patients and themselves.

- ✧ **Medical staff' cognition and knowledge about healthcare environment design at a community level**

The statistical analysis between the doctor group and nurse group identifies that they may have significant differences in the evaluation of **indoor atmosphere** (i.e. "indoor healing atmosphere", "indoor comfort and control of comfort" and "storage space") and **dignity** (i.e. "patients' dignity and privacy"), but these differences are at medium effect. The impacts are not large. Therefore, for the design issues related to end-users' needs, the results achieved from the Survey for Staff Group are representative, and a relatively high consensus can be reached. The results will be used for the further cross-comparative studies against the responses of Patient Group in Chapter 9.

Moreover, the aggregated results show that medical staff considers "brochures from healthcare facilities" as the most important approach of acquiring knowledge about healthcare environment design (96.5% of respondents chose it as the top learning approach) (see Figure 7.4). Based on the responses of open-ended questions, it is found that healthcare facilities would provide learning materials and trainings to their employees for improving their knowledge about healthcare service and healthcare environments. This way can also enrich medical staff's knowledge about evidence-based design. It is found that most of medical staff emphasises the healthcare outcomes of "healthcare-associated infection" (97.4%), "accidental falls" (82.5%), "staff's health" (80.7%), "mood and emotion" (79.8%), "staff's service quality and efficiency" (71.9%) and "staff's satisfaction" (71.9%) from evidence-based design. In the survey, some respondents indicated the importance of consultation and public participation in healthcare environment design. On one hand, they considered themselves as end-users who were influenced by both positive and negative impacts from healthcare environments; on the other hand, they acted as some professionals who should build a bridge between patients' needs and architects' design intent in the process of healthcare environment design.

✧ **Differences between patients' needs and the requirements from legislation**

It is found that there are a number of conflicts between the preferences of Staff Group and the evaluation content of GB/T 51153. Their value judgements are different. Staff Group shows less interests in some design strategies that are related to outdoor environments or vegetation (e.g. easy access to outdoors, good views inside and out of the building). However, these have important weights in GB/T 51153. Moreover, GB/T 51153 also neglects some design issues that medical staff considers very important. It can be inferred that only following the instruction of this sustainability assessment method does not mean that medical staff's needs for community-based healthcare environments can be met holistically. The results of the Survey for Staff Group are meaningful to optimise the social aspects of current building regulations. The cross-comparative study between medical staff's needs and GB/T 51153 will be discussed in detail in Chapter 9.

7.6 CHAPTER SUMMARY

This chapter describes the survey procedure and response analysis from Staff Group, based on both quantitative and qualitative data that was collected from 114 respondents who worked at the community-based healthcare facilities in SIP. Because of the time and cost of this research, some limitations (e.g. the sample size of some variables, including genders, working fields and work experience, is not enough for statistical analysis) in the Survey for Staff Group may impact upon the survey results, and will be discussed with the solutions in the last chapter.

The statistical analysis software SPSS was used to analyse the quantitative data. Finally, a comprehensive understanding of medical staff' needs (i.e. the preferences for the design issues related to end-users' needs for community-based healthcare environments) and relevant knowledge levels was achieved. The statistical analysis used the quantitative data as main resources. Based on the median values, design issues were categorised into different levels of relative importance. Most design issues were ranked at the level of "very important" (23 out of 27, 85.2%). According to the links between design issues and design strategies in the *Conceptual Framework for Healthcare Environment Design*, relevant design strategies were prioritised, which further explained medical staff's preferences for healthcare environment design at a community level (see Table 7.8). It was found that medical staff's attention was mainly paid to the aspects of indoor equipment and decoration. They also emphasised some design strategies that focused on patients' benefits, which reflected the career responsibility and humanistic concerns of medical staff.

In addition, medical staff's knowledge levels about evidence-based design were explored. It was found that learning materials from healthcare facilities might be an effective way for medical staff to improve their knowledge levels about healthcare environment design and evidence-based design strategies from previous research. In terms of survey experience, only 28.1% of respondents in Staff Group had previously participated in surveys about their satisfaction with the design of community-based healthcare environments (see Figure 7.6). Moreover, 61.4% of respondents had conducted surveys to learn about patients' satisfaction and suggestions about healthcare service at a community level (see Figure 7.7). It may enhance medical staff' understanding of patients' needs and attitudes, and their sense of responsibility.

Chapter 6 and 7 achieved an understanding of the preferences of end-users (i.e. patients and medical staff) for their environmental needs in the design of community-based healthcare facilities. A cross-comparative study between their preferences will be conducted in Chapter 9, in order to find the cognitive differences within these stakeholders. In the next chapter, the preferences of another important group in the participatory design, architects, will be explored to identify the design issues that draw attention only from patients and medical staff and be neglected by architects in healthcare environment design at a community level.

To regard thinking as a skill rather than a gift is the first step towards doing something to improve that skill.

- Edward de Bono

8

Survey and Response Analysis for Architect Group

8.1 CHAPTER INTRODUCTION

This chapter describes the response analysis from Architect Group, which explores architects' preferences for the design strategies that are related to end-users' needs for community-based healthcare environments. Based on the quantitative and qualitative data collected by self-completion questionnaires, the relative importance of design strategies is identified. Unlike the face-to-face survey procedure for patients and medical staff, the Survey for Architect Group is conducted based on emails and internet without the researcher's supervision. Since the target respondents are architects with work experience in healthcare environment design at a community level, it is believed that they are the **experts** who should be able to provide the **best data** to describe architects' cognition and knowledge levels.

8.2 SURVEY METHODS AND SAMPLE SIZE

Architects are the facilitators of end-user centred participatory design. They are able to use the architectural language to integrate end-users' needs into design work. To secure the social sustainability of community-based healthcare environments, architects are required to understand not only end-users' desires for the built environment, but also the design strategies that can realise these environmental needs. This requirement can effectively improve the overall environment design quality and efficiency of public participation.

This survey explores experienced architects' preferences for the design strategies related to end-users' needs for community-based healthcare environments. Qualitative and quantitative data is collected. Qualitative data is used to understand architects' cognition and knowledge levels about sustainable design for healthcare environments. Quantitative data is used to transfer the relative importance of design strategies into a measurable way (i.e. median values and levels of relative importance). According to a non-probability sampling method, in total 142 copies of *Questionnaires for Architect Group* (see Appendix 3.8) were sent by email to two companies (September 2016 ~ October 2016) (see Appendix 4.1). These companies were selected, as their main business was focused on the design and construction of healthcare buildings and environments. For ethical concerns, their names are abbreviated to codes – Company 1 and Company 2. All respondents had two ways of filling in questionnaires: 1) downloading the attached Word files and then sending them back with answers; and 2) using the web link (SOJUMP) and directly submitting answers online. Most of respondents chose the second way. Due to a voluntary basis and a strict standard for respondents (i.e. "relevant work experience of being involved in the design of community-based healthcare buildings or environments"), there were 57 usable questionnaires out of 91 responses. These questionnaires can be considered as valid responses. According to the response rate formula, the response rate of this survey is 40.1% (for more information, see Section 6.2).

As indicated by Bryman (2012, p.235), email surveys "typically result in lower response rates than comparable interview-based studies". According to previous research, 20% or over is considered as an acceptable response rate for email surveys (Prahalad & Hamel 1990; Couper 2000; Sherrie 2010). Some studies considered 24% as a normal response rate percentage for email surveys (Sheehan & McMillan 1999, p.56). Therefore, 40.1% can be counted as an acceptable response rate for this email survey.

8.3 RESPONSE ANALYSIS – DESCRIPTIVE STATISTICS

Based on the responses from experienced architects, the response analysis, including quantitative and qualitative data, is described. Compared with the surveys for Patient Group and Staff Group, the quantity of usable questionnaires in this survey is lower. However, the "best data" from "experts" can represent the cognition and preferences of architects. The analysis based on the descriptive statistics is demonstrated in this section.

8.3.1 Personal Background (Section A)

There are 57 responses out of 91, which are usable questionnaires. It is because that these questionnaires have completed answers and meet the standard of "relevant work experience of being involved in the design of community-based healthcare buildings or environments". In terms of other 34 responses, 5 respondents did not finish all mandatory questions, and others (29) did not have work experience in healthcare environment design at a community level (i.e. "No" for QAA-1). These 57 respondents can be seen as "experienced architects" or "expects" in this survey.

Among these respondents, 4 of them have worked in the field of healthcare environment design less than 2 years, 15 architects' work experience is between 2 and 5 years, and 38 architects have more than 5 year's work experience (QAA-2) (Figure 8.1). The "best data" from these expects allows to further explore experienced architects' preferences for the design strategies related to end-users' needs. Moreover, QAA-3 is designed to understand the quantity of community-based healthcare facilities that respondents have been involved in, and the answers are various, with a range from 1 to 50.

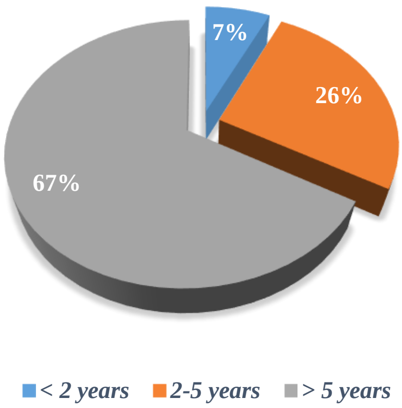

Figure 8.1 Respondents' work experience from Architect Group

8.3.2 Knowledge about Healthcare Environment Design (Section B)

Section B intends to understand architects' knowledge levels about healthcare environment design. Figure 8.2 demonstrates architects' preferences for information sources in the design decision-making process, including "building regulations from governments/local authorities", "past successful case study", "academic publications", "previous experience", "advisory opinions from consulting companies or academics", "post occupancy evaluation" and "design aided tools" (QAB-1). All these have been identified as useful information sources for architectural design (CHD 2015). These information sources are ranked as: "building regulations from governments/local authorities" (55 out of 57, 96.5%), "past successful case study" (49, 86.0%), "previous experience" (48, 84.2%), "academic publications" (40, 70.2%), "advisory opinions from consulting companies or academics" (34, 59.6%), "design aided tools" (15, 26.3%) and "post occupancy evaluation" (13, 22.8%). It can be seen that architects consider building regulations as the most important source, since building regulations set mandatory standards for the design and construction of built environments. Moreover, respondents do not pay proper attention to design aided tools, which accords with the argument "the research and application of design aided tools for healthcare buildings and environments in China are still limited" (Ban et al. 2016b, p.101).

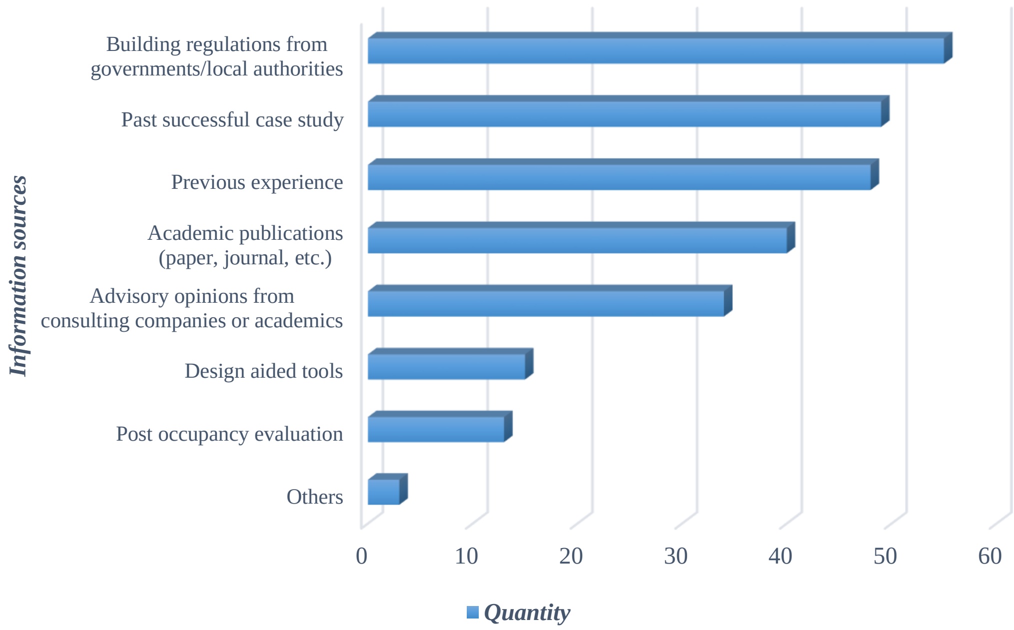

Figure 8.2 Ranks of information sources for the design decision-making from Architect Group

In terms of sustainability assessment methods for healthcare environments, the responses show that architects' knowledge levels are lower than expected. Of the respondents, 48 (84.2%) know about sustainability assessment methods (QAB-2). As shown in Figure 8.3, respondents evaluate their knowledge levels about prevailing sustainability assessment methods (i.e. *Evaluation Standard for Green Hospital Building* GB/T 51153, *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare*) based on the five-point Likert scale, from "very poor" to "very good" with interval variables. It is found that their knowledge level about GB/T 51153 (mean value 3.19, "neutral") is better than those of *BREEAM Healthcare 2008* (mean value 1.77, "very poor") and *LEED 2009 for Healthcare* (mean value 2.06, "poor"). It is important to note that, GB/T 51153 had been officially published (1st August 2016) only for one and half months before this survey (September 2016). *BREEAM Healthcare 2008* and *LEED 2009 for*

Healthcare were established separately in 2008 and 2009. It can be concluded that the "One Star" requirement gives architects more motives of studying GB/T 51153 for practice.

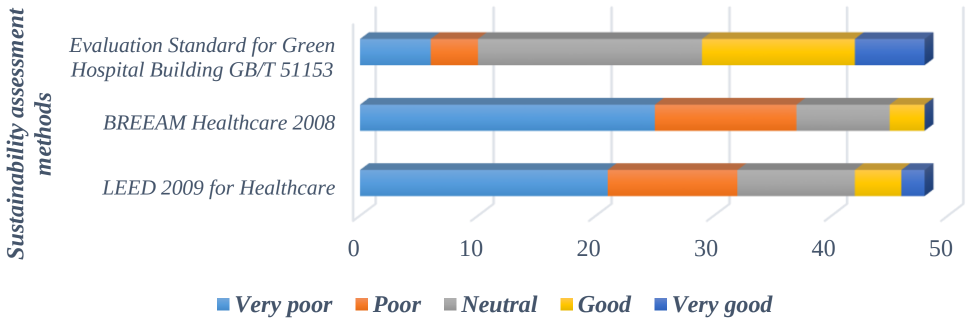

Figure 8.3 Knowledge about sustainability assessment methods from Architect Group

In terms of knowledge about evidence-based design, 32 respondents out of 57 (56.1%) choose "Yes" for QAB-3 "Do you know about evidence-based design?". They evaluate their knowledge level as "neutral" (mean value 3.06) based on the five-point Likert scale (Figure 8.4). Architects' knowledge level about this theory is lower than expected. Of these respondents, there are 1 architect with less than 2 year work experience, 9 with 2-5 years and 22 with more than 5 years (Figure 8.5). It can be inferred that long work experience may help architects have more knowledge about evidence-based design.

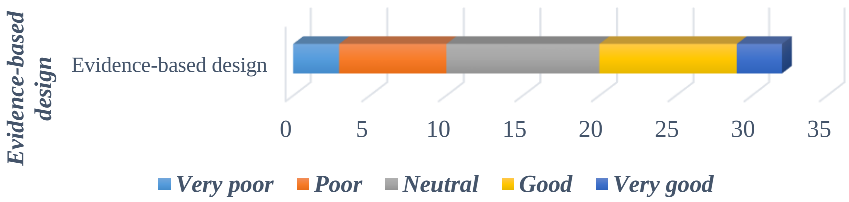

Figure 8.4 Knowledge about evidence-based design from Architect Group

Architects' knowledge levels about evidence-based design are further explored in this survey. Some options of healthcare outcomes (i.e. effects) do not draw proper attention from respondents (QAB-4) (Figure 8.6). It is important to note that the knowledge levels about evidence-based design from the respondents in "QAB-3: Yes" group are much higher than those of the respondents in "QAB-3: No" group. Therefore, it is believed that these architects with higher knowledge levels about evidence-based design may contribute more to the end-user centred participatory design and social sustainability of healthcare environments, with the consideration of relationship between healthcare environment design and end-users' health and well-being.

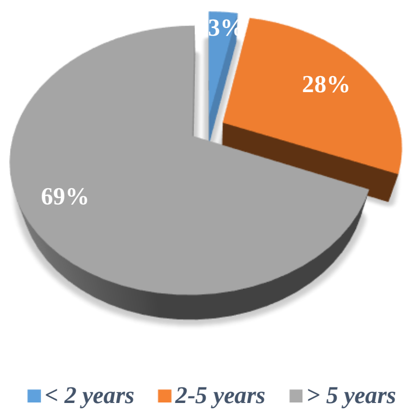

Figure 8.5 Respondents' work experience from the "QAB-3: Yes" group

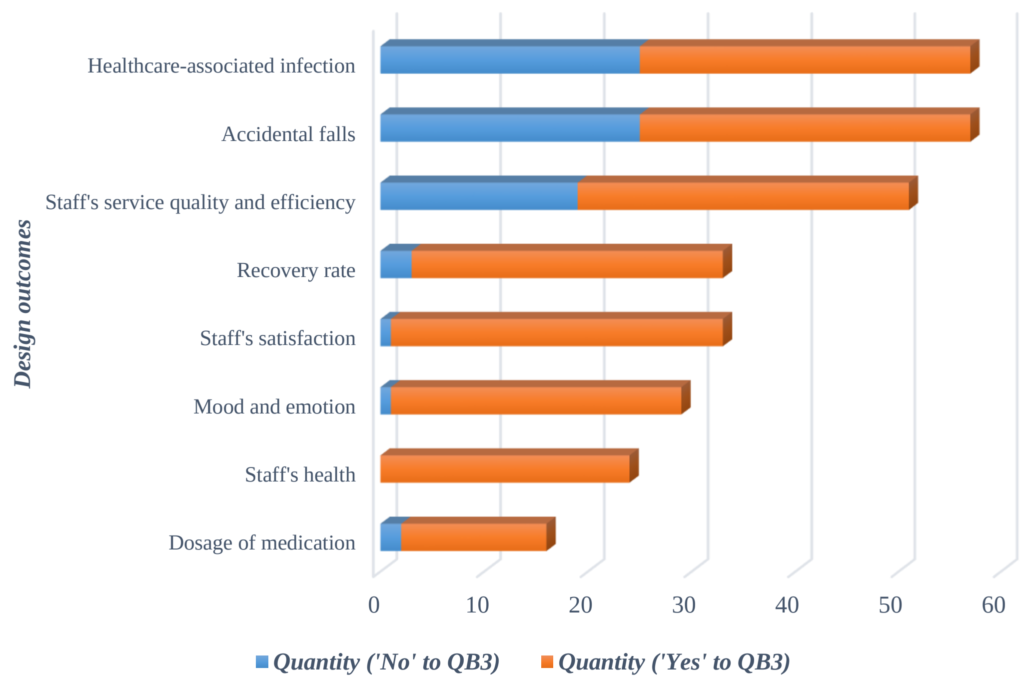

Figure 8.6 Knowledge about evidence-based design from Architect Group

8.3.3 Relative Importance of Design Strategies (Section C)

To explore architects' preferences for the design strategies related to end-users' needs for community-based healthcare environments, Section C is designed to allow respondents to evaluate the relative importance of these design strategies and then transfer their preferences into a measurable way (i.e. the five-point Likert scale with ordinal variables, from "not at all important" to "extremely important"; for more information, see Section 6.3.2). The aggregate results, which include median values and levels of relative importance, are illustrated in Figure 8.7 and Table 8.1.

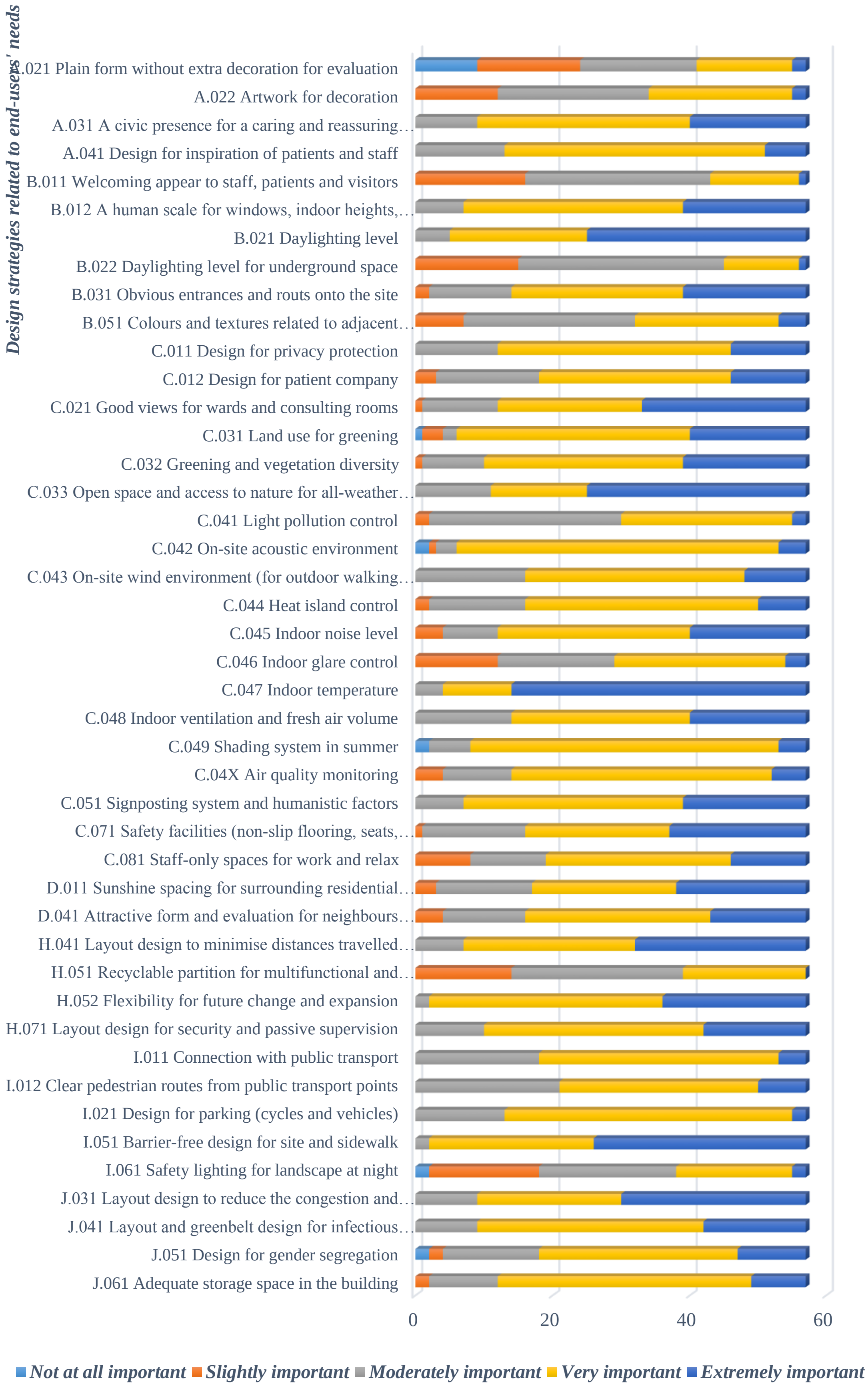

Figure 8.7 Relative importance of design strategies related to end-users' needs from Architect Group

Table 8.1 Relative importance (median values and levels of relative importance) of design strategies related to end-users' needs from Architect Group

Design strategy related to end-users' needs (44)		Architect		GB/T 51153		
		MV	L	PI	CSI	R
A.021	Plain form without extra decoration for elevation	3.0000	3	Yes	0	-
A.022	Artwork for decoration	3.0000	3	-	-	-
A.031	A civic presence for a caring and reassuring atmosphere	4.0000	4	-	-	-
A.041	Design for inspiration of patients and staff	4.0000	4	-	-	-
B.011	Welcoming appear to staff, patients and visitors	3.0000	3	-	-	-
B.012	A human scale for windows, indoor heights, doors and entrances	4.0000	4	-	-	-
B.021	Daylighting level	5.0000	5	No	2.5	3
B.022	Daylighting level for underground space	3.0000	3	No	2	5
B.031	Obvious entrances and routes onto the site	4.0000	4	-	-	-
B.051	Colours and textures related to adjacent buildings and environment	3.0000	3	-	-	-
C.011	Design for privacy protection	4.0000	4	-	-	-
C.012	Design for patient company	4.0000	4	-	-	-
C.021	Good views for wards and consulting rooms	4.0000	4	No	2	5
C.031	Land use for greening	4.0000	4	No	1.2	10
C.032	Greening and vegetation diversity	4.0000	4	No	0.9	14
C.033	Open space and access to nature for all-weather design	5.0000	5	No	1.25	9
C.041	Light pollution control	3.0000	3	No	0.6	17
C.042	On-site acoustic environment	4.0000	4	No	0.6	17
C.043	On-site wind environment (for outdoor walking in winter and ventilation in summer)	4.0000	4	No	1.2	10
C.044	Heat island control	4.0000	4	No	0.6	17
C.045	Indoor noise level	4.0000	4	Yes	5	1
C.046	Indoor glare control	3.0000	3	Yes	0	-
C.047	Indoor temperature	5.0000	5	Yes	2.5	3
C.048	Indoor ventilation and fresh air volume	4.0000	4	Yes	0	-
C.049	Shading system in summer	4.0000	4	No	2	5
C.04X	Air quality monitoring	4.0000	4	No	2.75	2
C.051	Signposting system and humanistic factors	4.0000	4	Yes	0	-
C.071	Safety facilities (non-slip flooring, seats, handrails and shelves) for bath/toilet	4.0000	4	-	-	-
C.081	Staff-only spaces for work and relax	4.0000	4	-	-	-
D.011	Sunshine spacing for surrounding residential buildings	4.0000	4	Yes	0	-
D.041	Attractive form and elevation for neighbours and passers-by	4.0000	4	-	-	-
H.041	Layout design to minimise distances travelled and lines crossed	4.0000	4	-	-	-
H.051	Recyclable partition for multifunctional and alterable rooms	3.0000	3	No	0.75	15
H.052	Flexibility for future change and expansion	4.0000	4	-	-	-
H.071	Layout design for security and passive supervision	4.0000	4	-	-	-
I.011	Connection with public transport	4.0000	4	No	1.05	12
I.012	Clear pedestrian routes from public transport points	4.0000	4	-	-	-
I.021	Design for parking (cycles and vehicles)	4.0000	4	No	0.75	15
I.051	Barrier-free design for site and sidewalk	5.0000	4	No	0.3	20
I.061	Safety lighting for landscape at night	3.0000	3	-	-	-
J.031	Layout design to reduce the congestion and circulation	4.0000	4	No	1.75	8
J.041	Layout and greenbelt design for infectious segregation	4.0000	4	No	1.05	12
J.051	Design for gender segregation	4.0000	4	-	-	-
J.061	Adequate storage space in the building	4.0000	4	-	-	-

Note: MV – median value; L – level of relative importance; PI – prerequisite item; CSI – credit of scoring items; R – rank.

All results in Table 8.1 show the relative importance of design strategies related to end-users' needs for community-based healthcare environments. Of these design strategies (44), 4 (9.1%) are defined as "extremely important" (L-5), 31 (70.5%) are defined as "very important" (L-4), and 9 (20.5%) are defined as "moderately important" (L-3). These results reflect architects' preferences for the design of community-based healthcare environments.

The comparison between the preferences of Architect Group and the evaluation content of GB/T 51153 is conducted. Both synergies and conflicts can be found. For synergies, there are 25 design strategies (56.8%) that are involved in GB/T51153, and 7 of them (A.021, C.045, C.046, C.047, C.048, C.051 and D.011) have prerequisite items. For conflicts, other 19 design strategies (43.2%) are overlooked by GB/T 51153. Most of them (15, 78.9%) are considered as "very important" (L-4) by Architect Group – for example, A.031, A.041, B.012, B.031, C.011, C.012, C.071, C.081, D.041, H.041, H.052, H.071, I.012, J.051 and J.061. In addition, two design strategies that have prerequisite items in GB/T 51153 receive relatively low values from Architect Group, including A.021 (L-3) and C.046 (L-3). Based on the comparison, it can be seen that architects' preferences for healthcare environment design at a community level are not as same as the requirements in legislation. Experienced architects have their own value judgements in healthcare environment design at a community level.

8.3.4 Knowledge about Healthcare Design Development (Section D)

Section D asks architects to define the factors that can improve or hinder the design quality of community-based healthcare environments currently, QAD-1 from a positive perspective and QAD-2 from a negative perspective (Figure 8.8 & 8.9). Their opinions on the development of healthcare environment design are explored.

As demonstrated in Figure 8.8, it is defined by respondents that the 3 top drivers of improving the design quality of community-based healthcare environments are "requirement of building regulations" (86.0%), "economic benefits" (70.2%) and "social requirement" (61.4%). The first two options can be viewed as the support from authorities, including polities and finance. For "social requirement", it reflects that architects have realised the importance of social sustainability in healthcare environment design.

With regard to barriers, respondents consider the 3 top factors that may hinder the design quality are "low public awareness" (50.9%), "lack of online research database" (45.6%) and "lack of awareness of environmental protection" (40.4%) (Figure 8.9). To some extent, the results mean that architects have potential desires to find a way of allowing them to communicate with end-users and integrating end-users' satisfaction and needs into their design work. It can be inferred that, in their sub-consciousness, they believe that the current public awareness for participation in healthcare environment design should be improved.

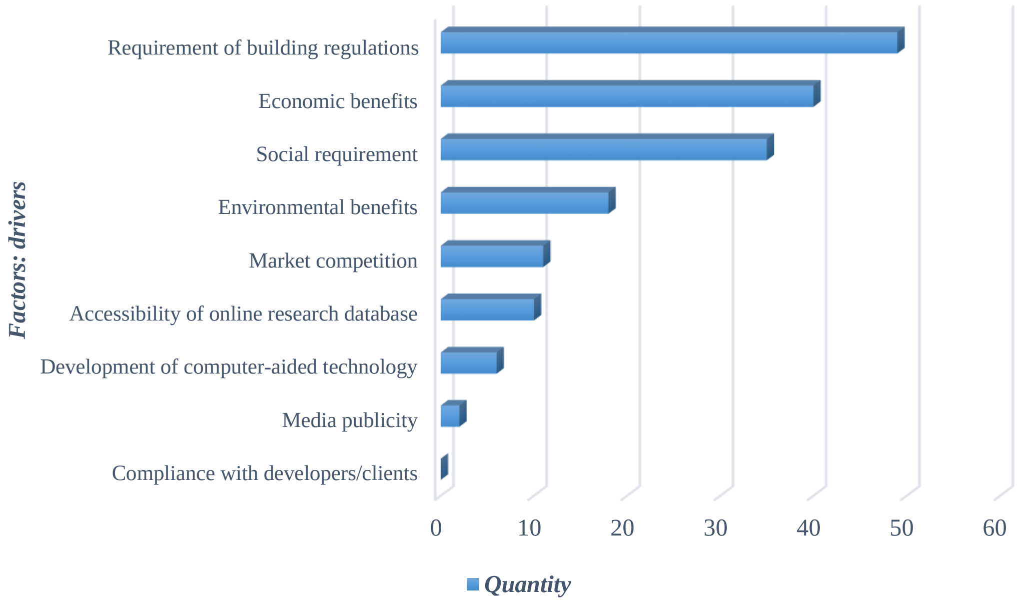

Figure 8.8 Drivers of improving the design quality of community-based healthcare environments

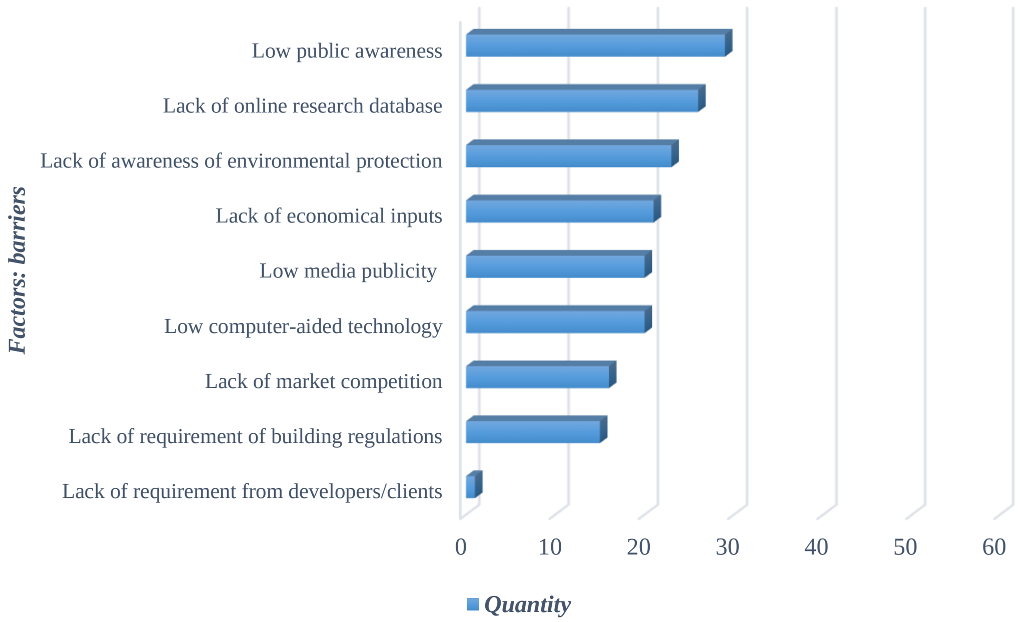

Figure 8.9 Barriers of hindering the design quality of community-based healthcare environments

In Figure 8.10, respondents indicate that the options "social responsibility" (77.2%), "direct communication with end-users" (77.2%), "career ethics" (71.9%), "awareness of environmental protection" (57.9%) and "ambition in market competition" (56.1%) are the top

5 choices that can help architects improve their skills of healthcare environment design (QAD-3). The results show that architects emphasise the social aspects from both subjective factors (e.g. responsibility for society and end-users) and objective ones (e.g. information for optimising design work from end-users). Moreover, the focus on "awareness of environmental protection" may encourage architects to apply eco-effective design strategies in practice more proactively.

Figure 8.10 Issues of improving the design skills of healthcare environments from an architect's perspective

8.3.5 Open-ended Questions (Section E)

Section E, with three open-ended questions, is designed for qualitative data collection. The first question attempts to explore the opinions on end-user centred principles for healthcare environments from an architect's perspective (QAE-1). Some representative responses are summarised as follows:

> S-A12 (with 15-year work experience in healthcare environment design): "…Healthcare environment design is more than just designing a building where healthcare service and medical treatments are supplied… It is not like designing a restaurant or supermarket. It is the important creative work that reflects **humanism**… Patients are the targets who architects create objectives and buildings for… End-user centred principles represent the next generation of healthcare environment design…"

S-A15 (with 23-year work experience in healthcare environment design): "…Architects should have unique techniques to understand patients and **what all patients need from healthcare environments**… Architects should know what strategies are good to improve the work efficiency of healthcare systems… The end-user centred principle is an advanced skill instead of a slogan…"

S-A19 (with 6-year work experience in healthcare environment design): "…Healthcare facilities are different from other types of buildings… For sustainability, architects should focus not only on energy-saving technologies and environmental protection, but also the people – **patients under bad situations**. It is different to define the importance between energy-saving and patients' well-being. The decisions of healthcare environment design are made based on **a series of trade-offs**…"

S-A31 (with 12-year work experience in healthcare environment design): "…I have studied **evidence-based design** for 5 years. It can be seen as **a principle of end-user centred design**… It (evidence-based design) cares about recovery, efficiency, mood, safety, anxiety and pressure… Therefore, end-user centred principles should emphasise patients' health, and create a healing and caring environment…"

S-A39 (with 9-year work experience in healthcare environment design): "…End-user centred principles are that architects know **the requirements of both patients and medical staff** about healthcare environments, and then use such information into their design work based on an integrated consideration… It is important to use end-users' needs to improve architects' design skills…"

S-A47 (with 3-year work experience in healthcare environment design): "…I think many architects may think end-user centred principles are about patients. But I pay more attentions to **doctors and nurses**… My design is not to make troubles but contributions for their work and efficiency... Design cannot **help patients recover faster**, but can help doctors **supply fast treatments**…"

S-A52 (with 1-year work experience in healthcare environment design): "…A good design should meet the **basic physical and psychological needs of end-users**… A reasonable healing environment should meet patients' basic needs and influence their recovery… In terms of medical staff, appropriate indoor environments will affect their working performance and emotions…"

Most of respondents express their opinions. They consider the "end-user centred" as an important principle for healthcare environment design from the perspectives of humanism and techniques. But some of them show different understanding:

> S-A07 (with 3-year work experience in healthcare environment design): "…The end-user centred principle for healthcare environments, for patients, is **a pseudo-proposition** in my opinion… Although architects learn something new and necessary from other people, such as doctors, nurses, engineers and assessors, we are the professionals. We know how to deal with the design of buildings. Patients or medical staff do not… I can improve my design skills based on their complaints, but the design should make trade-offs between many aspects… For doctors and nurses, the end-user centred principle is a **true-proposition**, as they are the masters of the buildings… But for patients, it (the end-user centred principle) is not…"

> S-A20 (with 10-year work experience in healthcare environment design): "…All domains emphasise end-user centred principles – for example, computer science, internet and service… But the end-user centred principle for healthcare environment design is different… It is special and complicated… **Communication between patients and architects** should be specially conducted for every project… Sometimes we are busy with work and forget what we work for…"

> S-A42 (with 1-year work experience in healthcare environment design): "…The **work efficiency of doctors and nurses** can be improved by improving the design quality of healthcare environments… I think this is the target of end-user centred principles…"

The qualitative responses reflect architects' opinions on end-user centred principles for the design of healthcare environments. It shows that some architects focus only on the benefits of patients, instead of medical staff. They understand the importance of meeting patients' needs in healthcare environment design. Some believe that architectural design can improve medical staff's work efficiency. In general, architects consider this principle as an important, effective theory that can improve the design quality of healthcare environments.

8.4 DISCUSSION AND FINDINGS

As stated earlier in Chapter 7, the appropriate sample size for correlational study is no less than 30, because "with large enough sample sizes (e.g. 30+), violation of the assumption should not cause any major problems" (Pallant 2005a, p.198). As the sample size of the Survey for Architect Group cannot accord with this standard, it is unable to conduct statistical analysis for quantitative data. Findings are mainly summarised from descriptive statistics, which explain architects' cognition, preferences and knowledge levels.

- ✧ **Architects' preferences for the design of community-based healthcare environments**

The preferences of architects for the design of community-based healthcare environments are identified. Based on the aggregated results, the relative importance of design strategies is calculated by using the five-point Likert scale, and architects' preferences are transferred into a measurable way (i.e. median values) (see Table 8.1). Of all design strategies that are related to end-users' needs for community-based healthcare environments (44), there are 4 design strategies (9.1%) at the level of "extremely important" (Level 5), 31 (70.5%) at the level of "very important" (Level 4) and 9 (20.5%) at the level of "moderately important" (Figure 8.11). It is found that architects pay attention not only to people's needs, but also **environmental aspects** and **values about architecture itself**. They try to find a relative balance between the social and environmental aspects.

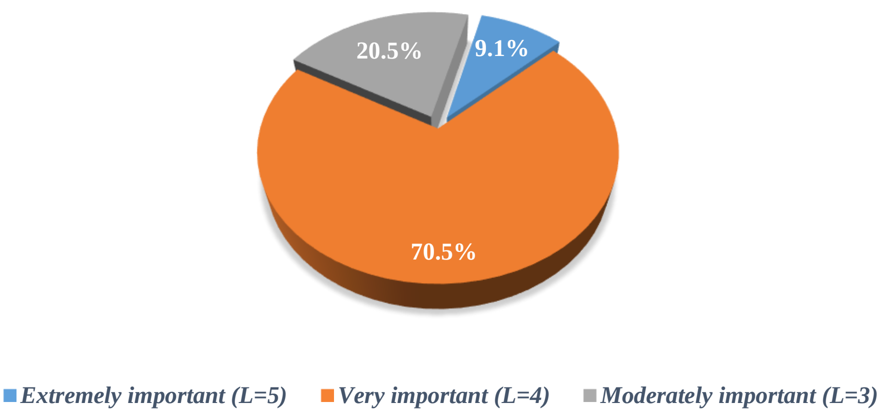

Figure 8.11 Design strategies at different levels of relative impotence from Architect Group

- ✧ **Architects' cognition and knowledge about healthcare environment design at a community level**

In this survey, architects considered building regulations as the most important information source for their design decision-making, because some building regulations set mandatory standards for the design and construction of buildings. Therefore, the development of relevant building regulations may be the most effective approach of guiding architects' cognition and improving their skills of healthcare environment design. However, according to the survey results, it is found that architects' knowledge levels about prevailing sustainability assessment methods for healthcare environments were insufficient (GB/T 51153 as "neutral"; *BREEAM*

Healthcare 2008 as “very poor”; and *LEED 2009 for Healthcare* as “poor”). In addition, as an important theory in healthcare environment design, evidence-based design did not draw proper attention from architects. Respondents evaluated their knowledge levels about evidence-based design as “neutral”. Based on the response analysis, architects cannot fully understand the links between healthcare environment design and healthcare outcomes (e.g. patients’ recovery rates, dosage of medicine and staff’s work efficiency). Therefore, **learning approaches** should be enhanced to help architects acquire sufficient knowledge about evidence-based design and facilitate the knowledge exchange between different stakeholders.

Moreover, from an architect’s perspective, the 3 top divers that can improve the design quality of community-based healthcare environments are “requirement of building regulations”, “economic benefits” and “social requirement”; while the 3 top barriers of hindering the design quality are “low public awareness”, “lack of online research database” and “lack of awareness of environmental protection”. Based on these findings, it can be seen that architects have been aware of the importance of social aspects of healthcare environments.

To obtain the “best data” from “expects” of community-based healthcare environment design, the recruitment standards for Architect Group were set up as “related work experience”. The strict standard led to a situation that there were only 57 usable responses. The sample size was not appropriate for statistical analysis. The cognitive differences within architects could not be explored. The ideal situation was to have enough respondents (30+ for each subgroup) to explore their cognitive consensus and variables that may lead to priority variances of strategies. It can be seen as a research limitation, which may affect the survey validity to some extent and, should be fixed in the future work.

- ✧ **Differences between architects’ preferences and the requirements in legislation**

There are obvious differences between architects’ preferences and the evaluation content of GB/T 51153. It was relatively easy for design strategies about indoor environment control (e.g. lighting, air, noise and energy) to receive high credits in GB/T 51153, but architects paid more attention to design details related to efficiency and humanity (e.g. barrier-free design and a human scale). Some design strategies that had corresponding prerequisite items in GB/T 51153 were not evaluated highly by Architect Group. On one hand, the application period of GB/T 51153 was relatively short (one and a half months before the Survey for Architect Group) and some architects were not familiar with this sustainability assessment method. On the other hand, the assessment scope of GB/T 51153 was not clear (i.e. a mixed use for all kinds of healthcare buildings with identical standards of all design items).

Some design strategies that receive attention from architects are not included in GB/T 51153, such as “H.052 flexibility for future change and expansion” (L-4), “H.041 layout design to minimise distances travelled and lines crossed” (L-4), “B.012 a human scale for windows, indoor heights, doors and entrances” (L-4), “A.031 a civic presence for a caring and reassuring atmosphere” (L-4), “H.071 layout design for security and passive supervision” (L-4), “C.071 safety facilities (non-slip flooring, seats, handrails and shelves) for bath/toilet” (L-4) and “B.031 obvious entrances and routes onto the site” (L-4). Long work experience enhances the observation of these experienced architects and gives them a comprehensive understanding of community-based healthcare environment design. These design strategies can be seen as those which are important not only to end-users, but also architects. Moreover, this information may be used to improve the assessment flexibility of GB/T 51153 for different types of healthcare buildings and environments.

8.5 CHAPTER SUMMARY

This chapter describes the response analysis from Architect Group. Both quantitative and qualitative data was collected in the survey, from a group of experienced architects. A strict standard for respondent recruitment selected 57 “experts”, who had relevant work experience in the design of community-based healthcare environments. Based on the response analysis, a comprehensive understanding of architects’ preferences for healthcare environment design at a community level has been achieved.

Design strategies related to end-users’ needs were categorised in order, based on the relative importance (i.e. median values calculated by the five-point Likert scale) (see Figure 8.7 & Table 8.1). According to the analysis, it was found that some cognitive conflicts existed between architects’ understanding and the requirements of GB/T 51153 in the design of community-based healthcare environments. Some design strategies that had corresponding design items with high credits in GB/T 51153 – for example, “C.049 shading system in summer” (credit 2), “C.04X air quality monitoring” (credit 2.75) and “B.022 daylighting level for underground space” (credit 2), were low-evaluated by architects. Some design strategies that had corresponding prerequisite items (e.g. “C.046 indoor glare control” and “A.021 plain form without extra decoration for elevation”) in GB/T 51153 were ranked at the level of “moderately important” by architects.

Some drivers and barriers that might affect the design quality of community-based healthcare environments were summarised. It could be found that public participation was considered as an effective driver of achieving excellence of healthcare environment design. Moreover, based on the cumulative feedback, the top barrier that hindered the design quality was “low public awareness”. Therefore, using end-user centred participatory design principles is an appropriate approach of improving public awareness and eliminating barriers. Moreover, in terms of issues that could improve architects’ design skills, respondents selected “social responsibility”, “direct communication with end-users” and “career ethics” as the 3 top ones. On one hand, it reflects that architects have been aware of the importance of end-user centred principles for the design of healthcare environments; on the other hand, the approaches that can facilitate communication and knowledge exchange should be further enhanced in the near future.

The surveys that explored the understanding of target groups (i.e. Patient Group, Staff Group and Architect Group) were described in Chapter 6 ~ 8. To further identify the cognitive differences between these stakeholder groups, the relative importance (i.e. median values) of design issues and design strategies will be cross-compared. The findings achieved from the comparisons are discussed in the next chapter.

The grand aim of science is to cover the greatest number of experimental facts by logical deduction from the smallest number of hypotheses or axioms. *– Albert Einstein*

9

Cross-comparative Study and Follow-up Focus Group

9.1 CHAPTER INTRODUCTION

The preferences of stakeholders for healthcare environment design at a community level have been explored based on the response analysis from Patient Group (Chapter 6), Staff Group (Chapter 7) and Architect Group (Chapter 8). Cognitive differences within each target group were identified. This chapter describes the cross-comparative studies, which further explore the issues that can lead to cognitive differences between target groups statistically. For this purpose, a follow-up focus group is conducted to shed an in-depth insight into the priority variances between patients and medical staff regarding the needs for community-based healthcare environments. Moreover, this chapter also discusses the findings that can be used to modify GB/T 51153 with its capacity of addressing social concerns in the sustainability assessment process for community-based healthcare environments.

9.2 CROSS-COMPARATIVE STUDIES OF TARGET GROUPS

According to the response analysis from target groups, it was found that various personal background (e.g. genders, ages and work experience) would result in cognitive differences in some environmental needs within an identical stakeholder group. To achieve a comprehensive understanding of end-users' needs for community-based healthcare environments, it is necessary to further explore the significant cognitive differences between patients and medical staff. Their preferences (i.e. relative importance) for the design issues related to end-users' needs are cross-compared. It is important to note that, in the cross-comparative studies, statistical methods are applied for the comparison between Patient Group and Staff Group, since their opinions on healthcare environment design at a community level have been collected against an identical standard (i.e. design issues – outcomes of design strategies) in the surveys. The comparisons about the relative importance of design strategies between End-user Groups (i.e. Patient Group and Staff Group) and Architect Group are conducted in a different way, mainly based on the levels of relative importance.

9.2.1 Comparison between Patient Group and Staff Group

The results of cross-comparative study between Patient Group and Staff Group can lead to a comprehensive understanding of end-users' significant cognitive differences in their needs for community-based healthcare environments. The information can be used to find their priority variances and thereby inform healthcare environment design at a community level in order to meet end-users' needs from a holistic perspective. In the comparison, the relative importance (i.e. median values) of design issues and knowledge levels about healthcare environment design at a community level are analysed in detail, using statistical methods on the basis of SPSS.

- ✧ **Cognitive Differences in the Relative Importance of Design Issues related to End-users' Needs for Community-based Healthcare Environments**

As shown in Table 9.1, the median values and levels of relative importance of design issues related to end-users' needs are compared between Patient Group and Staff Group, in order to identify their cognitive differences in the preferences for healthcare environment design at a community level. The median values are compared, on the evaluation of relative importance of design issues between Patient Group and Staff Group. The normality of data distribution is tested first. The significant results in Shapiro-Wilk (SPSS: *Analyse – Descriptive Statistics – Explore*) show that the data is not normally distributed. The results of the nonparametric technique Mann-Whitney U Test (SPSS: *Analyse – Non-parametric Tests – 2 Independent Samples*) are therefore taken into account (Table 9.2). It shows that the significant cognitive differences between Patient Group and Staff Group concentrate on 10 design issues out of 27 (37.0%): A.02 ("interesting look"), B.05 ("attractive colours and textures"), C.03 ("access to outdoors"), C.07 ("safety facilities"), C.08 ("staff-only places"), D.01 ("height, volume and skyline of the building"), H.04 ("workflows and logistics"), I.02 ("parking"), J.03 ("minimised circulation distance") and J.06 ("storage space") (highlighted in Table 9.2). The alternative statistical technique – parametric technique Independent-samples t-test (SPSS: *Analyse – Compare Means – Independent Samples T-test*) is also used in parallel. The results of both techniques are very alike, which further verifies the results from the nonparametric technique.

Table 9.1 Comparison between preferences for design issues from Patient Group and Staff Group

	Design issue related to end-users' needs (27)	**Patient**		**Staff**	
		MV	R	MV	R
A.02	The building is interesting to look at and move around in.	3.0000	3	3.0000	3
A.03	The building projects a caring and reassuring atmosphere.	4.0000	4	4.0000	4
A.04	The building appropriately expresses the values of the health service.	4.0000	4	4.0000	4
B.01	The building has a human scale and feels welcome.	4.0000	4	4.0000	4
B.02	The building is well orientated on the site.	4.0000	4	4.0000	4
B.03	Entrances are obvious and logically positioned in relation to likely points of arrival on site.	4.0000	4	4.0000	4
B.05	The external colours and textures seem appropriate and attractive.	3.0000	3	4.0000	4
C.01	The building respects the dignity of patients and allows for appropriate levels of privacy and company.	5.0000	5	5.0000	5
C.02	There are good views inside and out of the building.	3.0000	3	3.0000	3
C.03	Patients and staff have good easy access to outdoors.	4.0000	4	3.0000	3
C.04	There are high levels both of comfort and control of comfort.	4.0000	4	4.0000	4
C.05	The building is clearly understandable.	4.0000	4	4.0000	4
C.07	There are good bath/toilet and safety facilities for patients.	4.0000	4	4.0000	4
C.08	There are good facilities for staff including convenient places to work and relax without being on demand.	4.0000	4	4.0000	4
D.01	The height, volume and skyline of the building relate well to the surrounding environment.	3.0000	3	4.0000	4
D.04	The building is sensitive to neighbours and passers-by.	4.0000	4	4.0000	4
H.04	Workflows and logistics are arranged optimally.	4.0000	4	4.0000	4
H.05	The building is sufficiently adaptable to respond to change and to enable expansion.	4.0000	4	4.0000	4
H.07	The layout facilitates both security and supervision.	4.0000	4	4.0000	4
I.01	There is good access from available public transport including any on-site roads.	4.0000	4	4.0000	4
I.02	There is adequate parking for visitors and staff cars with appropriate provision for disabled people.	4.0000	4	4.0000	4
I.05	Pedestrian access routes are obvious, pleasant and suitable for wheelchair users and people with other disabilities/impaired.	4.0000	4	4.0000	4
I.06	Outdoor spaces are provided with appropriate and safe lighting indicating paths, ramps and steps.	4.0000	4	4.0000	4
J.03	The circulation distances travelled by staff, patients and visitors are minimised by the layout.	4.0000	4	4.0000	4
J.04	Any necessary isolation and segregation of spaces is achieved.	4.0000	4	4.0000	4
J.05	The design makes appropriate provision for gender segregation.	4.0000	4	4.0000	4
J.06	There is adequate storage space.	3.0000	3	4.0000	4

Note: MV – median value; L – level of relative importance.

Table 9.2 Test statistics [a] – (Group * Relative Importance)

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
A.02	23309.000	174834.000	-4.675	.000**
A.03	28896.000	35451.000	-1.473	.141
A.04	28362.000	179887.000	-1.770	.077
B.01	29828.000	181353.000	-.914	.360
B.02	29302.000	180827.000	-1.209	.227
B.03	28317.000	179842.000	-1.737	.082
B.05	26879.000	178404.000	-2.539	.011*
C.01	30910.000	182435.000	-.268	.789
C.02	30535.000	37090.000	-.476	.634
C.03	27502.000	34057.000	-2.249	.025*
C.04	28701.000	35256.000	-1.599	.110
C.05	29876.000	181401.000	-.854	.393
C.07	26659.000	178184.000	-2.792	.005**
C.08	24609.000	176134.000	-3.884	.000**
D.01	22775.000	174300.000	-4.844	.000**
D.04	29911.000	36466.000	-.837	.402
H.04	27502.000	34057.000	-2.249	.027*
H.05	31065.000	182590.000	-.163	.870
H.07	31178.000	37733.000	-.100	.920
I.01	27371.000	33926.000	-2.311	.051
I.02	26895.000	178420.000	-2.595	.009**
I.05	31230.000	37785.000	-.070	.945
I.06	28035.000	34590.000	-1.942	.052
J.03	26391.000	32946.000	-2.909	.004**
J.04	30716.000	37271.000	-.370	.712
J.05	28146.000	17967.000	-1.841	.066
J.06	23309.000	194834.000	-4.975	.000**

[a.] Grouping Variable: Group

Table 9.3 Effect size of significant differences – (Group * Relative Importance)

	Issue	r	Issue	r	Issue	r	Issue	r
Group	A.02	-0.41	B.05	-0.29	C.03	-0.21	C.07	-0.18
	C.08	-0.29	D.01	-0.42	H.04	-0.18	I.02	-0.22
	J.03	-0.15	J.06	-0.49				

The results of Mann-Whitney U Test are taken into account as findings. Of these design issues with significant differences between Patient Group and Staff Group, A.02, C.07, C.08, D.01, I.02, J.03 and J.06 have the significant differences of evaluation at the $p<.01$ level (Asymp. Sig. (2-tailed) value less than 0.01), while B.05, C.03 and H.04 have the significant differences at the $p<.05$ level (Asymp. Sig. (2-tailed) value less than 0.05). The effect size of the significant differences identified is calculated based on Z-score (the effect size statistics for Mann-Whitney U Test) (Table 9.3). It shows that the significant differences of A.02 ($r = 0.41$), D.01 ($r = 0.42$) and J.06 ($r = 0.49$) are close to a large effect ($r = .05$), which means the effects account for approximate 25% of the total variance. Moreover, the effects of significant differences of other design issues are between .01 (a small effect) and .03 (a medium effect). These effects account from 1% to 9% of the total variance. The statistical analysis verifies the hypothesis that **a complete consensus on healthcare environment design at a community level cannot be reached between patients and medical staff**. As stated earlier in the semi-structured interview, the design issues H.04 and J.06 were not chosen by the interviewees of patients. It means that patients did not believe these design issues could contribute to their needs for community-based healthcare environments. The results of statistical analysis further indicate that these two design issues do not draw proper attention from patients.

Based on the relationship between the design issues and design strategies in the *Conceptual Framework for Healthcare Environment Design*, the priority variances regarding the design of community-based healthcare environments between patients and medical staff may exist in the design strategies as follows:

- A.021 Plain form without extra decoration for elevation;
- A.022 Artwork for decoration;
- B.051 Colours and textures related to adjacent buildings and environment;
- C.031 Land use for greening;
- C.032 Greening and vegetation diversity;
- C.033 Open space and access to nature for all-weather design;
- C.071 Safety facilities (non-slip flooring, seats, handrails and shelves) for bath/toilet;
- C.081 Staff-only spaces for work and relax;
- D.011 Sunshine spacing for surrounding residential buildings;
- H.041 Layout design to minimise distances travelled and lines crossed;
- I.021 Design for parking (cycles and vehicles);
- J.031 Layout design to reduce the congestion and circulation; and
- J.061 Adequate storage space in the building.

All results achieved in the statistical analysis can be used by architects to further explore the priority variances between patients and medical staff. The statistical analysis also shows that both patients and medical staff focus on **patients' dignity** (e.g. privacy and company), **high-level indoor comfort**, **circulation convenience**, **a caring and reassuring atmosphere**, **decoration** and **efficiency of healthcare service**. These design strategies emphasise patients' benefits, which reflects medical staff's career responsibility and humanistic concerns.

✧ Cognitive Differences in the Approaches of Acquiring Knowledge about Healthcare Environment Design

In terms of the approaches that can help end-users acquire knowledge about healthcare environment design, Table 9.4 shows that huge cognitive differences occur between Patient Group and Staff Group. Based on the results calculated by chi-square test for independence (SPSS: *Analyse – Descriptive Statistics – Crosstabs*), it is found that significant association exists in almost all approaches (Asymp. Sig. (2-sided) values in Pearson Chi-Square less than .01), except the "visit and direct observation" (highlighted in Table 9.4). It shows that patients would like to acquire knowledge about healthcare environment design from "internet" (61.6%, R-1), "TV media" (58.5%, R-2) and "information shared by friends/relatives/neighbours" (53.5%, R-3). However, almost all medical staff of community-based healthcare facilities believes that "brochures from healthcare facilities" (96.5%, R-1) should be the first choice. "TV media" (82.5%, R-2) and "newspaper" (81.6%, R-3) are also favoured by medical staff. The findings can be used to enhance the learning channels of knowledge about healthcare environment design at a community level for residents in SIP.

Table 9.4 Comparison of approaches of acquiring knowledge about healthcare environment design

Approach	Patient		Staff		Rank variance
	%	Rank	%	Rank	
Newspaper	44.9%	5	81.6%	3	2
Brochures from healthcare facilities	52.0%	4	96.5%	1	3
TV media	58.5%	2	82.5%	2	0
Internet	61.6%	1	74.6%	4	3
Information from friends/relatives/neighbours	53.5%	3	71.1%	5	2
Visit and direct observation	37.1%	6	43.1%	6	0

✧ Cognitive Differences in the Knowledge about Evidence-based Design

As shown in Table 9.5, Staff Group's knowledge levels about evidence-based design are much better than Patient Group's. Significant cognitive differences are identified, according to the results of chi-square test for independence. It is found that patients and medical staff have different knowledge levels (Asymp. Sig. (2-sided) values in Pearson Chi-Square less than .01) in "healthcare-associated infection" (Patient Group: 50.4%, R-4; Staff Group: 97.4%, R-1), "accidental falls" (Patient Group: 39.3%, R-6; Staff Group: 82.5%, R-2), "mood and emotion" (Patient Group: 62.0%, R-2; Staff Group: 79.8%, R-4), "staff's health" (Patient Group: 39.3%, R-6; Staff Group: 80.7%, R-3) and "staff's satisfaction" (Patient Group: 53.1%, R-3; Staff Group: 66.7%, R-6) (highlighted in Table 9.5). Other options (i.e. "recovery rate", "dosage of medication" and "staff's service quality and efficiency") do not cause significant association statistically. These differences may lead to conflicts between patients and medical staff in the cognition about the design strategies that can contribute to these outcomes.

Table 9.5 Comparison of knowledge about evidence-based design

Design outcome	Patient		Staff		Rank variance
	%	Rank	%	Rank	
Healthcare-associated infection	50.4%	4	97.4%	1	3
Recovery rate	50.4%	4	58.8%	7	3
Dosage of medication	24.7%	8	33.3%	8	0
Accidental falls	39.3%	6	82.5%	2	4
Mood and emotion	62.0%	2	79.8%	4	2
Staff's health	39.3%	6	80.7%	3	3
Staff's service quality and efficiency	73.6%	1	71.9%	5	4
Staff's satisfaction	53.1%	3	66.7%	6	3

✧ Summary and Discussion

In the comparison between Patient Group and Staff Group, the cognitive differences in the needs for community-based healthcare environments, approaches of acquiring knowledge about healthcare environment design and knowledge levels about evidence-based design are identified. Based on the aggregated results, the Research Question 2 can be answered – **a complete consensus on good community-based healthcare environment design within end-user groups is unlikely to be reached in the near future**. Patients and medical staff showed different preferences for some design issues in the *Conceptual Framework for Healthcare Environment Design*. Based on statistical results, the priority variances of their needs for community-based healthcare environments are mainly focused on **building images** (i.e. "interesting look", "attractive colours and textures" and "height, volume and skyline of the building"), **space allocation** (i.e. "access to outdoors", "staff-only places", "parking" and "storage space"), **safety** (i.e. "safety facilities") and **circulation organisations** (i.e. "workflows and logistics" and "minimised circulation distances").

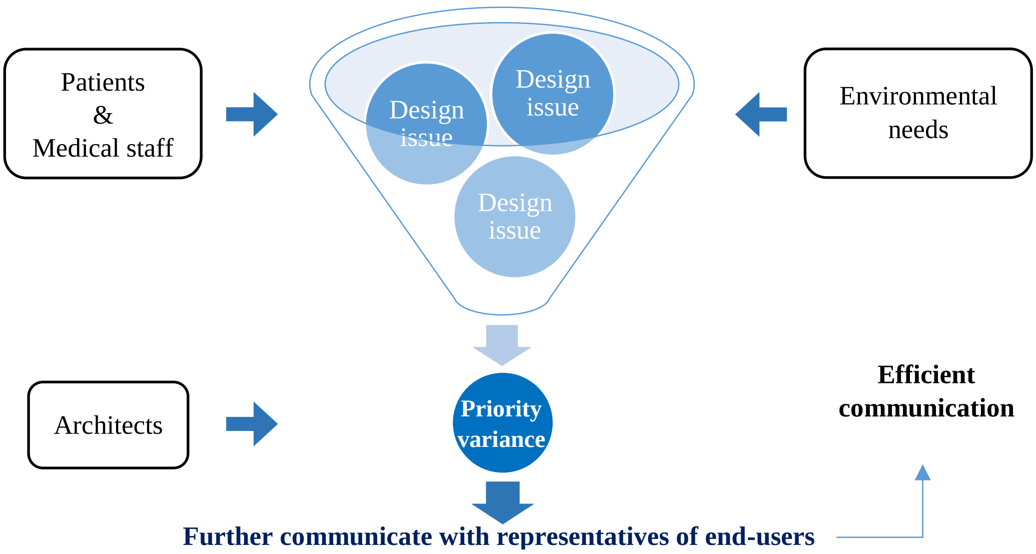

Figure 9.1 Communication based on the priority variances identified in this study

As stated earlier in Chapter 2, it is necessary for architects to understand the priority variances between different stakeholder groups in the design process. In this study, the findings about the design strategies with cognitive differences between patients and medical staff can be generalised beyond the cases. For those design strategies without significant differences, architects can understand the preferences of end-users and choose appropriate design strategies with little fear of resulting in conflicts of environmental needs between patients and medical staff. In terms of those priority variances identified in this study, architects can further communicate with the representatives of patients and medical staff, in order to gain an in-depth insight into these variances and thereby improve the holistic satisfaction of end-users with community-based healthcare environments in good trade-offs in the decision-making process (Figure 9.1). Architects' **workload about finding these priority variances** can be reduced in practice. As stakeholders have targets to discuss, the efficiency of end-users' participation in community-based healthcare environment design can be improved.

Moreover, it is necessary to enhance the learning channels for the public in the process of primary care delivery. General knowledge about evidence-based design can help end-users understand healthcare environments and the impacts upon the needs of themselves in a better way. In this study, it is found that medical staff has better knowledge levels about evidence-based design (e.g. accidental falls, mood and emotion, staff's health, and staff's satisfaction). It can be inferred that long experience of providing healthcare service enhances the knowledge levels of medical staff regarding the relationship between healthcare environment design and patients' recovery, mental health and well-being. In addition, the approaches of knowledge acquisition should be considered according to stakeholders' preferences and characteristics (e.g. cognitive abilities and personal background).

9.2.2 Comparison between End-user Groups and Architect Group

The cross-comparative study between the preferences of End-user Groups (i.e. Patient Group and Staff Group) and Architect Group explores the cognitive differences between stakeholders with less specialist knowledge in the built environment (e.g. patients and medical staff) and design professionals (e.g. architects). It intends to identify the design strategies that draw attention only from patients and medical staff and be neglected by architects in healthcare environment design at a community level. The analysis focuses on the differences of levels of relative importance and knowledge about evidence-based design.

- ✧ **Cognitive Differences in the Relative Importance of Design Strategies related to End-users' Needs for Community-based Healthcare Environments**

In the filed investigations, End-user Groups and Architect Group used different evaluation criteria, design issues (i.e. outcomes of design strategies) for end-user respondents (i.e. patients and medical staff) and design strategies (i.e. inputs of design strategies) for respondents from Architect Group. It is important to note that some design issues can be achieved through several design strategies in the *Conceptual Framework for Healthcare Environment Design*. For example, the design issue "C.04 there are high levels both comfort and control of comfort" (Patient Group: L-4; Staff Group: L-4) has 10 corresponding design strategies that are evaluated with different levels of relative importance (i.e. median values) by architects:

- C.041 Light pollution control (L-3, "moderately important");

- C.042 On-site acoustic environment (L-4, “very important”);
- C.043 On-site wind environment (outdoor walking in winter / ventilation in summer) (L-4, “very important”);
- C.044 Heat island control (L-4, “very important”);
- C.045 Indoor noise level (L-4, “very important”);
- C.046 Indoor glare control (L-3, “moderately important”);
- C.047 Indoor temperature (L-5, “extremely important”);
- C.048 Indoor ventilation and fresh air volume (L-4, “very important”);
- C.049 Shading system in summer (L-4, “very important”); and
- C.04X Air quality monitoring (L-4, “very important”).

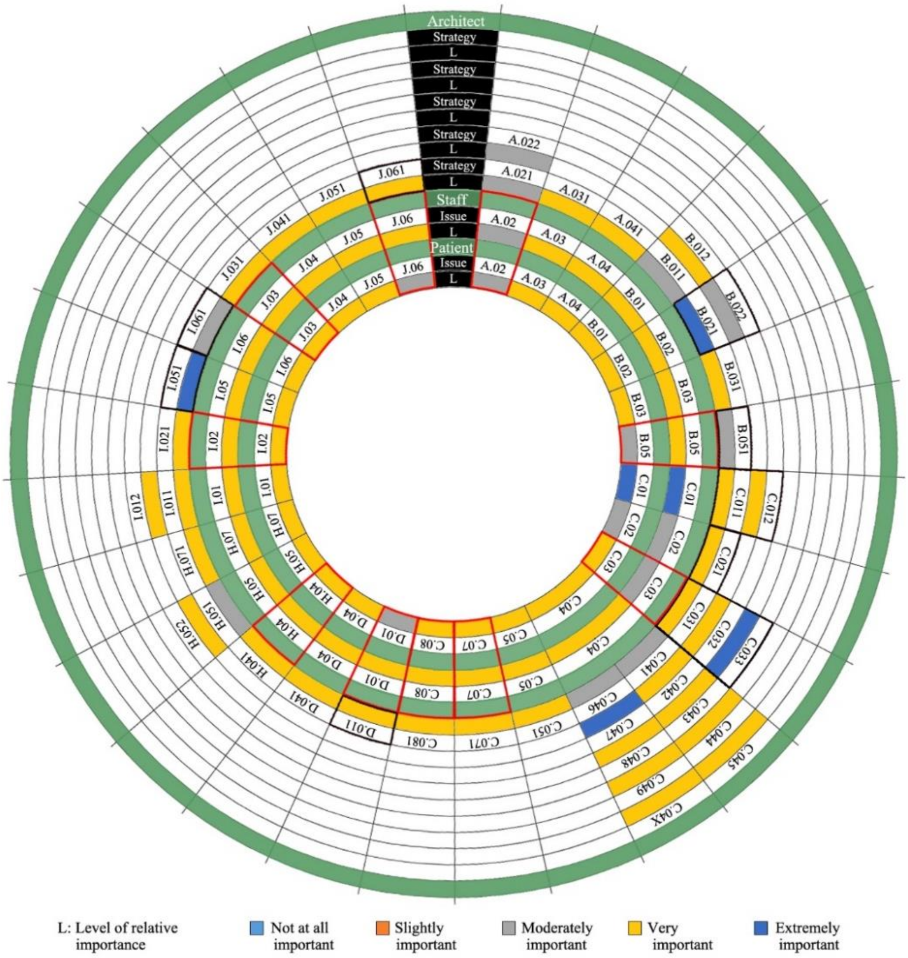

Figure 9.2 Comparison of the levels of relative importance between End-user Groups and Architect Group (*Note: red borders highlight the design issues with significant differences between Patient Group and Staff Group based on statistical analysis; black borders highlight the design strategies with cognitive differences between End-user Groups and Architect Group based on the levels of relative importance*)

For this “one-to-many” situation, it is unable to directly use statistical methods for cross-comparisons. Nevertheless, respondents use the same rating scale – the five-point Likert scale.

Their rating scale is identical, which provides a possibility of conducting a cross-comparative study by using the median values (i.e. levels of relative importance) of design issues and relevant design strategies. Based on the levels of their relative importance in Figure 9.2, obvious cognitive differences between End-user Groups (i.e. Patient Group and Staff Group) and Architect Group can be found in 9 design issues out of 27 (33.3%) (Table 9.6):

- B.02 The building is well orientated on the site;
- B.05 The external colours and textures seem appropriate and attractive;
- C.01 The building respects the dignity of patients and allows for appropriate levels of privacy and company;
- C.02 There are good views inside and out of the building;
- C.03 Patients and staff have good easy access to outdoors;
- D.01 The height, volume and skyline of the building relate well to the surrounding environment;
- I.05 Pedestrian access routes are obvious, pleasant and suitable for wheelchair users and people with other disabilities/impaired sight;
- I.06 Outdoor spaces are provided with appropriate and safe lighting indicating paths, ramps and steps;
- J.06 There is adequate storage space.

Table 9.6 Comparison of levels of relative importance between End-user Groups and Architect Group

Design issue (9)	Patient Group		Staff Group		Design strategy (13)	Architect Group	
	MV	L	MV	L		MV	L
B.02	4.0000	4	4.0000	4	B.021	5.0000	5
					B.022	3.0000	3
B.05	3.0000	3	4.0000	4	B.051	3.0000	3
C.01	5.0000	5	5.0000	5	C.011	4.0000	4
					C.012	4.0000	4
C.02	3.0000	3	3.0000	3	C.021	4.0000	4
C.03	4.0000	4	3.0000	3	C.031	4.0000	4
					C.032	4.0000	4
					C.033	5.0000	5
D.01	3.0000	3	4.0000	4	D.011	4.0000	4
I.05	4.0000	4	4.0000	4	I.051	5.0000	5
I.06	4.0000	4	4.0000	4	I.061	3.0000	3
J.06	3.0000	3	4.0000	4	J.061	4.0000	4

Note: RI – relative importance; MV – mean value; R – rank; VI – Very important; MI – Moderately important.

Of these design issues, B.02, C.01, C.02, D.01, I.05, I.06 and J.06 are evaluated by Patient Group and Architect Group into different levels of relative importance, while B.02, B.05, C.01, C.02, C.03, I.05 and I.06 are evaluated into different levels of relative importance by Staff Group and Architect Group. These results can be used to identify the information that may cause cognitive differences between stakeholders with less specialist knowledge in the built environment and design professionals. It is found that experienced architects' evaluation of healthcare environment design at a community level is different from the needs of end-users. They have different preferences for some design strategies related to end-users' needs. End-users focus on the design related to their own benefits, but architects also pay attention to **environmental aspects** (e.g. energy consumption, material saving and land use) and **values about architecture itself** (e.g. building forms, layouts, facades, space, local culture, impacts upon surrounding areas, future change and expansion).

✧ Cognitive Differences in the Knowledge about Evidence-based Design

Different from the comparison of preferences for design strategies, the knowledge levels about evidence-based design between End-user Groups and Architect Group can be compared based on the statistical method – chi-square test in pairs. In Figure 9.3, Table 9.7 and Table 9.8, it shows that the knowledge levels about the outcomes of evidence-based design are similar between Staff Group and Architect Group, both of which are better than Patient Group's as expected.

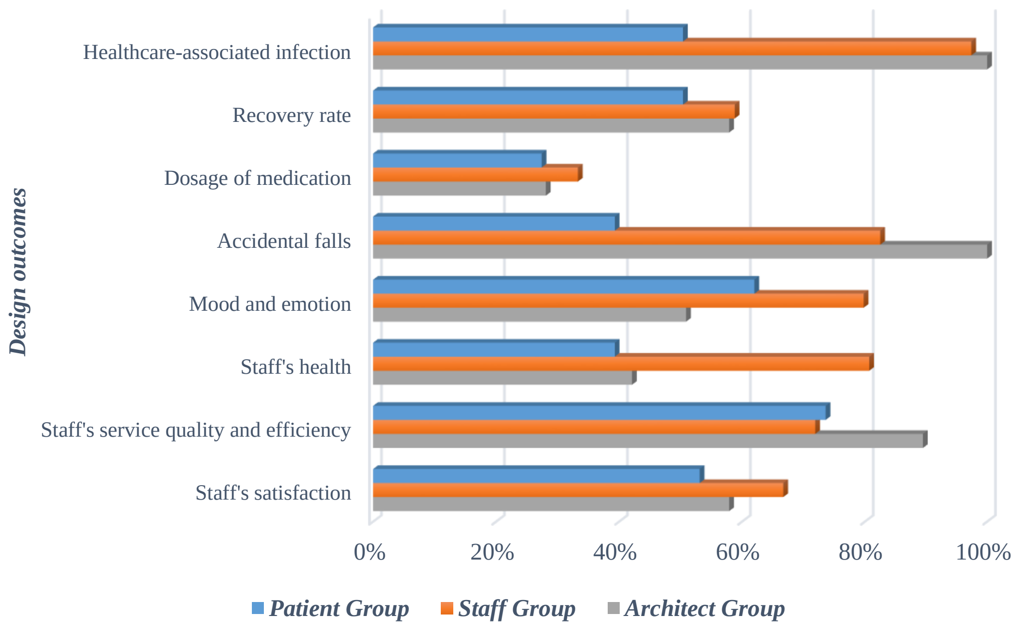

Figure 9.3 Comparison of knowledge about evidence-based design among Patient Group, Staff Group and Architect Group

The statistical analysis in Table 9.7 demonstrates that architects have better knowledge levels about evidence-based design, compared with patients, in the options "healthcare-associated infection", "accidental falls" and "staff's service quality and efficiency" (highlighted in Table

9.7). Table 9.8 shows that, between medical staff and architects, cognitive differences exist in the option "accidental falls", "mood and emotion", "staff's health", and "staff' service quality and efficiency" (highlighted in Table 9.8). It is noteworthy that evidence-based design is an important principle for architectural design of healthcare environments, but the results of cross-comparisons show that architects' knowledge level is not much better than that of medical staff's. Moreover, Pallant (2005a, p.290) indicates that the "minimum expected cell frequency" should be "5 or greater (or at least 80 percent of cells have expected frequencies of 5 or more)", otherwise the results of chi-square tests would be violated. In the footnote *a.* of the analysis of healthcare-associated infection, the value of "minimum expected count" is 4.67. In this comparison, the cognitive difference in "healthcare-associated infection" between Staff Group and Architect Group cannot be identified statistically. It needs to be further tested based on large sample size in the future work.

Table 9.7 Comparison of knowledge about EBD between Patient Group and Architect Group

Design outcome	Patient		Architect		Rank variance
	%	Rank	%	Rank	
Healthcare-associated infection	50.4%	4	100.0%	1	3
Recovery rate	50.4%	4	57.9%	4	0
Dosage of medication	24.7%	8	28.1%	8	0
Accidental falls	39.3%	6	100.0%	1	5
Mood and emotion	62.0%	2	50.9%	6	4
Staff's health	39.3%	6	42.1%	7	1
Staff's service quality and efficiency	73.6%	1	89.5%	3	2
Staff's satisfaction	53.1%	3	57.9%	4	1

Table 9.8 Comparison of knowledge about EBD between Staff Group and Architect Group

Design outcome	Staff		Architect		Rank variance
	%	Rank	%	Rank	
Healthcare-associated infection	97.4%	1	100.0%	1	0
Recovery rate	58.8%	7	57.9%	4	3
Dosage of medication	33.3%	8	28.1%	8	0
Accidental falls	82.5%	2	100.0%	1	1
Mood and emotion	79.8%	4	50.9%	6	2
Staff's health	80.7%	3	42.1%	7	4
Staff's service quality and efficiency	71.9%	5	89.5%	3	2
Staff's satisfaction	66.7%	6	57.9%	4	2

✧ **Summary and Discussion**

The comparison between End-user Groups and Architect Group identifies the cognitive differences in the relative importance of design strategies related to end-users' needs and knowledge levels about evidence-based design. It is found that architects' preferences for the design of community-based healthcare environments are not in accord with the preferences of patients or medical staff, which mainly concentrate on **building images** (i.e. "attractive colours and textures" and "height, volume and skyline of the building"), **space allocation** (i.e. "good orientation", "good views", "access to outdoors" and "storage space"), **safety** (i.e.

"lighting for outdoor spaces" and "pedestrian access routes") and **humanity** (i.e. "dignity of patients": privacy and company). The comparisons aim to identify the design strategies that only draw attention of patients or medical staff. It is found that some important design issues for patients or medical staff – for example, "**dignity of patients**", "**privacy**", "**company**" and "**lighting for outdoor spaces**", are not evaluated highly by architects. It is necessary for architects to understand these priority variances between end-users' needs and architects' preferences, to make **informed decisions** for their design work, and thereby to achieve **a win-win result** that can improve both overall design quality of community-based healthcare environments and efficiency of end-user centred participatory design (Figure 9.4).

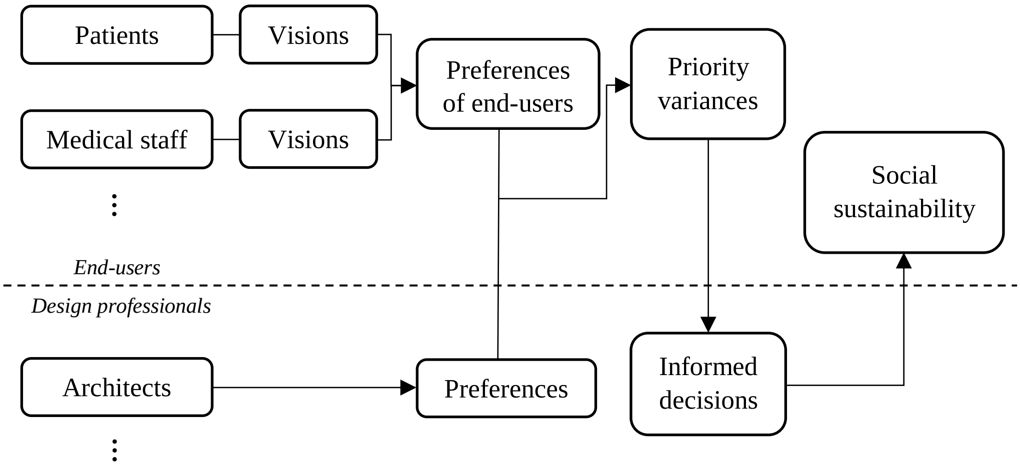

Figure 9.4 A win-win result for the efficiency of end-users' participation and social sustainability between end-users and design professionals

Moreover, based on the comparison between Staff Group and Architect Group, architects, to some extent, do not acquire better understanding of evidence-based design than medical staff in some aspects – for example, the relationship between healthcare environment design and healthcare outcomes of recovery rates, dosage of medication and medical staff's satisfaction. It is different from the previous statement "users can never be as knowledgeable about the design and construction as the architect" (Hamilton & Watkins 2009, p.11). In the participatory design process, architects are expected to have sufficient specialist knowledge about evidence-based design and then be sensitive to the design strategies that can effectively contribute to end-users' desires for community-based healthcare environments. They are required to act as facilitators who can assist stakeholders with less specialist knowledge in the built environment to understand healthcare environment design and explore their own needs. However, the comparison between Staff Group and Architect Group shows that architects had limited specialist knowledge about some aspects of evidence-based design – for example, "mood and emotion" and "staff's health". In some cases, architects also belong to "stakeholders with less specialist knowledge". The given phenomenon can be ascribed to that healthcare environment design is "a synthesis with multistage systems" (Gelun 2015, p.5). It is too complicated to require architects to have sufficient medical knowledge for the design of healthcare buildings. It is necessary to find approaches and tools that can provide architects required information about evidence-based design efficiently in the participatory design process to support the decision-making of healthcare environment design.

9.2.3 Summary of the Cross-comparative Studies of Target Groups

In the cross-comparative studies, a number of cognitive differences and priority variances between target groups were identified based on statistical analysis. Some design issues and design strategies that might cause priority variances between different stakeholders were found. The results from comparisons can be used to answer the second research question – "What are the cognitive differences (if there is no consensus on good community-based healthcare environment design within end-user groups)?". Based on the findings, architects can identify the information that causes priority variances between different stakeholder groups (i.e. patients, medical staff and architects). They can further communicate with representatives of end-users to explore these priority variances in the participatory design process, and thereby improve the efficiency of understanding end-users' needs. Moreover, it is found that architects' knowledge levels about evidence-based design should be enhanced. Some tools are needed to help them facilitate knowledge exchange between different stakeholder groups. To ensure end-users' satisfaction holistically, a follow-up focus group is conducted in order to shed an in-depth insight into these cognitive differences identified in the statistical analysis and the approaches that can help architects facilitate the knowledge exchange.

9.3 A FOLLOW-UP FOCUS GROUP

The results of cross-comparative study between Patient Group and Staff Group demonstrate some cognitive differences in end-users' needs for community-based healthcare environments. Some of them are caused by different knowledge levels about evidence-based design. Design issues with cognitive differences between patients and medical staff are identified. To explore the issues that lead to these cognitive differences, a focus group[20] is conducted to understand **end-users' opinions** on these priority variances and corresponding design strategies. Based on the feedback analysis, important findings about end-users' environmental needs and cognitive abilities can be achieved. This focus group also intends to explore the methods that

[20] Focus group: "the focus group technique is a method of interviewing that involves more than one, usually at least four, interviewees." Essentially, it is a group interview that typically "emphasises a specific theme or topic that is explored in depth" (Bryman 2012, p.501).

can help architects facilitate knowledge exchange, which can be used to explore the Research Question 3 – "Can evidence-based design principles be used to facilitate the knowledge exchange across different stakeholder groups in the participatory design process and achieve a win-win result?".

9.3.1 Methods and Sample Size

The follow-up focus group was conducted based on a face-to-face group interview. Invitations were randomly sent to the respondents of target groups (i.e. patients, medical staff and architects) who had left their contact information in questionnaires (see Appendix 4.1). In total, 18 respondents, including 9 patients, 7 medical staff workers and 2 architects agreed to participate in this focus group (Table 9.9). On the agreed date (23rd September 2017), this focus group was held in a classroom, which lasted about three hours (2:10 pm ~ 5:00 pm).

Table 9.9 Interviewees' personal characteristics

	Code	Personal Characteristics
Interviewees of end-users	Interviewees of patients	
	FG-P1	Female; age 58; n/a;
	FG-P2	Male; age 63; vocational degree, n/a;
	FG-P3	Female; age 22; undergraduate student, Economics;
	FG-P4	Female; age 22; undergraduate student, Economics;
	FG-P5	Male; age 69; n/a
	FG-P6	Male; age 35; master degree, IT;
	FG-P7	Male; age 42; bachelor degree, Chinese;
	FG-P8	Male; age 29; vocational degree, Management;
	FG-P9	Female; age 59; vocational degree, n/a;
	Interviewees of medical staff	
	FG-S1	Male; 7-year work experience; doctor;
	FG-S2	Female; 4-year work experience; nurse;
	FG-S3	Female; 20-year work experience; doctor;
	FG-S4	Female; 21-year work experience; doctor;
	FG-S5	Female; intern; nurse;
	FG-S6	Female; 29-year work experience; doctor;
	FG-S7	Male; 2-year work experience; doctor;
Interviewees of architects		
FG-A1		Male; 12-year work experience about healthcare environment design; 16 projects;
FG-A2		Male; intern; 1 project.

Note: To keep the information representative, interviewees of end-users with architecture-related careers (e.g. architecture, construction, environment assessment, and healthcare estate) were excluded for the focus group, as the sampling size is relatively small.

This meeting can be considered as a semi-structured group interview. Two questions have been prepared for interviewees (see Appendix 3.9). They are:

- Focus Group Question 1: Can you share your opinions on these design issues with significant cognitive differences between patients and medical staff? Why do these priority variances happen?

- Focus Group Question 2: Do you agree with the results (i.e. preferences for the design issues related to end-users' needs for community-based healthcare environments) summarised from the survey that you have previously participated in? Can you share your opinions on the design issues that are evaluated at the level of "moderately important"?

Before the focus group, all interviewees would receive files that presented the levels of relative importance of design issues and design strategies (see Table 9.1). The design issues that had significant differences between Patient Group and Staff Group were highlighted in the list.

9.3.2 Response Analysis and Findings for Focus Group Question 1

Qualitative data of the predefined questions is collected in narratives from the interviewees in the focus group. Representative feedback and key words for Focus Group Question 1 – "Can you share your opinions on these design issues with significant cognitive differences between patients and medical staff? Why do these priority variances happen?" are summarised in Appendix 4.2. By analysing the feedback of interviewees in the focus group, some important findings about the priority variances of the needs of patients and medical staff can be achieved:

- Both patients and medical staff emphasise the healthcare outcomes of design strategies and built environments. **Patients' desires of health and healing** have the greatest impact upon their satisfaction with healthcare environments. It leads to that patients and medical staff have certain similar requirements for good community-based healthcare environments – for example, "dignity of patients", "a caring and reassuring atmosphere" and "values of the health service".

- The significant cognitive differences that have been identified in the statistical analysis are further explored and filtered based on the discussion of focus group. It is found that, for healthcare environment design at a community level, the maximum priority variances between the needs of patients and medical staff focus on **parking**, **access to outdoors** and **storage space**. These variances are not easy to be reduced in the near future.

  1) **Parking**: most patients would like to go to community-based healthcare facilities on foot, as such facilities are located near to their residence. Based on the feedback of some patients, community-based healthcare facilities are expected to be designed within a 10-minute walking distance (i.e. 0.6km ~ 1.2km) around citizens' residence. This finding can be used to inform the design of service circles for community-based

healthcare facilities. Most patients do not rely on vehicles (including private cars and public transport systems), and in return, they consider “parking areas” less important in a community-based healthcare environment.

It is argued by some scholars that, for most of healthcare facilities in the urban areas of China, accessibility has become an extremely serious problem that affects patients’ satisfaction with the built environment (Chen & Song 2014; Zhang et al. 2016). This problem gradually becomes the “main factor” that can influence patients’ mood and their impression of healthcare facilities. To improve the accessibility of patients, it is necessary for healthcare facilities to enhance their parking capacity, and thereby ensure patients’ satisfaction with the healthcare environments (Chen & Song 2014). However, the results of focus group show that parking capacity may not be a serious impact upon the satisfaction of patients with healthcare facilities at a community level. This information can be used to optimise the conclusions and findings from previous research – the differences in patients’ satisfaction with the built environments of general hospitals and community-based healthcare facilities should be considered for the design of parking areas.

Usually, according to the work arrangement in healthcare systems, medical staff of community-based healthcare facilities does not live in the communities where they work. Some of them rely on private cars for commuting. Moreover, the Survey for Staff Group shows that the proportion of female medical staff is 75.4%. Therefore, the design of parking areas for community-based healthcare environments should be more “**female-friendly**”, which means that the parking areas should be designed based on females’ convenience and characteristics, with wider parking bays, bright colours, upgraded lighting and additional cameras (Derks et al. 2011; Sha 2017).

2) **Access to outdoors**: previous research has indicated that open space and access to outdoors are important evidence-based design strategies. They can effectively buffer the negative impacts of anxiety (for patients) and job stress (for medical staff) (Leather et al. 1997; Michael et al. 2001; Nejati et al. 2015). These design strategies are beneficial for both patients and medical staff. In the follow-up focus group, patients expected that community-based healthcare facilities could be integrated into public landscape and natural environments. It can enhance the connection between indoor environments and nature. But medical staff claimed that such design made the supervision and management of patients more difficult, and had potential safety risks (e.g. accident falls). Therefore, compared with an open community-based healthcare

environment that can buffer the job stress, medical staff would rather have a relatively closed environment, which can reduce potential safety risks that might result in strained relations between patients and medical staff.

3) **Storage space**: as most patients go to community-based healthcare facilities for primary care, they do not need to stay overnight. “Space for rest and storage” is not necessary to them. But medical staff considers such space important. This design issue is described in AEDET Evolution as “avoiding creating storage spaces which can easily be eliminated” (DH 2004a, p.23). Based on the feedback of medical staff, the ideal storage space for medical staff should include a changing room and a bathroom. Such design can also encourage the green travel and low-carbon commuting.

- With the development of economy and technologies, some important evidence-based design strategies should be updated. Based on clinical research, artwork is an important design strategy that can be used to relieve people’s pressure and anxiety (Ulrich et al. 1993; Macnaughton 2007). However, some patients indicated that a “mobile-friendly” environment in wards and waiting areas (e.g. public Wi-Fi and charging units) was more appropriate for modern people to distract attention, especially for young people. This information can help architects re-consider the layout design and indoor decoration of healthcare facilities, as well as noise control for mobile devices.

9.3.3 Response Analysis and Findings for Focus Group Question 2

Representative feedback and key words that can be used to answer Focus Group Question 2 – “Do you agree with the results (i.e. preferences for the design issues related to end-users’ needs for community-based healthcare environments) summarised from the survey that you have previously participated in? Can you share your opinions on the design issues that are evaluated at the level of ‘moderately important’?” are summarised in Appendix 4.3.

For this question, patients and medical staff basically agreed with the outputs (i.e. preferences and levels of relative importance of design issues) of the surveys they had previously participated in. It further proves that the results can represent end-users’ needs and preferences for the design of community-based healthcare environments. For the design issues that were evaluated at the level of “moderately important” (e.g. artwork, access to outdoors and good views), the feedback of some patients showed that they did not notice the relationship between these design strategies or their contributions to end-users’ health and well-being. To help them have an explicit understanding of these design strategies and their contributions, evidence from previous research was applied to provide information about the healthcare outcomes (i.e. measured effects) of these design strategies after the consultation – for example, "the patients (surgical inpatients who have undergone cholecystectomy) with window views of the trees spent less time in the hospital than those with views of the brick wall: 7.96 days compared with 8.70 days per patient" (Ulrich 1984, p.224) (see Appendix 2.1). In this process, the researcher acted as a facilitator for knowledge exchange, which reflected the principle of end-user centred participatory design approach.

Based on the researcher's observation, it is found that **evidence with measured effects of design strategies (i.e. evidence-based design strategies)** – for example, duration of hospitalisation, dosage of medicine, error rates and work efficiency, **can be used to help end-users acquire required information and fill in knowledge gaps more effectively and efficiently**. In the focus group, most of patients indicated that they had not known the functions and importance of these design strategies for healing. They expressed that they were willing to re-evaluate the importance of these design strategies after enhancing their relevant knowledge. **Evidence can be used as a common language**, which explains design outcomes more explicitly in the processes of communication and knowledge exchange. It provides an opportunity of evaluating design strategies quantitatively between different design features. The findings from the observation can be used to answer Research Question 3 – **evidence-based design principles can facilitate knowledge exchange between end-users and architects**, **by providing end-users with the explicit information about the impacts of design strategies upon healthcare outcomes and improving their knowledge levels in a relatively short time**. It can improve the efficiency of understanding design strategies comprehensively, and help the stakeholders with less specialist knowledge in the built environment make informed decisions in the participatory design process.

Moreover, an effective mutual understanding may reduce the debates and cognitive differences between end-users and architects relatively easily, and lead to a relatively high consensus. It is found from the feedback of focus group that patients evaluated design issues according to the consideration of their own benefits and interests, and medical staff would like to provide an integrated consideration for the benefits of both patients and medical staff. Some cognitive differences are caused due to that end-users misunderstand some design strategies. They did not realise the healthcare outcomes of these design strategies. A lack of proper knowledge exchange keeps them from providing their needs with accuracy. The consultation procedure also demonstrates a productive collaboration, which can be seen as the principle of end-users centred participatory design – design for users with users.

9.3.4 Summary

The study of focus group provides causal explanations for some cognitive differences within end-users. It was found that the main priority variances between patients and medical staff of community-based healthcare environments were focused on parking, access to outdoors and storage space. These variances were caused by the **nature of community-based healthcare facilities** – primary care delivery for convenience and non-emergency medical treatments. It aggravated the inevitable differences between patients and medical staff – **frequency of using healthcare environments** and **length of stay**. Compared to the similar issues in general hospitals, these priority variances might be more serious in CH Centres and CH Clinics. In the near future, it is unlikely to reach a complete consensus within end-users on the design strategies related to these priority variances in healthcare environment design at a community level. This study presents the information required by architects, which can be used to ensure end-users' holistic satisfaction with community-based healthcare environments. Architects can use it as a reference to separate the end-users' needs for these issues, and then inform sustainable design for healthcare environments at a community level in practice.

Moreover, it was found that a lack of specialist knowledge in the built environment kept patients from expressing their needs explicitly. To some extent, it might result in that these stakeholders misunderstood some important design strategies that could contribute to their health and medical staff's work efficiency. To help architects whose knowledge levels about evidence-based design were not sufficient as expected, this study explored that evidence-based design principles could be used in the communication process in order to explain design strategies (i.e. design outcomes) to stakeholders in the built environment in an explicit way. A common language on the basis of evidence could be built to bridge the knowledge gaps and improve the efficiency of end-users' participation.

9.4 CROSS-COMPARATIVE STUDIES BETWEEN END-USERS' NEEDS AND THE EVALUATION CONTENT OF GB/T 51153

One objective of this research is to provide information that can be used to modify the current building regulations for community-based healthcare environments in China and thereby improve the aspects on social sustainability. The response analysis from Patient Group and Staff Group has indicated that there are different levels of priority variances between end-users' preferences and the requirements from legislation (for more information, see Section 6.3.2 & 7.3.2). A cross-comparative study is conducted to achieve a full picture of these differences in healthcare environment design at a community level. Based on the results and findings of comparisons, the fourth research question (i.e. “How can the current building regulations in China be further modified to ensure end-users’ satisfaction and social sustainability for community-based healthcare environments?”) can be answered.

9.4.1 Comparison between end-users’ needs (preferences) and the evaluation content of GB/T 51153

A cross-comparative study is conducted between the evaluation content of GB/T 51153 and End-user Groups’ needs (i.e. preferences for design issues and design strategies related to end-users’ needs) in this research. The results, as the important findings of this cross-comparative study, can be used to inform the future development of GB/T 51153 and optimise its capacity to address social concerns for healthcare environment design at a community level. Results are demonstrated in Table 9.10. Some differences in design strategies are identified between end-users’ needs and the evaluation content of GB/T 51153 (highlighted in Table 9.10). Of the design strategies related to end-users’ needs for community-based healthcare environments, there are 19 design strategies out of 44 (43.2%) that are overlooked by GB/T 51153. Most of them (16 out of 19, 84.2%) are evaluated at the levels of “extremely important” or “very important” by End Groups in the surveys:

- Extremely important (2) – “privacy protection” (C.011) and “patient company” (C.012);
- Very important (14) – “a caring and reassuring atmosphere” (A.031), “inspiration of patients and staff” (A.041), “welcoming appear” (B.011), “a human scale” (B.012), “obvious entrances” (B.031), “safety facilities” (C.071), “staff-only spaces” (C.081), “attractive form and elevation” (D.041), “minimised distances and lines” (H.041), “future change and expansion” (H.052), “security and passive supervision” (H.071), “pedestrian routes” (I.012), “safety lighting” (I.061) and “gender segregation” (J.051).

Based on previous research, 10 design strategies out of 16 (62.5%) belong to evidence-based design, including C.011, C.012, A.031, A.041, B.011, B.031, C.071, H.041, J.051 and A.022 (see Appendix 2.1).

Differences also exist in the overlapping design strategies (25 out of 44, 56.8%). Some design strategies that are relatively important in GB/T 51153 (i.e. those with prerequisite items) are not evaluated highly by Patient Group or Staff Group – for example, “sunshine spacing” (D.011 – Patient Group: L-3) and “no extra decoration” (A.021 – Patient Group: L-3, Staff Group: L-3). Of these overlapping design strategies, it is found that there are 30 corresponding

Table 9.10 Comparison between end-users' needs (preferences) and the evaluation content of GB/T 51153

End-users' preference for healthcare design at a community level							GB/T 51153		
Design issue related to end-users' needs (27)				Design strategy related to end-users' needs (44)					
		Patient L	Staff L			Nature	PI	CSI	R
C.01	The building respects the dignity of patients and allows for appropriate levels of privacy and company.	5	5	C.011	Design for privacy protection	EBD	-	-	-
				C.012	Design for patient company	EBD	-	-	-
A.03	The building projects a caring and reassuring atmosphere.	4	4	A.031	A civic presence for a caring and reassuring atmosphere	EBD	-	-	-
A.04	The building appropriately expresses the values of the health service.	4	4	A.041	Design for inspiration of patients and staff	EBD	-	-	-
B.01	The building has a human scale and feels welcome.	4	4	B.011	Welcoming appear to staff, patients and visitors	EBD	-	-	-
				B.012	A human scale for windows, indoor heights, doors and entrances	-	-	-	-
B.02	The building is well orientated on the site.	4	4	B.021	Daylighting level	EBD & EED	No	2.5	3
				B.022	Daylighting level for underground space	EED	No	2	5
B.03	Entrances are obvious and logically positioned in relation to likely points of arrival on site.	4	4	B.031	Obvious entrances and routes onto the site	EBD	-	-	-
C.04	There are high levels both of comfort and control of comfort.	4	4	C.041	Light pollution control	-	No	0.6	17
				C.042	On-site acoustic environment	EBD & EED	No	0.6	17
				C.043	On-site wind environment (for outdoor walking in winter and ventilation in summer)	EED	No	1.2	10
				C.044	Heat island control	-	No	0.6	17
				C.045	Indoor noise level	EBD & EED	Yes	5	1
				C.046	Indoor glare control	-	Yes	0	-
				C.047	Indoor temperature	EBD	Yes	2.5	3
				C.048	Indoor ventilation and fresh air volume	EBD & EED	Yes	0	-
				C.049	Shading system in summer	EED	No	2	5
				C.04X	Air quality monitoring	EBD & EED	No	2.75	2
C.05	The building is clearly understandable.	4	4	C.051	Signposting system and humanistic factors	EBD	Yes	0	-
C.07	There are good bath/toilet and safety facilities for patients.	4	4	C.071	Safety facilities (non-slip flooring, seats, handrails and shelves) for bath/toilet	EBD	-	-	-
C.08	There are good facilities for staff including convenient places to work and relax without being on demand.	4	4	C.081	Staff-only spaces for work and relax	-	-	-	-
D.04	The building is sensitive to neighbours and passers-by.	4	4	D.041	Attractive form and elevation for neighbours and passers-by	EED	-	-	-
H.04	Workflows and logistics are arranged optimally.	4	4	H.041	Layout design to minimise distances travelled and lines crossed	EBD	-	-	-
H.05	The building is sufficiently adaptable to respond to change and to enable expansion.	4	4	H.051	Recyclable partition for multifunctional and alterable rooms	EED	No	0.75	15
				H.052	Flexibility for future change and expansion	EED	-	-	-
H.07	The layout facilitates both security and supervision.	4	4	H.071	Layout design for security and passive supervision	-	-	-	-
I.01	There is good access from available public transport including any on-site roads.	4	4	I.011	Connection with public transport	EED	No	1.05	12
				I.012	Clear pedestrian routes from public transport points	EED	-	-	-
I.02	There is adequate parking for visitors and staff cars with appropriate provision for disabled people.	4	4	I.021	Design for parking (cycles and vehicles)	EED	No	0.75	15
I.05	Pedestrian access routes are obvious, pleasant and suitable for wheelchair users and people with other disabilities/impaired.	4	4	I.051	Barrier-free design for site and sidewalk	-	No	0.3	20
I.06	Outdoor spaces are provided with appropriate and safe lighting indicating paths, ramps and steps.	4	4	I.061	Safety lighting for landscape at night	-	-	-	-
J.03	The circulation distances travelled by staff, patients and visitors are minimised by the layout.	4	4	J.031	Layout design to reduce the congestion and circulation	EED	No	1.75	8
J.04	Any necessary isolation and segregation of spaces is achieved.	4	4	J.041	Layout and greenbelt design for infectious segregation	-	No	1.05	12
J.05	The design makes appropriate provision for gender segregation.	4	4	J.051	Design for gender segregation	EBD	-	-	-
B.05	The external colours and textures seem appropriate and attractive.	3	4	B.051	Colours and textures related to adjacent buildings and environment	-	-	-	-
C.03	Patients and staff have good easy access to outdoors.	4	3	C.031	Land use for greening	EBD & EED	No	1.2	10
				C.032	Greening and vegetation diversity	EBD & EED	No	0.9	14
				C.033	Open space and access to nature for all-weather design	EBD & EED	No	1.25	9
D.01	The height, volume and skyline of the building relate well to the surrounding environment.	3	4	D.011	Sunshine spacing for surrounding residential buildings	-	Yes	0	-
J.06	There is adequate storage space.	3	4	J.061	Adequate storage space in the building	-	-	-	-
A.02	The building is interesting to look at and move around in.	3	3	A.021	Plain form without extra decoration for elevation	-	Yes	0	-
				A.022	Artwork for decoration	EBD	-	-	-
C.02	There are good views inside and out of the building.	3	3	C.021	Good views for wards and consulting rooms	EBD	No	2	5

Note: L – level of relative importance; PI – prerequisite item; CSI – credit of scoring items; R – rank; red borders highlight the design issues with priority variances based on the feedback of focus group.

design items in GB/T 51153. Of these corresponding design items, 7 are prerequisite items and the rest (23) are scoring items with 30.75 available credits (30.1%). There are still 58 design items in GB/T 51153 (16 prerequisite items and 42 scoring items with 71.5 credits) that are applied at the design stage but not related to end-users' needs. These missing design items are mainly applied for the environmental aspects of sustainability (e.g. energy consumption and resource saving). Sustainability, as an anthropocentric concept, should be enhanced from three dimensions – social, environmental and economic aspects (i.e. Triple Bottom Line). It is important to keep a relative balance among these dimensions (Lutzkendorf et al. 2012). GB/T 51153, which is a mandatory building regulation for the sustainability assessment of healthcare environments in China, has a unique and huge influence on sustainable design of healthcare environments. For the overall design quality, it should have the capacity of addressing the basic human needs and avoiding negative environmental impacts in the meantime. However, the comparison indicates that GB/T 51153 overlooks a number of design strategies that are related to the basic needs of patients or medical staff in community-based healthcare facilities – for example, "obvious entrances", "pedestrian routes", "gender segregation", "staff-only spaces" and "a human scale", which may impact upon the social sustainability of healthcare environments (see Table 9.10). To a great extent, the comparison results reflect that, currently, **the application of GB/T 51153 is unlikely to properly inform the design and delivery of a community-based healthcare environment that can** "**provide patients and medical with healthy**, **suitable and effective space**" (MOHURD & AQSIQ 2015, p.2).

9.4.2 Discussion

The comparisons have indicated some obvious differences between end-users' needs and the evaluation content of GB/T 51153. It can be inferred that the exploration of end-users' satisfaction and needs was insufficient before the launch of GB/T 51153. Representatives of end-user groups might have not been included in the decision-making process of the evaluation content or weighting systems of GB/T 51153. Public participation should be further enhanced for its development and optimisation in the near future. Moreover, it is found that some evidence-based design strategies – for example, "privacy protection", "patient company", "inspiration of patients and staff" and "safety facilities", are not included in GB/T 51153 as well. It may also affect the social concerns of GB/T 51153 for sustainability assessment of healthcare environments.

Sustainability assessment methods and other building regulations should be modified by taking into account opinions from end-user groups and academic studies on evidence-based design. According to the response analysis from Architect Group, it was found that 96.5% of architects chose building regulations from governments or local authorities as the main reference sources for their design decision-making. As stated earlier, architects' knowledge levels about evidence-based design were not as good as expected. It can be concluded that this problem concerns the situation that some evidence-based design strategies are overlooked by GB/T 51153. Building regulations, as the most important information sources for architects, establish a learning platform where architects can make trade-offs and informed decisions. It is necessary for GB/T 51153 to represent opinions from all levels of decision-makers and stakeholders of healthcare environments, based on a relatively high consensus on their own benefits and interests. Building regulations should have the capacity of providing information required by architects and other design professionals, and then guide healthcare environment design at a community level towards a good design quality of healing environments.

Therefore, all outputs of questionnaire surveys and the comparative studies (i.e. between the evaluation content of GB/T 51153 and the preferences of End-user Groups) provide an opportunity of exploring how to enhance the capacity of GB/T 51153 in addressing social concerns from a systematic perspective. The information identified can be used as a reference to modify GB/T 51153, by adding new contents and adjusting the relative importance of relevant design items (e.g. prerequisites and available credits), in order to be applicable for "all single healthcare buildings and building clusters", especially for community-based healthcare facilities (MOHURD & AQSIQ 2015, p.3).

Currently, to improve the capacity of GB/T 51153 in informing and accessing the design of a community-based healthcare building project, it is necessary to conduct **local interpretation**. GB/T 51153 is a national building regulation which is launched as a benchmarking standard to inform the development of regional sustainability assessment methods for healthcare environments (ibid). For this purpose, it can be modified hierarchically (i.e. national, regional and individual levels) based on the Triple Bottom Line concept (Figure 9.5).

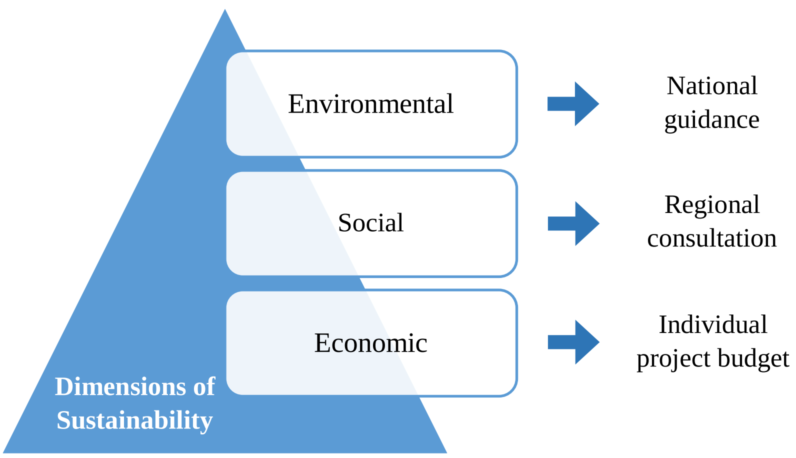

Figure 9.5 Hierarchical modification for GB/T 51153 based on the Triple Bottom Line

First, it is relatively easy to directly use the content related to the environmental dimension (e.g. protection of ecosystems and preservation of biodiversity) as national guidance. It is because the requirements, standards and expected outcomes of these design strategies are objective. The content, which belongs to eco-effective design strategies, is applied, mainly based on the consideration of local climate and natural resources. These design strategies are unlikely to be affected subjectively in the design of healthcare building projects at different scales (e.g. general hospitals or community-based healthcare facilities).

Second, for the content related to social aspects, it can be applied based a regional consultation. It needs a process of local interpretation, which means this part of content should be applied together with relevant characteristics. During the implementation of GB/T 51153, it is necessary to conduct a participatory design process and take into account the opinions from local residents and future end-users (Figure 9.6).

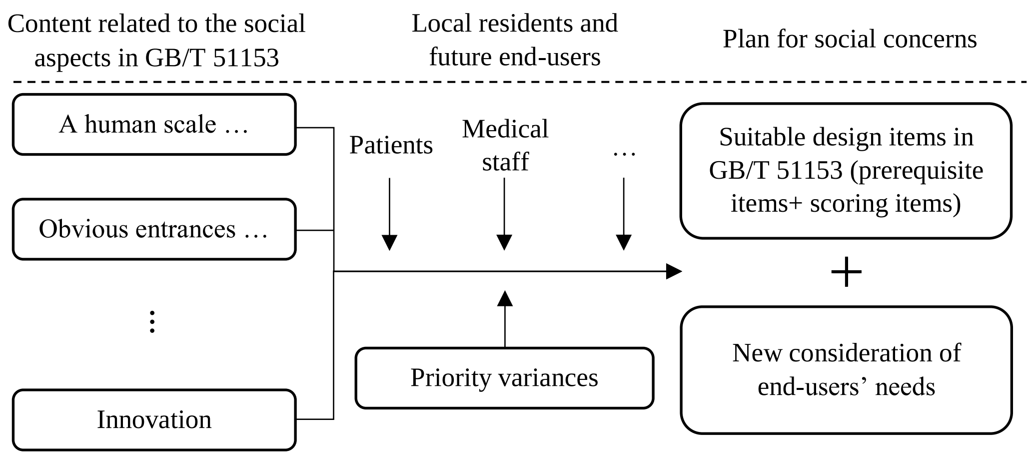

Figure 9.6 Local interpretation of GB/T 51153

Taking this research project as an example. The differences between the needs of end-users (patients and medical staff) and the evaluation content of GB/T 51153 have been identified based on a cross-comparative study (see Table 9.10). The output of this comparison can be used as a reference by architects and other design professionals, together with GB/T 51153, in the process of designing a community-based healthcare building project in SIP. The multi-level knowledge integration can be achieved, which can be used to improve the overall design quality and social sustainability of community-based healthcare environments in practice. The mismatch of information supply and demand can be avoided in the public participation, which leads to better capacity of GB/T 51153 in addressing social concerns. This process can also enhance the application of GB/T 51153 at a regional level in Suzhou. The participatory design helps architects understand the differences between end-users' needs and the requirements of GB/T 51153, which may result in that architects, especially for those with less experience in community-based healthcare environment design or participatory design, become interested in using and studying GB/T 51153.

After the local interpretation and public participation, the content regarding the economic domain can be applied finally to each individual, unique healthcare building project. Relevant design strategies can be filtered according to the budget and cost/benefit analysis of a project, and the final decisions for the selection of design strategies can thereby be made. According to the survey results, patients expected that community-based healthcare facilities could be designed within a 10-minute walking distance (i.e. 0.6km ~ 1.2km). However, in this research, it was found that some respondents from Patient Group had to travel 4.2km to a community-based healthcare facility (for more information, see Section 6.3.1). It reflects that, currently, the total amount of healthcare facilities at a community level does not fully meet the needs of patients. To optimise the primary care delivery and medical resource allocation in the urban areas of China, a large number of community-based healthcare facilities should be built in the following decades. Based on this hierarchical modification, GB/T 51153 can achieve a better performance in improving end-users' satisfaction and social sustainability for community-based healthcare environments currently, thereby informing sustainable design of healthcare environments from environmental aspects mainly to a broader set of environmental, social and economic aspects.

9.5 CHAPTER SUMMARY

In this chapter, the cognitive differences between target groups were identified based on a series of cross-comparative studies. The statistical analysis showed that it was unlikely to reach a complete consensus on healthcare environment design at a community level between patients and medical staff in the near future. To further explore the priority variances, a follow-up focus group was conducted within a small group of interviewees (i.e. 9 patients, 7 medical staff workers and 2 architects). It was found that the priority variances between patients and medical staff mainly focused on parking capacity, access to outdoors and storage space of community-based healthcare environments.

The feedback showed that, when evidence-based design strategies were applied in healthcare environment design, it was essential to combine them with local circumstances and characteristics. A number of evidence-based design strategies are focused on the impacts upon people's mood, which further affect the outcomes of healing or work efficiency. With the consideration of relationship between end-users' cognitive abilities and design strategies' outcomes, the effectiveness of evidence in other places should be studied comprehensively. It was also found that evidence-based design principles were effective to facilitate the knowledge exchange between stakeholders with different knowledge levels in the participatory design process. On the basis of measurable effects, better communication and a closer consensus between different stakeholder groups could be achieved.

An explorative study about the capacity of GB/T 51153 in addressing social concerns was conducted. The comparisons between the evaluation content of GB/T 51153 and the preferences of End-user Groups showed that the main focus of GB/T 51153 was still on environmental aspects. At the present stage, this building regulation could not provide patients or medical staff with effective space as expected, since some basic human needs were not addressed in it. The suggestions that could be used to enhance the application of GB/T 51153 for the social sustainability of community-based healthcare environments were proposed. These suggestions can be used as a reference, together with GB/T 51153 in the design decision-making process, in order to help architects understand end-users' needs, to facilitate the knowledge exchange between different stakeholders, and to make informed decisions for the overall design quality of healthcare environments from social aspects. For the purposes of solving the problems identified in the studies and expanding the influence of findings, a design aided tool is proposed and discussed in the next chapter.

Our lives are touched by those who lived centuries ago, and we hope that our lives will mean something to those who will live centuries from now. *- Dorothy Day*

10

End-user Centred Participatory Design for Community-based Healthcare Environments

10.1 CHAPTER INTRODUCTION

In previous chapters (Chapter 2 ~ 9), the whole process of this research project, including the desktop research and field investigations, was described. Important findings of this research – end-user centred participatory design for community-based healthcare environments, include that 1) a complete consensus is unlikely to be reached between patients and medical staff on good healthcare environment design at a community level; 2) evidence with measured effects can be used as a common language to facilitate the knowledge exchange between different stakeholder groups; 3) the design strategies that can contribute to the capacity of GB/T 51153 in addressing social concerns are identified; and 4) stakeholders' cognitive abilities and personal background should be taken into account in the design decision-making process for healthcare environments (i.e. local interpretation).

All results were achieved based on the field investigations that had been conducted in SIP (Suzhou Industrial Park, a district of Suzhou in China). It is expected that the findings of this research can be generalised beyond the cases – providing information that can also be used to inform healthcare environment design at a community level in other urban areas. To increase the influence of research findings and further verify the results in practice, the participatory design approach studied in this research is further visualised and digitalised into a computer programme – a design aided tool *End-user Centred Participatory Design for Community-based Healthcare Environments* Version 1.0 (hereafter referred to as ECPD). This tool can be used in the participatory design process of community-based healthcare environments, in order to help architects facilitate the communication and knowledge exchange between different stakeholder groups. It attempts to improve the overall quality of architects' design work – for example, exploring end-users' needs for community-based healthcare environments, providing a checklist for better healthcare environments based on evidence, and improving the social aspects of community-based healthcare environments in line with GB/T 51153 (i.e. environmental-aspect-mainly in the sustainability assessment of healthcare environments). Moreover, during the application of ECPD, this tool can further verify the findings achieved in this research project. This chapter introduces ECPD briefly, including its objectives, design rationale and interfaces. Feedback from experienced architects in the first round of beta test can be used to optimise ECPD comprehensively.

10.2 PARTICIPATORY DESIGN DECISION-MAKING

Chapter 2 has discussed that design is a process of exchange between areas of knowledge for the consensus of problem solving (Lawson 2005, p.130). In such process, explicit description can improve the efficiency of knowledge exchange. To implement an anthropocentric concept of sustainable design in the built environment, an end-user centred participatory design approach is proposed and studied in this research. It aims to create a participatory environment that can actively engage all stakeholders, especially for those with less specialist knowledge in the built environment, in the processes of design decision-making and consensus-building. Based on the effective communication, sustainability can be achieved with a relative balance among the three dimensions – social, environmental and economic aspects.

In the current construction market, sustainability assessment methods are important design decision-making aids. They are expected to act as a communication platform to support the knowledge exchange between different stakeholders. Sustainability assessment methods use certificate levels or ratings based on assessment results (e.g. "One Star" in GB/T 51153 or "Good" in *BREEAM Healthcare 2008*) to explain the excellence of architectural design to the stakeholders with less specialist knowledge in the built environment (for more information, see Section 4.2.2). In this process, architects and other design professionals can choose various design strategies to form a design plan and meet the standards of corresponding ratings (i.e. amount of prerequisite items and available credits).

However, there are some weaknesses in this communication process. First, this process is too general to engage all stakeholders. The description of evaluation contents in sustainability assessment methods currently is too difficult to understand for stakeholders with less specialist knowledge in the built environment. Based on the requirements of calculation models and certificate rating systems, there are hundreds of ways (i.e. different selections of design items) that can achieve a certificate rating. The stakeholders with less specialist knowledge in the built environment cannot explicitly understand the meaning of design items. For these stakeholders, they can only know the final outcome of architectural design (i.e. the certificate ratings), instead of understanding if their environmental needs would be realised in the process of sustainability assessment. This situation affects the efficiency of public participation.

Second, on a timely basis, a number of architects and design teams would not use sustainability assessment methods to communicate with other stakeholders (e.g. end-users) or gain effective outputs about their environmental needs. Some architects prefer to directly use these information sources and available credits to make informed decisions. However, based on the results of the cross-comparative study between end-users' needs and the evaluation content of GB/T 51153, it is found that a consensus between both value judgements cannot be reached. To some extent, sustainability imbalance still exists in this national, mandatory sustainability assessment method. More specifically, less attention has been paid to social aspects. It has some weaknesses of addressing the basic human needs (i.e. social concerns) properly in the sustainability assessment of healthcare environment design at a community level. This may affect its objectives of informing sustainable design of "all single healthcare buildings and building clusters" in China towards a healthcare environment that can "provide patients and medical staff with healthy, suitable and effective space" (MOHURD & AQSIQ 2015, p.3).

On one hand, some important information that can contribute to the social sustainability of community-based healthcare environments (e.g. end-users' satisfaction with the built environment) is overlooked by GB/T 51153 – for example, "privacy protection", "patient company", "a human scale" and "safety facilities" (for more information, see Section 9.4). On the other hand, the evaluation content of GB/T 51153 is hospital-based, and a series of design items are only appropriate for healthcare facilities with complex medical procedures, special departments (e.g. ICU) and large-scale service groups (e.g. 500 beds or above). Both issues seriously impact upon the performance of GB/T 51153 in informing sustainable design of healthcare environments at a community level. It is not easy for architects to identify information relating to the design of community-based healthcare environments in a relatively short time. It may also affect architects' interest of using or studying this sustainability assessment method. Relevant research should be conducted to enhance the social capability of

GB/T 51153 in the near future, just like the development process of *BREEAM Healthcare 2008* (for more information, see Section 4.2.5). Based on the given phenomena, this research proposes an approach – "end-user centred participatory design", which can be used to explore end-users' needs for community-based healthcare environments and then use their satisfaction with the built environment as a criterion to evaluate the relative balance of sustainability in healthcare environment design.

The results of this research are achieved from the field investigations in SIP. They may not fully represent end-users' needs or preferences in other urban areas of China. According to the definition of evidence-based design, design should be well considered by using current best evidence and references for each individual and unique project (Hamilton & Watkins 2009). When a community-based healthcare facility will be designed and built, it is necessary to conduct a series of social studies that collect representative responses from local residents and future end-users and identify their environmental needs. In order to improve the efficiency of exploring end-users' needs, this participatory design approach is visualised and digitalised to propose a design aided tool *End-user Centred Participatory Design for Community-based Healthcare Environments* Version 1.0 (ECPD). This tool simplifies the research process of "end-user centred participatory design for community-based healthcare environments" in this thesis (Chapter 2 ~ 9).

Moreover, as stated in the principle of end-user centred participatory design, in the design decision-making process, architects should act as facilitators to help end-users articulate their needs, since architects have professional knowledge. End-users can therefore make the value judgements and preferences without "the loss of any specialist knowledge that might be relevant" (Eason 1995, p.1671). However, the cross-comparative studies between End-user Groups and Architect Group show that architects' knowledge levels about evidence-based design are not sufficient. It means that, in some cases, architects are not able to efficiently facilitate the knowledge exchange between stakeholders with different knowledge levels in healthcare environment design. It is necessary to establish tools (e.g. ECPD) to provide updated knowledge about evidence-based design, in order to help architects facilitate the communication and knowledge exchange and assist all stakeholders to make informed decisions. For all purposes above, ECPD is designed to be applied in the design decision-making process for community-based healthcare environments. It creates a participatory environment with several objectives:

- Collecting end-users' preferences (i.e. relative importance) for their environmental needs and relevant design strategies based on a common language that explains design strategies in non-technical statements and provides corresponding measured effects summarised from previous research;

- Verifying evidence-based design strategies from previous research in the design of healthcare building projects currently;
- Assisting architects to approach updated findings from studies regarding evidence-based design and facilitate the knowledge exchange between different stakeholder groups;
- Providing findings about end-users' satisfaction with the built environment of healthcare buildings in conjunction with GB/T 51153 to improve the social aspects of community-based healthcare environments in practice;
- Improving the efficiency of public participation and knowledge exchange in the decision-making process of healthcare environment design; and
- Summarising information that can be used to modify the capacity of healthcare building regulations to address social concerns in the sustainability assessment.

10.3 DESIGN RATIONALE OF ECPD

ECPD is set as a design aided tool that creates a simplified investigation process of end-users' satisfaction and environmental needs in the participatory design of healthcare environments at a community level (Ban 2017). It is a computer programme that provides an electronic survey and questionnaires for stakeholders with different knowledge levels. For design professionals, it can be used as a dictionary of evidence-based design strategies and a database of research findings about end-users' satisfaction with the built environment of healthcare facilities. All functions of this design aided tool can be found from its interfaces of the English version (Figure 10.1 ~ 10.2). In this section, its design rationale is briefly introduced to explain the objectives in detail.

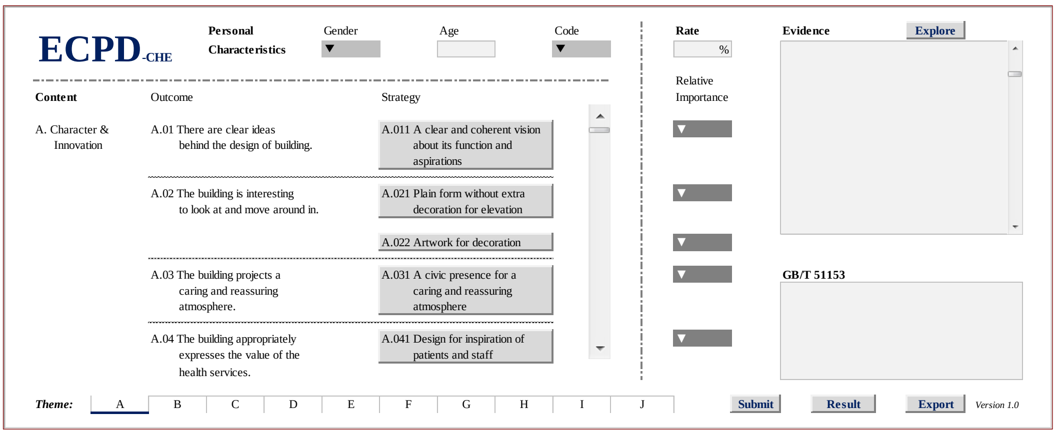

Figure 10.1 Interface 1 of ECPD (English version)

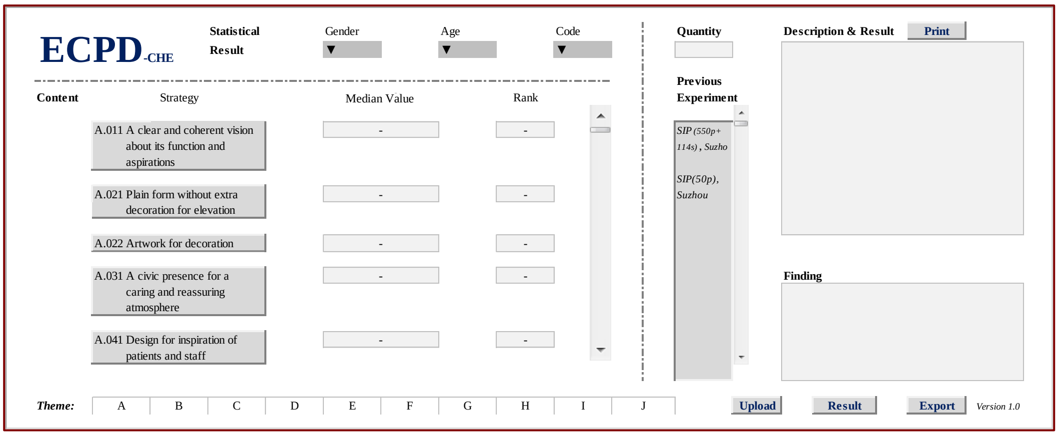

Figure 10.2 Interface 2 of ECPD (English version)

✧ **Collecting end-users' preferences (i.e. relative importance) for their environmental needs and relevant design strategies based on a common language that explains design strategies in non-technical statements and provides corresponding measured effects summarised from previous research**

Interface 1 (Figure 10.1) is designed mainly for the end-users of community-based healthcare environments. They can provide their personal information, including genders and ages, by using the "Personal Characteristics" section. Each respondent will have an individual "Code" for identification (e.g. patient, visitor or medical staff). This function is designed to set variables for statistical analysis.

To help end-users explore healthcare environment design at a community level, the design strategies that are related to healthcare environments are presented in the "Content" section. All design strategies, which are in line with the content of *Conceptual Framework for Healthcare Environment Design*, are divided into ten themes (the "Theme" section) (for more information, see Table 4.10). To provide a common language for end-users, the explanations of design outcomes in non-technical statements (i.e. design issues) are listed ahead of design strategies. Available evidence with measured effects from previous research is presented in the "Evidence" section while corresponding design items in GB/T 51153 are presented in the "GB/T 51153" section, when tool users click the button of a design strategy (Figure 10.3). This procedure can explain the professional content of GB/T 51153 in an explicit way, which can effectively keep end-users from misunderstanding design strategies.

The "Relative Importance" section is designed to translate end-users' preferences for relevant design strategies into a measurable way. A five-point Likert scale with six options, including "extremely important – 5", "very important – 4", "moderately important – 3", "slightly important – 2", "not at all important – 1" and "unrelated" is applied. It is important to note that the "unrelated" option is used to filter the design strategies that are not suitable for a community-based healthcare facility based on respondents' opinions. With the "Submit" section, the median values of selected design strategies can be calculated, which reflect the end-users' preferences for healthcare environment design at a community level. Architects can review these statistical, aggregated results in Interface 2, using the "Result" function. Finally, end-users' preferences for their environmental needs can be collected conveniently from a broader area. Architects can use the results summarised in surveys to inform healthcare environment design and select relevant design items from GB/T 51153.

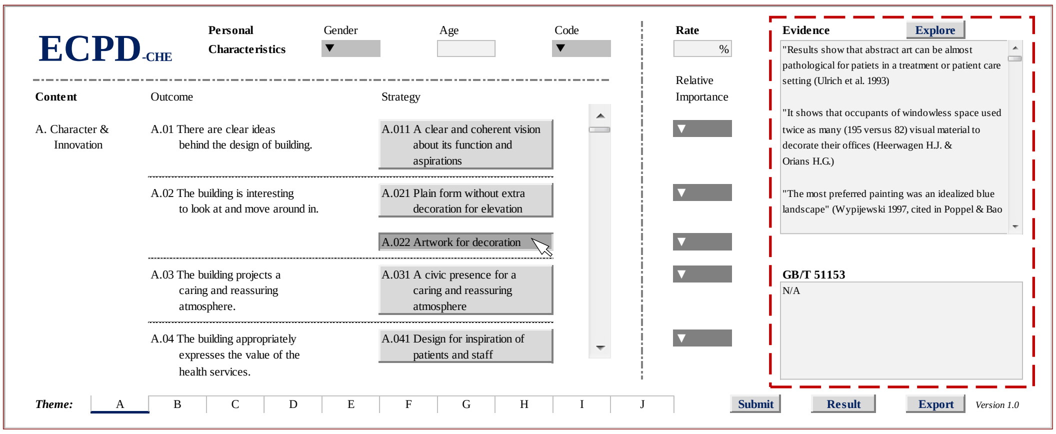

Figure 10.3 Example of "Evidence" section and "GB/T 51153" section (English version)

- ✧ **Verifying evidence-based design strategies from previous research in the design of healthcare building projects currently**

In the process of evaluating the relative importance of design strategies, tool users can acquire knowledge about corresponding evidence. It is noteworthy that some evidence-based design strategies were achieved based on previous clinical studies. ECPD provides an opportunity of verifying their functions of influencing people's physical and psychological needs during the ongoing change of society.

For example, it is found in this research, with the development of economy and technologies, artwork's functions of relieving people's pressure and anxiety are weaken. More patients would like to have a mobile-friendly environment, which can help them approach media and news and thereby reduce their stress. A number of evidence was achieved in 1990s or 2000s, when personal mobile devices were not popular. With the development of economy and technologies, some evidence-based design strategies are out of date and need to be changed or optimised. For example, indoor positioning systems of mobiles can redefine the design of wayfinding and hospital guide. It is important to note that, in ECPD, respondents evaluate the relative importance of evidence-based design strategies in the context of understanding corresponding evidence from previous research. A record system is provided in ECPD to track and identify the evidence-based design strategies that do not draw proper attention from end-users in some healthcare building projects. Architects and researchers can review respondents' preferences in the "Previous Experiment" section and identify such evidence-based design strategies (Figure 10.4). Some potential, new evidence can also be explored in this process.

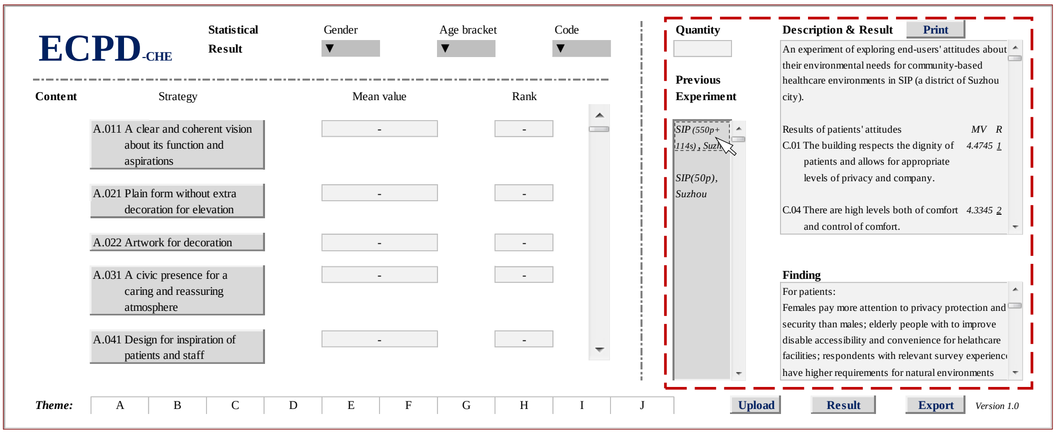

Figure 10.4 Example of "Previous Experiment" section (English version)

- ✧ **Assisting architects to approach updated findings from studies regarding evidence-based design and facilitate the knowledge exchange between different stakeholder groups**

In this research, it is found that, currently, architects' knowledge about evidence-based design is insufficient, which affects their performance in the participatory design process of healthcare environments. It is necessary to provide tools to help them facilitate the knowledge exchange between different stakeholders by providing information about evidence-based design. ECPD can act a dictionary of evidence-based design strategies. When tool users use the "Explore" section, they can browse updated findings (i.e. design inputs and measured effects) regarding evidence-based design strategies (see Figure 10.3). All these findings are from published papers. Based on this function, architects and other design professionals can obtain sufficient knowledge to understand how to contribute to end-users' needs and facilitate the knowledge exchange more effectively.

- ✧ **Providing findings about end-users' satisfaction with the built environment of healthcare buildings in conjunction with GB/T 51153 to improve the social aspects of community-based healthcare environments in practice**

ECPD can be seen as a database that collects survey results from previous social studies regarding end-users' satisfaction and needs for healthcare environments. After respondents evaluate the relative importance of relevant design strategies, the results and findings of that survey can be recorded through the “Upload” function. Architects can browse these findings in the “Previous Experiment” section (see Figure 10.4). When architects do not have enough time to explore end-users’ needs on a timely basis, they can use these results and findings as references to inform healthcare environment design, especially for healthcare environment design at a community level. To explore the cognitive differences between different end-user groups, architects can choose the “Export” function to export the statistical data into an Excel file. End-users’ preferences can be categorised based on the variables of genders, ages and identification (stakeholder groups). Statistical analysis programmes (e.g. SPSS) can then be applied to identify the significant differences and priority variances in the needs of different stakeholder groups. A dialogue can be built between end-users and architects. Moreover, in this way, findings from previous research can also be verified based on the application of ECPD in practice.

In summary, ECPD provides a common language to describe healthcare environment design, in order to support the knowledge acquisition for stakeholders with different knowledge levels. Using ECPD, people can obtain the **required information**[21] more efficiently. Surveys for end-users’ satisfaction and environmental needs can be conducted simultaneously. It means that tool users from the stakeholders with less specialist knowledge in the built environment (e.g. end-users, including patients, medical staff and visitors) are able to finish the investigations without the supervision of design professionals. In terms of healthcare building projects on a timely basis, architects often have to find relevant references to understand end-users’ needs in a relatively short time. ECPD can improve the efficiency of public participation and knowledge exchange. It can also improve the influence of previous findings and provide an opportunity of verifying these findings. Moreover, together with the results and findings collected in this tool, the sustainability assessment of GB/T 51153 can be shifted from environmental-aspect-mainly to a broader set of social, environmental and economic aspects. A relative balance among these aspects and sustainable development can be achieved.

10.4 BETA TEST

To validate the feasibility of ECPD, the Chinese version of this design aided tool was recommended to design professionals of healthcare environment design. For the first round,

[21] Required information: based on the findings of this research, the information required by end-users and other stakeholders with less specialist knowledge in the participatory design process is the explanation of design strategies, which are design outcomes in non-technical statements based on evidence with measured effects from previous research. For design professionals, the required information is the updated knowledge about evidence-based design strategies.

five experienced architects agreed to participate in this "beta test"[22] procedure. The personal information of the beta testers is listed in Table 10.1. Each of them was required to use ECPD in practice for two weeks, and then gave feedback through an individual unstructured interview (see Appendix 4.1). Representative comments about the feasibility of ECPD are abstracted as follows.

Table 10.1 Participators' personal information and interview schedule

Code	Personal Information	Interview Time
BT-A1	Male; age 42; bachelor; 18 years (architectural design)	9:30 ~ 10:00, 18th Oct 2017;
BT-A2	Male; age 28; master; 3 years (architectural design)	10:00 ~ 10:30, 18th Oct 2017;
BT-A3	Male; age 35; master; 10 years (architectural design)	14:00 ~ 14:45, 19th Oct 2017;
BT-A4	Male; age 32; master; 5 years (project management)	15:00 ~ 15:35, 19th Oct 2017;
BT-A5	Female; age 30; master; 4 year (architectural design)	14:00 ~ 15:00, 20th Oct 2017.

BT-A3: "…I have used it in my design work in the last two weeks. I sent it to several patients by email, and they finished it and sent it back… All design strategies they were interested in were categorised in order… In emails, some patients said it was relatively easy to read and understand… (But) I do not know how to calculate the cognitive differences… According to the specification of this tool, some statistical analysis programmes are still required… I do not know how to use statistical programmes or methods… I think it is important. I know that different people with different features may have different requirements… In my opinion, this tool should have **a function that can teach us how to use statistical methods**… I am interested in its design procedures and assistance for GB/T 51153… I have been using this building regulation as a reference for one year, and I find it should be improved… **Some human needs are not included in GB/T 51153**. Some of them are very important based on my work experience… For example, patients' dignity protection, privacy protection, safety, passive supervision, human-scale design and medical staff's relax space… I found such content (related to the above missing human needs) from this tool. It is very necessary… These needs were also highlighted by some patients… I think it is very helpful for architects, especially for novices… Healthcare facilities should be human-centric, and this is why I think **GB/T 51153 should be further optimised in the near future**…"

BT-A2: "…I think it is a good example of the 'Digital +' principle in healthcare environment design. I can see some potential… This tool can collect data continuously,

[22] Beta test: a type of testing period that involves individual users (beta testers) outside the design team for feedback. This terminology stems from computer science. This research uses it to describe a process where the feedback about the effectiveness of a computer programme ECPD is collected from experienced architects in healthcare environment design.

and then upload the data to clouds… Architects can use the data to understand end-users' preferences for their needs regarding healthcare facilities (at a community level)… We can compare the data across different cities and regions… Information from these comparisons can be used to **inform the design of local sustainability assessment methods**… I did not use this tool to do investigations last two weeks, but I browsed **the findings of previous research**… It informed me that patients had a high requirement for walking convenience when they used CH Centres and CH Clinics. I thereby did some changes to optimise my current design work of a small private hospital… For example, using different materials and colours to build clear relationship between pedestrian walkways and bicycle paths… I also added some devices for pedestrians' safety and rest… I think it may ensure their satisfaction with outdoor environments, and help with their mood during the therapeutic process… I would like to use this information more carefully and completely, when we have relevant healthcare building projects… It really saves time and efforts…"

BT-A4: "…I think the logic of this programme could be better. In my opinion, **patients and medical staff should have different weightings**, and I can decide and set up the weightings of different stakeholder groups in this tool… I think medical staff's viewpoints are more important, as they spend much more time in hospitals (than other end-user groups)… Their user experience is more comprehensive for healthcare environment design… Compared with patients' environmental needs, **architects should learn more about medical staff's opinions**… There are two reasons, on one hand, architects would do some studies to explore patients' satisfaction. Relatively speaking, we know patients' needs, because we have done some studies on patients' needs… On the other hand, **the group of medical staff did not draw enough attention from architects for a long time**… During the design process, some architects consider medical staff's requirements as equipment selection and pipeline layouts… They do not pay proper attention to medical staff's needs for the indoor environments or other details… It is necessary to enhance the weighting of medical staff's opinions…"

BT-A5: "…The content (design strategies related to healthcare environments) is not enough… I did not see the strategies that are related to the design of local culture or heritage… They are all important and necessary for patients' satisfaction… They may have a home-like feeling, which is helpful for their mood… I think **people should have opportunities to add design strategies that are overlooked by this tool**. It may help with the content enrichment of this tool… The description of design outcomes should be more clear and explicit… It may help patients and medical staff understand the design strategies and potential effects. When this tool can be widely used, people should understand the content and functions of this tool as much as possible… It is good for the survey efficiency… I am very happy with the database of evidence-based design strategies… I think it is the most important function of this tool… Architects need to learn new, cutting-edge knowledge for healthcare environment design to improve our design abilities… Evidence-based design is essential and vital, but there are some issues that impede our learning… On one hand, architects do not have enough time to find such knowledge from relevant research or articles. Time is limited… On the other hand, **most of papers about the research on evidence-based design strategies are in English**. I think a number of architects, especially for the elderly, cannot understand the content… Therefore, I like two functions of this tool. It is like a dictionary that collects evidence-based design strategies for architects. It saves us time. All content is in Chinese… I know that most of them are summarised from foreign literature… We really need **evidence-based design strategies that are established based on our national conditions**… **The research on evidence-based design should be enhanced in China**… Proper attention should be paid…"

BT-A1: "…It helps me find some innovative information. But it is a pity that I can only know people's requirements in SIP and Suzhou. It is representative, but I really would like to know people's requirements where I will design a project… I have been working for 20 years, and this is the first time that I see a design aided tool of exploring people's cognition… **It costs me a large amount of time to learn this tool**. It needs time to learn… I do not think currently I can fully handle it… It is not very friendly for elderly architects… I did such research several years ago. I, with my assistants, sent questionnaires to patients, in order to understand their potential needs for a general hospital project… It was the first design that I was in charge of… The survey content was not as much as that of this tool… In order to get enough samples, we sent about 600 questionnaires… The statistical results made me rethink my design. It was helpful. I concentrated on design details that could improve patients' satisfaction with the built environment… There was also a pity, as I did not do extra surveys for medical staff… This tool is a new way of exploring end-users' needs, different from the traditional way… It can calculate their needs quickly… The specification says it can find the differences among different stakeholder groups… But **it is necessary to optimise the interfaces for the elderly**… I think the aged patients and medical staff may not understand this tool quickly… They need much more time. **The unfriendly operation process may make them impatient**, and **some of them then give you wrong results without thinking**…"

The feedback from experienced architects provides comments not only for ECPD, but also this research. Comments are focused on **user-friendly design**, **weighting setting** for different stakeholder groups, **evaluation content enhancement** and **education of statistical analysis**. These issues will be addressed in the future work, in order to optimise the research on public participation and efficiency of knowledge exchange in the design decision-making process for community-based healthcare environments. All interviewees agreed on that ECPD could be used to acquire knowledge about evidence-based design and thereby improve the efficiency of communication and knowledge exchange between different stakeholders during the design process. Moreover, comments also reflected that architects had realised the sustainability imbalance in GB/T 51153 – some basic human needs were not addressed in it. Based on long work experience, architects indicated that some important design strategies related to end-users' basic needs were overlooked by this building regulation. They also argued that the research on evidence-based design was in an extremely slow development in China, and in the current construction market of China, there were no design aided tools that were tailored for healthcare environment design or evidence-based design. These issues affect the sustainable design for healthcare environments in China.

10.5 CHAPTER SUMMARY

This chapter demonstrates the design aided tool *End-user Centred Participatory Design for Community-based Healthcare Environments* Version 1.0 (ECPD), including its objectives, design rationale and interfaces. It is a computer programme that visualises and digitalises the end-user centred participatory design approach for community-based healthcare environments. ECPD can be seen as an information source and checklist about healthcare environment design at a community level, providing evidence-based design strategies and assisting the application of GB/T 51153. A "beta test" for ECPD was conducted to investigate experienced architects in the field of healthcare environment design. Positive comments were collected in the first round, which could prove the feasibility of ECPD. In practice, this tool can be used in conjunction with GB/T 51153, to contribute to the social sustainability of community-based healthcare environments. It can improve the capability of primary care delivery systems in urban areas from an architect's perspective. Comments on this design aided tool also reflect architects' attitudes about end-user centred participatory design and the limitations of this tool. Based on the results of all studies and feedback from all target samples, this research is concluded in the next chapter.

11

Conclusions and Future Work

11.1 CHAPTER INTRODUCTION

This chapter concludes the entire research, including the research framework, methodology and findings for the research questions. Research limitations and the future work are summarised based on a self-reflection on the research. It is expected that the final research outcome, a design aided tool ECPD (*End-user Centred Participatory Design for Community-based Healthcare Environments* Version 1.0), can be widely applied in practice, providing useful information, improving the social sustainability of community-based healthcare environments and thereby facilitating the healthcare reform in China.

11.2 RESEARCH FINDINGS

Currently, a long-term key task of China's national healthcare reform (2009 ~ Present) is to transform the allocation of medical resources in urban areas from a "centralised" pattern to a "decentralised" one and thereby establish a more accessible, affordable and equitable healthcare service for the whole society. A large number of healthcare facilities at a community level (i.e. Community Healthcare Centres and Community Healthcare Clinics) have been built to support the primary care delivery, which can also respond to the requirements of the Healthy City movement and Chinese ageing society. However, in the current construction market of China, there is a lack of specific building regulations or standards that are tailored to inform or assess the design of community-based healthcare environments. Most of building regulations in China are mainly designed for general hospitals.

Based on the given situation, this research focused on healthcare environments at a community level. It intended to optimise the design process and quality of community-based healthcare environments in China. Previous research had indicated that end-users' satisfaction with the built environment was an important requirement for healthcare environment design. Particular attention of this research was therefore paid to the social sustainability of community-based healthcare environments. It attempted to explore how end-users' satisfaction with the built environment of healthcare buildings could be used as a criterion to inform the decision-making process for healthcare environment design at a community level and improve the social sustainability. To shed an in-depth insight into this, an end-user centred participatory design approach was designed to describe the "design for users with users" principle. Patients and medical staff, who consisted of the vast majority of end-users in healthcare environments, were selected as target stakeholders. Their cognitive abilities and value judgements for relevant design strategies were studied to have a comprehensive understanding of their priority variances of needs for community-based healthcare environments. Results achieved in all studies aimed to improve the efficiency of public participation and knowledge exchange, and enhance the social sustainability of healthcare environments at a community level. Some suggestions that could be used to modify current building regulations (e.g. *Evaluation Standard for Green Hospital Building* GB/T 51153) were proposed as well.

It is expected that the research findings can be used to **provide an understanding of end-users' satisfaction and design strategies related to end-users' needs for community-based healthcare environments**, **and then develop an approach that can improve the efficiency of end-users' participation and social sustainability of healthcare environments at a community level**. To achieve the research aims, specific research questions have been answered as follows, based on the data and results summarised in this research.

- ✧ **Research Question 1: What design strategies can improve the quality of community-based healthcare environments and thereby meet end-users' needs? What are end-users' preferences for these strategies?**

Currently, buildings are required to be evaluated according to relevant building regulations (e.g. sustainability assessment methods) for ensuring the design quality of their environments.

It is argued by some scholars that most sustainability assessment methods emphasise environmental aspects, instead of looking at the balance between social, economic and environmental concerns (Lutzkendorf & Lorenz 2006; Kaatz et al. 2006; Zhou et al. 2013). It may result in a lack of social outcomes and sustainability imbalance. End-users' satisfaction can inform healthcare environment design and improve the overall quality of healthcare environments, which leads to better end-users' health and well-being. The relationship between the environmental needs of end-users (i.e. patients and medical staff in this research) and the design quality of healthcare environments at a community level was explored based on evidence-based design principles. Cross-comparative studies (i.e. between GB/T 51153 and *BREEAM Healthcare 2008*/*LEED 2009 for Healthcare*/AEDET Evolution) were conducted to collect the design strategies for healthcare environments, based on literature review and archive study. These collected design strategies (i.e. an architectural language) were translated into design outcomes in non-technical statements (i.e. a common language) on the basis of evidence from previous research. All content, including design issues and design strategies, constituted a communication platform, *Conceptual Framework for Healthcare Environment Design*, to support the knowledge exchange between different stakeholder groups (i.e. patients, medical staff and architects) in the mock-up participatory design process.

An interview was conducted to identify the design issues related to the needs of end-users for a community-based healthcare environment. With the help of a common language, all interviewees finally selected 27 design issues out of 60, based on those addressed in the *Conceptual Framework for Healthcare Environment Design* (see Table 5.5). Using this conceptual framework, **design strategies that could meet end-users' needs and thereby improve the quality of community-based healthcare environments** were identified (see Figure 5.5). Of these design strategies, 43.2% were from the assessment criterion Staff & Patient Environment (see Table 4.12). The results reflect that patients and medical staff show little interest in the contents of Performance, Engineering or Construction (see Table 5.5).

The preferences of Patient Group and Staff Group for the design issues related to end-users' needs for community-based healthcare environments were explored using self-completion questionnaires and transferred into a measurable way using a five-point Likert scale (see Table 6.2 & 7.3). On the basis of median values of these design issues, relevant design strategies were prioritised at the different levels of relative importance, which reflected **the preferences of patients and medical staff** (see Table 6.25 & 7.8). It was found that **end-users' attention was mainly focused on patients' dignity**, **indoor comfort**, **circulation convenience**, **equipment and decoration**. Based on these findings summarised in the semi-structured interview and questionnaire surveys, the first research question can be answered, which leads to a new query – "are there any differences between the preferences of patients and medical staff (Research Question 2)?".

- **Research Question 2: Is there a consensus on good community-based healthcare environment design within end-user groups? If no, what are the cognitive differences?**

The results from the semi-structured interview showed that patients and medical staff had different cognitive abilities and knowledge levels about healthcare environment design at a community level. Based on this, a hypothesis was proposed that a complete consensus on good community-based healthcare environment design was unlikely to be reached between patients and medical staff in the near future.

Based on the cross-comparative studies between Patient Group and Staff Group, the statistical results showed that the main priority variances between the needs of patients and medical staff for the design of community-based healthcare environments were focused on **building images** (i.e. "interesting look", "attractive colours and textures" and "height, volume and skyline of the building), **space allocation** (i.e. "access to outdoors", "staff-only places", "parking" and "storage space"), **safety** (i.e. "safety facilities") and **circulation organisations** (i.e. "workflows and logistics" and "minimised circulation distances") (see Table 9.2 & 9.3). A follow-up focus group was conducted to further verify the statistical findings and provide an in-depth insight into the rationale behind these priority variances. It was found that some priority variances between patients and medical staff – for example, building images, safety and circulation organisations, could be mitigated easily based on effective knowledge exchange. However, priority variances still existed in the design of **parking**, **access to outdoors** and **storage space**.

- Medical staff considers parking much more important than patients. Most patients of community-based healthcare facilities do not rely on vehicles very often for traffic. They would like to walk to community-based healthcare facilities, as their residence is not far away. Most of them consider "parking areas" less important for community-based healthcare environments. This finding is conflictive to previous research that parking capacity was one of main factors that could influence patients' satisfaction and mood during the process of seeking medical treatments in urban areas.

  On the contrary, medical staff does not usually live in the communities where they work, and some of them rely on private cars. This variance cannot be solved in the near future. Findings can be used to optimise the accessibility of patients and medical staff to healthcare environments in urban areas. To inform the design of community-based healthcare environments, the differences in patients' satisfaction with the built environments of general hospitals and community-based healthcare facilities should be considered for the design of parking areas. Moreover, as the proportion of female medical staff is much higher than that of males, the design of parking areas for community-based healthcare environments should be more "female-friendly".

- "Access to outdoors" can buffer the negative impacts of patients' anxiety and medical staff's job stress. Community-based healthcare facilities are expected by patients to be open-planned, being integrated into public landscape and natural environments. It can enhance the connection between indoor environments and nature. Medical staff has concerns about the potential safety risks against the overall supervision and management of patients, even though most of medical staff has realised the positive impacts of this strategy upon their well-being and work efficiency.

- As most patients of community-based healthcare facilities seek primary care, they do not need to stay overnight. "Space for rest and storage" is not necessary to them. But medical staff has a higher requirement for storage space. They can store their bicycles, change clothes and have a shower. This strategy can ensure their satisfaction with the built environment, and also encourage the low-carbon commuting.

It was found that these priority variances were caused by the inevitable differences between patients and medical staff – **frequency of using healthcare environments** and **length of stay**. Compared to the similar issues in general hospitals, these priority variances might be more serious in community-based healthcare facilities. It was found in the comparisons that **patients evaluated design issues according to the consideration of their own benefits and interests, and medical staff would like to provide an integrated consideration for the benefits of both patients and medical staff**. To a great extent, the design issues discussed above do not have direct impacts upon patients' health or well-being, which results in that these priority variances cannot be resolved easily in a participatory design in the near future.

Cognitive differences were also identified within each end-user group. For patients, it was found that 1) male and female patients had cognitive differences in the aspects of **building images** (i.e. "interesting look" and "attractive colours and textures"), **safety** (i.e. "security and supervision" and "lighting for outdoor space") and **privacy** (i.e. "gender segregation"); and 2) patients at different ages had cognitive differences in the aspects of **building forms** (i.e. "a human scale" and "obvious entrances"), **access** (i.e. "available public transport", "parking" and “pedestrian access routes”) and **safety** (i.e. “lighting for outdoor space”). For medical staff, the statistical results showed that doctors and nurses had different preferences for the design issues related to **indoor atmosphere** (i.e. “a caring and reassuring atmosphere”, “high-level comfort” and “storage space”) and **dignity** (i.e. “dignity of patients: privacy and company”). As the sample size of each variable in the focus group was limited, causal explanations about these variances were not achieved.

An understanding of end-users’ cognitive differences in the needs of patients and medical staff was achieved. These findings can help architects save time and effort from identifying priority variances between these stakeholder groups in practice. Architects can further communicate with relevant representatives in the participatory design process, gain an in-depth insight into these variances in each project, and thereby make good trade-offs in improving end-users’ satisfaction with healthcare environments at a community level. The next research question is thereby raised – how to facilitate the knowledge exchange between different stakeholder groups when differences exist in cognition.

- **Research Question 3: Can evidence-based design principles be used to facilitate the knowledge exchange across different stakeholder groups in the participatory design process and achieve a win-win result?**

End-user centred principles are important to improve the design quality of healthcare buildings from a social perspective. The feedback collected from questionnaires showed that end-users understood the importance of end-user centred principles for healthcare service. However, most of them did not realise the importance of participation in the design decision-making process. Only a part of medical staff indicated that architects should conduct consultation with medical staff before starting design. This finding means that, currently, there is a lack of awareness for public participation in community-based healthcare environment design. It is necessary to enhance this awareness, which can encourage end-users to actively participate in the design process and express their particular needs. Architects indicated that “low public awareness” was the biggest barrier of hindering the design quality of community-based healthcare environments in China.

Based on the cross-comparative studies between End-user Groups and Architect Group, the priority variances for healthcare environment design at a community level mainly concentrated on **building images** (i.e. “attractive colours and textures” and “height, volume and skyline of the building”), **space allocation** (i.e. “good orientation”, “good views”, “access to outdoors” and “storage space”), **safety** (i.e. “lighting for outdoor spaces” and “pedestrian access routes”) and **humanity** (i.e. “dignity of patients: privacy and company”) (see Figure 9.2 & Table 9.6).

Some design issues that were highly evaluated by patients or medical staff did not draw proper attention from architects, **including** "**dignity of patients**", "**privacy**", "**company**" and "**lighting for outdoor spaces**". This situation may impact upon end-users' satisfaction with architects' design work, and further affect their health and well-being. A good public participation can help architects understand potential priority variances and then reduce negative impacts.

One of the main reasons of low awareness for public participation is that there is a lack of approaches for end-users to share their opinions. The professional restriction impacts upon the accuracy of their description about end-users' visions to design professionals. A common language is necessary for them to understand architects' design intent effectively and express their own needs explicitly. This research proposed an end-user centred participatory design approach, which aimed to provide a communication platform that could support the knowledge exchange between different stakeholders in healthcare environment design.

Knowledge exchange is important to end-user centred participatory design, which ensures that end-users' needs can be understood by architects. To facilitate the knowledge exchange between different stakeholders and reduce their cognitive differences, this research proposed an idea of using evidence as a common language to enhance a mutual understanding between end-users and architects. It was found that **evidence with measured effects** (e.g. duration of hospitalisation, dosage of medicine, error rates and work efficiency) **could explain the outcomes of design strategies in a more explicit way**. It identified design strategies and measured them, which could **facilitate the knowledge exchange between end-users and architects more efficiently**.

Evidence can also be used to reduce debates between end-users and architects in some **design strategies that are misunderstood by end-users**[23]. Based on evidence with measureable effects, end-users can understand design strategies more efficiently, and a relatively high consensus on these design strategies can be reached more easily. In brief, for the design

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[23] In this research, such design strategies are concluded as "artwork" and "good views", based on the feedback of the focus group. In the questionnaire surveys, these design strategies were evaluated at the level of "moderately important". Proper attention was not paid. These design strategies are important evidence-based design strategies on one hand; on the other hand, they have prerequisite items in GB/T 51153. In the follow-up focus group, evidence of these design strategies was provided to participants – for example, "the patients (surgical inpatients who had undergone cholecystectomy) with window views of the trees spent less time in the hospital than those with views of the brick wall: 7.96 days compared with 8.70 days per patient" (Ulrich 1984, p.224). Most participants indicated that they had not known the effectiveness and healthcare outcomes of these design strategies. They claimed that it was necessary to re-evaluate these design strategies. These cognitive differences between end-users and architects can be therefore reduced based on solid evidence.

strategies related to common interests of end-users, it was found that **using evidence-based design principles could be an effective way of facilitating knowledge exchange in the participatory design process and achieving a win-win result by improving the efficiency of a mutual understanding between end-users and architects**. End-users can use evidence to express their needs and preferences for healthcare environment design explicitly, and architects can find relevant design strategies that are related to these outcomes based on solid evidence from previous clinical studies (see Figure 2.15 & 4.5).

According to the "design for user with users" principle, architects' responsibility should be re-identified (see Figure 2.11). They should abandon the idea that architects are dominant in the design decision-making process, act as facilitators in the participatory design, and understand the particular needs of stakeholders in the built environment (see Figure 2.15). It requires architects to have sufficient specialist knowledge to make informed decisions and thereby ensure the environmental satisfaction of all stakeholders. However, only 56.1% of architects in the survey knew about evidence-based design (see Figure 8.4). The cross-comparative studies between End-user Groups and Architect Group further showed that the knowledge levels about evidence-based design were similar between Staff Group and Architect Group (see Table 9.8). Each of them had limitations in some aspects of healthcare outcomes. Moreover, both medical staff and architects had better knowledge levels than patients (see Table 9.5).

These findings are different from the previous statement "users can never be as knowledgeable about the design and construction as the architect" (Hamilton & Watkins 2009, p.11). Long experience of providing healthcare service may enhance the knowledge levels of medical staff regarding the relationship between patients' recovery and healthcare environment design. In the participatory design process, it is expected that architects should have sufficient specialist knowledge about evidence-based design and then be sensitive to the design strategies that can contribute to end-users' desires for community-based healthcare environments. However, the results of Survey for Architect Group showed that architects had limited specialist knowledge about some evidence-based design strategies. **In some cases**, **architects also belong to** "**stakeholders with less specialist knowledge**". This phenomenon can be ascribed to that healthcare environment design is "a synthesis with multistage systems" (Gelun 2015, p.5). It is too complicated to require architects to have sufficient medical knowledge for the design of healthcare buildings. It is necessary to find approaches that can provide architects specialist knowledge about evidence-based design (general education) quickly to support the decision-making of healthcare environment design.

As a revelatory study, this research provided a design aided tool ECPD (*End-user Centred Participatory Design for Community-based Healthcare Environments* Version 1.0) (see Figure 10.1 & 10.2). It created a communication platform and participatory environment for end-users and architects. This tool intends to **help architects facilitate the knowledge exchange between different stakeholders by providing information about evidence-based design – design outcomes in non-technical statements (design issues)**, **design inputs with standards (design strategies) and measured effects (evidence collected from previous research)**. Such design can assist both end-users and architects to acquire required information and improve the efficiency of end-users' participation in the design process of community-based healthcare environments.

ECPD also provides an opportunity of verifying relevant findings and evidence from previous research repeatedly, by continually collecting the data about stakeholders' environmental needs and the changes of these needs in practice. In the focus group, some patients indicated that using artwork to relieve people's pressure and anxiety was out of date. A "mobile-friendly" environment (e.g. public Wi-Fi and charging units) in wards and waiting areas was better to distract patients' attention to their illnesses. According to literature review, the evidence about artwork decoration was produced in 1990s, when personal mobile devices were not popular. A record system is necessary to track existing evidence-based design strategies, in order to test their effectiveness in each unique project and explore potential new evidence with the development of society, economy and technologies. Based on all findings, it was concluded that **architects**, **especially for those with less experience in participatory design or healthcare environment design**, **should use some tools that could help them learn new specialist knowledge about evidence-based design from updated findings**, **in order to facilitate the knowledge exchange between stakeholders with different knowledge levels and make informed decisions in the participatory design process in a more effective way**. All discussion and analysis above can be used to answer the third research question.

- ✧ **Research Question 4: How can the current building regulations in China be further modified to ensure end-users' satisfaction and social sustainability for community-based healthcare environments?**

In the current construction market, building regulations, especially for sustainability assessment methods, are widely used as information sources and design decision-making aids, which can provide all stakeholders with required information to address issues related to their benefits and interests appropriately. Based on the results of Survey for Architect Group, "building regulations from governments/local authorities" were considered as the most important information source for architects to make decisions. It is expected that sustainability assessment methods can support the communication and knowledge exchange between stakeholders with different knowledge levels in a participatory design process. However, some weaknesses of *Evaluation Standard for Green Hospital Building* GB/T 51153 that might affect such functions in healthcare environment design at a community level were identified. Based on a series of cross-comparative studies between prevailing sustainability assessment methods (i.e. *Evaluation Standard for Green Hospital Building* GB/T 51153, *BREEAM Healthcare 2008* and *LEED 2009 for Healthcare*) and design aided tools (i.e. AEDET Evolution and ASPECT), it was found that:

- Several evidence-based design strategies that had been proved in previous clinical studies were overlooked by GB/T 51153 – for example, user guide participation, safety, artwork, privacy protection and workflow design for medical staff's work efficiency (see Table 4.7). Some basic human needs were not addressed in it;

- In total, 98.9% of design items in GB/T 51153 had identical standards for "all single healthcare buildings and building clusters", some of which with complex, technical requirements were not suitable for the design of healthcare environments at a community level (MOHURD & AQSIQ 2015, p.3);

- The content of GB/T 51153 was technical. It provided detailed techniques and requirements about design inputs that were only for professional stakeholders. It was not effective to act as a communication platform.

The cross-comparative study between End-user Groups and GB/T 51153 identified the differences between the value judgements of end-users (i.e. patient and medical staff) and legislation. It was found that 19 design strategies out of 44 were not included in GB/T 51153, and most were evaluated as "extremely important" and "very important" by both Patient Group and Staff Group (see Table 9.10). Of the missing design strategies, 10 belonged to evidence-based design strategies. In terms of overlapping design strategies, some that were relatively important in GB/T 51153 (those with prerequisite items) were not evaluated highly by Patient Group or Staff Group. Based on these results, it was found that, **currently**, **the application of GB/T 51153 was unlikely to properly inform the design and delivery of a community-based healthcare environment that could** "**provide patients and medical staff with healthy**, **suitable and effective space**" **for** "**all single healthcare buildings and building clusters**" (MOHURD & AQSIQ 2015, p.2 & p.3). It still pays more attention to environmental aspects – ecosystem and resource utilisation, which may result in **sustainability imbalance** in the process of assessing healthcare buildings.

Suggestions were proposed for GB/T 51153 from a social perspective, in order to modify it to ensure end-users' satisfaction and social sustainability for community-based healthcare environments. This national sustainability assessment method is launched as **a benchmarking standard** for the development of regional building regulations. **When GB/T 51153 is applied to inform or access a community-based healthcare building project in somewhere**, **local interpretation is necessary**. Building regulations can be modified hierarchically (i.e. national, regional and individual) based on the Triple Bottom Line concept (i.e. environmental, social and economic aspects) (see Figure 9.5). First, it is relatively easy to directly use the content related to the environmental dimension (e.g. protection of ecosystems and preservation of biodiversity) as national guidance. The requirements, standards and expected outcomes of these design strategies are objective, which are unlikely to be affected subjectively in the design of healthcare building projects. Second, for the social dimension, the content should be applied based on regional consultation and local characteristics. During this process, it is necessary for GB/T 51153 to be modified by taking into account opinions from local residents and future end-users in a participatory design process.

Taking this research project as an example. Based on the cross-comparative studies, various levels of differences between the value judgements of GB/T 51153 and each end-user group in SIP in healthcare environment design at a community level were found (see Table 6.2 & 7.3). These differences could be used as a reference, in conjunction with GB/T 51153, to achieve the multi-level knowledge integration, as well as the ways of addressing social concerns and avoiding the mismatch of information supply and demand. A design aided tool ECPD was proposed to describe this participatory design approach in a visual and digital way. It provided a communication platform in healthcare environment design at a community level that could translate the content of GB/T 51153 into a common language, collect end-users' needs for the built environment, and identify the differences between end-users' preferences and the requirements in legislation. ECPD can be used to conduct the participatory design more effectively, since end-users can finish this process independently, without the face-to-face supervision of architects or other professionals. Based on this participatory design approach, public participation in healthcare environment design can be enhanced, which leads to better capacity of GB/T 51153 in addressing social concerns.

The local interpretation can also enhance the application of GB/T 51153 at a regional level. This participatory design approach requires architects not only to explore end-users' needs, but also understand the differences between end-users' needs and the requirements of GB/T 51153. In the Survey for Architect Group, architects evaluated their knowledge levels about this sustainability assessment method as "neutral". This finding was further verified based on the comparison results that – the preferences of experienced architects did not correspond with the evaluation content of GB/T 51153. Using ECPD, architects, especially for those with less experience in community-based healthcare environment design, may become interested in applying and studying GB/T 51153, acquire specialist knowledge about evidence-based design, and thereby provide informed decisions to their design work.

After the local interpretation, the content regarding the economic domain can be conducted finally to each unique healthcare building. Relevant design strategies can be filtered according to the budget analysis of each individual community-based healthcare building project. These issues make the final decisions of selecting design strategies. As stated earlier, the total amount of community-based healthcare facilities will continue growing in the following decades in China in order to further support the primary care delivery in urban areas and meet the demands of the whole society (CHYXX 2016a; Ban et al. 2018). On the basis of such modification, GB/T 51153 may achieve a better performance in ensuring end-users' satisfaction and social sustainability for community-based healthcare environments, thereby informing sustainable healthcare environment design at a community level.

In summary by answering to all research questions, a comprehensive understanding of end-users' needs for healthcare environments at a community level can be achieved. The research findings can be used to improve the design quality and social sustainability of community-based healthcare environments from an architect's perspective. A design aided tool (ECPD) is developed to provide an approach of educating architects, especially for those with less experience in participatory design or healthcare environment design, on evidence-based design in practice. It also leaves architects free space for creative thinking and innovation to improve their design work. This is the first time in China that evidence-based design principles are proposed to facilitate the knowledge exchange between different stakeholders. As the research and application of evidence-based design are in an extremely slow development in China, there are limited studies that can verify the effectiveness of current evidence-based design strategies based on the Chinese context. The findings of this research can be fed back into previous research on end-users' satisfaction, and thereby contribute to the development of evidence-based design theories and a health-supportive environment in China.

11.3 RESEARCH LIMITATIONS AND FUTURE WORK

A successful social research project relies on prominent criteria – reliability, replication and validity (Bollen 1989; Nunnaly & Bernstein 1994; Robson 2011; Bryman 2012). This PhD research project is designed based on a considerable amount of time and effort, which means it may lead to errors relating to the reliability, replication or validity of some findings. Several research limitations are summarised in this section, based on which, the future work is proposed accordingly to further optimise the quality of findings.

For sampling methods, most of social studies in this research were conducted at a single point in time, and the longitudinal design was only used in the response analysis from patients (i.e. a verification study between Patient Group and Patient Group II). It is because that the amount of patients who received medical treatments from the community-based healthcare facilities in SIP during the period of field investigations was impossible to be obtained. The verification study can improve the reliability of findings about patients' cognition and knowledge levels. Methods that could effectively estimate test reliability in a social research project – for example, test-retest methods, were not applied in the studies for medical staff or architects. On one hand, the amount of medical staff could be obtained from the selected community-based healthcare facilities (i.e. 296 in total), and the response rate of Survey for Staff Group was appropriate (i.e. 38.5%). On the other hand, the responses of Architect Group were achieved from experienced architects who had been involved in the design of community-based healthcare buildings and environments. Therefore, due to the consideration of time and effort for a PhD research project, verification studies were not implemented for these stakeholder groups. For the future work, test-retest studies will be conducted to improve the consistency of measurements over time and reduce random errors, in order to ensure the reliability of relevant findings in the research (Bryman 2012).

The scientificity of sample size for patients, medical staff and architects was not precise enough. It is indicated that the average sample size should be between 500 and 1000 cases (persons) for regional research (Wu 2003, p.4; Sudman 1976). It is also argued that, for social research, the minimum proportion of sample size in the research group is 10% (Wu 2003, p.5; Bryman 2012). The sample size of Patient Group was designed as 550, since it was hardly to know the exact number of patients. This sample size might not be qualified for the requirement of 10%. For Staff Group and Architect Group, the amount of some responses was fewer than the minimum sample size (30). It led to that correlational studies could not be conducted for each group or variable.

Moreover, the follow-up focus group was conducted to provide causal explanations about the priority variances identified based on statistical results. Significant differences within each end-user group – for example, between male and female patients, between patients at different ages, and between doctors and nurses, were not discussed in the focus group, as the sample size was limited. In the future work, the sample sizes will be enriched to implement more detailed measurements for statistical analysis, in order to further explore the priority variances that are caused by these variables.

The key stakeholders of healthcare environments can be subdivided into nine groups. Patients, caregivers, family, visitors, medical staff and community partners all belong to end-user groups. Stakeholders from the areas of design, construction, finance and research can be considered as professionals. In this research, only patients and medical staff were explored as end-users, while architects were explored as professionals. The stakeholder groups who were not explored in this research also play important roles in the design decision-making. They should also be engaged in the participatory design process of healthcare environments at a community level. Their satisfaction and environmental needs will be explored to have a bigger picture of knowledge exchange between stakeholders with different knowledge levels. In addition, all field investigations were conducted in SIP. Compared to other cities in China, it has a special urban morphology – neighbourhood planning principles. Findings achieved in this research intend to provide representative information to the cities that would like to use SIP's experience to enhance their construction of primary care networks and community-based healthcare environments.

Since some research limitations have been recognised, they will be solved in the future work. The research framework will be further optimised. To increase the influence of research findings and further verify the results, this participatory design approach has been digitalised into a design aided tool – *End-user Centred Participatory Design for Community-based Healthcare Environments* Version 1.0 (ECPD). The feasibility and effectiveness of ECPD will be tested in real-life projects, together with building regulations and post occupancy evaluation (POE) from all stakeholders. Based on the information that is continually collected and analysed by ECPD in practice, people's satisfaction with the built environment of healthcare buildings will be explored comprehensively. Relevant findings can be iteratively refined, in order to contribute to the design quality of community-based healthcare environments and the development of the national healthcare reform in China in the near future.

"Let life be beautiful like summer flowers …"

– Rabindranath Tagore, 1913

~ THE END ~

REFERENCES

A

Altimier, L.B. (2004). Healing environments: for patients and providers. *Newborn and Infant Nursing Reviews*. 4(2) p. 89-92.

AQSIQ (General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China) & SAC (Standardisation Administration of the People's Republic of China). (2017). *Guidelines for the Use of English in Public Service Areas – Part 7: Health and Medicine GB/T 30240.7*. Beijing: China Planning Press.

Arsand, E. & Demiris, G. (2008). User-centred methods for designing patient-centric self-help tools. *Informatics for Health & Social Care*. 33(3) p. 158-169.

Ashcroft, R. (2015). Health promotion and primary health care: examining the discourse. *Social Work in Public Health.* 30(2) p. 107-116.

B

Bajunid, A.F.I., Abbas, M.Y., Nawawi, A.H. & Rodi, W.N.W. (2014). Cul-de-sac courtyard physical environment evaluation toolkit. *Procedia – Social and Behavioral Sciences*. 153 p. 148-158.

Ban, Q., Chen, B., Sharples, S. & Phiri, M. (2016a). An applied research on evidence-based design principles in healthcare environment. *Chinese Hospital Architecture & Equipment*. 10 p. 95-100.

Ban, Q., Chen, B., Gelun, Sharples, S. & Phiri, M. (2016b). A study on architectural design tools and sustainability assessment standards of the healthcare environment. *Architectural Journal*. 578(11) p. 99-103.

Ban, Q. (2017). *Green Healthcare Environment Aided Design – (Weighing Tool)*. [CD-ROM]. Beijing: National Copyright Administration of the People's Republic of China.

Ban, Q., Chen, Z., Chen, B. & Liu, X. (2017). Research on evidence-based design for healthcare buildings based on building information modelling. *In 2017 Forum on Academic Innovation for Postgraduates in Jiangsu Province – "Digital +" and Changes in Yangzi Rover Dells*. Suzhou, Saturday 16th to Sunday 17th December 2017. Suzhou: Journal of Suzhou University of Science and Technology. p. 162-172.

Ban, Q., Chen, B. & Sharples, S. (2018). User-centered participatory design for community-based healthcare environment: a pilot study in Suzhou Industry Park, China. *In Environmental Design Research Association (EDRA) 49 Conference*. Oklahoma, Wednesday 6th to Saturday 9th June 2018. Saint Paul: The Environmental Design Research Association. p. 169-176.

Bardos, R.P., Jones, S., Stephenson, I., Menger, P., Beumer, V., Neonato, F., Maring, L., Ferber, U., Track, T. & Wendler, K. (2016). Optimising value from the soft re-use of brownfield sites. *Science of The Total Environment*. 563-564 p. 769-782.

Baron, R.A. (2006). Environmentally induced positive affect: its impact on self-efficacy, task performance, negotiation, and conflict. *Journal of Applied Social Psychology*. 20(5) p. 368-384.

Baum, M., Shepley, M., Rostenberg, B. & Ginsberg, R. (2009). *Eco-effective design and evidence-based design: removing barriers to integration* [Online]. Available at: <URL: http://www.aia.org/aiaucmp/groups/aia/documents/pdf/aiab080501.pdf> [Accessed on 27th June 2014].

Beauchemin, K.M. & Hays, P. (1998a). Sunny hospital rooms expedite recovery from severe and refractory depressions. *Journal of Affective Disorders*. 40 p. 352-354.

Beauchemin, K.M. & Hays, P. (1998b). Dying in the dark: sunshine, gender and outcomes in myocardial infarction. *Journal of the Royal Society of Medicine*. 91 p. 352-354.

Benton, C. (1998). Architecture Revised: On Listening to Buildings. In: Scott, A. (ed.) *Dimensions of Sustainability*. London: E & FN Spon.

Berdie, D.R. (1994). Reassessing the value of high response rates to mail surveys. *Marketing Research*. 1 p. 52-64.

Bilbo, D., Bigelow, B., Escamilla, E. & Lockwood, C. (2015). Comparison of construction manager at risk and integrated project delivery performance on healthcare projects: a comparative case study. *International Journal of Construction Education and Research*. 11 p. 40-53.

Blutstein, H. & Rodger, A. (2001). The sustainable tall building of the third millennium. *In the 6th World Congress of the Councile on Tall Buildings and Urban Habitat*. Melbourne, Monday 26th February to Friday 2nd March 2001. London: Spon Press. p. 131-142.

Bollen, K.A. (1989). *Structural Equations with Latent Variables*. 1st Ed. Chichester, West Susses: John Wiley & Sons.

Boron, S. & Murray, K. (2004). Bridging the unsustainability gap: a framework for sustainable development. *Sustainable Development*. 12 p. 65-73.

BRE (Building Research Establishment). (2012). *BREEAM Healthcare 2008* [Online]. Available at: <URL: http://www.breeam.com/filelibrary/Technical%20Manuals/SD5053_4_1BREEAM_ Healthcare_ 2008.pdf> [Accessed on 1st September 2014].

Brown S. (2010). *Likert scale examples for surveys* [Online]. Available at: <URL: http://www.extension.iastate.edu/Documents/ANR/LikertScaleExamplesforSurveys.pdf> [Accessed on 10th October 2014].

Bruntland, G. (1987). *Our Common Future: The World Commission on Environment and Development*. Oxford: Oxford University Press.

Bryman, A. (1988). *Quantity and Quality in Social Research*. London: Routledge.

Bryman, A. (2012). *Social Research Methods*. 4th Ed. Oxford: Oxford University Press.

C

CABE (Commission for Architecture and the Built Environment). (2004). *The role of hospital design in the recruitment, retention and performance of NHS nurses in England* [Online]. Available at: <URL: http://webarchive.nationalarchives.gov.uk/20110118123545/http://www.cabe.org.uk/publications/role-of-hospital-design-in-the-recuritment> [Accessed on 17th January 2016].

Carayanni, V. (2007). Constructing confidence intervals around incremental cost effectiveness ratios (ICER's) in healthcare evaluations: a review. *Journal of Statistics and Management Systems*. 10 p. 609-619.

Carbon Trust. (2010). *Hospitals: Healthy budgets through energy efficiency* [Online]. Available at: <URL: http://www.carbontrust.com/media/39216/ctv024_hospitals.pdf> [Accessed on 6th July 2017].

Cardoso, C. & Clarkson, P.J. (2012). Simulation in user-centred design: helping designers to empathise with atypical users. *Journal of Engineering Design*. 23(1) p. 1-22.

Carifio, J. & Perla, R.J. (2007). Ten common misunderstandings, misconceptions, persistent myths and urban legends. *Journal of Social Science*. 3(3) p. 106-116.

Carifio, J. & Perla, R.J. (2008). Resolving the 50-year debate around using and misusing Likert scales. *Medical Education*. 42(12) p. 1150-1152.

Carroll, J.B. (1993). *Human Cognitive Abilities: A Survey of Factor-analytic Studies*. Victoria: Cambridge University Press.

CDC (Centres for Disease Control and Prevention). (2013). *Workplace safety and health topics: healthcare workers* [Online]. Available at: <URL: http://www.cdc.gov/niosh/topics/healthcare/> [Accessed on 2nd August 2014].

CHA (Chinese Hospital Association). (2011). *Assessment Standard for Healthcare Green Building CSUS/GBC-2*. Beijing: China Planning Press.

Chang, Y., Huang, P., Chuang, T. & Chang, S. (2016). A pilot study of the colour performance of recycling green building materials. *Journal of Building Engineering*. 7 p. 114-120.

Chao, J. & Xie, H. (2008). A glimpse of hospital evidence-based design in the UK. *Urban and Architecture*. 7 p. 31-32.

Chen, B., Phiri, M., Mills, G. & Chang, C. (2011). Design strategies and environmental assessment methods in healthcare: lessons from UK's BREEAM. *Architectural Journal*. s2 p. 159-163.

Chen, B., Zhang, H., Yin, J., Song, L. & Kang, J. (2016). Evidence-based design principles and their application in green building. *Eco-City and Green Building*. 23(2) p. 35-41.

Chen, J. & Song, Y. (2014). Research on traffic problems and solving strategies of polyclinics in the city of Shenzhen. *Transportation Science & Technology*. 264 p. 186-189.

Chen, Q., Conway, A. & Cheng, J. (2017). Parking for residential delivery in New York City: regulations and behaviour. *Transport Policy*. 54 p. 53-60.

Chen, W. & Shu, X. (2014). The combined model of urban community service system: a study on the SIP's neighbourhood centre model. *Journal of Henan University (Social Science)*. 54(1) p. 55-61.

CHD (The Centre for Health Design). (2014a). *Building the Evidence Base: Understanding Research in Healthcare Design*. 3rd Ed. Concord, CA: The Centre for Health Design.

CHD (The Centre for Health Design). (2014b). *Integrating the Evidence-Base Design: Practicing the Healthcare Design Process*. 3rd Ed. Concord, CA: The Centre for Health Design.

CHD (The Centre for Health Design). (2015). *An Introduction to Evidence-based Design: Exploring Healthcare and Design*. 3rd Ed. Concord, CA: The Centre for Health Design.

China Society for Urban Studies (ed.) (2013). *China Green Building*. Beijing: China Architecture & Building Press.

Chong, W., Wang, X., Wong, K., Mojumder J. & Poh, S. (2016). Performance assessment of a hybrid solar-wind-rain eco-roof system for buildings. *Energy and Buildings*. 127 p. 1028-1042.

CHYXX. (2016a). *A report on market trends and prospect forecast for Chinese community medical faculties 2017-2022* [Online]. Available at: <URL: http://www.chyxx.com/research/201611/465446.html> [Accessed on 12th November 2017].

CHYXX. (2016b). *A report on status analysis and investment strategies for Chinese ageing industry 2017-2022* [Online]. Available at: <URL: http://www.chyxx.com/research/201609/451914.html> [Accessed on 15th October 2017].

Cohen, J. (1988). *Statistical Power Analysis for the Behavioural Sciences*. 2nd Ed. New York: Academic Press.

Cohen, J. (1992). A power primer. *Psychological Bulletin*. 112(1) p. 155-159.

Cole, R.J. (1999). Building environmental assessment methods: clarifying intentions. *Building Research & Information*. 27(4/5) p. 230-246.

Cole, R.J. (2005). Building environmental assessment methods: redefining intentions and roles. *Building Research & Information*. 35(5) p. 455-467.

Cooper, I. (1999). Which focus for building assessment methods – environmental performance or sustainability?. *Building Research & Information*. 27(4/5) p. 321-331.

Couper, M. (2000). Web surveys: A review of issues and approaches. *Public Opinion Quarterly*. 64 p. 464-494.

Central Committee of CPC (Central Committee of the Communist Party of China) & State Council. (1997). Decisions on Healthcare Reforms and Development by the Central Committee of the Communist Party of China and State Council. *Chinese Health Economics*. 16(169) p. 5-9.

Creswell, J.W. (1998). *Qualitative Inquiry and Research Design: Choosing among Five Traditions*. Thousand Oaks, CA: Sage Publications.

Creswell, J.W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Method Approaches*. 2nd Ed. Thousand Oaks, CA: Sage Publications.

Creswell, J.W. (2014). *Educational Research: Planning, Conducting and Evaluating Quantitative and Qualitative Research*. 5th Ed. Upper Saddle Reiver, New Jersey: Pearson Education Inc.

Cundy, A.B., Bardos, R.P., Puschenreiter, M., Mench, M., Bert, V., Friesl-Hanl, W., Muller, I., Li, X., Weyens, N., Witters, N. & Vangronsveld, J. (2016). Brownfield to green fields: realising wider benefits from practical contaminant phytomanagement strategies. *Journal of Environmental Management*. 184 p. 67-77.

Cvijikj, I.P. & Michahelles, F. (2011). 4 The toolkit approach for end-user participation in the internet of things. In: Uckelmann, D., Harrison, M. & Michahelles, F. (eds.). *Architecting the Internet of Things*. Heidelberg: Springer.

D

Dammann, S. & Elle, M. (2006). Environmental indicators: establishing a common language for green building. *Building Research & Information*. 34(4) p. 387-404.

DeVellis, R.F. (2003). *Scale Development: Theory and Applications*. 2nd Ed. Thousand Oaks, CA: Sage Publications.

Derks, B., Scheepers, D., Laar, C.V. & Ellemers, N. (2011). The threat vs. challenge of car parking for women: how self- and group affirmation affect cardiovascular responses. *Journal of Experimental Social Psychology*. 47 p. 178-183.

DH (Department of Health). (2004a). *Achieving excellence design evaluation toolkit (AEDET Evolution)* [Online]. Available at: <URL: http://webarchive.nationalarchives.gov.uk/

20130107105354/http://www.dh.gov.uk/pord_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_082085.pdf > [Accessed on 5th September 2015].

DH (Department of Health). (2004b). *A staff and patient environment calibration tool (ASPECT)* [Online]. Available at: <URL: http://webarchive.nationalarchives.gov.uk/20130107705354/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_082081.pdf> [Accessed on 5th September 2015].

DH (Department of Health). (2014). *Health building note 00-01 General design guidance for healthcare buildings* [Online]. Available at: <URL: http://www.gov.uk/government/uploads/system/uploads/attachmentdata/316247/HBN_00-01-2.pdf> [Accessed on 9th December 2014].

DH Hong Kong (Department of Health Hong Kong). (2007). *Building healthy cities – guidelines for implementing a Healthy Cities Project in Hong Kong* [Online]. 2nd Ed. Available at: <URL: http://www.chp.gov.hk/files/pdf/Building_Healthy_Cities_Guidelines.pdf> [Accessed on 12th June 2017].

Ding, G.K.C. (2005). Developing a multicriteria approach for the measurement of sustainable performance. *Building Research & Information*. 33(1) p. 3-16.

Dong, E., Bao, Y. & Liu, W. (2016). A review of "medical and old-age care fusion" integration model for community-based health centre and the elderly nursing care home. *Chinese Health Service Management*, 340(10) p. 731-732.

Dorrington, P., Wilkinson, C., Tasker, L. & Walters A. (2016). User-centred design method for the design of assistive switch devices to improve user experience, accessibility, and independence. *Journal of Usability Studies*. 11(2) p. 66-82.

Douglas, C.H. & Douglas, M.R. (2005). Patient-centred improvements in healthcare built environments: perspectives and design indicators. *Health Expectations*. 8(3) p. 264-276.

E

Eason, K.D. (1995). User-centred design: for users or by users?. *Ergonomics*. 38(8) p. 1667-1673.

Edwards, B. & Turrent, D. (2000). *Sustainable Housing: Principles and Practice*. Abingdon, Oxon: E & FN Spon.

F

Farmer, J. (1996). *Green Shift: Towards A Green Sensibility in Architecture*. Oxford: Butterworth Architecture with WWF-UK.

Field, A. (2009). *Discovering Statistics Using SPSS*. 3rd Ed. Thousand Oaks, California: SAGE Publications Inc.

Flanagan, R., Ingram, I. & Marsh, L. (1998). *A Bridge to the Future: Profitable Construction for Tomorrow's Industry and its Costumers*. London: Thomas Telford RCF.

G

Gardner, H.J. & Martin, M.A. (2007). Analysing ordinal scales in studies of virtual environments: Likert or Lump it!. *Presence: Teleoperators and Virtual Environments*. 16(4) p. 439-446.

Gelun. (2012). Three steps of evidence-based design development in China healthcare construction. *Chinese Hospital Architecture & Equipment*. 13(10) p. 56-56.

Gelun. (2015). *Thoughts about Hospital Building in China: Gelun's Interview Record*. Beijing: China Architecture & Building Press.

Geumacs. (2009). *Virtual life D2.1: end user definition and needs* [Online]. Available at: <URL: http://virtuallife.mif.vu.lt/public/VirtualLife_D2.1_EndUserDefinitionAndNeeds.pdf> [Accessed on 21st June 2017].

Ghazali, R. & Abbas, M.Y. (2012). Assessment of healing environment in paediatric wards. *Procedia – Social and Behavioural Sciences*. 38 p. 149-159.

Gibberd, J. (2001). *The sustainable building assessment tool – assessing how buildings can support sustainability in developing countries* [Online]. Available at: <URL: http//pdfs. Semanticscholar.org/ba1d/c72071e7a4b77884b033a07e892cef55fb02.pdf> [Accessed on 16th April 2017].

Glaser, B.G. & Strauss, A. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago: Aldine Transaction.

Glass, P., Avery, G.B., Subramanian, K.N., Keys, M.P., Sostek, A.M. & Friendly, D.M. (1985). Effects of bright light in hospital nursery on the incidence of retinopathy of maturity. *The New England Journal of Medicine*. 313(7) p. 401-404.

Guenther, R. & Vittori, G. (2013). *Sustainable Healthcare Architecture*. 2nd Ed. Hoboken, New Jersey: John Wiley & Sons.

Guinee, J. (ed.) (2002). *Handbook on Life Cycle Assessment*. Boston: Kluwer Academic Publishers.

Gwizdka, J. (n.d.). *Cognitive differences: personal characteristics facet* [Online]. Available at: <URL: http://zh.scribd.com/presentation/22356932/Cognitive-Differences> [Accessed on 4th October 2017].

H

de Haes, U. & Lindeijer, E. (2002). The areas of protection in life cycle assessment. *Global LAC Village*. 3 p. 1-8.

Hamilton, D.K. & Watkins, D.H. (2009). *Evidence-based Design for Multiple Building Types*. Hoboken, New Jersey: John Wiley & Sons.

Hamilton, D.K & Shepley, M.M. (2009). *Design for Critical Care: An Evidence-based Approach*. New York: Architectural Press.

Hancock, T. & Duhl, L. (1988). *Promoting Health in the Urban Context*. WHO Healthy Cities Papers No. 1. Copenhagen: WHO.

Hartmann, B., Torok, S., Borcsok, E. & Groma, V.O. (2014). Multi-objective method for energy purpose redevelopment of brownfield sites. *Journal of Cleaner Production*. 84 p. 202-212.

Hayes, N. (2013). "Our hospital"? Voluntary provision, community, and civic consciousness in Nottingham before the NHS. *Midland History*. 37 p. 84-105.

He, J.A. (2011). China's ongoing public hospital reform: initiatives, constraints, and prospect. *Journal of Asian Public Policy*. 4(3) p. 342-349.

He, Q. & Chen, F. (2016). A research on current development of community health service at home and abroad. *Chinese Rural Health Service Administration*. 36(3) p. 328-331.

Heerwagen, H.J. & Orians, H.G. (1986). Adaptations to windowlessness: a study of the use of visual décor in windowed & windowless offices. *Environment and Behaviour*. 18(5) p. 623-639.

Hendrick, H.W. (1991). Ergonomics in organisational design and management. *Ergonomics*. 34 p. 743-756.

Hofstetter, P. (1998). *Perspectives in Life Cycle Impact Assessment: A Structured Approach to Combine Models of the Technosphere, Ecosphere and Valuesphere*. 1st Ed. Boston: Kluwer Academic Publishers.

Hoskin T. (n.d.). *Parametric and nonparametric: demystifying the terms* [Online]. Available at: <URL: http://www.mayo.edu/mayo-edu-docs/center-for-translational-science-activities-documents/berd-5-6.pdf> [Accessed on 5th May 2016].

I

IPCC (Intergovernmental Panel on Climate Change). (2015). *Climate Change 2014 Synthesis Report* [Online]. Available at: <http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_ALL_Topics.pdf> [Accessed on 11st July 2017].

ISO (International Organisation for Standardisation). (1999). ISO13407:1999. *Human-centred Design Processes for Interactive Systems*. Geneva: International Organisation for Standardisation.

J

Jackson, C.S. & Smith, K.H. (2014). A social marketing template for solving the musicians' dilemma through non-profit healthcare networks. *Journal of Nonprofit & Public Sector Marketing*. 26 p. 80-98.

Johnson, L. (2009). Sustainable design is founded on evidence. In: Hamilton, D.K. & Watkins, D.H. (eds.). *Evidence-based Design for Multiple Building Types*. Hoboken, New Jersey: John Wiley & Sons.

K

Kaatz, E., Root, D.S., Bowen, P.A. & Hill, R.C. (2006). Advancing key outcomes of sustainability building assessment. *Building Research & Information*. 34(4) p. 308-320.

Kujala, S. (2003). User involvement: a review of the benefits and challenges. *Behaviour & Information Technology*. 22 p. 1-16.

L

Langley G.R. (1997). Evidence-based Medicine: How to Practice and Teach EBM. *Journal of American Medical Association*. 10(2) p. 2382-2383.

Lawson, B. & Phiri, M. (2003). *Architectural Healthcare Environment and Its Effects on Patient Health Outcomes*. London: The Stationery Office.

Lawson, B. (2005). *How Designers Think*. 4th Ed. Oxford: Architectural Press.

Layard, A., Davoudi, S. & Batty S. (ed.) (2001). *Planning for A Sustainable Future*. London: Spon Press.

Leather, P., Pygras, M., Beale, D. & Lawrence, C. (1997). Windows in the workplace: sunlight, view and occupational stress. *Environment and Behaviour*. 30(6) p. 739-762.

Leedy, P.D. & Ormrod, J.E. (2001). *Practical Research: Planning and Design*. 7th Ed. Upper Saddle River, NJ: Merrill Prentice Hall.

Li, L. (2011). The challenges of healthcare reforms in China. *Public Health.* 125 p. 6-8.

Liang, W. & Chan, D.K.Y. (2004). *Community health care reform and general practice training in China – lessons learned* [Online]. Available at: <URL: http://www.tandfonline.com/doi/abs/10.3402/meo.v9i.4366> [Accessed on 21st October 2014].

Lincoln, Y.S. & Guba, E.G. (1985). *Naturalistic Inquiry*. Newbury Park, CA: Sage Publications.

Liu, X., Chi, J. & Han, Y. (2010). Research on the improvement of elderly care service in China based on community medical service resources. *Chinese Journal of General Practice*. 8(4) p. 474-476.

Liu, X., Zhao, S., Zhang, M., Hu, D. & Meng, Q. (2015). The development of rural primary health care in China's health system reform. *Journal of Asian Public Policy*. 8(1) p. 88-101.

Lutzkendorf, T. & Lorenz, D.P. (2006). Using an integrated performance approach in building assessment tools. *Building Research & Information*. 34(4) p. 334-356.

Lutzkendorf, T., Hajek, P., Lupisek, A., Immendorfe, A., Nibel, S. & Hakkinen T. (2012). New trends in sustainability assessment systems – based on top-down approach and stakeholders needs. *International Journal of Sustainable Building Technology and Urban Development*. 3(4) p. 256-269.

Lv, Z. (2011). The construction standards and status of community health centre in China. *Chinese Hospital Architecture & Equipment*. 12 p. 13-14.

M

Macnaughton, J. (2007). Art in hospital spaces. *International Journal of Cultural Policy*. 13 p. 85-101.

Malkin, J. (2008). *A Visual Reference for Evidence-based Design*. Concord, CA: The Centre for Health Design.

Malone, E.B., Mann-Dooks, J.R. & Strauss, J. (2007). *Evidence-based Design: Application in the MHS*. Falls Church, VA: Noblis.

Mann, N.P., Haddow, R., Stokes, L., Goodley, S. & Rutter, N. (1986). Effect of night and day on preterm infants in a newborn nursery: randomised trial. *British Medical Journal*. 293 p. 1265.

MBDC (McDonough Braungart Design Chemistry). (2008). *Glossary of key concepts* [Online]. Available at: <URL: http://www.mbdc.com/c2c_gkc.htm> [Accessed on 11th November 2014].

McKinley, R.K., Manku-Scott, T., Hastings, A.M., French, D.P. & Baker, R. (1997). Reliability and validity of a new measure of patient satisfaction with out of hours primary medical care in the United Kingdom: development of a patient questionnaire. *BMJ*. 314(7075) p. 193-198.

MFE (Ministry of the Environment Manatu Mo Te Taiao). (2008). *Passive solar design guidance* [Online]. Available at: <URL: http://www.mfe.govt.nz/sites/default/files/passive-solar-design-guidance.pdf> [Accessed on 1st July 2016].

Michael, S.E., Hull, R.B. & Zahm, D.L. (2001). Environmental factors influencing auto burglary: a case study. *Environment and Behaviour*. 33(3) p. 368-388.

Mills, G.R.W., Phiri, M., Erskine, J. & Price, D.F. (2015). Rethinking healthcare building design quality: an evidence-based strategy. *Building Research & Information*. 43(4) p. 499-515.

Moeinaddini, M., Asadi-Shekari, Z., Ismail, C.R. & Shah, M.Z. (2013). A practical method for evaluating parking area level of service. *Land Use Policy*. 33 p. 1-10.

MOHURD (Ministry of Housing and Urban-Rural Development of the People's Republic of China). (2011). *Technical Instruction for Green Hospital Building Assessment*. Beijing: China Planning Press.

MOHURD (Ministry of Housing and Urban-Rural Development of the People's Republic of China) & AQSIQ (General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China). (2014). *Code for Design of General Hospital GB/T 51039*. Beijing: China Planning Press.

MOHURD (Ministry of Housing and Urban-Rural Development of the People's Republic of China) & AQSIQ (General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China). (2015). *Evaluation Standard for Green Hospital Building GB/T 51153*. Beijing: China Planning Press.

Murray, J. (2013). Likert data: what to use, parametric or non-parametric?. *Internal Journal of Business and Social Science*. 4(11) p. 258-264.

N

Nachshon, U., Netzer, L. & Livshitz, Y. (2016). Land cover properties and rain water harvesting in urban environments. *Sustainable Cities and Society*. 27 p. 398-406.

Neducin, D., Krkljes, M. & Kurtovic-Folic, N. (2010). Hospital outdoor spaces: therapeutic benefits and design considerations. *Architecture and Civil Engineering*. 8(3) p. 293-305.

Nejati, A., Rodiek, S. & Shepley, M. (2015). Using visual simulation to evaluate restorative qualities of access to nature in hospital staff break areas. *Landscape and Urban Planning*. 148 p. 132-138.

NHFPC (National Health and Family Planning Commission of the People's Republic of China). (1999). Opinions on developing urban community health service. *Chinese General Practice*. 2(5) p. 337-339.

NHFPC (National Health and Family Planning Commission of the People's Republic of China). (2002). Opinions on speeding up the development of urban community health service. *Chinese Hospitals*. 6(12) p. 53-54.

NHFPC (National Health and Family Planning Commission of the People's Republic of China). (2006). *Management methods for urban community healthcare service facilities* [Online]. Available at: <URL: http://www.gov.cn/zwgk/2006-08/10/content_359147.htm> [Accessed on 14th December 2015].

NHFPC (National Health and Family Planning Commission of the People's Republic of China). (2013). *Construction Standard for Community Health Service Centre/Station JGJ 163*. Beijing: China Planning Press.

Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Adv in Health Sci Educ*. 15 p. 625-632.

Nunnally, J.C. & Bernstein, I.H. (1994). *Psychometric Theory*. New York: McGraw-Hill.

O

O'Keeffe, D. (2008). *Facilitation of the Design Quality of Hospitals by Using the Achieving Excellence Design Evaluation Tool*. Unpublished.

Onwuegbuzie, A.J. & Collins, K.M.T. (2007). A typology of mixed methods sampling designs in social sciences research. *The Qualitative Report*. 12(2) p. 281-316.

P

Pallant, J.F. (2005a). *SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS*. 12th Ed. NSW: Open University Press.

Pallant, J.F. (2005b). *SPSS Survival Manual: A step by Step Guide to Data Analysis Using SPSS*. 2th Ed. NSW: Allen & Unwin.

Pallant, J.F. (2016). *SPSS Survival Manual: A Step by Step Guide to Data Analysis Using IBM SPSS*. 6th Ed. NSW: Open University Press.

Phiri, M. (2014). *Design Tools for Evidence-based Healthcare Design*. Abington: Routledge.

Phiri, M. & Chen, B. (2014). *Sustainability and Evidence-based Design in the Healthcare Estate*. Heidelberg: Springer.

Pitts, A. (2004). *Planning and Design Strategies for Sustainability: Pragmatic Sustainable Design on Building and Urban Scales*. Oxford: Architectural Press.

Prahalad, C. & Hamel, D. (1990). The core competence of the corporation. *Harvard Business Review*. 68(3) p. 79-91.

Pratt, A. & Nunes, J. (2015). *Interactive Design: An Introduction to the Theory and Application of User-centred Design*. New York: Rochport Publishers.

R

Rashid, M. (2010). Environmental design for patient families in intensive care units. *Journal of Healthcare Engineering*. 1(3) p. 367-397.

Ratner, B.D. (2004). "Sustainability" as a dialogue of values: challenges to the sociology of development. *Sociological Inquiry*. 74(1) p. 59-69.

Retzlaff, R.C. (2008). Green building assessment systems: a framework and comparison for planners. *Journal of the American Planning Association*. 74(4) p. 505-519.

Ricciardi, P., Torchia, F., Belloni, E., Lascaro, E. & Buratti, C. (2017). Environmental characterisation of coffee chaff, a new recycled material for building applications. *Construction and Building Materials*. 147 p. 185-193.

RIBA (Royal Institute of British Architects). (2013). *The RIBA plan of work 2013* [Online]. Available at: <URL: http://www.ribaplanofwork.com/> [Accessed on 17th January 2019].

Rice, C.G., Talbott, J.A. & Stern, D. (1980). Effects of environmental agents on social behaviour of patients in a hospital dining room. *Hospital & Community Psychiatry*. 31(2) p. 128-130.

Ritchie, A. & Thomas, R. (eds.). (2009). *Sustainable Urban Design: An Environmental Approach*. 2nd Ed. New York: Taylor & Francis.

Robson, C. (2011). *Real World Research: A Resource for Users of Social Research Methods in Applied Settings*. 3rd Ed. Chichester, West Susses: John Wiley & Sons.

Ruddock, S. (2009). *Assessment of the Built Environment for Healthcare: A Case Study in the Development of an Evaluation Framework*. A Thesis Submitted in partial fulfilment of the Requirements of The University of Salford for the Degree of Doctor of Philosophy. Manchester: The University of Salford.

S

Scholtz, B.M., Calitz, A.P., Marx Gomez, J. & Fischer, F. (2014). Voluntary and mandatory company sustainability reporting: a comparison of approaches. *In 28th EnviroInfo 2014*

Conference, Oldenburg, Wednesday 10th to Friday 12th September 2014. [Online]. Available at: <URL: http://pdfs.semanticscholar.org/ce86/8a1401d177f83e20e6c69ae77c4076791d5e.pdf> [Accessed on 2nd July 2018].

Schroeder, H.W. (1991). Preference and meaning of arboretum landscapes: combining quantitative and qualitative data. *Journal of Environmental Psychology*. 11 p. 231-248.

Selvaraj, S. (2010). Evidence-based medicine – a new approach to teach medicine: a basic review for beginners. *Biology and Medicine*. 2(1) p. 1-5.

Sha, Z. (2017). Design of females' parking facilities. *Science & Technology Information*. 29 p. 238-239.

Sharma, V., Simpson, R.C., LoPresti, E.F., Mostowy, C., Olson, J., Puhlman, J., Hayashi, S., Cooper, R.A., Konarski, E. & Kerley, B. (2008). Participatory design in the development of the wheelchair convoy system. *Journal of NeuroEngineering & Rehabilitation*. 5 p.1-10.

Sheehan, K.B. & McMillan, S.J. (1999). Response variation in email surveys: an exploration. *Journal of Advertising Research*. 39(4) p. 45-54.

Shepley, M., Baum, M., Ginsberg, R. & Rostenberg, B. (2012). Ecological efficiency design and evidence based design: universals and peculiarities. *Chinese Hospital Architecture & Equipment*. 11 p. 23-27.

Sherrie M. (2010). *Increase response rates with these 5 survey tips* [Online]. Available at: <URL: http://survey.cvent.com/blog/cvent-web-surveys-blog/increase-response-rates-with-these-5-survey-tips> [Accessed on 10th November 2015].

Sheskin, D. (2011). *Handbook of Parametric and Nonparametric Statistical Procedures*. 5th Ed. Boca Raton, FL: Chapman & Hall/CRC.

Shiers, D.E., Rapson, D. & Keeping, M. (2006). Sustainable construction: the development and evaluation of an environmental profiling system. *Construction Economics & Management*. 24 p. 10-12.

SIPAC. (n.d.a). *Location and traffic of SIP* [Online]. Available at: <URL: http://www.sipac.gov.cn/zjyq/dljt/201107/t20110708_103658.htm> [Accessed on 9th May 2015].

SIPAC. (n.d.b). *Introduction of SIP* [Online]. Available at: <URL: http://www.sipac.gov.cn/zjyq/yqgk/201801/t20180120_677084.htm> [Accessed on 13th August 2018].

SIPAC. (n.d.c). *Distribution of medical resources* [Online]. Available at: <URL: http://www.jkyp.sipac.gov.cn/MedicalResource/HospitalMap> [Accessed on 9th January 2019].

Stephan, A. & Stephan, L. (2017). Life cycle water, energy and cost analysis of multiple water harvesting and management measures for apartment buildings in a Mediterranean climate. *Sustainable Cities and Society*. 32 p. 584-603.

Strauss, A.C. & Corbin, J.M. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Newbury Park, CA: Sage.

Strauss, A.C. & Corbin, J.M. (1998). *Basic of Qualitative Research: Techniques and Procedures for Development Grounded Theory*. Thousand Oaks, CA: Sage.

Strauss, A.C. & Corbin, J.M. (2007). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. 3rd Ed. Thousand Oaks, CA: Sage Publications.

Sudman, S. (1976). *Applied Sampling*. New York: Academic Press.

T

Tabachnick, B.G. & Fidell, L.S. (2001). *Using Multivariate Statistics*. 4th Ed. New York: HarperCollins.

Tan, W. (2018). Suzhou: process re-engineering based on health needs. *China Health*. 9 p.23-24.

Thomson, S.B. (2011). Sample size and grounded theory. *JOAAG*. 5(1) p. 45-52.

Trochim, W.M.K. (2001). *Research Methods Knowledge Base*. 2nd Ed. Cincinnati, Ohio: Atomic Dog Pub.

U

Uckelmann, D., Harrison, M. & Michahelles, F. (eds.) (2011). *Architecting the Internet of Things*. Heidelberg: Springer.

Ulrich, R.S. (1984). View through a window may influence recovery from surgery. *Science*. 224 p. 420-421.

Ulrich, R.S., Lunden, O. & Eltinge, J.L. (1993). Effects of exposure to nature and abstract pictures on patients recovering from heart surgery. *Psychophysiology*. 30 p. 7.

Ulrich, R.S., Zimring, C., Zhu, X., DuBose, J., Seo, H., Choi, Y., Quan, X. & Joseph, A. (2008). *A review of the research literature on evidence-based healthcare design* [Online]. Available at: <URL: http://www.healthdesign.org/sites/default/files/hcleader_5_litreviewwp1.pdf> [Accessed on 11st July 2017].

UN DESA (United Nations Department of Economic and Social Affairs). (2013). *World Population Prospects: the 2012 Revision. Volume 2: Demographic Profiles*. New York: UN DESA, Population Division.

USGBC (U.S. Green Building Council). (2014). *LEED 2009 for Healthcare* [Online]. Available at: <URL: http://cn.usgbc.org/sites/default/files/LEED%202009%20RS_HC_07.01.2016_clean.pdf> [Accessed on 10th January 2015].

V

Vagias W.M. (2006). *Likert-type scale response anchors* [Online]. Available at: <URL: http://www.stlhe.ca/wp-content/uploads/2013/04/LOTS-sample-scales.pdf> [Accessed on 10th October 2014].

Verderber, S. (2010). *Innovations in Hospital Architecture*. New York: Routledge.

Vischer, J.C. (2008). Towards a user-centred theory of the built environment. *Building Research & Information*. 36(3) p. 231-240.

W

Walsh, J.E. (1962). *Handbook of Nonparametric Statistics*. New York: D.V.Nostrand.

Wang, M. (2009). New town planning in Singapore and its revelation. *City Planning Review*. 8 p. 43-51.

Wang, Y., Feng, Y., Liu, X., Yang, M., Ma, L., Qiao, M., She, Y. & Deng, L. (2015). Thought on the development mode of community health service settings in the elderly supporting mechanism construction. *Chinese General Practice.* 18(13) p. 1493-1497.

Wever, R., Kuijk J. & Boks, C. (2008). User-centred design for sustainable behaviour. *International Journal of Sustainable Engineering*. 1 p. 9-20.

WHO (World Health Organisation). (1948). *Official Records of the World Health Organisation No.2*. New York: United Nations.

WHO (World Health Organisation). (1997). *Twenty Steps for Developing a Healthy Cities Project*. 3rd Ed. Copenhagen: WHO.

WHO (World Health Organisation). (1998). *Health Promotion Glossary*. Geneva, Switzerland: WHO Press.

WHO (World Health Organisation). (2015). *China Country Assessment Report on Ageing and Health*. Geneva, Switzerland: WHO Press.

WHO (World Health Organisation). (n.d.). *Types of healthy setting – health cities* [Online]. Available at: <URL: http//www.who.int/healthy_settings/types/cities/en/> [Accessed on 6th July 2015].

Wilkinson, C.R. & Angeli, A.D. (2014). Applying user centred and participatory design approaches to commercial product development. *Design Studies*. 35(6) p. 614-631.

Wilkinson, C.R., Walters, A. & Evans, J. (2016). Creating and testing a model-driven framework for accessible user-centric design. *The Design Journal*. 19(1) p. 69-91.

Wu, M. (2003). *SPSS Tong Ji Ying Yong Shi Wu Wen Juan Fen Xi Yu Ying Yong Tong Ji*. Beijing: Science Press.

Wu, S., Wang, C. & Zhang, G. (2015). Has China's new health care reform improved efficiency at the provincial level? Evidence from a panel data of 31 Chinese provinces. *Journal of Asian Policy*. 8(1) p. 36-55.

Wypijewski, J. (ed.) (1998). *Painting by Numbers: Komar and Melamid's Scientific Guide to Art*. New York: University of California Press.

X

Xu, L. & Huang, W. (2010). Mirror significance of community health services institution in Australis and UK on community health services in China. *Chinese Nursing Research*. 24(28) p. 2552-2554.

Xu, W., Zhang, W. & Li, L. (2017). Measuring the expected locational accessibility of urban transit network for commuting trips. *Transportation Research Part D: Transport and Environment*. 51 p. 62-81.

Y

Yang, J., Hong, Y. & Ma, S. (2016). Impact of the new health care reform on hospital expenditure in China: a case study from a pilot city. *China Economic Review*. 39 p. 1-14.

Yao, Z., Yin, J. & Xu, Z. (2011). The mechanism of China's difficulty in seeing a doctor and high expense of getting medical service. *Shandong Social Science*. 9 p. 137-137.

Ye, L., Cheng, Z., Wang, Q., Lin, H., Lin, C. & Liu, B. (2015). Developments of green building standards in China. *Renewable Energy*. 73 p. 115-122.

Z

Zhang, Q., Li, T. & Shi, R. (2016). Evaluation on the accessibility of high order urban hospitals for the aged – a case study of the first-level hospitals in Xi'an city. *Journal of Shaanxi Normal University (National Science Edition)*. 44 p. 96-101.

Zhang, S., Mi, Y., Tang, Y., Zhang, Z. & Zhu, W. (2018). Discussion on regional medical coordinated development implementation path under the environment of hierarchical healthcare system: analysis on demand and supply of Suzhou Industrial Park. *Chinese Hospitals*. 22(11) p. 5-9.

Zhang, X., Chen, L., Mueller, K., Yu, Q., Liu, J. & Lin, G. (2011). Tracking the effectiveness of health care reform in China: a case study of community health centres in a district of Beijing. *Health Policy*. 100 p. 181-188.

Zhao, H. & Feng, X. (2010). Health-care reform in China. *The Chinese Economy*. 43(3) p. 31-36.

Zhou, L., Keivani, R. & Kurul, E. (2013). Sustainability performance measurement framework for PFI projects in the UK. *Journal of Financial Management of Property and Construction*. 18(18) p. 232-250.

APPENDIX 1: PUBLICATIONS

APPENDIX 1.1: List of Academic Publications

Journal Papers

- **Ban, Q.**, Chen, B., Sharples, S. & Phiri, M. (2016). An applied research on evidence-based design principles in healthcare environment. *Chinese Hospital Architecture & Equipment*. 10 p. 95-100. (in Chinese)
- **Ban, Q.**, Chen, B., Gelun, Sharples, S. & Phiri, M. (2016). A study on architectural design tools and sustainability assessment standards of the healthcare environment. *Architectural Journal*. 578 (11) p. 99-103. (in Chinese)
- **Ban, Q.**, Chen, B., Kang, J., Sharples, S., Li, J. & Yao, J. (2018). User behaviour information management and design quality optimisation of the built environment. *Building Science*. 34 (6) p. 74-81. (in Chinese)
- Ren, F. & **Ban, Q.*** (2018). Research on a training model for comprehensive innovation capabilities of college talents based on methodology teaching. *Talent Research*. (accepted, in Chinese)
- Li, J., **Ban, Q.***, Chen, X. & Yao, J. (2019). Glazing sizing in large atrium buildings: a perspective of balancing daylight quantity and visual comfort. *Energies*. 12 (4), 701.

Conference Papers

- **Ban, Q.**, Chen, Z., Chen, B. & Liu, X. (2017). Research on evidence-based design for healthcare buildings based on building information modelling. *In 2017 Forum on Academic Innovation for Postgraduates in Jiangsu Province – 'Digital+' and Changes in Yangzi River Dells*. Suzhou, Saturday 16th to Sunday 17th December 2017. Suzhou: Journal of Suzhou University of Science and Technology. p. 162-172. (in Chinese)
- **Ban, Q.**, Chen, B. & Sharples, S. (2018). User-centered participatory design for community-based healthcare environment: a pilot study in Suzhou Industry Park, China. *In Environmental Design Research Association (EDRA) 49 Conference*. Oklahoma, Wednesday 6th to Saturday 9th June 2018. Saint Paul: The Environmental Design Research Association. p. 169-176.
- Yao, J., Yang, F., Zhuang, Z., Shao, Y., **Ban, Q.**, Li, J. & Yuan, F. (2018). Outdoor natural ventilation and construction sequence based urban planning strategies in extended district of Lujiazui CBD, Shanghai. *In 4th International Conference on Building Energy, Environment*. Melbourne, Monday 5th to Friday 9th February 2018. Melbourne: COBEE. p. 821-826.

- Li, J., Chen, X., **Ban, Q.**, Chen, Z. & Wang, P. (2018). A study on BIM-based green building collaborative design and information platform. *In 2018 International Conference on Green and Energy-Efficient Building*. Shenzhen, Monday 2nd to Tuesday 3rd April 2018. Beijing: Chinese City Press. p. 809-812. (in Chinese)
- Li, J., Chen, X., **Ban, Q.** & Yao, J. (2018). Skylight sizing based on balancing daylighting performance and visual comfort in atrium buildings. *In The 9th Edition of the International SOLARIS Conference*. Chengdu, Thursday 30th to Friday 31st August 2018. (accepted)

Books

- Phiri, M. & Chen, B. (2019). *Sustainability and Evidence-based Design in the Healthcare Estate* (**Ban, Q.** & Ren, F. Trans.). Beijing: China Architecture & Building Press. (2014). (in press)

Computer Programmes

- **Ban, Q.** (2017). *Green Healthcare Environment Aided Design – (Weighing Tool)*. [CD-ROM]. Beijing: National Copyright Administration of the People's Republic of China.

Patents

- **Ban, Q.** (2019). *An information-aided architectural design approach for green buildings*. [Patent]. China, ZL-2016-1-0191656.5.

APPENDIX 1.2: An Applied Research on Evidence-based Design Principles in Healthcare Environment

循证设计策略在医疗建筑环境领域的应用研究

AN APPLIED RESEARCH ON EVIDENCE-BASED DESIGN PRINCIPLES IN HEALTHCARE ENVIRONMENT

文 | 班淇超 陈冰 Stephen Sharples Michael Phiri
By Ban Qichao Chen Bing Stephen Sharples Michael Phiri

摘　要：文章分析了循证设计原理及三要素，回顾了其发展历程，从自然元素、空间环境和功能设备3个方面详细阐述了循证设计策略的开发模式，旨在进一步推动循证设计在我国医疗建筑设计中的应用，促进整体医疗环境的优化发展。
关键词：循证设计；医疗建筑环境；循证设计要素；循证大数据

Abstract: The article analyzes the principles and the three elements of evidence-based design; recalls its development process; elaborates the development model of evidence-based design strategies from three aspects, the natural elements, space environment and functional devices; further promotes the application of evidence-based design in medical building design in our country, then the overall medical environment optimization.
Keywords: Evidence-based design; Medical building environment; Evidence-based design elements; Evidence-based big data

doi:10.3969/j.issn.1671-9174.2016.10.009

“以人为本”的设计理念是建筑行业设计行为的主要出发点之一。作为面向患者提供治疗和康复的医疗建筑，其以人为本的设计模式，就是通过科学的方法，从使用者的视角出发，打造一个良好的康复环境，使患者在该环境内最大效率地康复。20世纪80年代兴起于美国的“循证设计”原理，即通过对医疗环境各物理元素的设计，强调环境对患者康复、安全以及医护人员工作效率的影响，成为上述人文主义精神在医疗环境设计中的重要体现。

一、循证设计的原理、发展历史和三要素

循证设计中“循证”二字源自医学界的“循证医学”理论——“遵循证据的医学”，循证医学于20世纪70~80年代进入医疗实践领域。建筑界将“循证医学”原理与“基于性能的建筑设计”理论结合并应用于医疗建筑设计，形成早期的“循证设计”概念，解释为“遵循证据的建筑设计”。

与循证设计理论相关的文字记录最早出现于1984年，美国德克萨斯A&M大学建筑学院的罗杰·乌利齐教授在《Science》杂志上发表了一篇名为《窗外景观可影响术后患者恢复》的论文。这篇论文不仅首次通过严谨的科学方法证明了建筑环境对患者治疗和康复情况有直接的影响，还阐明了循证设计原理在医疗建筑环境设计过程中的重要指导意义。

2007年，美国注册建筑师、德克萨斯A&M大学的汉密尔顿教授经过修正，在《各类型建筑的循证设计》一书中，给出了目前对“循证设计”较为完整的定义：“当（建筑师）做每一个决定时，慎重、准确和明智地应用在当前研究和实际操作中所能找到的最佳研究依据，并据此与业主（用户）进行有建设性的沟通，去设计独一无二的建筑”。基于对该定义的理解，循证设计“三要素”可表述为：研究依据、用户期望和策略决定（图1）。

其中，“研究依据”可以看作是循证设计过程的基础与核心，是众多来自不同领域的学者和研究人员通过在实验和调研中收集和整理相关数据而取得

APPENDIX 1.3: A Study on Architectural Design Tools and Sustainability Standards of the Healthcare Environment

医疗建筑环境设计辅助工具与可持续评价标准的研究

A Study on Architectural Design Tools and Sustainability Assessment Standards of the Healthcare Environment

[班淇超] Ban Qichao [1, 2]
[陈冰] Chen Bing [1]
[格伦] Gelun [3]
[斯蒂芬·沙普尔斯] Stephen Sharples [2]
[迈克尔·菲利] Michael Phiri [4]

作者单位
1 西交利物浦大学城市规划与设计系（苏州，215123）
2 英国利物浦大学建筑学院
3 北京建筑大学建筑与城市规划学院（北京，100044）
4 医疗建筑研究中心（英国）

收稿日期
2016/08/16

西交利物浦大学研究发展基金项目
(RDF-15-01-19 & RDF-11-01-15)

摘　要

结合国际医疗环境设计辅助工具和我国医疗建筑可持续评价标准的分析及对比，提出适用于我国的绿色医疗建筑环境设计辅助工具，在医疗建筑项目的策划阶段为建筑从业人员和所有参与策划的团队搭建技术交流平台，为促进多方合作效率和医疗建筑环境的整体设计品质提供学术支持和研究基础。

关键词

医疗建筑环境，设计辅助工具，循证设计，可持续评价标准，AEDET，绿色医院建筑评价标准

ABSTRACT

This paper explores the healthcare environment design in China, based on a comparative study between Achieving Excellence Design Evaluation Toolkit (AEDET) and an official Chinese Evaluation Standards for Green Hospital Building GB/T51153. It presents a pilot model of design tool for healthcare environment that intends to improve the overall design quality and cooperation efficiency across different stakeholder groups involved in the design and delivery of healthcare environment.

KEY WORDS

healthcare environment; architectural design tools; evidence-based design; sustainability assessment standards; AEDET; *Evaluation Standard for Green Hospital Building*

1 循证设计原理

医疗建筑环境的循证设计原理源于医学界的“循证医学(Evidence-based Medicine)”理论，即“遵循证据的医学”[1-2]。其核心思想是：“医疗决策（即对病患的处理、治疗指南和医疗政策的制定等）应以临床研究为依据，在当前最佳研究成果的基础上做出判断，同时也重视与个人（医生）临床经验的结合”[1-2]。该思想被医学界称之为“伟大的人文主义思想”，“（某诊断）是否有循证医学加以辅佐”已成为拥有良好专业素养的当代医生应具备的惯性思维[3]。自1970–1980年代起，循证医学理念在引发医疗实践领域巨大变革的同时，也引导医疗建筑环境的设计逐步转向“循证设计”。

循证设计(Evidence-based Design)可直译为“遵循证据的建筑设计”，旨在弱化建筑设计过程中人为主观因素影响，转而通过运用各领域（医疗领域、建筑领域等）前期研究中所证实的、可信的客观科学依据来指导建筑设计思维和过程[4-5]。“循证”要求建筑师参考已有的实验中所提供的“证据(evidence)”——研究成果和数据，并结合建筑师自身的从业经验，针对医疗环境设计过程中存在的各种问题，提出最适宜、最科学的解决方案。目前已有的学术成果中，涉及的循证设计策略，主要是通过对建筑细节（如窗墙比、空间颜色、铺地材质、辅助设施等）的设计影响医院物理环境中的自然元素，从而对医院最终使用者（患者和医护人员）产生影响，通过环境设计加快病人康复、降低用药量、提高病人满意度以及医护人员的工作效率等因素[6-7]。

在循证设计原理的基础上，各类适用于医疗建筑环境的设计辅助工具被陆续开发出来，其中最为知名的AEDET(Achieving Excellence Design Evaluation Toolkit)，已广泛应用于国际医疗建筑环境设计的前期策划及整个设计过程[8-9]，并通过对设计环节及策略产出的量化，简化了复杂的操作流程，提高了团队间的合作效率和成果品质。下文通过对比AEDET与《绿色医院建筑评价标准》GB/T51153-2015，希望能够为我国当前的医疗建筑环境建设提出一些在循证设计方面的建议。

2 设计辅助工具AEDET介绍

AEDET是Achieving Excellence Design Evaluation Toolkit的缩写，译为“获得‘卓越’的设计评价工具”，由英国国家卫生部NHS(National Health Service)授权、谢菲尔德大学医疗建筑研究中

APPENDIX 1.4: User Behaviour Information Management and Design Quality Optimisation of the Built Environment

第 34 卷第 6 期　　建 筑 科 学　　Vol. 34, No. 6
2018 年 6 月　　BUILDING SCIENCE　　Jun. 2018

[文章编号] 1002-8528(2018)06-0074-08　　DOI:10. 13614/j. cnki. 11-1962/tu. 2018. 06. 11

用户行为信息管理与建筑环境设计品质改善

班淇超[1,2,5],陈　冰[2],康　健[3,4],斯蒂芬·沙普尔斯[5],李　节[2],姚佳伟[6](1. 青岛理工大学 建筑与城乡规划学院,山东 青岛 266033;2. 西交利物浦大学 城市规划与设计系,江苏 苏州 215123;3. 英国谢菲尔德大学 建筑学院,英国 谢菲尔德;4. 哈尔滨工业大学 建筑学院,黑龙江 哈尔滨 150001; 5. 英国利物浦大学 建筑学院,英国 利物浦;6. 同济大学 建筑与城市规划学院,上海 200092)

[摘　要] 结合绿色建筑与 BIM 理论,以数字技术为基础,提出将建筑使用者的行为与状态等信息纳入建筑信息范畴,并对这些信息进行统计与归纳,形成可用于改善建筑环境设计品质的方法——用户行为信息管理。研究选取医疗建筑为研究对象,通过实验采集环境噪声与用户满意度等相关信息并进行对比,验证这一系统的有效性,揭示了建立用户健康信息数据库、并以之辅助建筑环境循证设计的重要性。

[关键词] 用户行为信息管理; 数字技术; 声环境; 循证设计; 健康建筑
[中图分类号] TU023　　[文献标识码] A

User Behavior Information Management and Design Quality Optimization of the Building Environment

BAN Qichao[1,2,5], *CHEN Bing*[2], *KANG Jian*[3,4], *Stephen SHARPLES*[5], *LI Jie*[2], *YAO Jiawei*[6] (1. *College of Architecture and Urban Planning, Qingdao University of Technology, Qingdao* 266033, *Shandong, China*;2. *Department of Urban Planning and Design, Xi' an Jiaotong-Liverpool University, Suzhou* 215123, *Jiangsu, China*; 3. *School of Architecture, University of Sheffield, Sheffield, UK*;4. *School of Architecture, Harbin Institute of Technology, Harbin* 150001, *Heilongjiang, China*;5. *School of Architecture, University of Liverpool, Liverpool, UK*;6. *College of Architecture and Urban Planning, Tongji University, Shanghai* 200092, *China*)

Abstract: This paper proposes a User Behavior Information Management system on the basis of digital technologies by combining with the principles of green architecture and Building Information Modeling (BIM). This paper shows a pilot study that is designed to verify the effectiveness of the User Behavior Information Management system based on a comparative study between the acoustic environment of a hospital and patients' satisfaction degrees. The importance of establishing users' health information database and using it to inform the design of healthcare environments according to the evidence-based design principle is also stressed in this paper.

Keywords: user behavior information management (UBIM), digital technology, acoustic environment, evidence-based design, healthy building

0　引　言

纵观当今建筑设计理论及发展趋势 "全周期绿色建筑"与"BIM"受到了建筑界乃至整个社会的关注。绿色建筑设计注重自然环境与人的和谐共生,强调建筑环境的整体品质及可持续性,以及对环境保护和人体健康的影响[1];而 BIM 则强调建筑设计与管理的信息化,利用数字技术优势,打造"智能管理下的建筑模式"[2]。其中 BIM 可归纳为 Building Information Modeling(建筑信息建模)、Building Information Model(建筑信息模型)或 Building Information Management(建筑信息管理),而这三组定义又可看作是建筑信息运用的不同发展阶段,即"建筑信息通过计算机三维模型的方式建立和统一起来"、"计算机三维模型在建筑各个方面提供可依据的相关信息"、以及"在建筑各方面、各阶

[收稿日期] 2017-09-14　　[修回日期] 2017-11-22
[基金项目] 西交利物浦大学研究发展基金项目(RDF-15-01-19 & RDF-11-01-15);中国博士后科学基金面上资助项目(2018M632162)
[作者简介] 班淇超(1986-),男,博士,讲师
[通讯作者] 姚佳伟(1987-),男,博士,博士后
[联系方式] qichao. ban@ qut. edu. cn

APPENDIX 1.5: Research on Evidence-based Design for Healthcare Buildings based on Building Information Modelling

基于 BIM 技术的医疗建筑循证设计研究

班淇超[1,2,4] 陈志远[3] 陈冰[2] 刘学贤[1] 姚佳伟[5]

（1 青岛理工大学建筑与城乡规划学院，山东青岛 266033；2 西交利物浦大学城市规划与设计系，江苏苏州 215123；3 中诚工程建设管理（苏州）股份有限公司，江苏苏州 215008；4 利物浦大学建筑学院，英国利物浦 L69 3BX；5 同济大学建筑与城市规划学院，上海 200092）

摘　要：当前建筑市场 BIM 技术主要应用于建筑设计和施工阶段的碰撞检测，而通过建筑信息的管理，获得室内外环境使用过程中对用户健康的影响程度，并利用统计信息优化建筑整体品质和引导未来建筑设计等方面的应用，尚未得到重视。为推动我国“健康建筑”理念的发展，本研究旨在通过 BIM 的信息管理方法，在建立现阶段 BIM 模型的同时，强化对用户健康和工作效率产生影响的设备的信息收集，建立“健康信息”对照实验数据库，实现健康大数据的统计，最终提高建筑整体性能，进而开发应用于我国医疗建筑的循证设计策略和全生命周期信息平台。

关键词：建筑信息模型（BIM）；循证设计；医疗建筑；健康；大数据

RESEARCH ON EVIDENCE-BASED DESIGN FOR HEALTHCARE BUILDINGS BASED ON BUILDING INFORMATION MODELING

Ban Qichao[1,2,4] Chen Zhiyuan[3] Chen Bing[2] Liu Xuexian[1] Yao Jiawei[5]

(1 Qingdao University of Technology, College of Architecture and Urban Planning, Shandong Qingdao 266033; 2 Xi'an Jiaotong-Liverpool University, Department of Urban Planning and Design, Jiangsu Suzhou 215123; 3 Zhongcheng Project Management (Suzhou) Co.Ltd., Jiangsu Suzhou 215008; 4 University of Liverpool, School of Architecture, UK Liverpool L69 3BX; 5 Tongji University, College of Architecture and Urban Planning, Shanghai 20092)

Abstract: BIM (Building Information Modeling) technologies are currently applied for the intersection detection at the stages of design and construction in the architectural field. However, little attention has been paid to the application of statistical building information that can inform the architectural design and improve the overall design quality and users' health. To promote the development of the Healthy Building theory, this research explores a method that applies BIM technologies for health information statistics to achieve the design quality of buildings. A database that collects information of health-supportive devices was created, which was embedded in a traditional building information model. This database can also be viewed as a platform that supports the life cycle analysis for evidence-based design strategies in China.

Key words: Building Information Modeling (BIM); Evidence-based Design; Healthcare Building; Health; Big Data

APPENDIX 1.6: User-centred Participatory Design for Community-based Healthcare Environment: A Pilot Study in Suzhou Industry Park, China

Track: Participatory Design Strategies

User-centered Participatory Design for Community-based Healthcare Environment: A Pilot Study in Suzhou Industry Park, China

Qichao Ban (University of Liverpool); Bing Chen (Xi'an Jiaotong-Liverpool University); Steve Sharples (University of Liverpool)

1. Introduction

China's current healthcare reform aims to establish an accessible, affordable, and equitable healthcare system for the whole society [1]. One of the long-term key tasks is to transform the allocation of medical resources in urban areas from a "centralized" to a "decentralized" pattern. It is expected that such a transformation would improve the capacities of primary care delivery and respond to new issues arising from the aging society [2]. According to the statistical results, the percentage of the elderly (e.g. people aged 60 years or above) in China will rise from 12.4% of the total population (168 million) in 2010 to 28% (402 million) by 2040. There is an urgent need to solve the potential problems caused by this demographic trend [3]. It is believed that a high-quality healthcare environment at community level, as a key performance indicator for the social development, is necessary. By 2016, the quantity of community-based healthcare facilities in the urban areas has reached about 34,000, and will continue to grow in the following 10 years in order to meet the demands of the society [4]. However, for now there is no specific design regulations or unified standards in China to assess the design quality of community-based healthcare environment.

Previous research showed that healthcare buildings should be designed as a therapeutic environment that can contribute to the process of healing rather than a place where only medical treatments take place [5]. One of the most important conceptual design trends is to look at users' satisfaction of the built environment. Such information can effectively inform the healthcare design and thereby improve the overall quality of the healthcare environment and users' health and well-being [6-8]. To improve users' satisfaction, a user-centered participatory design process is proposed – by encouraging users to become involved in the design decision-making, such a process would efficiently establish communication between users and professional stakeholders (e.g. architects, engineers, developers, assessors, administrators).

However, some scholars argued that there were concerns that might impact upon the efficiency of the users' participation in the design decision-making process [9-11]. First, in the current construction market, some sustainability assessment methods (e.g. LEED, BREEAM, DGNB) are widely used as information sources and design decision-making aids by architects to holistically improve the quality of their design work [12]. It is believed that these methods are appropriate checklists and thereby can serve as a communication platform to involve all stakeholders in design [10]. Nevertheless, the contents of these documents are professional and technical. There is a lack of common language for lay stakeholders (e.g. users) to express their visions and needs by evaluating the design strategies directly. Second, as the peoples' needs are mainly derived from a consciousness of their previous experience or dissatisfaction with reality, the different characteristics (e.g. gender, age) of users may cause the cognitive differences that further lead to the priority variances of users' needs [13]. To comprehensively meet the users' satisfaction and needs for healthcare environment, it is important for architects to understand the cognitive differences of target users.

This paper aims to explore the users' needs for community-based healthcare environment. It will provide an insight into the users' needs and propose a model that can efficiently use the findings to inform the design decision-making of community-based healthcare environment towards a standard of sustainability.

2. Methods

2.1 Literature Review and Archive Study

Desktop research, including a literature review and archive study, has been conducted to collect design strategies for the healthcare environment. Users with less professional knowledge of healthcare design often express their satisfaction and needs as "visions to be comfortable" instead of explicit expectation with solutions [14]. By participating in the design decision-making, they can have a better understanding of the outcomes or intentions of the design strategies being applied. Some sustainability assessment methods for healthcare (e.g. LEED 2009 for Healthcare, Evaluation Standard for Green Hospital Building GB/T 51153) and healthcare design aided tools (e.g. AEDET Evolution, ASPECT) were reviewed first. Based on that, a conceptual framework for healthcare design was built in line with the structure of AEDET Evolution, which was designed to support the participation of different stakeholders. As shown in Table 1, it consists of ten assessment criteria (A – J), providing both design issues in non-technical statements for users and several corresponding design strategies that can achieve these design issues for architects. Lay stakeholders and professionals can use it as a communication platform to facilitate the knowledge exchange in a participatory design process. It also helps them understand each other more appropriately [15].

2.2 A Semi-structured Interview

Research on post-occupancy evaluation of existing community-based healthcare facilities was conducted in Suzhou Industry Park (SIP). The semi-structured interview approach has been used to identify the design issues that are important to a community-based healthcare environment from a user's perspective. Patients and medical staff are defined as the main users of a

APPENDIX 1.7: Green Healthcare Environment Aided Design – Weighing Tool (Version 1.0)


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开发完成日期： 2016年07月13日

首次发表日期： 2016年11月01日

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No. 01683270

2017年06月08日

APPENDIX 1.8: An Information-aided Architectural Design Approach for Green Buildings

证书号第3220995号

发明专利证书

发 明 名 称：适用于信息辅助的绿色建筑设计方法

发　明　人：班淇超

专　利　号：ZL 2016 1 0191656.5

专利申请日：2016年03月30日

专 利 权 人：班淇超

地　　　址：215000 江苏省苏州市工业园区仁爱路111号西交利物浦大学EB433

授权公告日：2019年01月18日　　　授权公告号：CN 105760633 B

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第 1 页 (共 2 页)

其他事项参见背面

APPENDIX 2: EBD STRATEGIES & EED STRATEGIES

APPENDIX 2.1: Evidence-based Design Strategies in AEDET Evolution

Factor	Code	Evidence
Artwork	A.022	e.g. "Results show that abstract art can be almost pathological for patients in a treatment or patient care setting." (Ulrich et al. 1993); Heerwagen & Orians 1986; Niedenthal et al. 1994; Wypijewski 1998; Macnaughton 2007; etc.
Home-like	B.011 C.061	e.g. "Family members' ranking of specific waiting area amenities is: private space for consultation with physician 84%, windows 81%, public telephones 77%, educational materials about the recovery period 72%, tables to sit at for eating or working 72%, reclining chairs 69%, a beeper so visitors can leave the waiting area 69%, educational materials about the procedure 67%, cancer specific educational materials 61%, free snacks, coffee, tea and soda 61%, several small TVs 60%, separate children's area 54%, food cart 50%, soft music 43%, access to a computer for entertainment 39%, locker 36%, one large TV 33%, coatroom 33%." (Carmichael & Agre 2002); Hui & Tse 1996; Leather et al. 2003; etc.
Lighting	B.021	e.g. "The length of stay for depressed patients in sunny rooms averaged 16.9 days whereas those in dull rooms required 19.5 days of care a difference of 2.6 days." (Beauchemin & Hays 1998a); Glass et al. 1985; Mann et al 1986; Boubekri et al. 1991; Buchanan et al. 1991; Beauchemin & Hays 1998b; McDaniel et al. 2001; Altimier 2004; etc.
Wayfinding	B.031 C.051	e.g. "Results show most DAT patients to be incapable of developing an overall plan to solve the wayfinding task and incapable of producing decisions involving memory or inferences." (Passini et al. 1998); Gilleard et al. 1981; Weisman 1981; Levine 1982; Passini et al. 2000; etc.
Privacy	C.011 J.051	e.g. "Pain patients in private rooms are twice as likely to receive injectable request contingent medications as patients in semi-private rooms and all patients regardless of room type are more likely to receive contingent than time contingent narcotics." (Dolce et al. 1985); Sundstrom et al. 1982; Kerr 1985; Newell 1995; Lewis et al. 1999; Altimier 2004; etc.
Company	C.012	e.g. "For ophthalmic patients, younger patients are more attracted to multi-bedded rooms than older patients" (Spaeth & Angell 1968); Silvers & Harding 1969; Kulik et al. 1993; etc.
Views (Window)	C.021 C.031	e.g. "Patients with tree views have statistically significantly shorter hospitalisations (7.96 days vs. 8.70 days)." (Ulrich 1984); Heerwagen & Orians 1986; Butler & Biner 1989; Heerwagen 1990; Leather et al. 1997; etc.
Greening (Open space, access to nature, etc.)	C.032 C.033 D.022 D.031	e.g. "A view of natural elements (trees, vegetation, plants and foliage) is found to buffer the negative impact of job stress on intention to quit and to have a similar albeit marginal effect on general well-being." (Leather et al. 1997); Wolfe 1975; Rice et al. 1980; Talbot et al. 1984; Ulrich & Parsons 1992; Barnhart et al. 1998; Ulrich 1999; Michael et al. 2001; Nejati et al. 2015; etc.
Noise	C.042 C.045	e.g. "Noise exceeded 55dBA may impact the patients' recovery." (Bayo et al. 1995); Minckley 1968; Whitfield 1975; Soutar & Wilson 1986; Caine 1991; Topf 1992; Zahr & Balian 1995; etc.
Temperature	C.048	e.g. "The maintenance of rectal temperature of 97 to 98 degree F is advantageous for the premature babies." (Jolly et al. 1962);

		Bell et al. 1980; Wilson 1987; D'Souza et al. 1992; Gorin et al. 1999; etc.
Air quality	C.049 C.04X	e.g. "A reduced infection rate after total hip replacement (from 1.4% to 0.8%) and an increased infection rate after total knee replacement (from 1.4% to 3.9%) are found when patients operate on in the filtered laminar air-flow operating room are compared with those whose operations are done in 2 conventional rooms." (Salvati et al. 1982); Cotterill 1996; Sauer et al. 1984; Belgaumkar & Scott 1975; etc.
Safety	C.071	e.g. "Results show that gait speed and step length are significantly greater on the carpeted than the vinyl surface (30% greater or more) for elderly patients."(Wilmont 1986); Anderson et al. 1982; Morgan et al. 1985; Janken et al. 1986; Noskin et al. 2000; etc.
Work efficiency	H.041	e.g. "The overall presceiption error rate is3.39%. An illumination level of 146 foot-candles is associated with a significantly lower error rate (2.6%) than the baseline level of 45 foot-candles (3.38%). There is a linear relationship between each pharmacist's error rate and that pharmacist's corresponding daily prescription workload for all 3 illumination levels." (Buchanan et al. 1991); HcLaughlin 1964; Seelye 1982; Kwallek et al. 1988; Ridge et al. 1995; Roseman & Booker 1995; DeJoy 1996; Phelan et al. 1996; Landrigan et al. 2004; etc.

APPENDIX 2.2: Eco-effective Design Strategies

Category	Indicator	Code	Reference
Site Planning	Connection to nature; Habitat restoration	C.031 C.032 C.033	Padilla 2002; etc.
	Brownfield site	E.053 E.055	Hartmann et al. 2014; Bardos R.P. et al. 2016; Cundy et al. 2016; etc.
	Transit access	I.011 I.012	Xu et al. 2017; etc.
	Innovative parking	I.021	Moeinaddini et al. 2013; Chen et al. 2017; etc.
Form and Façade	Narrow floor plate	J.011 J.021 J.022 J.031	Heerwagen & Zagreus 2005; owler et al. 2005; Khalil & Husin 2009; Hassanain 2011; etc.
Water	Water use reduction; Reclaimed water reuse; Onsite wastewater treatment	F.062	PERD 1997; Fowler et al. 2005; Zachary et al. 2010 etc.
	Rainwater harvesting	F.063	Nachshon et al. 2016; Chong et al. 2016; Stephan & Stephan 2017; etc.
Energy	Low energy use intensity (EUI); Innovative source energy systems	B.021 B.022 C.049 F.031	Cutler & Kane 2009; Khalil & Husin 2009; Zachary et al. 2010; Hassanain 2011; Stringer et al. 2012; etc.
	Natural ventilation	C.043 C.048 C.04X F.033	Todd 2001; Fowler et al. 2005; Milne et al. 2006; Murray et al. 2009; etc.
	Onsite renewable energy systems	F.032	Fowler et al. 2005; Hassanain 2011; etc.
	Occupant control	E.011	Fowler et al. 2005; Zachary et al. 2010; etc.
Materials + Construction Practice	Prefabrication / Modularity / Adaptability	B.044 B.045 F.021 G.071 H.051 H.052 H.061	Fernandez 2003; Blok & Herwijnen 2005; Till et al. 2006; Saari & Heikkila 2008; Finch 2009; Niklas & Bengt 2009; Fitzgerald et al. 2009; etc.
	Recycled content material	F.061	Chang et al. 2016; Ricciardi et al. 2017; etc.
	Acoustics	C.042 C.045 G.031 I.041	Fowler et al. 2005; Khalil & Husin 2009; etc.
	Safe construction practices	B.043 G.051	Carayanni 2007; Bilbo et al. 2015; etc.
Community	Civic function	D.021 D.041 H.011	Daniels 2010; Hayes 2013; Jackson & Smith 2014; etc.

Note: design strategies are categorised by the indicators of measuring eco-effective performance of healthcare environment (for more information, see Section 2.3.3).

APPENDIX 3: DOCUMENTS FOR FIELD INVESTIGATIONS

APPENDIX 3.1: Approval from XJTLU Research Ethics Subcommittee

Xi'an Jiaotong-Liverpool University
西交利物浦大学

P156D Xi'an Jiaotong-Liverpool University
111 Ren'ai Road, Dushu Lake Higher Education Town SIP
Suzhou 215123,
P.R. China.

30 March 2016

Dear Qichao Ban,

Proposal Number: **14-01-06**
Title: **Integrated Design Strategies for Community Healthcare Environments in China based on Evidence-based Sustainable Design Principles**
Researcher: **Qichao Ban**
Supervisor: **Bing Chen**

Your application for Ethics Approval has been reviewed and approved by Chair's action. Please be advised that you would have to cite the proposal number in all future correspondence with the Research Ethics Sub-Committee about this project.

For reference, the latest version of the document 'Ethics in Research: Provisional Guidelines on Best Practice' is attached.

Sincerely,

Elmer V Villanueva, MD ScM FACE
Chair, Research Ethics Sub-Committee

江苏省苏州市中国新加坡工业园区独墅湖科教创新区仁爱路 111 号 电话：0512 8816 1000 传真：0512 8816 1899 邮编：215123
Address: 111 Ren'ai Road, Dushu Lake Higher Education Town, Suzhou Industrial Park, Suzhou 215123, Jiangsu Province, PRC
Tel: + 86 512 8816 1000 Fax: + 86 512 8816 1899 www.xjtlu.edu.cn

APPENDIX 3.2: Cover Letter

UNIVERSITY OF LIVERPOOL

Xi'an Jiaotong-Liverpool University
西交利物浦大学

Research Ethics Committee

PARTICIPANT INFORMATION SHEET GUIDELINES

[Form Version Number 1 Date: 01 March 2015]

PLEASE COULD YOU HELP WITH THIS RESEARCH?

Title of Research: Integrated Design Strategies for Community Healthcare Environments in China based on Evidence-based Sustainable Design Principles

You are being invited to take part in an independent Ph.D. research project about design strategies for community healthcare environments. Please take time to read the following information carefully and discuss it with friends, colleagues and relatives if you wish.

Feel free to ask me if anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Your participation in this research study is entirely voluntary and helpful.

Thank you for reading this.

Yours sincerely,

Bing Chen
Qichao BAN (Ph.D. Candidate)

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Version 1
01 March 2015

研究伦理委员会

参与信息表

[表格版本号 1 日期：2015 年 03 月 01 日]

诚挚邀请您参与本次研究

题目：基于循证可持续设计原理的中国社区医疗建筑环境综合设计策略的研究

诚挚邀请您参与本次关于社区医疗建筑环境综合设计策略的独立博士研究课题，希望您能稍微花费一点时间，仔细阅读相关的文件，并在必要的时候跟朋友、同事或亲戚进行讨论。

当您认为有不清楚的地方、或者希望得到更多信息时，请及时与我们联系，以确保您在参与本次调研之前能够完全了解本次研究所涉及的各种内容。

您的选择是完全自愿的，并且您的参与将会为中国基层医疗环境以及社区医院建筑的优化设计的发展带来帮助。

非常感谢您阅读此信。

此致

敬礼

陈冰（导师）
班淇超（博士研究生）

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Version 1
01 March 2015

APPENDIX 3.3: Ethical Concern

UNIVERSITY OF LIVERPOOL

Xi'an Jiaotong-Liverpool University 西交利物浦大学

Research Ethics Subcommittee

PARTICIPANT INFORMATION SHEET GUIDELINES

[Form Version Number 1 Date: 01 March 2015]

Title of Research: Integrated Design Strategies for Community Healthcare Environments in China based on Evidence-based Sustainable Design Principles

What is the purpose of the study?

This study aims to support a Ph.D. research project focusing on Chinese community healthcare environments based on Evidence-based Sustainable Design Principles. We want to understand better how people feel about existing hospitals and what would make a really excellent quality environment around their communities so that we can use this knowledge to accomplish design strategies to improve community healthcare facilities and future designs.

To accommodate the ethical concerns, we are therefore asking you to provide your signed consent form to take part in this study. Your answers and the results of this research may be used to inform stakeholders (e.g. architects, engineers, consultants, policy-makers, hospital representatives, etc.) involved in the design of community healthcare facilities and make improvements to physical environments so that they can be more practical, complementing and assisting the work of medical and nursing staff. Your answers and the results may also be used to improve healthcare environments thereby enhancing the living quality of users.

Why have I been chosen to take part?

You are eligible to take part in this study because you are regarded as one of the representatives of the stakeholder groups (e.g. Designer Group, Patient Group, Hospital Staff Group, etc.) involved in the design, procurement and use of community healthcare environments.

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Version 1
01 March 2015

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you would be given this information sheet to keep and be asked to sign a consent form. If you decide to take part, you are still free to withdraw at any time and without giving a reason. This would not affect your legal rights.

What will happen if I take part?

During the study, at a mutually convenient date and time, you will be invited to come and talk to me and other people similarly involved in this study as well as those who are going to occupy and use the built environments. Schedules for interviews or focus groups will be provided in advance for your consideration. It normally takes 0.5-1 hour for a one-to-one interview while the focus group discussion might take longer. However 10-15 minutes breaks will be provided if necessary. You would of course be free to leave at any time during the interviews or focus group discussions. It is unlikely that this will change the healthcare environments immediately but your experience and contributions will be important in improving future designs and healthcare environments.

Are there any risks in taking part?

In your taking part in this study there would be no perceived disadvantages or risks. Please feel free to let us know if there is anything you think may affect your legal rights.

Are there any benefits in taking part?

Your answers and the results of this study will be used to explore aspects which may make community healthcare facilities and other hospitals better (i.e. energy efficient and carbon neutral, etc.) and improve the lives of patients and their carers who use them. Your answers and the results of this study will also be used to explore the better partnerships for stakeholders involved in the design and procurement processes of healthcare facilities. You may have a positive experience including an opportunity to socialize.

What if I am unhappy or if there is a problem?

If you are unhappy, or if there is a problem, please feel free to let us know by contacting the principal investigator and we will try to help. If you remain unhappy or have a complaint which you feel you cannot come to us with then you should contact the Research Ethics Subcommittee at Na.Pan@xjtlu.edu.cn. When contacting the Research Ethics Subcommittee, please provide details of the name or description of the study (so that it can be identified), the researcher involved, and the details of the complaint you wish to make.

Will my participation be kept confidential?

All information which is collected about you during the course of the research would be kept strictly confidential.

All information provided will be treated as confidential by the independent survey team. Survey reports will use the summaries of information and will not reveal the identities of individuals.

What will happen to the results of the study?

The results of this study will be used to enhance the design, management and operation of healthcare facilities. People may also receive their treatments and care in buildings that assist to maximize their sense of wellbeing.

At the end of the study the researchers will produce a report to the sponsors who may share the results of the study with local authorities and other relevant organizations. This case study will also be included in the Ph.D. thesis titled as *Integrated Design Strategies for Community Healthcare Environments in China based on Evidence-based Sustainable Design Principles* (working title).

What will happen if I want to stop taking part?

If you want to stop taking part, please let us know. You are free to stop the cooperation and withdraw all information at any time and without giving a reason.

What should I do now?

If you agree to take part, we will discuss with you when the interview or the discussion group will take place. You will be asked for a signed copy of the consent form at the start of the discussion, a copy of which you will be able to keep.

Who can I contact if I have further questions?

If you have any further questions please contact:

Dr. Bing Chen
Department of Urban Planning and Design
Xi'an Jiaotong Liverpool University
111 Ren'ai Road, Suzhou Dushu Lake Higher Education Town
Suzhou, Jiangsu Province, China 215123
Tel: +86(0)512-88161737 Email: Bing.Chen@xjtlu.edu.cn

Mr. Qichao Ban
School of Architecture
The University of Liverpool

Department of Urban Planning and Design
Xi'an Jiaotong Liverpool University
111 Ren'ai Road, Suzhou Dushu Lake Higher Education Town
Suzhou, Jiangsu Province, China 215123
Tel: +86(0)512-88161840 Email: Qichao.Ban@xjtlu.edu.cn

Finally you will be given a copy of this information sheet together with a signed consent form for you to keep.

研究伦理委员会

参与信息表

[表格版本号 1 日期：2015 年 03 月 01 日]

题目：基于循证可持续设计原理的中国社区医疗建筑环境综合设计策略的研究

本次研究的目的

本次调查旨在为《中国社区医疗环境综合设计策略研究》的博士研究课题（英国利物浦大学）提供数据支持，该课题的研究范围主要针对医疗环境。我们希望能够就人们对现存医院的使用感受以及如何提高社区级别的医疗环境品质等问题有更清晰、直接的了解，从而可以得到一套完善的设计策略，用于提高社区医疗设施和未来医院的建设。

为了达到道德关怀的目的，我们希望您在决定是否参加本次研究之前，阅读本信息表及同意书。您的答案和本次研究结果将会给社区医疗设施建设的相关从业者（如建筑师、工程师、咨询人士、政策制定者、医院代表等）提供相应的信息指导以优化建筑环境和促进医护人员的工作效率。您的帮助和本次研究结果将有助于提高全体使用者在医疗环境中的生活品质和康复疗效。

您被选中的原因

您被选中参与本次研究的原因是因为您具有成为调研组代表（如设计师组、病员组、医护人员组）的资格。所有调研组的成员都对社区医疗环境的建设有着直接或间接的责任和能力来支持和引导社区医疗设施的建设及发展。

您是否必须参与

您的参与完全是自愿的。如果您愿意参与本次调研，您将得到所有信息表并在相应同意书上面签字。同时，即便您决定参与本次调研，您仍然有权利在任何

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时间、无需给出任何理由的情况下中断合作并撤销所有回答信息。本次调研绝不会侵犯您任何合法权利。

您参与后的责任

在研究过程中，本着互利互助的原则，在双方都合适的日期时间内，您将会收到邀请来与我以及其他研究成员或同那些使用医疗环境的人们一起进行问答或讨论形式的咨询，具体时间会在跟您协商后安排。通常情况下每次一对一采访持续时间在一小时以内，而小组讨论时间将会适当延长，期间会有 10 到 15 分钟的休息时间。在一对一采访或小组讨论中，您有权在您需要的情况下离场。但是希望您理解的是， 本次研究无法立即改变现存的医疗环境，但是您的经验和贡献将会对未来医院设计提供极大的帮助。

潜在的风险或不利

在您的参与过程中，不会有任何对您产生风险或者不利的因素存在。当您认为某些情况下您的权利有可能受到侵害时，请及时与我们沟通。

参与的贡献和优势

您的答案和本次研究结果将会应用于探索社区医疗设施和相关绿色医院建设等方面（如节能、碳中和等），并用于优化病人和医护人员的使用环境和居住品质。同时，您的答案以及研究结果也会有利于优化在医院建设过程中所有参与方的合作模式，您也将有机会将个人关于医疗设施的意见及宝贵经验向相关管理部门反映。

当您不满意或出现问题时

当您不满意或出现问题时，请您及时联系主要负责人（联系方式在信息表尾页）进行沟通，我们将以最快速度进行解决。如果您认为我们没有给出您满意的解决方式，您可以联系研究道德委员会（电邮：Na.Pan@xjtlu.edu.cn），并提供本次研究的题目、相关描述、研究成员和您希望解决的问题。

UNIVERSITY OF LIVERPOOL　　Xi'an Jiaotong-Liverpool University 西交利物浦大学

关于您参与的保密性

您在本次研究过程中提供的任何信息将进行严格的保密措施。

相关独立调研小组会对所有信息进行保密处理。调研报告只会提供总结性数据，不会提供任何与参与者相关的信息。

研究结果的应用

本次调研的研究结果将会用于加强医疗设施的设计、管理和操作等方面，加强医疗建筑的节能及碳中和等能力，提高在医院中接受治疗和护理的病人的康复速度和幸福感。

本次研究结束时，调研人员将信息汇总并形成报告，将研究成果与当地管理部门、相关组织以及相关领域的专业人士进行分享。本次调研案例也将为利物浦大学“基于循证可持续设计原理的中国社区医疗建筑环境综合设计策略的研究”博士课题提供数据支持。

当您希望中途停止时

当您希望中途停止时，请及时与我们沟通，并可以在任何情况下、无需给出理由的停止我们的合作，您有权将所有提供的信息撤回。

您现在需要做

如果您愿意参与本次调研，我们将跟您确定采访时间，您需完成同意书，并一式两份。

联系方式

当您有任何问题时，请联系：

陈　冰（导师）

西交利物浦大学
城市规划与设计学院
地址：江苏省苏州市园区独墅湖高等教育区仁爱路 111 号
邮编：215123
电话: +86(0)512-88161737　　电邮: Bing. Chen@xjtlu.edu.cn

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班淇超
（博士研究生）

英国利物浦大学
建筑学院

西交利物浦大学
城市规划与设计学院
地址：江苏省苏州市园区独墅湖高等教育区仁爱路 111 号
邮编：215123
电话: +86(0)512-88161840　　电邮: Qichao.Ban@xjtlu.edu.cn

最后，双方各保留一份信息表以及同意书。

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APPENDIX 3.4: Participant Consent Form

UNIVERSITY OF LIVERPOOL

Xi'an Jiaotong-Liverpool University 西交利物浦大学

Research Ethics Subcommittee

PARTICIPANT CONSENT FORM

Title of Research Project:	Integrated Design Strategies for Community Healthcare Environments in China based on Evidence-based Sustainable Design Principles
Researcher(s):	Bing Chen, Qichao Ban

Please initial box

1. I confirm that I have read and have understood the information sheet dated 01 March 2015 (Version 1) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactory. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my rights being affected. In addition, when I not wish to answer any particular question or questions, I am free to decline. ☐
3. I understand that, under the Data Protection Act, I can at any time ask for access to the information I provide and I can also request the destruction of that information if I wish. ☐
4. I agree for the data collected from me to be used in relevant future research. ☐
5. I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any publications. ☐
6. I agree to take part in the above study. ☐

Participant Name	Date	Signature
Name of Person taking consent	Date	Signature
Researcher	Date	Signature

Principal Investigator:
Name Bing Chen
Work Address 111Ren'ai Road, Suzhou Dushuhu Lake Higher Education Town, Suzhou, Jiangsu Province, China 215123
Work Telephone +86(0)512-88161737
Work Email Bing.Chen@xjtlu.edu.cn

Student Researcher:
Name Qichao Ban
Work Address 111Ren'ai Road, Suzhou Dushuhu Lake Higher Education Town, Suzhou, Jiangsu Province, China 215123
Work Telephone +86(0)512-88161840
Work Email Qichao.Ban@xjtlu.edu.cn

[Form Version Number 1 Date: 01 March 2015]

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UNIVERSITY OF LIVERPOOL　　Xi'an Jiaotong-Liverpool University 西交利物浦大学

研究伦理委员会

参与同意书

研究项目题目： 基于循证可持续设计原理的中国社区医疗建筑环境综合设计策略的研究

研究人员： 陈冰，班淇超

Please initial box

1. 我确认已读并了解了所涉及到的研究项目的信息表（开始于 2015 年 03 月 01 日），并得到充足的时间去考虑我所提供的信息、询问问题和得到令我满意的回馈。 ☐
2. 我明白我的参与是自愿的，而当我认为我的权利受到侵害时，我有权在任何情况下不需要给予理由地退出本次研究合作。而且，我有权随时拒绝我不想回答的问题。 ☐
3. 我明白，依照数据保护法，我可以在任何时间询问我所提供过得信息并有权销毁或拒绝该信息在研究中被使用。 ☐
4. 我同意我所提供的信息可以被应用在未来相关研究中。 ☐
5. 我明白个人信息将会在研究中严格保密和匿名，并在任何出版物中都无法找到任何关于本人的信息。 ☐
6. 我同意参与本次研究。 ☐

参与者	日期	签名
授权者（如果不是研究人员本人）	日期	签名
研究人员	日期	签名

主要调研者:
姓名　陈冰
工作地址　江苏省苏州市园区独墅湖高等教育区仁爱路 111 号
工作电话　051288161737
工作电邮　Bing.Chen@xjtlu.edu.cn

学生调研者:
姓名　班淇超
工作地址　江苏省苏州市园区独墅湖高等教育区仁爱路 111 号
工作电话　051288161840
工作电邮　Qichao.Ban@xjtlu.edu.cn

[表格版本号　1　　日期：2015 年 03 月 01 日]

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01 March 2015

APPENDIX 3.5: Questionnaire for Interviewees

Questionnaire for Interviewees

PARTICIPANT INFORMATION SHEET GUIDELINES **No. ( )**

[Form Version Number 1 Date: 01 March 2015] **Date ( )**

Title of Research: End-user Centred Participatory Design for Community-based Healthcare Environments in China

研究题目：中国社区医疗环境以用户为中心的参与式设计研究

This study aims to support a research project that focuses on the design strategies and end-users' satisfaction for community-based healthcare environments in China (Community Healthcare Centres/Clinics). You are invited to take part in this study because you are regarded as a representative of end-users. **Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.** This research has been approved by the Research Ethics Subcommittee of XJTLU (Proposed number: 14-01-06).

本次调研旨在为针对**中国社区医疗环境以用户为中心的参与式设计**研究课题提供必要的数据支持，特邀请您作为社区医疗环境使用者用户代表参与本次问卷调研。参与完全自愿，任何个人信息将严格保密处理。该研究已获得西交利物浦大学研究道德委员会的批准（14-01-06）。

A. PERSONAL BACKGROUND

✧ **For patients**

A1. Are you?

□ Male / □ Female

A2. How old are you?

A3. What is your purpose of visiting this community-based healthcare facility?

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A4. What are your educational background and major?

....

✧ **For medical staff**

A1. Are you?

□ Male / □ Female

A2. How long have you worked in CH facilities?

□ Intern □ Regular employee .... years

A3. Please indicate your working field in this CH facility:

□ Treatment □ Nursing □ Administration □ Others: ....

A4. The community-based healthcare facility where you work:

□ CH Centre □ CH Clinic □ Others: ....

B. INTERVIEW QUESTIONS

B1. Based on our understanding, what design factors are necessary for a community-based healthcare environment, and why?

....

B2. What design issues can meet your needs for a community-based healthcare environment, based on those addressed in the *Conceptual Framework for Healthcare Environment Design*?

....

B3. Comments – if you have any comments regarding the research project or surveys, please do so:

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

所有收集信息将严格按照保密协议处理，仅有用于本次关于社区医疗环境的博士课题研究。数据将以统计结果的形式呈现在调查报告中，并严格保护个人信息。欢迎针对本次研究提供建议。

Many thanks for your cooperation.

感谢您的合作。

Yours Sincerely,

Qichao BAN（班淇超）　　Supervised by Bing CHEN （陈冰 – 导师）

If you have any question please contact me freely at the address below. Thanks again for your participation.

如果您有任何问题或者想进一步参与研究，请按照以下地址联系：

Address: Xi'an Jiaotong-Liverpool University, Suzhou　地址：苏州工业园区西交利物浦大学

Tel: (0512) 88161840　Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737　Email: Bing.Chen@xjtlu.edu.cn

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UNIVERSITY OF LIVERPOOL　　Xi'an Jiaotong-Liverpool University 西交利物浦大学

Questionnaire for Interviewees

PARTICIPANT INFORMATION SHEET GUIDELINES　　**No. (　　　)**

[Form Version Number 1　　Date: 01 March 2015]　　**Date (　　　)**

Title of Research: End-user Centred Participatory Design for Community-based Healthcare Environments in China

研究题目：中国社区医疗环境以用户为中心的参与式设计研究

This study aims to support a research project that focuses on the design strategies and end-users' satisfaction for community-based healthcare environments in China (Community Healthcare Centres/Clinics). You are invited to take part in this study because you are regarded as a representative of end-users. **Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.** This research has been approved by the Research Ethics Subcommittee of XJTLU (Proposed number: 14-01-06).

本次调研旨在为针对**中国社区医疗环境以用户为中心的参与式设计**研究课题提供必要的数据支持，特邀请您作为社区医疗环境使用者用户代表参与本次问卷调研。参与完全自愿，任何个人信息将严格保密处理。该研究已获得西交利物浦大学研究道德委员会的批准（14-01-06）。

A. 个人背景

✧ **患者内容**

A1. 您的性别

□男 / □女

A2. 您的年龄

A3. 您来本社区卫生服务中心/站的目的是

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A4. 您的教育背景及专业

....

✧ 医护人员内容

A1. 您的性别

□ 男 / □ 女

A2. 您在该中心/站的工作性质和时间

□ 实习 □ 正式员工 .... 年（或）月

A3. 您在该中心/站的工作范围

□ 治疗 □ 护理 □ 行政管理 □ 其他: ....

A4 您的所工作的机构是

□ 社区卫生服务中心 □ 社区卫生服务站 □ 其他: ....

B. 采访问题

B1. 基于您的理解，哪些设计因素对于社区医疗环境是必需的，为什么？

....

B2. 哪些设计内容能够满足您对社区医疗环境的需求，请从“医疗环境设计概念框架”中选择：

....

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B3. 请您对该研究项目或本次调研问卷提出宝贵意见：

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

所有收集信息将严格按照保密协议处理，仅有用于本次关于社区医疗环境的博士课题研究。数据将以统计结果的形式呈现在调查报告中，并严格保护个人信息。欢迎针对本次研究提供建议。

Many thanks for your cooperation.

感谢您的合作。

Yours Sincerely,

Qichao BAN（班淇超）　　Supervised by Bing CHEN （陈冰 – 导师）

If you have any question please contact me freely at the address below. Thanks again for your participation.

如果您有任何问题或者想进一步参与研究，请按照以下地址联系：

Address: Xi'an Jiaotong-Liverpool University, Suzhou　地址：苏州工业园区西交利物浦大学

Tel: (0512) 88161840　Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737　Email: Bing.Chen@xjtlu.edu.cn

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APPENDIX 3.6: Questionnaire for Patient Group

UNIVERSITY OF LIVERPOOL   Xi'an Jiaotong-Liverpool University 西交利物浦大学

Questionnaire for Patient Group

PARTICIPANT INFORMATION SHEET GUIDELINES **No. (   )**

[Form Version Number 1   Date: 01 March 2015] **Date (   )**

Title of Research: End-user Centred Participatory Design for Community-based Healthcare Environments in China

研究题目：中国社区医疗环境以用户为中心的参与式设计研究

This study aims to support a research project that focuses on the design strategies and end-users' satisfaction for community-based healthcare environments in China (Community Healthcare Centres/Clinics). You are invited to take part in this study because you are regarded as a representative of Patient Group. **Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.** This research has been approved by the Research Ethics Subcommittee of XJTLU (Proposed number: 14-01-06).

本次调研旨在为针对**中国社区医疗环境以用户为中心的参与式设计**研究课题提供必要的数据支持，特邀请您作为社区医疗环境使用者——患者代表参与本次问卷调研。参与完全自愿，任何个人信息将严格保密处理。该研究已获得西交利物浦大学研究道德委员会的批准（14-01-06）。

A. PERSONAL BACKGROUND

A1. Are you?

□ Male / □ Female

A2. How old are you?

....

A3. Which community do you live in and how long?

Name of community .... Years / Months

1

B. RELATIVE IMPORTANCE OF DESIGN ISSUES

B1. Please rate the relative importance of following design issues during using CH facilities:
(N: Not at all important; S: Slightly important; M: Moderately important; V: Very important; E: Extremely important)

CHARACTER & INNOVATION	N	S	M	V	E
The building is interesting to look at and move around in.	☐	☐	☐	☐	☐
The building projects a caring and reassuring atmosphere.	☐	☐	☐	☐	☐
The building appropriately expresses the values of the health service.	☐	☐	☐	☐	☐

FORM & MATERIALS	N	S	M	V	E
The building has a human scale and feels welcome.	☐	☐	☐	☐	☐
The building is well orientated on the site.	☐	☐	☐	☐	☐
Entrances are obvious and logically positioned in relation to likely points of arrival on site.	☐	☐	☐	☐	☐
The external colours and textures seem appropriate and attractive.	☐	☐	☐	☐	☐

STAFF & PATIENT ENVIRONMENT	N	S	M	V	E
The building respects the dignity of patients and allows for appropriate.	☐	☐	☐	☐	☐
There are good views inside and out of the building.	☐	☐	☐	☐	☐
Patients and staff have good easy access to outdoors.	☐	☐	☐	☐	☐
There are high levels both of comfort and control of comfort.	☐	☐	☐	☐	☐
The building is clearly understandable.	☐	☐	☐	☐	☐
There are good bath/toilet and safety facilities for patients.	☐	☐	☐	☐	☐
There are good facilities for staff including convenient places to work and relax without being on demand.	☐	☐	☐	☐	☐

URBAN & SOCIAL INTEGRATION	N	S	M	V	E
The height, volume, and skyline of the building relate well to the surrounding environment.	☐	☐	☐	☐	☐
The building is sensitive to neighbours and passers-by.	☐	☐	☐	☐	☐

USE	N	S	M	V	E
Workflows and logistics are arranged optimally.	☐	☐	☐	☐	☐
The building is sufficiently adaptable to respond to change and to enable expansion.	☐	☐	☐	☐	☐
The layout facilitates both security and supervision.	☐	☐	☐	☐	☐

ACCESS	N	S	M	V	E
There is good access from available public transport including any on-site roads.	☐	☐	☐	☐	☐
There is adequate parking for visitors and staff cars with appropriate provision for disabled people.	☐	☐	☐	☐	☐
Pedestrian access routes are obvious, pleasant, and suitable for wheelchair users and people with other disabilities/impaired sight.	☐	☐	☐	☐	☐
Outdoor spaces are provided with appropriate and safe lighting indicating paths, ramps, and steps.	☐	☐	☐	☐	☐

2

SPACE	N	S	M	V	E
The circulation distances travelled by staff, patients, and visitors are minimised by the layout.	□	□	□	□	□
Any necessary isolation and segregation of spaces is achieved.	□	□	□	□	□
The design makes appropriate provision for gender segregation.	□	□	□	□	□
There is adequate storage space.	□	□	□	□	□

OTHERS, PLEASE SPECIFY:	N	S	M	V	E
	□	□	□	□	□

C. KNOWLEDGE ABOUT HEALTHCARE ENVIRONMENT DESIGN

C1. Please indicate following issues that help you acquire knowledge about healthcare environment design (multiple options):

- □ News paper
- □ Brochures from healthcare facilities
- □ TV media
- □ Internet
- □ Information from friends / relatives / neighbours
- □ Visit and direct observation
- □ Others, please specify: ....

C2. Please indicate following issues that you think have relationships with healthcare environment design (multiple options):

- □ Healthcare-associated infection
- □ Recovery rate
- □ Dosage of medication
- □ Accidental falls
- □ Mood and emotion
- □ Staff's health
- □ Staff's service quality and efficiency
- □ Staff's satisfaction
- □ Others, please specify: ....

C3. Have you ever received any survey about your environmental satisfaction with a CH facility?

□ Yes / □ No

C4. Have you ever received any survey about your satisfaction with health service of a CH facility?

□ Yes / □ No

D. OPEN-ENDED QUESTIONS

D1. Please describe your understanding of healthcare service at a community level:

....

3

D2. Please give comments on community-based healthcare environment design:

D3. Please share your opinions on end-user centred principles for healthcare environments:

D4. Personal information – if you would like to participate in the follow-up 'test-retest' survey and learn about the results of response analysis, please show your contact information:

D5. Comments – if you have any comments regarding the research project or surveys, please do so:

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

所有收集信息将严格按照保密协议处理，仅有用于本次关于社区医疗环境的博士课题研究。数据将以统计结果的形式呈现在调查报告中，并严格保护个人信息。欢迎针对本次研究提供建议。

Many thanks for your cooperation.

感谢您的合作。

Yours Sincerely,

Qichao BAN（班淇超） Supervised by Bing CHEN （陈冰 – 导师）

If you have any question please contact me freely at the address below. Thanks again for your participation.

如果您有任何问题或者想进一步参与研究，请按照以下地址联系：

Address: Xi'an Jiaotong-Liverpool University, Suzhou 地址：苏州工业园区西交利物浦大学

Tel: (0512) 88161840 Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737 Email: Bing.Chen@xjtlu.edu.cn

4

Questionnaire for Patient Group

PARTICIPANT INFORMATION SHEET GUIDELINES **No. ( )**

[Form Version Number 1 Date: 01 March 2015] **Date ( )**

Title of Research: End-user Centred Participatory Design for Community-based Healthcare Environments in China

研究题目：中国社区医疗环境以用户为中心的参与式设计研究

This study aims to support a research project that focuses on the design strategies and end-users' satisfaction for community-based healthcare environments in China (Community Healthcare Centres/Clinics). You are invited to take part in this study because you are regarded as a representative of Patient Group. **Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.** This research has been approved by the Research Ethics Subcommittee of XJTLU.

本次调研旨在为针对**中国社区医疗环境以用户为中心的参与式设计**研究课题提供必要的数据支持，特邀请您作为社区医疗环境使用者——患者代表参与本次问卷调研。参与完全自愿，任何个人信息将严格保密处理。该研究已获得西交利物浦大学研究道德委员会的批准（14-01-06）。

A. 个人背景

A1. 您的性别

□男 / □女

A2. 您的年龄

A3. 您所居住的小区名称及时间

小区名称 ______________________ 共 ______________ 年 (或) 月

1

B. 设计内容的相对重要性

B1. 请对以下设计内容在社区卫生服务中心/站的环境设计过程中的重要程度进行评价：
(N: 完全不重要; S: 不太重要; M: 一般重要; V: 非常重要; E 极其重要)

特征及创新	完全不重要	不太重要	一般重要	非常重要	极其重要
医院看上去非常有特色。	□	□	□	□	□
医院营造出一种康复和对患者关怀的氛围。	□	□	□	□	□
医院能够体现出医疗服务体系的宗旨和价值。	□	□	□	□	□

形式及材料	完全不重要	不太重要	一般重要	非常重要	极其重要
医院考虑人体尺度，创造“欢迎”的感觉。	□	□	□	□	□
在场地内医院建筑有良好的朝向。	□	□	□	□	□
医院场地及建筑的进出口明显，容易找到。	□	□	□	□	□
医院整体颜色和材料质感搭配合理、吸引人。	□	□	□	□	□

医护人员&患者环境	完全不重要	不太重要	一般重要	非常重要	极其重要
医院尊重患者，保护患者私密性。	□	□	□	□	□
建筑内外有良好的景观。	□	□	□	□	□
患者及医护人员可以很容易接触到自然景观。	□	□	□	□	□
室内有高标准的舒适度及舒适度控制系统。	□	□	□	□	□
医院交通很容易被理解，容易找到目的地。	□	□	□	□	□
医院针对患者具有良好的卫生间/浴室服务。	□	□	□	□	□
医护人员有独立办公和休息空间。	□	□	□	□	□

城市社会融合	完全不重要	不太重要	一般重要	非常重要	极其重要
医院建筑高度、尺度、天际线不会周围环境产生影响。	□	□	□	□	□
医院建筑设计考虑周边邻里和行人的影响。	□	□	□	□	□

使用	完全不重要	不太重要	一般重要	非常重要	极其重要
交通流线和场地物流具备良好的设计。	□	□	□	□	□
建筑有良好的改造和扩建性能。	□	□	□	□	□
场地安全，有安保和监控系统。	□	□	□	□	□

通道	完全不重要	不太重要	一般重要	非常重要	极其重要
医院场地附近有良好的公共交通系统。	□	□	□	□	□
医院场地针对患者和员工提供数量够用的停车空间，尤其是针对残疾人。	□	□	□	□	□
行人道路明显、适宜，尤其是针对轮椅用户和具有其他存在身体或视力障碍的用户。	□	□	□	□	□
室外空间针对行人道路、坡道、台阶等提供适宜、安全的照明系统。	□	□	□	□	□

2

空间	完全不重要	不太重要	一般重要	非常重要	极其重要
场地、建筑内部通过空间划分设计降低医护人员、患者和访客的交通距离。	□	□	□	□	□
场地规划、建筑设计考虑到必要的空间隔离。	□	□	□	□	□
建筑设计充分考虑性别隔离。	□	□	□	□	□
建筑内有充足的储存空间。	□	□	□	□	□

其他需求，请标注：	完全不重要	不太重要	一般重要	非常重要	极其重要
	□	□	□	□	□

C. 医疗环境设计相关知识

C1. 请选出您认为可以帮助您了解医疗环境设计方面相关知识的途径（多选）：

- □ 报纸介绍
- □ 医院宣传册
- □ 电视媒体
- □ 网络
- □ 亲友推荐
- □ 进入直接观察
- □ 其他，请注明：

C2. 请选出您认为与医疗环境设计存在联系的选项（多选）：

- □ 影响治疗和康复的交叉感染
- □ 康复效率
- □ 用药量
- □ 患者就诊过程中意外摔倒
- □ 患者就诊时心情和情绪
- □ 医护人员健康
- □ 医护人员服务质量和工作效率
- □ 医护人员工作满意度
- □ 其他，请注明：

C3. 您是否收到过任何针对你对某社区卫生服务中心/站的环境设计方面满意度的调研问卷？

□ 是 / □ 否

C4. 您是否收到过任何针对你对某社区卫生服务中心/站的服务质量方面满意度的调研问卷？

□ 是 / □ 否

D. 开放性问题

D1. 请您描述一下您对社区卫生服务(作用、意义等)的理解：

3

D2. 请您对社区医疗环境设计提出看法和建议：

D3. 请您谈一下您对医疗环境"以用户为中心"设计的理解：

D4. 个人信息 – 如果您愿意参与下一轮"重复验证"的调研并希望了解本调研的分析结果，请留下您的联系方式：

D5. 请您对该研究项目或本次调研问卷提出宝贵意见：

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

所有收集信息将严格按照保密协议处理，仅有用于本次关于社区医疗环境的博士课题研究。数据将以统计结果的形式呈现在调查报告中，并严格保护个人信息。欢迎针对本次研究提供建议。

Many thanks for your cooperation.

感谢您的合作。

Yours Sincerely,

Qichao BAN（班淇超） Supervised by Bing CHEN （陈冰 – 导师）

If you have any question please contact me freely at the address below. Thanks again for your participation.

如果您有任何问题或者想进一步参与研究，请按照以下地址联系：

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Tel: (0512) 88161840 Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737 Email: Bing.Chen@xjtlu.edu.cn

4

APPENDIX 3.7: Questionnaire for Staff Group

Questionnaire for Staff Group

PARTICIPANT INFORMATION SHEET GUIDELINES **No. ( )**

[Form Version Number 1 Date: 01 March 2015] **Date ( )**

Title of Research: End-user Centred Participatory Design for Community-based Healthcare Environments in China

研究题目：中国社区医疗环境以用户为中心的参与式设计研究

This study aims to support a research project that focuses on the design strategies and end-users' satisfaction for community-based healthcare environments in China (Community Healthcare Centres/Clinics). You are invited to take part in this study because you are regarded as a representative of Staff Group. **Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.** This research has been approved by the Research Ethics Subcommittee of XJTLU (Proposed number: 14-01-06).

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A. PERSONAL BACKGROUND

A1. Are you?

□ Male / □ Female

A2. Please indicate your working field in this CH facility:

□ Treatment □ Nursing □ Administration □ Others: ____________

A3. How long have you worked in CH facilities:

□ Intern □ Regular employee ________ years

1

B. RELATIVE IMPORTANCE OF DESIGN ISSUES

B1. Please rate the relative importance of following design issues during using CH facilities:
(N: Not at all important; S: Slightly important; M: Moderately important; V: Very important; E: Extremely important)

CHARACTER & INNOVATION	**N**	**S**	**M**	**V**	**E**
The building is interesting to look at and move around in.	☐	☐	☐	☐	☐
The building projects a caring and reassuring atmosphere.	☐	☐	☐	☐	☐
The building appropriately expresses the values of the health service.	☐	☐	☐	☐	☐

FORM & MATERIALS	**N**	**S**	**M**	**V**	**E**
The building has a human scale and feels welcome.	☐	☐	☐	☐	☐
The building is well orientated on the site.	☐	☐	☐	☐	☐
Entrances are obvious and logically positioned in relation to likely points of arrival on site.	☐	☐	☐	☐	☐
The external colours and textures seem appropriate and attractive.	☐	☐	☐	☐	☐

STAFF & PATIENT ENVIRONMENT	**N**	**S**	**M**	**V**	**E**
The building respects the dignity of patients and allows for appropriate.	☐	☐	☐	☐	☐
There are good views inside and out of the building.	☐	☐	☐	☐	☐
Patients and staff have good easy access to outdoors.	☐	☐	☐	☐	☐
There are high levels both of comfort and control of comfort.	☐	☐	☐	☐	☐
The building is clearly understandable.	☐	☐	☐	☐	☐
There are good bath/toilet and safety facilities for patients.	☐	☐	☐	☐	☐
There are good facilities for staff including convenient places to work and relax without being on demand.	☐	☐	☐	☐	☐

URBAN & SOCIAL INTEGRATION	**N**	**S**	**M**	**V**	**E**
The height, volume, and skyline of the building relate well to the surrounding environment.	☐	☐	☐	☐	☐
The building is sensitive to neighbours and passers-by.	☐	☐	☐	☐	☐

USE	**N**	**S**	**M**	**V**	**E**
Workflows and logistics are arranged optimally.	☐	☐	☐	☐	☐
The building is sufficiently adaptable to respond to change and to enable expansion.	☐	☐	☐	☐	☐
The layout facilitates both security and supervision.	☐	☐	☐	☐	☐

ACCESS	**N**	**S**	**M**	**V**	**E**
There is good access from available public transport including any on-site roads.	☐	☐	☐	☐	☐
There is adequate parking for visitors and staff cars with appropriate provision for disabled people.	☐	☐	☐	☐	☐
Pedestrian access routes are obvious, pleasant, and suitable for wheelchair users and people with other disabilities/impaired sight.	☐	☐	☐	☐	☐
Outdoor spaces are provided with appropriate and safe lighting indicating paths, ramps, and steps.	☐	☐	☐	☐	☐

SPACE	N	S	M	V	E
The circulation distances travelled by staff, patients, and visitors are minimised by the layout.	□	□	□	□	□
Any necessary isolation and segregation of spaces is achieved.	□	□	□	□	□
The design makes appropriate provision for gender segregation.	□	□	□	□	□
There is adequate storage space.	□	□	□	□	□

OTHERS, PLEASE SPECIFY:	N	S	M	V	E
	□	□	□	□	□

C. KNOWLEDGE ABOUT HEALTHCARE ENVIRONMENT DESIGN

C1. Please indicate following issues that help you acquire knowledge about healthcare environment design (multiple options):

- □ News paper
- □ Brochures from healthcare facilities
- □ TV media
- □ Internet
- □ Information from friends / relatives / neighbours
- □ Visit and direct observation
- □ Others, please specify: ....

C2. Please indicate following issues that you think have relationships with healthcare environment design (multiple options):

- □ Healthcare-associated infection
- □ Recovery rate
- □ Dosage of medication
- □ Accidental falls
- □ Mood and emotion
- □ Staff's health
- □ Staff's service quality and efficiency
- □ Staff's satisfaction
- □ Others, please specify: ....

C3. Have you ever received any survey about your environmental satisfaction of a CHS facility?

□ Yes / □ No

C4. Have you ever conducted any survey to patients about their satisfaction of health service?

□ Yes / □ No

D. OPEN-ENDED QUESTIONS

D1. Please describe your understanding of healthcare service at a community level:

....

3

D2. Please give comments on community-based healthcare environment design:

D3. Please share your opinions on end-user centred principles for healthcare environments:

D4. Personal information – if you would like to participate in the follow-up 'test-retest' survey and learn about the results of response analysis, please show your contact information:

D5. Comments – if you have any comments regarding the research project or surveys, please do so:

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

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Many thanks for your cooperation.

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Tel: (0512) 88161840　Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737　Email: Bing.Chen@xjtlu.edu.cn

4

Questionnaire for Staff Group

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[Form Version Number 1 Date: 01 March 2015] **Date ( )**

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A. 个人背景

A1. 您的性别

□男 / □女

A2. 您在该中心/站的工作范围

□治疗 □护理 □行政管理 □其他: ____________

A3. 您在该中心/站的工作性质和时间

□实习 □正式员工 ____________ 年（或）月

1

B. 设计内容的相对重要性

B1. 请对以下设计内容在社区卫生服务中心/站的环境设计过程中的重要程度进行评价：
(N: 完全不重要; S: 不太重要; M: 一般重要; V: 非常重要; E 极其重要)

特征及创新	完全不重要	不太重要	一般重要	非常重要	极其重要
医院看上去非常有特色。	☐	☐	☐	☐	☐
医院营造出一种康复和对患者关怀的氛围。	☐	☐	☐	☐	☐
医院能够体现出医疗服务体系的宗旨和价值。	☐	☐	☐	☐	☐

形式及材料	完全不重要	不太重要	一般重要	非常重要	极其重要
医院考虑人体尺度，创造“欢迎”的感觉。	☐	☐	☐	☐	☐
在场地内医院建筑有良好的朝向。	☐	☐	☐	☐	☐
医院场地及建筑的进出口明显，容易找到。	☐	☐	☐	☐	☐
医院整体颜色和材料质感搭配合理、吸引人。	☐	☐	☐	☐	☐

医护人员&患者环境	完全不重要	不太重要	一般重要	非常重要	极其重要
医院尊重患者，保护患者私密性。	☐	☐	☐	☐	☐
建筑内外有良好的景观。	☐	☐	☐	☐	☐
患者及医护人员可以很容易接触到自然景观。	☐	☐	☐	☐	☐
室内有高标准的舒适度及舒适度控制系统。	☐	☐	☐	☐	☐
医院交通很容易被理解，容易找到目的地。	☐	☐	☐	☐	☐
医院针对患者具有良好的卫生间/浴室服务。	☐	☐	☐	☐	☐
医护人员有独立办公和休息空间。	☐	☐	☐	☐	☐

城市社会融合	完全不重要	不太重要	一般重要	非常重要	极其重要
医院建筑高度、尺度、天际线不会周围环境产生影响。	☐	☐	☐	☐	☐
医院建筑设计考虑周边邻里和行人的影响。	☐	☐	☐	☐	☐

使用	完全不重要	不太重要	一般重要	非常重要	极其重要
交通流线和场地物流具备良好的设计。	☐	☐	☐	☐	☐
建筑有良好的改造和扩建性能。	☐	☐	☐	☐	☐
场地安全，有安保和监控系统。	☐	☐	☐	☐	☐

通道	完全不重要	不太重要	一般重要	非常重要	极其重要
医院场地附近有良好的公共交通系统。	☐	☐	☐	☐	☐
医院场地针对患者和员工提供数量够用的停车空间，尤其是针对残疾人。	☐	☐	☐	☐	☐
行人道路明显、适宜，尤其是针对轮椅用户和具有其他存在身体或视力障碍的用户。	☐	☐	☐	☐	☐
室外空间针对行人道路、坡道、台阶等提供适宜、安全的照明系统。	☐	☐	☐	☐	☐

2

空间	完全不重要	不太重要	一般重要	非常重要	极其重要
场地、建筑内部通过空间划分设计降低医护人员、患者和访客的交通距离。	□	□	□	□	□
场地规划、建筑设计考虑到必要的空间隔离。	□	□	□	□	□
建筑设计充分考虑性别隔离。	□	□	□	□	□
建筑内有充足的储存空间。	□	□	□	□	□

其他需求，请标注：	完全不重要	不太重要	一般重要	非常重要	极其重要
	□	□	□	□	□

C. 医疗环境设计相关知识

C1. 请选出您认为可以帮助您了解医疗环境设计方面相关知识的途径（多选）：

- □ 报纸介绍
- □ 医院宣传册
- □ 电视媒体，广告
- □ 网络
- □ 亲友推荐
- □ 进入直接观察
- □ 其他，请注明：

C2. 请选出您认为与医疗环境设计存在联系的选项（多选）：

- □ 影响治疗和康复的交叉感染
- □ 康复效率
- □ 用药量
- □ 患者就诊过程中意外摔倒
- □ 患者就诊时心情和情绪
- □ 医护人员健康
- □ 医护人员服务质量和工作效率
- □ 医护人员工作满意度
- □ 其他，请注明：

C3. 您是否收到过任何针对你对某社区卫生服务中心/站的环境设计方面满意度的调研问卷？

□ 是 / □ 否

C4. 您是否向患者发放过任何针对某社区卫生服务中心/站的服务质量方面满意度的调研问卷？

□ 是 / □ 否

D. 开放性问题

D1. 请您描述一下您对社区卫生服务(作用、意义等)的理解：

3

D2. 请您对社区医疗环境设计提出看法和建议：

D3. 请您谈一下您对医疗环境"以用户为中心"设计的理解：

D4. 个人信息 – 如果您愿意参与下一轮“重复验证”的调研并希望了解本调研的分析结果，请留下您的联系方式：

D5. 请您对该研究项目或本次调研问卷提出宝贵意见：

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

所有收集信息将严格按照保密协议处理，仅有用于本次关于社区医疗环境的博士课题研究。数据将以统计结果的形式呈现在调查报告中，并严格保护个人信息。欢迎针对本次研究提供建议。

Many thanks for your cooperation.

感谢您的合作。

Yours Sincerely,

Qichao BAN（班淇超）　　Supervised by Bing CHEN （陈冰 – 导师）

If you have any question please contact me freely at the address below. Thanks again for your participation.

如果您有任何问题或者想进一步参与研究，请按照以下地址联系：

Address: Xi'an Jiaotong-Liverpool University, Suzhou　地址：苏州工业园区西交利物浦大学

Tel: (0512) 88161840　Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737　Email: Bing.Chen@xjtlu.edu.cn

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APPENDIX 3.8: Questionnaire for Architect Group

UNIVERSITY OF LIVERPOOL   Xi'an Jiaotong-Liverpool University 西交利物浦大学

Questionnaire for Architect Group

PARTICIPANT INFORMATION SHEET GUIDELINES **No. (   )**

[Form Version Number 1   Date: 01 March 2015] **Date (   )**

Title of Research: End-user Centred Participatory Design for Community-based Healthcare Environments in China

研究题目：中国社区医疗环境以用户为中心的参与式设计研究

This study aims to support a research project that focuses on the design strategies and end-users' satisfaction for community-based healthcare environments in China (Community Healthcare Centres/Clinics). You are invited to take part in this study because you are regarded as a representative of Architect Group. **Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.** This research has been approved by the Research Ethics Subcommittee of XJTLU (Proposed number: 14-01-06).

本次调研旨在为针对**中国社区医疗环境以用户为中心的参与式设计**研究课题提供必要的数据支持，特邀请您作为社区医疗环境设计从业人员代表参与本次问卷调研。参与完全自愿，任何个人信息将严格保密处理。该研究已获得西交利物浦大学研究道德委员会的批准（14-01-06）。

A. PERSONAL BACKGROUND

A1. Have you been involved in the design of community-based healthcare buildings or environments?

□ Yes / □ No

A2. How long have you been involved in healthcare environment design?

.... years

A3. Please specify the amount of projects (i.e. CH Centres or Clinics) that you have been involved in:

.... projects

1

B. KNOWLEDGE ABOUT HEALTHCARE ENVIRIONMENT DESIGN

B1. In the design decision-making process of healthcare environments, please indicate the following issues that you would like to choose as information sources: (multiple options)

- □ Building regulations from governments/local authorities
- □ Past successful case study
- □ Academic publications (papers, journal, etc.)
- □ Previous experience
- □ Advisory opinions from consulting companies or academics
- □ Post occupancy evaluation
- □ Design aided tools
- □ Others, please specify: ______________________

B2. Do you know about sustainability assessment methods about healthcare environments?

□ Yes / □ No

If ***yes***, please rate your knowledge levels of the following sustainability assessment methods:
(VP: Very poor; P: Poor; N: Neutral; G: Good; VG: Very good)

	VP	P	N	G	VG
• *Evaluation Standard for Green Hospital Building* GB/T 51153	□	□	□	□	□
• *BREEAM Healthcare 2008* (UK)	□	□	□	□	□
• *LEED 2009 for Healthcare* (US)	□	□	□	□	□
• Others, please specify:	□	□	□	□	□

B3. Do you know about Evidence-based Design?

□ Yes / □ No

If ***yes***, please rate your knowledge level:
(VP: Very poor; P: Poor; N: Neutral; G: Good; VG: Very good)

	VP	P	N	G	VG
• Evidence-based Design	□	□	□	□	□

B4. Please indicate following issues that you think have relationships with the design of healthcare environments (multiple options):

- □ Healthcare-associated infection
- □ Recovery rate
- □ Dosage of medication
- □ Accidental falls
- □ Mood and emotion
- □ Staff's health
- □ Staff's service quality and efficiency
- □ Staff's satisfaction
- □ Others, please specify: ______________________

2

C. RELATIVE IMPORTANCE OF DESIGN STRATEGIES

C1. Please rate the relative importance of following design strategies during the process of designing a community-based healthcare facility:
(N: not at all important; S: slightly important; M: moderately important; V: very important; E: extremely important)

CHARACTER & INNOVATION	N	S	M	V	E
Plain form without extra decoration for elevation	□	□	□	□	□
Artwork for decoration	□	□	□	□	□
A civic presence for a caring and reassuring atmosphere	□	□	□	□	□
Design for inspiration of patients and staff	□	□	□	□	□

FORM & MATERIALS	N	S	M	V	E
Welcome appear to staff, patient, and visitors	□	□	□	□	□
A human scale for windows, indoor heights, doors, and entrances	□	□	□	□	□
Daylighting level	□	□	□	□	□
Daylighting level for underground space	□	□	□	□	□
Use on-site condition to increase daylight/ventilation	□	□	□	□	□
Obvious entrances and routes onto the site	□	□	□	□	□
Colours and textures related to adjacent buildings and environment	□	□	□	□	□

STAFF & PATIENT ENVIRONMENT	N	S	M	V	E
Design for privacy protection	□	□	□	□	□
Design for patient company	□	□	□	□	□
Good views for wards and consulting rooms	□	□	□	□	□
Land use for greening	□	□	□	□	□
Greening and vegetation diversity	□	□	□	□	□
Open space and access to nature for all-weather design	□	□	□	□	□
Light pollution control	□	□	□	□	□
On-site acoustic environment	□	□	□	□	□
On-site wind environment (for outdoor walking in winter and ventilation in summer)	□	□	□	□	□
Heat island control	□	□	□	□	□
Indoor noise level	□	□	□	□	□
Indoor glare control	□	□	□	□	□
Indoor temperature	□	□	□	□	□
Indoor ventilation and fresh air volume	□	□	□	□	□
Shading system in summer	□	□	□	□	□
Air quality monitoring	□	□	□	□	□
Signposting system and humanistic factors	□	□	□	□	□
Safety facilities (non-slip flooring, seats, handrails, and shelves) for bath / toilet	□	□	□	□	□
Staff-only spaces for work and relax	□	□	□	□	□

3

URBAN & SOCIAL INTEGRATION	N	S	M	V	E
Sunshine spacing for surrounding residential buildings	□	□	□	□	□
Attractive form and elevation for neighbours and passers-by	□	□	□	□	□

USE	N	S	M	V	E
Layout design to minimise distances travelled and lines crossed	□	□	□	□	□
Recyclable partition for multifunctional and alterable rooms	□	□	□	□	□
Flexibility for future change and expansion	□	□	□	□	□
Layout design for security and passive supervision	□	□	□	□	□

ACCESS	N	S	M	V	E
Connection with public transport	□	□	□	□	□
Clear pedestrian routes from public transport points	□	□	□	□	□
Design for parking (cycles and vehicles)	□	□	□	□	□
Barrier-free design for site and sidewalk	□	□	□	□	□
Safety lighting for landscape at night	□	□	□	□	□

SPACE	N	S	M	V	E
Layout design to reduce the congestion and circulation	□	□	□	□	□
Layout and greenbelt design for infectious segregation	□	□	□	□	□
Design for gender segregation	□	□	□	□	□
Adequate storage space in the building	□	□	□	□	□

OTHERS, PLEASE SPECIFY:	N	S	M	V	E
	□	□	□	□	□
	□	□	□	□	□
	□	□	□	□	□

D. KNOWLEDGE ABOUT HEALTHCARE DESIGN DEVELOPMENT

D1. What do you think are the top 3 drivers to improve the design quality of CH facilities (3 only)?

- □ Requirement of building regulations
- □ Environmental benefits
- □ Economic benefits
- □ Social requirement
- □ Market competition
- □ Media publicity
- □ Compliance with developers/clients
- □ Development of computer-aided technology
- □ Accessibility of online research database
- □ Others, please specify: ____________

D2. What do you think are the top 3 barriers that may hinder the improvement based on the current situation (3 only)?

- □ Lack of requirement of building regulations
- □ Lack of awareness of environmental protection
- □ Lack of awareness of economic inputs
- □ Low social awareness
- □ Lack of market competition
- □ Low media publicity
- □ Lack of requirement from developers/clients
- □ Low of computer-aided technology
- □ Lack of online research database
- □ Others, please specify: ______________________________

D3. What do you think are the top 5 choices that can improve the design skills of healthcare environments (5 only)?

- □ Social responsibility
- □ Career ethics
- □ Awareness of environmental protection
- □ Take training courses
- □ Consideration of economic benefits & budget
- □ Obtain information through academic publications/conferences
- □ Direct communication with end users (feedback, Post Occupancy Evaluation, etc.)
- □ Learn relative computer-aided technology
- □ Ambition in market competition
- □ Meet the demands from developers/administrators/clients
- □ Others, please specify: ______________________________

E. OPEN-ENDED QUESTIONS

E1. Please share your opinions on end-user centred principles for healthcare environments:

____

E2. Personal information – if you would like to participate in the follow-up interview about "how to facilitate the cognitive consensus between different stakeholder groups for the design of community-based healthcare environments", please show your contact information:

____

5

E3. Comments – if you have any comments regarding the research project or surveys, please do so:

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

所有收集信息将严格按照保密协议处理，仅有用于本次关于社区医疗环境的博士课题研究。数据将以统计结果的形式呈现在调查报告中，并严格保护个人信息。欢迎针对本次研究提供建议。

Many thanks for your cooperation.

感谢您的合作。

Yours Sincerely,

Qichao BAN（班淇超） Supervised by Bing CHEN （陈冰 – 导师）

If you have any question please contact me freely at the address below. Thanks again for your participation.

如果您有任何问题或者想进一步参与研究，请按照以下地址联系：

Address: Xi'an Jiaotong-Liverpool University, Suzhou 地址：苏州工业园区西交利物浦大学

Tel: (0512) 88161840 Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737 Email: Bing.Chen@xjtlu.edu.cn

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UNIVERSITY OF LIVERPOOL

Xi'an Jiaotong-Liverpool University 西交利物浦大学

Questionnaire for Architect Group

PARTICIPANT INFORMATION SHEET GUIDELINES **No. ( )**

[Form Version Number 1 Date: 01 March 2015] **Date ( )**

Title of Research: End-user Centred Participatory Design for Community-based Healthcare Environments in China

研究题目：中国社区医疗环境以用户为中心的参与式设计研究

This study aims to support a research project that focuses on the design strategies and end-users' satisfaction for community-based healthcare environments in China (Community Healthcare Centres/Clinics). You are invited to take part in this study because you are regarded as a representative of Architect Group. **Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.** This research has been approved by the Research Ethics Subcommittee of XJTLU (Proposed number: 14-01-06).

本次调研旨在为针对**中国社区医疗环境以用户为中心的参与式设计**研究课题提供必要的数据支持，特邀请您作为社区医疗环境设计从业人员代表参与本次问卷调研。参与完全自愿，任何个人信息将严格保密处理。该研究已获得西交利物浦大学研究道德委员会的批准（14-01-06）。

A. 个人特征

A1. 您是否参与设计过社区医疗建筑，如社区卫生服务中心？

□是 / □否

A2. 您从事医疗建筑设计行业：

.... 年

A3. 请注明您参与的社区卫生服务中心/站项目的大概数量：

.... 个

1

B. 医疗环境设计知识

B1. 在医疗建筑设计过程中，请选出您参考的相关资料或方式（多选）：

- □ 官方建筑设计规范/标准/方法
- □ 成功案例分析
- □ 学术出版物，包括期刊、论文等
- □ 早期经验
- □ 跟相关咨询公司沟通
- □ 使用后评估资料和信息
- □ 设计辅助工具
- □ 其他，请注明：

B2. 您是否了解针对医疗建筑领域的环境可持续性评价标准或方法？

□ 是 / □ 否

如果 ***“是”***，请选择您对以下评价标准或方法的了解程度：
(VP: 完全不了解; P: 不太了解; N: 一般; G: 了解; VG: 非常了解)

	VP	P	N	G	VG
• 绿色医院建筑评价标准 GB/T51153-2015（中国）	□	□	□	□	□
• *BREEAM Healthcare 2008* (英国)	□	□	□	□	□
• *LEED 2009 for Healthcare* (美国)	□	□	□	□	□
• 其他，请注明：	□	□	□	□	□

B3. 您是否了解循证设计？

□ 是 / □ 否

如果 ***“是”***，请选择您对此的了解程度：
(VP: 完全不了解; P: 不太了解; N: 一般; G: 了解; VG: 非常了解)

	VP	P	N	G	VG
• 循证设计	□	□	□	□	□

B4. 请选出您认为与医疗环境设计存在联系的选项（多选）：

- □ 影响治疗和康复的交叉感染
- □ 康复效率
- □ 用药量
- □ 病人就诊过程中意外摔倒
- □ 病人就诊时心情和情绪
- □ 医务人员健康
- □ 医务人员服务质量和工作效率
- □ 医务人员工作满意度
- □ 其他，请注明：

2

C. 设计策略的相对重要性

C1. 请对一下设计策略在社区卫生服务中心/站的环境设计过程中的重要程度进行评价：
(N: 完全不重要; S: 不太重要; M: 一般重要; V: 非常重要; E 极其重要)

特征及创新	完全不重要	不太重要	一般重要	非常重要	极其重要
立面朴素，没有不必要的装饰。	□	□	□	□	□
利用艺术品进行装饰。	□	□	□	□	□
医院营造出一种康复和对患者关怀的氛围。	□	□	□	□	□
医院能够体现出医疗服务体系的宗旨和价值。	□	□	□	□	□

形式及材料	完全不重要	不太重要	一般重要	非常重要	极其重要
医院创造“欢迎”的感觉。	□	□	□	□	□
医院设计充分考虑人体尺度。	□	□	□	□	□
建筑有良好的日照	□	□	□	□	□
地下空间有良好的日照	□	□	□	□	□
利用当地情况，提高建筑光照/自然通风。	□	□	□	□	□
医院场地及建筑的进出口明显，容易找到。	□	□	□	□	□
医院整体颜色和材料质感搭配合理、吸引人。	□	□	□	□	□

医护人员&患者环境	完全不重要	不太重要	一般重要	非常重要	极其重要
医院尊重患者，保护患者私密性。	□	□	□	□	□
医院设计考虑患者陪同家属。	□	□	□	□	□
病房与诊断室具有良好的室外景观。	□	□	□	□	□
绿地容积率高。	□	□	□	□	□
绿化考虑生物多样性。	□	□	□	□	□
考虑建筑设计与自然环境的全天候交流。	□	□	□	□	□
光污染控制。	□	□	□	□	□
场地声环境优化。	□	□	□	□	□
场地风环境优化。	□	□	□	□	□
热岛效应控制。	□	□	□	□	□
室内噪声控制。	□	□	□	□	□
室内炫光控制。	□	□	□	□	□
室内保持适宜温度。	□	□	□	□	□
室内通风和新风量。	□	□	□	□	□
夏季遮阳设计。	□	□	□	□	□
室内空气质量监控。	□	□	□	□	□
室内指示牌及人性化因素。	□	□	□	□	□
安全辅助措施（防滑垫、座椅、扶手等）。	□	□	□	□	□
员工专属的工作和休息空间。	□	□	□	□	□

3

城市社会融合	完全不重要	不太重要	一般重要	非常重要	极其重要
与周边住宅保持良好的楼间距。	□	□	□	□	□
医院建筑设计考虑周边邻里和行人的影响。	□	□	□	□	□

使用	完全不重要	不太重要	一般重要	非常重要	极其重要
交通流线和物流相对独立，减少交通距离。	□	□	□	□	□
多功能房间采用循环、简易隔断。	□	□	□	□	□
设计充分考虑到未来建筑改造、扩建性能。	□	□	□	□	□
场地安全的被动式设计，有安保和监控系统。	□	□	□	□	□

通道	完全不重要	不太重要	一般重要	非常重要	极其重要
医院场地附近有良好的公共交通系统。	□	□	□	□	□
医院与公共交通之间有清晰的行人专用道路。	□	□	□	□	□
医院场地提供数量够用的停车空间。	□	□	□	□	□
无障碍设计。	□	□	□	□	□
室外行人道路、坡道、台阶等照明系统。	□	□	□	□	□

空间	完全不重要	不太重要	一般重要	非常重要	极其重要
场地、建筑内部通过空间划分设计降低医护人员、患者和访客的交通距离。	□	□	□	□	□
场地规划、建筑设计考虑到必要的空间隔离。	□	□	□	□	□
建筑设计充分考虑性别隔离。	□	□	□	□	□
建筑内有充足的储存空间。	□	□	□	□	□

其他需求，请标注	完全不重要	不太重要	一般重要	非常重要	极其重要
	□	□	□	□	□

D. 医疗环境设计的发展

D1. 请选择您认为在促进社区医疗环境设计质量方面最重要的 3 项：

- □ 相关设计规范和环境评价标准的要求
- □ 环保因素的要求
- □ 经济因素的制约和要求
- □ 社会公众的需求
- □ 市场竞争压力
- □ 媒体宣传的影响
- □ 开发商的要求及标准
- □ 计算机辅助技术/软件技术的发展
- □ 在线设计信息资源数据库的辅助
- □ 其他，请标注：

4

D2. 请选择您认为当前影响社区医疗环境设计质量方面最为严重的 3 项：

- □ 缺少必要的设计规范和环境评价标准
- □ 缺少环保意识
- □ 缺少对经济因素方面的考虑
- □ 缺少社会公众需求的关怀
- □ 缺少市场竞争力
- □ 宣传力度不够
- □ 计算机辅助技术程度不高
- □ 没有合适的在线设计信息资源的辅助
- □ 其他，请注明：

D4. 请选择您认为促使您的医疗环境设计能力提高最为有效的 5 项：

- □ 社会责任（人文关怀）的驱使
- □ 职业道德
- □ 环保意识
- □ 参与相关培训课程
- □ 对建筑成本效益等经济方面的考虑
- □ 通过学术文献或参加相关会议获取知识
- □ 直接跟建筑的最终使用者（病人、医生）的沟通，如意见反馈、使用后评估等信息
- □ 学习计算机技术、软件操作
- □ 市场竞争压力驱使
- □ 满足开发商的具体要求
- □ 其他，请注明：

E. 开放性问题

E1. 请您谈一下您对医疗环境“以用户为中心”设计的理解：

E2. 个人信息 – 如果您愿意参与下一轮关于“如何促进不同用户群体在社区医疗环境设计过程中达成观点一致”的调研，请留下您的联系方式：

5

E3. 请您对该研究项目或本次调研问卷提出宝贵意见：

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

所有收集信息将严格按照保密协议处理，仅有用于本次关于社区医疗环境的博士课题研究。数据将以统计结果的形式呈现在调查报告中，并严格保护个人信息。欢迎针对本次研究提供建议。

Many thanks for your cooperation.

感谢您的合作。

Yours Sincerely,

Qichao BAN（班淇超） Supervised by Bing CHEN （陈冰 – 导师）

If you have any question please contact me freely at the address below. Thanks again for your participation.

如果您有任何问题或者想进一步参与研究，请按照以下地址联系：

Address: Xi'an Jiaotong-Liverpool University, Suzhou 地址：苏州工业园区西交利物浦大学

Tel: (0512) 88161840 Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737 Email: Bing.Chen@xjtlu.edu.cn

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APPENDIX 3.9: Questionnaire for Focus Group

UNIVERSITY OF LIVERPOOL　　Xi'an Jiaotong-Liverpool University 西交利物浦大学

Questionnaire for Focus Group

PARTICIPANT INFORMATION SHEET GUIDELINES **No. ( )**

[Form Version Number 1 Date: 10 August 2017] **Date ( )**

Title of Research: End-user Centred Participatory Design for Community-based Healthcare Environments in China

研究题目：中国社区医疗环境以用户为中心的参与式设计研究

This study aims to support a research project that focuses on the design strategies and end-users' satisfaction for community-based healthcare environments in China (Community Healthcare Centres/Clinics). You are invited to take part in this study because you are regarded as a representative of end-users/architects. **Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.** This research has been approved by the Research Ethics Subcommittee of XJTLU (Proposed number: 14-01-06).

本次调研旨在为针对**中国社区医疗环境以用户为中心的参与式设计**研究课题提供必要的数据支持，特邀请您作为社区医疗环境使用者用户/建筑师代表参与本次问卷调研。参与完全自愿，任何个人信息将严格保密处理。该研究已获得西交利物浦大学研究道德委员会的批准（14-01-06）。

A. PERSONAL BACKGROUND

✧ **For patients**

A1. Are you?

□ Male / □ Female

A2. How old are you?

A3. What are your educational background and major?

1

✧ **For medical staff**

A1. Are you?
□ Male / □ Female

A2. How long have you worked in CH facilities?
□ Intern □ Regular employee ______ years

A3. Please indicate your working field in this CH facility:
□ Treatment □ Nursing □ Administration □ Others: ______

✧ **For architects**

A1. Are you?
□ Male / □ Female

A2. How long have you been involved in healthcare environment design?
______ years

A3. Please specify the amount of projects (i.e. CH Centres or Clinics) that you have been involved in:
______ projects

B. FOCUS GROUP QUESTIONS

B1. Can you share your opinions on these design issues (in the list) with significant cognitive differences between patients and medical staff? Why do these priority variances happen?

______

B2. Do you agree with the results (i.e. preferences for the design issues related to end-users' needs for community-based healthcare environments) summarised from the survey that you have previously participated in? Can you share your opinions on the design issues that are evaluated at the level of "moderately important"?

______

2

B3. Comments – if you have any comments regarding the research project or surveys, please do so:

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

所有收集信息将严格按照保密协议处理，仅有用于本次关于社区医疗环境的博士课题研究。数据将以统计结果的形式呈现在调查报告中，并严格保护个人信息。欢迎针对本次研究提供建议。

Many thanks for your cooperation.

感谢您的合作。

Yours Sincerely,

Qichao BAN（班淇超） Supervised by Bing CHEN （陈冰 – 导师）

If you have any question please contact me freely at the address below. Thanks again for your participation.

如果您有任何问题或者想进一步参与研究，请按照以下地址联系：

Address: Xi'an Jiaotong-Liverpool University, Suzhou 地址：苏州工业园区西交利物浦大学

Tel: (0512) 88161840 Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737 Email: Bing.Chen@xjtlu.edu.cn

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Questionnaire for Focus Group

PARTICIPANT INFORMATION SHEET GUIDELINES No. ( )

[Form Version Number 1 Date: 10 August 2017] Date ( )

Title of Research: End-user Centred Participatory Design for Community-based Healthcare Environments in China

研究题目：中国社区医疗环境以用户为中心的参与式设计研究

This study aims to support a research project that focuses on the design strategies and end-users' satisfaction for community-based healthcare environments in China (Community Healthcare Centres/Clinics). You are invited to take part in this study because you are regarded as a representative of end-users/architects. **Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.** This research has been approved by the Research Ethics Subcommittee of XJTLU (Proposed number: 14-01-06).

本次调研旨在为针对**中国社区医疗环境以用户为中心的参与式设计**研究课题提供必要的数据支持，特邀请您作为社区医疗环境使用者用户/建筑师代表参与本次问卷调研。参与完全自愿，任何个人信息将严格保密处理。该研究已获得西交利物浦大学研究道德委员会的批准（14-01-06）。

A. 个人背景

✧ **患者内容**

A1. 您的性别

□男 / □女

A2. 您的年龄

A3. 您的教育背景及专业

1

✧ 医护人员内容

A1. 您的性别

□男 / □女

A2. 您在该中心/站的工作性质和时间

□实习 □正式员工 ________ 年（或）月

A3. 您在该中心/站的工作范围

□治疗 □护理 □行政管理 □其他: ________

✧ 建筑师内容

A1. 您的性别

□男 / □女

A2. 您从事医疗建筑设计行业：

________ 年

A3. 请注明您参与的社区卫生服务中心/站项目的大概数量：

________ 个

B. 焦点小组问题

B1. 请您对附件中列出来的那些会导致患者与医护人员产生不同认知需求的设计内容，提出您的见解，您认为是什么导致了这些需求差异的存在？

B2. 您是否同意附件中所列出来的研究结果（按照之前调研数据所总结出的、关于用户对社区卫生环境需求相关的设计内容的相对重要性）？请您对那些被标注为"一般重要"的设计内容提出您的见解。

2

B3. 请您对该研究项目或本次调研问卷提出宝贵意见：

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

所有收集信息将严格按照保密协议处理，仅有用于本次关于社区医疗环境的博士课题研究。数据将以统计结果的形式呈现在调查报告中，并严格保护个人信息。欢迎针对本次研究提供建议。

Many thanks for your cooperation.

感谢您的合作。

Yours Sincerely,

Qichao BAN（班淇超） Supervised by Bing CHEN （陈冰 – 导师）

If you have any question please contact me freely at the address below. Thanks again for your participation.

如果您有任何问题或者想进一步参与研究，请按照以下地址联系：

Address: Xi'an Jiaotong-Liverpool University, Suzhou 地址：苏州工业园区西交利物浦大学

Tel: (0512) 88161840 Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737 Email: Bing.Chen@xjtlu.edu.cn

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APPENDIX 3.10: Questionnaire Sample from Staff Group

UNIVERSITY OF LIVERPOOL   Xi'an Jiaotong-Liverpool University 西交利物浦大学

Questionnaire for Staff Group

PARTICIPANT INFORMATION SHEET GUIDELINES **No. (** WT01 **)**

[Form Version Number 1   Date: 01 March 2015] **Date (** 13/11/2016

Title of Research: End-user Centred Participatory Design for Community-based Healthcare Environments in China

研究题目：中国社区医疗环境以用户为中心的参与式设计研究

This study aims to support a research project that focuses on the design strategies and end-users' satisfaction for community-based healthcare environments in China (Community Healthcare Centres/Clinics). You are invited to take part in this study because you are regarded as a representative of Staff Group. **Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.** This research has been approved by the Research Ethics Subcommittee of XJTLU (Proposed number: 14-01-06).

本次调研旨在为针对**中国社区医疗环境以用户为中心的参与式设计**研究课题提供必要的数据支持，特邀请您作为社区医疗环境使用者——员工代表参与本次问卷调研。参与完全自愿，任何个人信息将严格保密处理。该研究已获得西交利物浦大学研究道德委员会的批准（14-01-06）。

A. 个人背景

A1. 您的性别

☑男 / ☐女

A2. 您在该中心/站的工作范围

☑治疗   ☐护理   ☐行政管理   ☐其他: ....

A3. 您在该中心/站的工作性质和时间

☐实习   ☑正式员工   ....9 12.... 年（或）月

1

B. 设计内容的相对重要性

B1. 请对以下设计内容在社区卫生服务中心/站的环境设计过程中的重要程度进行评价：
(N: 完全不重要; S: 不太重要; M: 一般重要; V: 非常重要; E 极其重要)

特征及创新	完全不重要	不太重要	一般重要	非常重要	极其重要
医院看上去非常有特色。	☐	☐	✓	☐	☐
医院营造出一种康复和对患者关怀的氛围。	☐	☐	☐	☐	✓
医院能够体现出医疗服务体系的宗旨和价值。	☐	☐	☐	✓	☐

形式及材料	完全不重要	不太重要	一般重要	非常重要	极其重要
医院考虑人体尺度，创造"欢迎"的感觉。	☐	☐	☐	☐	✓
在场地内医院建筑有良好的朝向。	☐	☐	☐	☐	✓
医院场地及建筑的进出口明显，容易找到。	☐	☐	☐	☐	✓
医院整体颜色和材料质感搭配合理、吸引人。	☐	☐	✓	☐	☐

医护人员&患者环境	完全不重要	不太重要	一般重要	非常重要	极其重要
医院尊重患者，保护患者私密性。	☐	☐	☐	☐	✓
建筑内外有良好的景观。	☐	☐	✓	☐	☐
患者及医护人员可以很容易接触到自然景观。	☐	☐	✓	☐	☐
室内有高标准的舒适度及舒适度控制系统。	☐	☐	☐	☐	✓
医院交通很容易被理解，容易找到目的地。	☐	☐	☐	☐	✓
医院针对患者具有良好的卫生间/浴室服务。	☐	☐	☐	☐	✓
医护人员有独立办公和休息空间。	☐	☐	☐	✓	☐

城市社会融合	完全不重要	不太重要	一般重要	非常重要	极其重要
医院建筑高度、尺度、天际线不会周围环境产生影响。	☐	☐	☐	☐	✓
医院建筑设计考虑周边邻里和行人的影响。	☐	☐	☐	☐	✓

使用	完全不重要	不太重要	一般重要	非常重要	极其重要
交通流线和场地物流具备良好的设计。	☐	☐	☐	☐	✓
建筑有良好的改造和扩建性能。	☐	☐	✓	☐	☐
场地安全，有安保和监控系统。	☐	☐	☐	☐	✓

通道	完全不重要	不太重要	一般重要	非常重要	极其重要
医院场地附近有良好的公共交通系统。	☐	☐	✓	☐	☐
医院场地针对患者和员工提供数量够用的停车空间，尤其是针对残疾人。	☐	☐	☐	☐	✓
行人道路明显、适宜，尤其是针对轮椅用户和具有其他存在身体或视力障碍的用户。	☐	☐	☐	☐	✓
室外空间针对行人道路、坡道、台阶等提供适宜、安全的照明系统。	☐	☐	☐	✓	☐

空间	完全不重要	不太重要	一般重要	非常重要	极其重要
场地、建筑内部通过空间划分设计降低医护人员、患者和访客的交通距离。	□	□	□	☑	□
场地规划、建筑设计考虑到必要的空间隔离。	□	□	□	☑	□
建筑设计充分考虑性别隔离。	□	□	☑	□	□
建筑内有充足的储存空间。	□	□	□	□	☑

其他需求，请标注：	完全不重要	不太重要	一般重要	非常重要	极其重要
	□	□	□	□	□

C. 医疗环境设计相关知识

C1. 请选出您认为可以帮助您了解医疗环境设计方面相关知识的途径（多选）：

- □ 报纸介绍
- ☑ 医院宣传册
- □ 电视媒体，广告
- □ 网络
- ☑ 亲友推荐
- □ 进入直接观察
- □ 其他，请注明：

C2. 请选出您认为与医疗环境设计存在联系的选项（多选）：

- ☑ 影响治疗和康复的交叉感染
- □ 康复效率
- □ 用药量
- ☑ 患者就诊过程中意外摔倒
- ☑ 患者就诊时心情和情绪
- ☑ 医护人员健康
- ☑ 医护人员服务质量和工作效率
- □ 医护人员工作满意度
- □ 其他，请注明：

C3. 您是否收到过任何针对你对某社区卫生服务中心/站的环境设计方面满意度的调研问卷？

□ 是 / ☑ 否

C4. 您是否向患者发放过任何针对某社区卫生服务中心/站的服务质量方面满意度的调研问卷？

☑ 是 / □ 否

D. 开放性问题

D1. 请您描述一下您对社区卫生服务(作用、意义等)的理解：

针对基础疾病、常见疾病提供基本的诊断和治疗，指导常见疾病的用药和康复。

3

D2. 请您对社区医疗环境设计提出看法和建议：

更加合理化、人性化，易于辨认，指示明确.

D3. 请您谈一下您对医疗环境"以用户为中心"设计的理解：

以用户为中心"应理解为以"医、患"双方的用户为中心，而不是单纯指患者一方.

D4. 个人信息 – 如果您愿意参与下一轮"重复验证"的调研并希望了解本调研的分析结果，请留下您的联系方式：

[redacted] [redacted]

D5. 请您对该研究项目或本次调研问卷提出宝贵意见：

无

All information which is collected from you will be strictly treated as confidential by the independent survey team and only used as part of this research about community-based healthcare environments. Survey reports will use summaries of information and will not reveal the identities of individuals. Any suggestions about this research work are also welcome.

所有收集信息将严格按照保密协议处理，仅有用于本次关于社区医疗环境的博士课题研究。数据将以统计结果的形式呈现在调查报告中，并严格保护个人信息。欢迎针对本次研究提供建议。

Many thanks for your cooperation.

感谢您的合作。

Yours Sincerely,

Qichao BAN（班淇超）　　Supervised by Bing CHEN（陈冰 – 导师）

If you have any question please contact me freely at the address below. Thanks again for your participation.

如果您有任何问题或者想进一步参与研究，请按照以下地址联系：

Address: Xi'an Jiaotong-Liverpool University, Suzhou　地址：苏州工业园区西交利物浦大学

Tel: (0512) 88161840　Email: Qichao.Ban@xjtlu.edu.cn

Tel: (0512) 88161737　Email: Bing.Chen@xjtlu.edu.cn

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APPENDIX 4: INVETIGATION PROCEDURES AND RESPONSES OF FOCUS GROUP

APPENDIX 4.1: Investigation procedures

✧ **The investigation procedures for patients and medical staff**

- Step 1: Contacting the director of a community-based healthcare facility in SIP, to ask if he/she would be interested in this research and allow the researcher to 1) approach both medical staff and patients in the site for interviews and questionnaire surveys; and 2) take photos of physical environments for observation;
- Step 2: Providing a copy of all documents for field investigations, including a cover letter, an information sheet, a participant consent form (see Appendix 3.2 ~ 3.4) and all questionnaires (see Appendix 3.5 ~ 3.7), to the director who approves the application;
- Step 3: Collecting the participant consent form with the director's signature;
- Step 4: Deciding the dates of visits by mutual convenience;
- Step 5: During the visits, identifying a potential sample (patient samples: people who seek medical treatments from this community-based healthcare facility; staff samples: medical workers who are hired by this community-based healthcare facility);
- Step 6: Providing an oral invitation for the interview/questionnaire survey to the patient/medical worker;
- Step 7: Providing a copy of all documents for ethical concerns, including a cover letter, an information sheet and a participant consent form, to the patient/medical worker who consents to participate;
- Step 8: Collecting the participant consent form with the signature of the patient/ medical worker;
- Step 9: Providing a list with all questions for the interview/questionnaire survey;
- Step 10: Supervising the process of answering questions or filling in the questionnaire by the patient/medical staff;
- Step 11: Collecting the questionnaire;
- Step 12: Identifying the usable questionnaires.

✧ **The investigation procedure for architects**

- Step 1: Contacting the director of a company whose main business is focused on the design and construction of healthcare buildings and environments, to ask if he/she would be interested in this research and allow the researcher to approach the employees of this company for interviews and questionnaire surveys;

- Step 2: Sending a copy of all documents for field investigations, including a cover letter, an information sheet, a participant consent form (see Appendix 3.2 ~ 3.4) and a questionnaire (see Appendix 3.8), to the director who approves the application;
- Step 3: Collecting the participant consent form with the director's signature;
- Step 4: Receiving a list with all email addresses of the employees of this company;
- Step 5: Sending an invitation email with a cover letter, an information sheet, a participant consent form, a questionnaire and an online survey link to the employee;
- Step 6: Collecting the questionnaire by email or online from the employee who consents to participant;
- Step 7: Identifying the usable questionnaires.

✧ **The investigation procedure for the focus group**

- Step 1: Contacting the patient/medical staff/architect who left contact information in the questionnaire;
- Step 2: Providing an invitation for the focus group by phone/email;
- Step 3: Deciding the date of the focus group by mutual convenience of other participants;
- Step 4: Conducting the meeting on the agreed date;
- Step 5: Providing a copy of all documents for ethical concerns, including a cover letter, an information sheet and a participant consent form (see Appendix 3.2 ~ 3.4), to the participant of the focus group;
- Step 6: Collecting the participant consent form with the participant's signature;
- Step 7: Providing a questionnaire with all questions (see Appendix 3.9);
- Step 8: Recording the answers to the questions with permissions;
- Step 9: Collecting the questionnaire.

✧ **The investigation procedure for the beta test**

- Step 1: Contacting the architect who left contact information in the questionnaire;
- Step 2: Sending a copy of documents for the beta test, including a cover letter, an information sheet, a participant consent form, a questionnaire (see Appendix 3.2 ~ 3.4) and the ECPD prototype, to the architect who consents to participant;
- Step 3: Collecting the participant consent form with the architect's signature;
- Step 4: Conducting an interview to understand the feedback of the architect regarding the user experience of ECPD.

APPENDIX 4.2: Response analysis for Focus Group Question 1

FG-P6: "…The most important patients' needs are **health and healing**… We have to go to healthcare facilities, but we are **not willing to go there**… It is necessary to consider our **user experience and mood for healthcare environment design**... When patients are in a community-based healthcare facility, we are easy to become nervous and impatient… A **considerate**, **well-designed healing environment** with **a reassuring atmosphere** and **good decoration** gives us equanimity. Such consideration should also be paid to medical staff... For cognitive differences between patients and medical staff, I do not think it is be a problem… Choose the higher demands from specific groups to represent the demands of the entire group… Architects can **pay more attention to the people with higher demands**… Design standards can also be set up based on the higher demands… Differences (in cognition) are thereby reduced…"

FG-P2: "…I think everyone present would not disagree that **health is the greatest satisfaction for patients**, **as well as medical staff**… Convenient and effective medical treatments and a quick recovery are the most important things for patients… For the inevitable differences between patients and medical staff, I agree with the participant about **'pay more attention to the people with higher demands**'… These issues can be dealt with in the communication process, as long as architects have realised these differences and then find solutions… Before this meeting, I did not know that design has such functions, improving my health and recovery, increasing medical staff's work efficiency, and then continuing to impact upon my recovery in return… **When I was filling in the questionnaire**, **I only considered my satisfaction and well-being**… I am **willing to understand what medical staff would like to need** (for community-based healthcare environments) – for example, staff-only places and storage space… They (medical staff) know how to treat diseases… They have much better knowledge levels about the design of healthcare environments (than patients)… I am willing to listen to them about how to design, **as long as let me know why**…"

FG-P4: "…For using artwork and design features to decorate the indoor and outdoor environments, I think it is useful… It provides a good atmosphere… But I think we need to **re-consider the function of artwork**. Architects said artwork was an important strategy that could reduce the pressure and anxiety of patients when they were in wards or waiting areas… This finding was from a great abroad experiment… But it is only for old time… Paintings, plants and sculptures are beautiful, and patients' attention is therefore distracted… I did not give a high score to this option in the survey… It is fine for other people. However, if you would like to distract my attention and reduce my anxiety, give my free **Wi-Fi**, a **cell phone**, an **iPad** or a **TV** in the waiting area… These are what I need for anxiety reduction, better than artwork… That is why I do not think artwork is that important… Maybe, for now, artwork means **diverse approaches that have the function of distracting patients' attention**...”

FG-P7: "…I did not know artwork can help me with my recovery and mood, but I think **a well-designed indoor environment can make me trust this facility**… The **building image is important for patients to find the facility**… I think survey results can only represent the knowledge levels of patients… Attitudes of some patients are selfish… I think **medical staff's preferences are better than patients'**… They know how to provide recommendations to optimise healthcare environment design… They know how to improve the efficiency of healthcare service… I think a community-based healthcare facility should be designed within **a 10-minute walking distance**… I can go there on foot and do not need to use vehicles. **Parking is not that important**… Moreover, some patients of community-based healthcare facilities are elder people, who cannot drive…”

FG-P9: "…I do not think safety facilities would cause cognitive differences between patients and medical staff… It is important for the elderly and the disabled… Maybe some young people do not realise the meaning of these facilities, but medical staff knows that… They (medical staff) believe **humanistic design** is much more important than all patients do…”

FG-P1: "…We come here for primary care… I do not stay overnight, so I think the **storage space is not that important**… Maybe it is important to medical staff… When I was in the facility, I would like to **find my destination easily and conveniently**… I do not need too much walking around… The circulation should be well designed, and I do not need to **go upstairs and downstairs** …”

FG-P3: "…Most community-based healthcare facilities are designed in the centre of communities, surrounded by plants and landscapes… I think it is important for patients to **access to outdoors and the natural environment**… When patients are waiting for medical treatments, they can go to outdoors, enjoying plants and landscapes… I think it is an important feature that can differentiate community-based healthcare facilities and general hospitals…”

FG-S1: "…A communication between different stakeholders is a meaningful, effective way to reduce cognitive differences and misunderstanding… When medical staff provides views about healthcare environment design, we must have **a scientific reason**… Most suggestions are for the overall healthcare outcomes and management… Attention of medical staff is mainly paid to **work efficiency** – for example, distances of walking and responding, and other medical procedures... For the cognitive differences between patients and medical staff, I do not think it would be a serious problem… All conflicts in the list, including the quality of indoor environments, artwork, decoration, rest space, storage space and safety facilities, can be dealt with by using architectural design, as long as these requirements can be **heard by architects**… Because community-based healthcare facilities are not at large scale, it is relatively easy to solve these differences…"

FG-S5: "…To some extent, patients do not understand the real situation of healthcare facilities… I find that patients do not pay enough attention to **private space for medical staff**… I think it is necessary for medical staff, especially for nurses… Doctors own offices, but nurses have to stay behind the table in the corridor… When I am not on demand, I do not have an office to have a nap…"

FG-S7: "…The storage space is necessary… I mean a changing room with a bathroom for a shower… I live nearby, and I use a bike to go to work… The administrators encourage us to have 'a green travel', but there are **no auxiliary facilities**… Moreover, the **supervision** is also very important… For example, during the process of intravenous infusion, a nurse can supervise several patients at the same time, when the design of **passive supervision** is well considered… With a good angle between the nurse station and the injection area, nurses can work effectively as expected… Maybe patients do not understand this issue, and the cognitive difference thereby happens…"

FG-S3: "…I notice that there is a cognitive difference related to circulation distances… Some patients mentioned that the circulation distance in a Community Healthcare Centre should be minimised as much as possible… But **an important issue that affects the design of a healthcare environment is the indoor infection control**. Some rooms should be linked together, and some rooms should have the necessary distance… As my colleague said 'there is a scientific reason'… But architects can deal with this issue and help patients find their **destination** quickly… Safety facilities are very important for healthcare environments. I think it is common sense… Different from patients, **parking is important for medical staff**… I do not live in the community where I work, and I drive every workday… Medical staff of this community-based healthcare facility shares the parking area with the customers of the surrounding supermarket… Sometimes I cannot find a parking space…"

FG-S2: "…**A well-designed indoor environment can be much easier to get patients' trust**… In a place that patients trust, they will have **a good mood and recover soon**… But the reality is that the design of community-based healthcare facilities does not draw enough attention from authorities or the public… These healthcare facilities need financial support, for equipment procurement, design and retrofit, in order to provide better healthcare service…"

FG-S6: "…After the consideration about patients, medical staff begins to consider themselves… This is medical staff's responsibility and professional quality… The knowledge exchange should be built based on **a mutual understanding**… We try to understand patients, including their desires for health, requirements about the quality of healthcare service, satisfaction and needs for design and other equipment, but we also need patients' understanding… We spend much more time, staying in the healthcare environments… We try to figure out how it can be optimised for better healthcare service… The **communication should be enhanced**, between patients and medical staff, and between medical staff and architects… The communication may not eliminate the (cognitive) differences, but it definitely helps one group understand what other groups think and need… Conflicts and compromises are OK, as long as the **final results are scientific**… We can use **specific data as standards to evaluate the design** – for example, **cross-infection control quality**, **recovery period**, **dosage**, **error rates and emergency measure for the special period**…"

FG-S4: "…Some participants of patients said that healthcare facilities at a community level should be designed to access to outdoors… They can enjoy landscapes during the process of obtaining medical treatments… I know this idea is good. Patients can have a good mood… But healthcare facilities should not have open-plan design… It may make the **supervision and management more difficult**… What about **accident falls**? There are not so many nurses who can supervise the patients to go to outdoors and enjoy plants… "

FG-A1: "…During my ten years' experience in healthcare environment design, I have done dozens of projects, including general hospitals and community-based healthcare facilities... In the process, architects need to deal with many requirements, according to building regulations, developers, administrators and end-users... Generally, architects do not have enough time to explore end-users' needs… I know it is necessary… I believe **cognitive differences within different end-user groups and between architects and end-users do exist**… I also believe that communication and knowledge exchange can reduce differences. For example, based on the demands of patients and medical staff, architects can use professional knowledge to deal with the demands… But it is a huge workload of exploring and identifying the specific needs and differences… I know it is meaningful, however, it is **a relatively short time** for architects to prepare design and find useful information... For these issues (i.e. design issues with cognitive differences between patients and medical staff), I would like to adopt medical staff's preferences for design details, including external colours and textures, indoor decoration, artwork, relax space and adequate storage space… I will adopt patients' preferences for layouts, circulation and access to outdoors… But I will make a trade-off, because environmental protection is also important… Good design is not only satisfying stakeholders' needs… We may have a list of design strategies, based on end-users' preferences… But I do not think I would follow this list completely… I do not put other strategies for energy saving just behind this list… Design is a technical thing, and it needs specialist knowledge and experience…"

FG-A2: "…To improve the overall design quality, I would like to use building regulations to find relevant references and information… I studied the *Code for Design of General Hospital* (GB 51039) and *Evaluation Standard for Green Hospital Building* (GB/T 51153)… But **these building regulations are mainly for general hospitals**… I used the credits of scoring items to select relevant design strategies and evaluate my design… In terms of these design issues with cognitive differences, I planned to use the *Evaluation Standard for Green Hospital Building* (GB/T 51153) to deal with the cognitive differences… But I found that there is a lack of relevant design strategies or requirements for some design strategies that have cognitive differences – for example, artwork for decoration, colours and textures, adequate storage space and design for passive supervision… There are some differences between the requirements of this building regulation and end-users' preferences… I think architects also need to have the capabilities of dealing with such problems… As other participants said, health is the most important satisfaction. **Architects should be good at evidence-based design** and use architectural design to help patients' healing and medical staff's work efficiency… Such information relating to end-users' needs for healthcare environments provides useful guide for me, saves time to do investigation in the design process, and contributes to the design quality..."

APPENDIX 7.3: Response analysis for Focus Group Question 2

FG-P6: "…I think the results can reflect patients' preference… The **design issues that have direct relationships with our comfort should be ranked highly** – for example, temperature, ventilation, noise control and lighting… Then design issues about patients' convenience and transportation, including auxiliary facilities, entrance and connection with public transport, are at the second level… A lack of convenience may increase the anxiety during the process of medical treatments… However, **a lack of artwork may make the building less attractive and dull**, **but may not increase the anxiety**… It is the reason why I think the decoration should be low-evaluated… It is relatively easy to implement artwork decoration, even after the construction… For good views, I think it is important for patients who have to stay in bed… They may consider viewing out important…"

FG-P8: "…There is a little difference between the results and my preference… I think artwork in healthcare environments is important… I have **a little disagreement** with the results… The levels of design issues related to the building form, decoration and landscapes should be moved up… But I can understand other participants… As a young girl, I do not need to worry about if there are enough safety facilities. So I do not think barrier-free design is really necessary for young people… But I understand that the human scale, barrier-free equipment and safety protection are very important to the elderly… They go there more often than us… The results are based on **a comprehensive thinking**… Hope architects could understand stakeholders at different ages, and design an ageing-friendly environment with an attractive, cosy image of buildings… Some design issues were low-evaluated by us, but it does not mean they are not important… No matter how architects put themselves into energy saving and material consumption, they still need to provide an artistic work at last…"

FG-S3: "…For medical staff, we would like to have **a well-designed environment** for both interiors and exteriors… Because every week, from Monday to Friday, I work here. A good environment with **artwork**, **good decoration and good views can relieve the pressure** caused from the work… But the results achieved today (i.e. preferences of Patient Group and Staff Group) really reflect that a number of design issues should be enhanced for current community-based healthcare environments. These issues can be found at the top of the lists… Indoor decoration and artwork are important, but I think **they belong to the second level**, or **a higher demand beyond the basic level**… Putting a TV or a computer in waiting areas is really meaningful to reduce patients' anxiety during the waiting process…"

FG-A1: "…**Cognitive differences between end-users and architects do exist** and will exist forever… There may be two reasons. First, during the design process, architects have to deal with many issues… The design related to end-users' needs was not in the first position, or end-users' needs were not well understood by architects… Second, because these needs are not well satisfied in the practice, end-users would like to enhance this dissatisfaction with reality… In terms of the survey results, I think they are representative for most end-users…

Design is perceptual and sensitive… There are no strict standards for evaluation… I do not think the results are absolutely right, but they are enlightening… There are some problems – for example, artwork is an important design strategy that can release people's anxiety and stress, but it was evaluated at the level of "moderately important". Almost the last… It reflects that **end-users' knowledge about healthcare environment design is limited**, a**nd they only pay attention to their current demands**… The professional knowledge requires architects to think more… The results can be used together with building regulations and architects' work experience, which gives architects an in-depth thinking… A better design work can be provided for end-users of community-based healthcare facilities **beyond the case**… The preferences of end-users give architects an idea… It is like **designing architecture with end-users**… I use professional knowledge to re-evaluate the design strategies based on end-users' preferences, and thereby improve their satisfaction and the overall quality of my design in the meantime… It makes the design not blind… It means 'we architects know your satisfaction and needs, and I will solve them, together with problems that belong to us architects'…"

FG-A2: "…I had a basic understanding of evidence-based design… Artwork, access to outdoors and views out are important design strategies that can contribute to patients' recovery and medical staff' work efficiency… But these design strategies did not draw enough attention or cognition from end-users, because their specialist knowledge in healthcare environment design is limited… Architects should use specialist knowledge in the built environment to help these non-professionals realise their visions… **Architects need a platform to conduct communication**, **for both acquiring opinions from all kinds of stakeholders and giving them suggestions for healthcare environment design**… Design is a collaborative process… For sustainable design, the human-centric principle is the core of built environments…"