CLUSTER searching approach to inform evidence syntheses: A methodological review

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Abstract

***Background*:** The CLUSTER model of searching was proposed as a systematic method of searching for studies for reviews of complex interventions. The method has not been evaluated before.

***Aim*:** This methodological review identified and evaluated a sample of evidence syntheses that have used CLUSTER.

Methods: A forward citation search on the seed CLUSTER publication was conducted on Web of Science Core Collection using six journal citation indexes and Google Scholar in December 2020. Reviews which used the CLUSTER method were eligible for inclusion. A narrative synthesis was used to describe the types of evidence syntheses that used CLUSTER searching, the extent to which the CLUSTER approach has been operationalised within evidence syntheses and whether the value, benefits and limitations of CLUSTER were assessed by the reviewers.

Findings: A total of sixteen reviews were identified and eligible for synthesis. Six different review types that used CLUSTER were identified with realist reviews being the most prominent. The evaluation of complex interventions was the most common review topic area. The use of CLUSTER varied among reviews with the retrieval of sibling studies being the most common reason. 'Citations' and 'Lead authors' were the most followed elements of CLUSTER.

Conclusions: Evidence suggests that CLUSTER has been adopted for use in reviews of complex interventions. Its usage varied among the included reviews. It is imperative that future reviewers diligently report the elements and steps of CLUSTER that were utilised in order to provide a reproducible and transparent search strategy that can be reported with similar transparency to bibliographic database searches.

1. Introduction

CLUSTER (Citations, Lead authors, Unpublished materials, Scholar searches, Theories, Early examples and Related projects) was introduced in 2013 as one of the first systematic models of searching for studies for systematic reviews of complex interventions. It is principally a derivative of Bate's set of search techniques termed berry picking.[1] The metaphor berry picking highlights the notion that search queries are not linear, but rather divergent and iterative, adaptable as emerging information becomes available. Despite its accepted and recommended use for knowledge building and theory generation in qualitative systematic reviews,[2] it presents challenges with regards to its perceived shortcomings. The inherent nature of berry picking poses major limitations that come in the form of questionable transparency, reproducibility and systematicity issues,[3] which is unlikely to adhere to current reporting standards in systematic reviews.[4] The CLUSTER approach extends and systematises Bates' model of searching to address the posed challenges. Further support in the development of CLUSTER is its function to facilitate in the identification of context.[5] Context is an important characteristic that is difficult to accommodate for in bibliographic database searching.[5]

The CLUSTER model of searching incorporates seven elements and thirteen procedural steps (see Table 1). It aims to identify associated evidence that is fundamentally linked as 'sibling studies' (i.e., evidence identified as an output from the same research project) and theoretically conceptually linked as 'kinship studies' (i.e., evidence related to the original study of interest). From identifying at least one 'key pearl citation' (i.e., exemplar evidence in a topic area), the reviewers can contact lead authors to identify potentially unpublished materials and relevant projects, conduct citation searches on key pearl citations, track theories, undertake

ancestry searching by combining project name and identifier for early examples and related projects.

The proposed series of search techniques embodied within CLUSTER can fulfil the prerequisites of locating relevant literature in complex evidence syntheses that requires the identification of conceptual underpinnings (e.g., meta-ethnography) or contextual detail involved in programme theory development (e.g., realist reviews). However, the intent of the search procedures of CLUSTER should be seen as supplementary not as an alternative, complementing the limitations or omissions from bibliographic database searches.[5]

The contribution of CLUSTER to the paradigm of supplementary searching has the potential to provide a more rigorous and reproducible search strategy. This may appeal to researchers by improving the transparency in the conduct of supplementary search techniques. An additional benefit of CLUSTER is that it can be adapted to a wide range of reviews and topics, a mutual characteristic shared with other examples of search approaches.[6–8] However, a major distinction of CLUSTER is that it was designed to identify evidence both directly and indirectly associated with a key citation. This is inherently different to other examples of search approaches that were specifically designed and utilised in the identification and retrieval of grey literature.[6–8]

The use of supplementary search methods to maximise the identification of relevant evidence across different review types is increasing.[9–13] Considering this in conjunction with our knowledge that CLUSTER has not been previously evaluated, it is timely to explore how the CLUSTER approach has been applied within the landscape of evidence syntheses.

[INSERT TABLE 1 APPROXIMATELY HERE]

1.1. Review aim and objectives

This methodological review aimed to identify and evaluate a sample of evidence syntheses that have used the CLUSTER approach.

From this sample, the specific objectives were to:

i) identify eligible reviews by type (e.g., realist reviews) and group reviews by methodological approach (e.g., mixed-methods reviews) and topic (e.g., health-related interventions and exploration of experiences)
ii) determine if CLUSTER was used as a primary or supplementary search approach as described by authors
iii) determine from eligible reviews why the authors used CLUSTER
iv) examine the extent of the use of CLUSTER as reported by authors
v) describe the value of CLUSTER (i.e., the reported number of studies found via CLUSTER and/or eligible for synthesis)
vi) determine from eligible reviews the benefits and limitations of using CLUSTER as reported by authors

2. Methods

2.1 Search strategy

A forward citation search was conducted on Web of Science (WoS) Core Collection using six journal citation indexes (i.e., Science Citation Index Expanded (1970-present), Social Sciences Citation Index (1970-present), Arts & Humanities Citation Index (1975-present), Conference Proceedings Citation Index-Science (1990-present), Conference Proceedings Citation Index-Social Science & Humanities (1990-present), and Emerging Sources Citation Index (2015-present)) and Google Scholar (GS) up to 11th December 2020. GS has one of the most comprehensive coverages for citation searches[14] and can help in the retrieval of citation data in areas where coverage of WoS or Scopus is deficient.[15] The retrieval rate between using GS and WoS and GS and Scopus is less than 1%.[16] Additionally, there is a higher likelihood of yielding more unique citations when using GS in conjunction with WoS compared with GS and Scopus.[15]

The seed CLUSTER paper by Booth and colleagues[5] was identified in WoS and GS that offered functionality for forward citation searching. The title of the seed paper was searched in GS and then *Cited by* link was selected. In WoS, the *Cited Reference Search* was selected followed by the search of the seed paper using the *Cited Title* field. Finally, only the citations that resembled the original citation were

selected to complete the search. The searches were conducted on Windows 10 using Google Chrome (version 87.0.4280) by one reviewer (AT). No language or other restrictions on any of the searches were imposed. Search results were compiled in the reference manager Mendeley Desktop (version 1.19.8).[17] Duplicates were removed by one reviewer (AT) using Mendeley's duplicate identification inbuilt tool and then manually. Following the deduplication process, all studies were independently reviewed by the two reviewers at a full-text level. All discrepancies in eligibility were resolved via discussion.

2.2. Eligibility criteria

A review was defined to include the following characteristics: i) a description of a search strategy, ii) searches in more than one database, and iii) an eligibility criteria. Any published or unpublished review identified by searches of databases in WoS Core Collection and GS which used the CLUSTER approach were included. Reviews were excluded based on the following criteria due to limited resources and/or insufficient data to address review aim and objectives: i) non-English language reviews, ii) not an evidence synthesis, iii) CLUSTER was cited to support other search approaches (e.g., citation searches and contacting authors), iv) the seed CLUSTER publication was not cited, v) protocols, and vi) CLUSTER was not cited to inform a search strategy.

2.3. Data extraction

The following data, where reported, were extracted by one reviewer (AT) in a Microsoft Excel spreadsheet: i) review type, category and topic, ii) whether CLUSTER was used as a primary or supplementary search method, iii) an explanation to why CLUSTER was used, iv) the extent of the use of CLUSTER, v) the value of CLUSTER as illustrated descriptively and/or in a flow diagram, and vi) the benefits and limitations of using CLUSTER. A sample (20%) of extracted data were independently checked by MM. Ambiguities in data extraction were discussed until a resolution was reached.

2.4 Synthesis

A narrative synthesis was undertaken to present the findings. Textual descriptions of reviews and tabulation of data (see Table 2) have been organised by review

objectives. The classification of reviews were based on the framework developed by Sutton and colleagues.[18] Quality appraisal of reviews was not conducted as this review was descriptive in nature and quality ratings would not have informed the synthesis.

3. Findings

3.1 Results of the search

Sixteen reviews fulfilled inclusion into this review.[19–34] The forward citation search on the original CLUSTER publication[5] yielded 144 records. This was reduced to 88 records following the removal of duplicates. See annex in supplementary material for the total number of records yielded from each database. Seventy-two reviews were excluded following full-text screening. Those excluded included protocols (*n* = 19), were not an evidence synthesis (*n* = 23), where CLUSTER did not inform the search strategy (*n* = 22), CLUSTER was cited to support other search approaches (*n* = 6) and CLUSTER was not cited (*n* = 2). See supplementary material (Table 1 and Table 2) for the full list of excluded reviews and reasons. The characteristics of the 16 evidence syntheses included in this review are illustrated in Table 2.

3.2 Characteristics of included reviews

The 16 reviews included 14 published evidence syntheses and two unpublished theses. There were a total of six review types which included:

- Six realist reviews[23,25,26,30,32,34]
- Five systematic reviews[19–21,24,28]
- Two rapid realist review[22,31]
- One meta-ethnography[29]
- One meta-study[33]
- One critical interpretive review[27]

Using Sutton et al's framework[18] the six review types were classified into four main categories:

- Mixed-method reviews (i.e., realist reviews and critical interpretive review)[23,25–27,30,32,34]
- Systematic reviews[19–21,24,28]

- Rapid reviews (i.e., rapid realist reviews)[22,31]
- Qualitative reviews (i.e., meta-ethnography and meta-study)[29,33]

The topics among the reviews included complex health or health-related interventions (*n* = 13), education technology (*n* = 1), methodology development (*n* = 1) and exploration of experiences (*n* = 1).

3.2 CLUSTER as a primary or supplementary approach to searching

The CLUSTER approach was used as a supplementary search approach in all reviews.

[INSERT TABLE 2 APPROXIMATELY HERE]

3.3 Why was CLUSTER searching used?

Eight-one percent (*n* = 13) of reviews reported a rationale for the use of CLUSTER searching, which varied between reviews. There were a total of seven different rationales with the most prevalent reasoning being to enable the retrieval of sibling studies (*n* = 4).[19,22,23,28] Other reasonings for the use of CLUSTER searching include to enable the retrieval of both sibling and kinship studies (*n* = 2),[20,21] to compensate for thin reporting (i.e., insufficient reporting of evidence; *n* = 2),[25,26] to gather a sample of pertinent documents and move analysis from a single study to detailed cluster of related papers (*n* = 2),[24,30] relevant studies were anticipated to be poorly indexed (*n* = 1),[29] database searches using search terms yielded results that were either too narrow or broad (*n* =1),[27] and to identify conceptual factors to generate theoretical and methodological insights (*n* = 1).[33] Three reviews did not report their rationale or purpose for the use of CLUSTER searching.[31,32,34]

3.4 The extent of the use of CLUSTER searching

Six out of seven elements of CLUSTER were followed by two reviews,[26,30] four elements in four reviews,[20,28,29,34] three elements in three reviews,[23,32,33] two elements in four reviews[21,22,25,27] and one element was followed by one review.[19] Two reviews did not report the number of elements followed.[24,31]

The most prevalent element that was followed was identifying key citations (*n* = 14). The lead authors was the second most prevalent element (*n* = 10), followed by conducting scholar searches (*n* = 8). The least followed elements were searching for

theories (*n* = 4) related projects (*n* = 4), unpublished materials (*n* = 2), and early examples (*n* = 2).

Eleven of thirteen CLUSTER steps were followed in one review,[26] 10 steps in one review[30] and seven steps in three reviews.[20,29,34] Only one review followed one step[19]. Two reviews did not report the total number of steps followed.[24,31] The total number of steps and elements followed by each review are illustrated in Table 3.

Step 1 of CLUSTER (identify key citations) was the most followed step with only two reviews not following it.[22,31] Step 4 (searching for lead author) was the second most followed (*n* = 9) with step 5 (citation searches on key citations) the third most (n= 8). Step 2 (screening reference lists), 3 (rechecking for additional relevant records by authors), and 6 (searches on project name/identifier, if available) were then next most followed (*n* = 7). Five reviews followed step 12 (citation searches for relevant projects identified from cluster documents) and 3 reviews followed step 8 (follow-up key citations to identify relevant theory) and step 11 (follow-up key citations for citations to project antecedents and related projects). The least followed steps were step 7 (contacting lead authors), step 9 (rechecking mentions of relevant theory in titles, abstracts, and keywords), step 10 (iterative searches for theory mentioned in combination with condition of interest), and step 13 (seek cross-case comparisons), which were each followed by two reviews.

3.5 Description of the value of CLUSTER searching

Forty-four percent of the reviews reported the value of cluster (*n* = 7). Three reviews noted the inclusion of additional studies in their synthesis as a direct result of using the CLUSTER approach detailed in written form[32] or depicted in a flow diagram.[22,29] One review highlighted the systematic and explicit use of the CLUSTER approach that showed the key pearl citations and the exact number of studies retrieved from the specific steps that were conducted.[29] The value of CLUSTER was assessed descriptively in four reviews with one describing CLUSTER as enhancing the reviewer's ability to judge perspectives and allowed them to analyse multiple clusters[33]. CLUSTER compensated for thin reporting[26] and it allowed the gathering of an extensive assortment of linked sources.[24] Another review noted how CLUSTER complements realist synthesis and when studies shared a study identifier, acronym or an RCT identifying number, such connections were easy to establish.[30]

3.6 Description of benefits and limitations of using CLUSTER

Only two reviews reported any strengths and limitations of the CLUSTER approach. The authors of one review[20] were confident that the use of CLUSTER identified the most significant literature related to their research question and minimised the risk of missing relevant studies (e.g., qualitative and cost). Several benefits of CLUSTER were noted in one review[33] suggesting that the focus on contextual richness makes the search strategy a valuable tool and enhanced the comprehensiveness of the review. Additional advantages of the technique mentioned suggest that CLUSTER enhanced the reviewers' ability to interpret the processes behind multiple data collection methods and it can provide a rich source of data surrounding a key study, providing methodological, analytical and theoretical knowledge. The limit to the number of study CLUSTERS that can be feasibly analysed was the only stated limitation of this technique.[33]

[INSERT TABLE 3 APPROXIMATELY HERE]

4. Discussion

This methodological review has examined how CLUSTER searching has been applied and used in evidence syntheses. The review has identified that the extent of the use of CLUSTER varied considerably among different review types. Complex health or health-related interventions were the most prevalent review topics. The rationale for the use of CLUSTER varied with the most common reason being to enable the retrieval of sibling studies (e.g., multiple publications from the same study). There were no reviews that followed the full CLUSTER procedure with steps 1, 4 and 5 being the most commonly used. Two reviews reported on the benefits or limitations of CLUSTER and less than half of the reviews reported the value of CLUSTER either descriptively or depicting the additional evidence retrieved via a flow chart diagram.

The findings demonstrated that CLUSTER was most used in realist reviews and systematic reviews of complex interventions. CLUSTER was also found to be used in qualitative evidence syntheses[27,29] and reviews that integrated quantitative and

qualitative evidence.[21,24] One explanation for this is that CLUSTER is able to harvest rich and thick data. Therefore, this has a greater potential contribution to reviews that depend heavily on developing a programme theory and an understanding of context.[35,36] Using 'key pearl citations' establishes a basis for theoretical analysis and for cross case comparisons, facilitating identification of useful contributions to understanding of a study without topical knowledge.[5]

Two reviews were found that stated the number of additional studies identified in a flow diagram that were included in either analysis[22] or synthesis.[29] Furthermore, one review[29] provided a table that outlined the specific CLUSTER steps used in a supplementary file. It included key pearl citations that were selected, how many studies were identified from the steps the authors undertook, and the key pearl the additional eligible study was derived from. However, this does not appear to be common practice nor a reporting standard, which means it is not possible to ascertain which elements or steps of CLUSTER harvested additional studies of relevance. The importance of reporting which element or steps were used to identify the number of studies found, may enhance the transparency of this model of searching and showcase its perceived/potential usefulness to reviewers who may be considering this search approach.

The extent to which the CLUSTER approach has been operationalised was found to be entirely dependent on the nature of the review and the type of evidence that is sought after. All the reviews included used CLUSTER as a supplementary search method, which supports the original purpose of CLUSTER to supplement and complement the deficiencies of data- and topic-based searches. The overarching goal of CLUSTER allows identification of conceptually rich or contextually thick 'clusters' of evidence, producing a wide-ranging view of a particular field of study.

The primary reason for the use of CLUSTER can be broken down into three distinct categories: to explore context (steps 1-7), enhance identification of theory (steps 8-10), and to seek data where "direct evidence" is lacking (steps 11-13).[5] This is supported in the findings as the most prevalent provided rationale was to retrieve sibling studies in search of context, to gather a sample of data to review a single topic, and to compensate for thin reporting, all of which were reported in realist reviews. This is consistent with the iterative, non-linear searching in realist reviews

and the need for theory in qualitative evidence syntheses. However, there is some evidence to suggest that CLUSTER was also simply used as a series of search techniques to find relevant evidence that presumed to maximise the retrieval of potentially relevant evidence as some reviews did not outline their methodology of using CLUSTER. The utilisation of CLUSTER may not be fully realised beyond the potential added value of additional studies. It can allow reviewers to explore the theoretical underpinnings or context of an intervention to establish their effectiveness. This indicates that the heterogeneity in the way CLUSTER has been deployed may be explained by meeting the specific needs of a review.

The identification of key pearl citations was predictably the most followed step, presumably due to the fact it is the first step introduced in CLUSTER. The overall usage of CLUSTER however, varied considerably. Aside from identifying key pearls, steps between 2 and 6 were most followed. This suggests that reviews were mostly concerned with enhancing the exploration of context and were seeking directly related evidence. Additionally, these steps are standard approaches for supplementary search techniques in systematic reviews, which may explain the prevalent usage. However, it may also indicate that reviewers are unsure how to perform other steps due to unfamiliarity and lack of guidance available. Steps 8 to 13 were amongst the least followed, which are particularly useful for identifying and exploring theory by seeking indirectly related evidence. The findings demonstrated the majority of the realist reviews included followed some, if not all of these steps as development of a programme theory supported by substantive theory is one of the primary goals in realist reviews.[35]

4.1 Strengths and limitations

To the best of our knowledge, this is the first methodological review that has examined the CLUSTER searching approach. This review has identified key characteristics relating to CLUSTER including the variety of different reviews that employ this search approach, the extent of the use of CLUSTER, and the rationale behind its usage. It is apparent that this search procedure is gaining more traction in the field of reviews as the majority of the evidence syntheses included in this review were completed in the last three years. However, current reporting practices of CLUSTER are not adequately transparent to allow replication of such searches.

Additionally, a considerable number of protocols were identified in the screening of reviews but were excluded due to ineligibility. Those which might result in eligible reviews, if this work were to be repeated or expanded, have been tabulated in the supplementary material (Table 3).

There was a risk of bias and potential error given that only one reviewer conducted all data extraction and synthesis with only a sample cross-checked by the second reviewer for consistency. Additionally, reviews that cited the seed paper were only sought after in WoS and GS, which may have limited the reliability of the sample and the conclusions that can be drawn. There was a possibility the databases used in this review may have missed potentially relevant and unique citations only found in other databases such as Scopus, Crossref, and Dimensions. The omission of potential case studies, evaluation reports and conference abstracts may have inhibited an accurate representation of the examination of CLUSTER. All these methodological decisions were necessary given the limited resources available to support the review process. The functionality and scope of WoS and in particular GS was anticipated to have identified all reviews that have cited the seed CLUSTER paper. Also, considering that this is a descriptive review, it is unlikely any missing eligible reviews would have influenced the interpretations of the broadly homogenous set of findings.

There was a very limited number of reviews available focusing on the benefits and limitations of using CLUSTER. This is compounded by the sourcing data being contingent on such data being reported in the reviews. This limitation could have been circumvented by contacting review authors to potentially gain a more comprehensive and representative description of the benefits and limitations of using CLUSTER. However, this was not conducted due to time constraints and a lack of resources. Additionally, the lead author of the seed CLUSTER paper was the lead author of one [20] and a co-author of two[19,30] identified reviews that were included in the synthesis. These issues may pose a bias in the findings and therefore the synthesis for this particular segment should be interpreted with caution.

4.2 Conclusions

CLUSTER allows the direction of searches to be divergent rather than linear, which may contribute to the difficulty of producing a protocol-based search strategy. A recently published checklist for reporting searches has been explicitly detailed (items 4-7 in the checklist are specific to supplementary searches) for systematic reviews and systematic review protocols to ameliorate this issue.[4] It is accepted practice for most reviews to have fully developed the search strategy before the search procedures begin. This notion of prespecification of search methods contributes to procedural objectivity in reviews.[37,38] However, this review identified two published reviews in the findings that did not report any details regarding how CLUSTER was operationalised. The seven elements and 13 steps embedded within CLUSTER are both time-consuming and labour-intensive,[39] which may potentially explain the inconsistent and varied use within the reviews examined in this article. This is likely compounded by the lack of clarity regarding the identification of key pearl citations.

To our knowledge, there is no gold standard or guidance in how this subjective exercise should be undertaken, which may dissuade reviewers from undertaking the full CLUSTER search procedure. Conversely, it may only encourage selective use of certain search techniques that are more commonplace (e.g., citation searches) embedded within CLUSTER. Further adding to this burden is the variation in terminology used in the wider literature referring to supplementary searching, all of which is seemingly synonymous. This includes non-database searches[8,40,41] and complementary strategies,[7,42,43] contributing to the confusion and difficultly of what is already a meticulous exercise. Ultimately, CLUSTER is an adaptable search methodology that can meet an array of different review needs by locating additional studies for systematic reviews. It can also identify theory to help fulfil the purpose of qualitative-based reviews.

The findings of this methodological review have widened our understanding of the implementation of CLUSTER in reviews. They have provided a more coherent understanding of the most used elements and steps of CLUSTER. However, there is considerable variability in the use of CLUSTER making it difficult to ascertain the true value of the full CLUSTER search procedure. It is therefore important for future reviews to concisely outline the specific elements and steps used and how many

studies were retrieved as a result of its usage. This not only provides transparency of the search strategy, but also enhances reproducibility.

CONFLICT OF INTEREST

The authors declare that they have no competing interests

AUTHOR CONTRIBUTIONS

Anthony Tsang and Michelle Maden conceptualised the study. The scope of the review was refined by both AT and MM. AT performed the citation searches. Both authors screened search results to the inclusion set out in the paper. AT extracted all data and a sample was cross-checked by MM. Analysis and synthesis was carried out by AT in consultation with MM. AT wrote the manuscript with input from MM. Both authors read and approved the final manuscript.

Highlights

What is already known?

- The CLUSTER approach provides a systematic and coherent framework of searching drawing on commonly used study identification methods.
- CLUSTER establishes a transparent procedure to seek directly or indirectly related information, to explore context and enhance identification of theory.

What is new?

- No review has evaluated the CLUSTER approach to inform different types of evidence syntheses.
- This methodological review identifies the type of evidence syntheses that has used CLUSTER and examines the extent of the use and value of CLUSTER.

Potential impact for Review Synthesis Methods readers outside the authors' field

- The findings demonstrate that CLUSTER has been used in a wide-range of different evidence syntheses and has potential to retrieve relevant evidence.
- CLUSTER is a flexible supplementary model of searching for evidence for reviews of complex interventions that allows for transparency and reproducibility.

DATA AVAILABILITY STATEMENT: Data sharing not applicable to this article

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Table 1. The full CLUSTER technique[5]

Element (Procedural steps)	**Search procedure**	**Sources**
Citations (Step 1)	Identify at least one 'key pearl' citation through consensus with review team	Preliminary searches of databases and grey literature
Lead authors (Step 2-4)	Check reference list of 'key pearl' citations, recheck for additional relevant records by authors and conduct lead author search	Full text of 'key pearl citations', search of reference management collection, Google (e.g., institutional repository, author publication webpage)
Unpublished materials (Step 7)	Make contact with lead author (particularly regarding related publications and unpublished articles)	Email/Personal web pages
Scholar searches (Step 5-6)	Citation searches on 'key pearl' citations and other relevant studies. Conduct search of project name/identifier (if available)	Web of Science/Google Scholar
Theories (Step 8-10)	Follow up 'key pearl' citations and other cluster documents for citations of theory. Recheck for mentions of theory in titles, abstracts, keywords. Perform iterative searches for theory in combination with condition of interest	Full text of 'key pearl' citations, search of reference management collection and original set of databases
Early examples (Step 11)	Follow up key pearl citation and other cluster documents for citations to project antecedents and related projects	Full text of 'key pearl' citations

Related projects (Step 12-13)	Conduct named project and citation searches for relevant projects identified from cluster documents. Seek cross case comparisons by combining project name/identifier for cluster with project name/identifiers for other relevant projects	Web of Science/Google Scholar and original set of databases

Table 2. Characteristics of included reviews

Study ID	Topic of review	Type of review	Type of synthesis	CLUSTER used as a primary or supplementary approach to search	Rationale/purpose of CLUSTER	How CLUSTER was followed as described by study authors
Akparibo et al. (2017),[19] *UK*	Malnutrition	Systematic review	Narrative synthesis	Supplementary	To enable the retrieval of sibling studies	CLUSTER searching techniques were used
Booth et al. (2015),[20] *UK*	Chronic health conditions	Systematic review	Narrative synthesis	Supplementary[a]	To search and retrieve qualitative studies that were associated with the trials as well as more distant 'kinship' studies citing trials for reasons of topical relevance	Follow-up of references, citation searching and searching for study clusters
Forman-Hoffman et al. (2017),[21] *USA*	Mental health	Systematic review	Narrative synthesis and qualitative comparative analysis	Supplementary	To identify sibling or kinship studies to uncover contextual information to explain failure or success of strategies	Performed additional search approaches of related publications, contacted study authors to obtain information about critical components for strategies of included studies of a parallel project

Gee et al. (2016),[22] *UK*	Complex intervention	Rapid realist review	Realist synthesis	Supplementary	To identify documents (sibling studies) relating to potential case studies	Contacted authors to identify all relevant published or unpublished documents related to potential case studies
Greenhalgh et al. (2018),[23] *UK*	Patient reported outcomes measures	Realist synthesis	Realist synthesis	Supplementary	To identify related studies	Key author searches, citation tracking of key papers and systematic reviews. Citation tools Scopus and GS were used for forward tracking
Harpur et al. (2018),[24] *South Africa*	Education technology	Systematic review	Framework synthesis	Supplementary	To gather a sample of pertinent documents to review a single topic	NR
Harris et al. (2015),[25] *UK*	Stakeholder participation	'Participatory' realist synthesis	Realist synthesis	Supplementary	To compensate for thin reporting to identify additional reports for each report	For each health topic, authors constructed a 'cluster' of data that included an index paper (key pearl citation), which was linked to at least two or more additional papers from the same study through supplementary searches. Theories that were explicitly used and/or cited

						within studies in each cluster were noted.
Harris et al. (2019),[26] *Norway*	Diabetes	Realist synthesis	Realist synthesis	Supplementary	To compensate for thin reporting to identify additional reports for each report	Project names and members of the author team were used. Completed trials, additional projects and papers that presented theories or conceptual frameworks were sought after
Hunter et al. (2017),[27] *Australia*	Clinical guideline development	Critical interpretive review	Interpretive synthesis	Supplementary	Database searches using search terms were either too narrow or broad	Bibliographic cluster searching
Menear et al. (2020),[28] *Canada*	Care programmes for anxiety and depression disorders	Systematic review	Narrative synthesis	Supplementary	Searching for 'sibling' articles that had potential to contain additional relevant information	Reference list searches of all eligible trial articles, author searches in WoS, reverse citation searches and searches in GS using study trial names (e.g., IMPACT study)
Morgan et al. (2018),[29] *UK*	Paediatric febrile neutropenia	Meta-ethnography	Qualitative synthesis	Supplementary	Eligible studies were anticipated to be poorly indexed	Using key reports as nodes from which to explore the literature. Reference lists of all

						included and relevant excluded papers were searched. All authors were contacted to request details of other works in the area
Morrell et al. (2016),[30] *UK*	Postnatal depression	Realist synthesis[b]	Realist synthesis	Supplementary	To move from analysis of a single study report to a detailed examination of a cluster of related papers	GS citation searches were conducted on eligible study reports, lists of results for articles citing an index paper were examined carefully for shared authorship, a common study identifier or for other common study-level denominators (e.g., setting or institution), reference list of eligible reports as well as reference list of 'sibling' studies were scrutinised for earlier 'sibling' studies (e.g., protocols and pilot studies) or related 'kinship' studies (e.g., studies sharing a

						common intervention or underpinning theory)
O'Rourke et al. (2019),[31] *Australia*	Doula support programmes for socially disadvantaged women	Rapid realist review	Realist synthesis	Supplementary	To conduct manual searching	The CLUSTER framework was used
Rivas et al. (2019),[32] *UK*	Advocacy interventions for abused women	Realist synthesis	Realist synthesis	Supplementary	NR	Backwards and forwards citation checking, kinship- and sibling-paper searches, the 'search similar citations' function on PubMed for all relevant papers that accrued through the review
Sworn (2015),[33] *UK*	Methodological development and alternative communication methods in dementia	Meta-study[b]	Qualitative synthesis	Supplementary	Clustering could enhance understanding about perspectives embedded within studies and how they developed over time	NR
Willis et al. (2016),[34] *Australia*	Scaling up interventions to benefit wider populations	Realist synthesis	Realist synthesis	Supplementary	NR	The initial step involved identifying a subset of key documents for each case example (considered as the most comprehensive

											and recent documents), from which all cited and related references were retrieved, and a GS search for all linked citations

Notes: NR, Not reported; GS, Google Scholar; WoS, Web of Science

[a]CLUSTER formed part of the search for qualitative studies within a wider search strategy

[b]These reviews used multiple types of evidence syntheses, but CLUSTER was only used in the one stated in the table

Table 3. The extent of the use of CLUSTER

Study ID	Number of elements followed out of 7 (%)	Number of steps followed out of 13 (%)
Akparibo et al. (2017)[19]	1(14%)	1 (8%)
Booth et al. (2015)[20]	4 (57%)	7 (54%)
Forman-Hoffman et al. (2017)[21]	2 (29%)	2 (15%)
Gee et al. (2016)[24]	2 (29%)	2 (15%)
Greenhalgh et al. (2018)[14]	3 (43%)	5 (38%)
Harpur et al. (2018)[22]	NR	NR
Harris et al. (2015)[30]	2 (29%)	2 (15%)
Harris et al. (2019)[15]	6 (86%)	11 (85%)
Hunter et al. (2017)[28]	2 (29%)	2 (15%)
Menear et al. (2020)[23]	4 (57%)	6 (46%)
Morgan et al. (2018)[26]	4 (57%)	7 (54%)
Morrell et al. (2016)[16]	6 (86%)	10 (77%)
O'Rourke et al. (2019)[25]	NR	NR
Rivas et al. (2019)[40]	3 (43%)	4 (31%)
Sworn (2015)[27]	3 (43%)	6 (42%)
Willis et al. (2016)[18]	4 (57%)	7 (54%)

Notes: NR, not reported