

Review Article

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RESPONSE TO THE NOVEL CORONA VIRUS (COVID-19) PANDEMIC ACROSS AFRICA: SUCCESSES, CHALLENGES AND IMPLICATIONS FOR THE FUTURE

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Abstract

Background: The COVID-19 pandemic has already claimed considerable lives. There are major concerns in Africa due to existing high prevalence rates for both infectious and non-infectious diseases and limited resources in terms of personnel, beds and equipment. Alongside this, concerns that lockdown and other measures will have on prevention and management of other infectious diseases and non-communicable diseases (NCDs). NCDs are an increasing issue with rising morbidity and mortality rates. The World Health Organization (WHO) warns that a lack of nets and treatment could result in up to 18 million additional cases of malaria and up to 30,000 additional deaths in sub-Saharan Africa. **Objective:** Document current prevalence and mortality rates from COVID-19 alongside economic and other measures to reduce its spread and impact across Africa. In addition, suggest ways forward among all key stakeholder groups. **Our Approach:** Contextualise the findings from a wide range of publications including internet-based publications coupled with input from senior-level personnel. **Ongoing activities:** Prevalence and mortality rates are currently lower in Africa than among several Western countries and the USA. This could be due to a number of factors including early instigation of lockdown and border closures, the younger age of the population, lack of robust reporting systems and as yet unidentified genetic and other factors. Innovation is accelerating to address concerns with available equipment. There are ongoing steps to address the level of misinformation and its consequences including fines. There are also ongoing initiatives across Africa to start addressing the unintended consequences of COVID-19 activities including lockdown measures and their impact on NCDs including the likely rise in mental health disorders, exacerbated by increasing stigma. Strategies include extending prescription lengths, use of drones, telemedicine and encouraging vaccination. However, these need to be accelerated to prevent increased morbidity and mortality **Conclusion:** There are multiple activities across Africa to reduce the spread of COVID-19 and address misinformation, which can be catastrophic, assisted by the WHO and others, which appear to be working in a number of countries. Research is ongoing to clarify the unintended consequences given ongoing concerns to guide future activities. Countries are learning from each other.

1. Introduction

1.1 COVID-19 and key risk factors

The novel coronavirus named SARS-CoV-2 causing COVID-19 was first reported in Hubei Province in China in December 2019 (1-4), and has subsequently spread to all continents (5). COVID-19 is transmitted from person to person through respiratory droplets as well as directly through touching surfaces and other fomites (6-10). Initial observations from China suggested a case fatality ratio (CFR) of 2.3% (3). In their July 1 2020 report, the World Health Organization (WHO) suggested a case fatality ratio (CFR) of 4.91% based on 10,357,662 confirmed cases worldwide and 508,055 recorded deaths (5).

Increased morbidity and case fatality from COVID-19 is associated with a number of underlying health conditions, alongside male gender and older age. These include hypertension, cardiovascular disease (CVD), diabetes, obesity, chronic kidney disease, chronic obstructive pulmonary disease (COPD), history of smoking and shortness of breath, as well as some immunosuppressive conditions and potentially blood type (11-33). Ethnicity, particularly for people of Black Afro-Caribbean origin alongside those from South Asia, has also emerged as a significant factor associated with a higher mortality risk versus the white population in Europe and the United States of America (USA) (11, 25, 34-37). However, it is currently not fully understood how ethnicity, poverty and deprivation, cultural and behavioural differences, as well as underlying health, interplay in morbidity or mortality risk especially with currently lower mortality rates in Africa at the end of June 2020 compared with a number of European countries and the USA (5).

1.2 Prevention and treatment of COVID-19

Response activities to the COVID-19 pandemic typically included personal protection through physical distancing and hand washing coupled with respiratory precautions through face covering (6, 38-41). Increased testing and screening with contact tracing are fundamental to transmission control, and this has been variably combined with “locking down” of public places including educational establishments, retail outlets, factories and offices combined with closure of borders and quarantining suspected persons (41-43). Case management of patients includes supportive care with

supplementary oxygen coupled with ventilatory support for those most severely affected (6, 12, 44-47). Depending on the threshold for hospital admission, it is estimated that up to 17% of hospitalized patients will require intensive care, with an appreciable proportion needing mechanical ventilation (26, 48-50). This is a concern even in high-income countries where there have been challenges with the availability of critical care beds, appropriately trained staff and personal protective equipment (PPE) (15, 51-55).

An encouraging example of a positive response among low- and middle- income countries (LMICs) is Vietnam where multiple activities including extensive testing, contact tracing, and social distancing, under the government slogan “Fighting the epidemic is like fighting against the enemy”, have been successful in limiting the transmission of COVID-19 with only 355 confirmed cases by the end of June 2020 and no recorded attributable mortality (5, 56-60).

Currently, there does not appear to be a cure for COVID-19; however, there are a number of medicines undergoing trials including antivirals, steroids, antimalarials, immunomodulators, and herbal medicines, some of which have shown positive findings although there have been concerns with the trial design of a number of studies (61-70).

The most promising therapeutic breakthrough to date has come from the UK-based adaptive randomised Recovery trial (62, 70, 71). The low cost corticosteroid dexamethasone has recently been shown to significantly reduce mortality in the most severely affected patients with COVID-19; patients with an oxygen requirement and those requiring ventilatory support (70, 71). The prescribing of 6mg of dexamethasone daily for 10 days is now recommended for widespread use in the UK unless contraindicated for other reasons as well as endorsed by the National Institute of Health (NIH) in the USA (72, 73). However, currently optimal dosing and duration of dexamethasone in COVID-19 is unknown; consequently, current recommendations reflect those used in the Recovery trial.

Initial studies with remdesivir failed to demonstrate clinical benefit over placebo although these were underpowered (74-76). More recently, larger scale studies conducted by NIH in the USA have shown encouraging results including a reduction in the time to recovery and a trend towards lower mortality (hazard ratio for death = 0.70) leading to the issuance of an Emergency Use Authorization by the US FDA as well as endorsement by the European Medicines Agency and the NHS in the UK (77-81). However, further studies are needed before the prescribing of remdesivir can be fully endorsed.

However, much controversy surrounds the use of chloroquine and hydroxychloroquine with or without azithromycin for both the prevention and treatment of COVID-19. Following initial studies in China, coupled with the findings of Gautret *et al.* (2020) (66, 82-85), its use was endorsed among a number of governments and medical societies (86-91). However, the lack of a comparator arm in the initial studies has been heavily criticised coupled with concerns with side-effects including cardiac side-effects with hydroxychloroquine (84, 92-96) as well as reports of fatal overdoses (97-100). Recent studies have failed to demonstrate any clinical benefit for both the prevention and treatment of COVID-19 (69, 85, 101, 102). The study by Mehra *et al.* (2020) also showed increased mortality with chloroquine or hydroxychloroquine; however, this has now been retracted subject to external auditing (103, 104). The European Medicines Agency now advises caution with the prescribing of hydroxychloroquine outside of clinical trials (105), and the WHO has halted the hydroxychloroquine arm in its ongoing Solidarity Trial with the NIH in the USA also halting the use of hydroxychloroquine in its studies (62, 106, 107). In South Africa, the South African Pharmacy Council has also warned against the misuse of hydroxychloroquine for the treatment of COVID-19, which builds on concerns from the regulatory agency given the lack of evidence (108, 109).

The antiretroviral treatment (ART) lopinavir-ritonavir, which showed activity against MERS-CoV, has been recommended for treating COVID-19 patients alongside arbidol (68, 110-113). However, there have also been contrasting data regarding its effectiveness in COVID-19 patients, with most studies failing to show any clinical benefit including the UK Recovery study (62, 110, 114, 115). Consequently, lopinavir-ritonavir cannot currently be recommended for use outside of clinical trials. A recent study though by Hung *et al.* (2020) found that early triple antiviral therapy with interferon beta-1b, lopinavir/ritonavir and ribavirin alleviated the symptoms and shortened the duration of viral shedding and hospital stay compared with lopinavir/ ritonavir alone in patients with mild to moderate COVID-19 (116). Any positive findings though with combination therapies need confirmation before

they can be endorsed. Studies regarding the potential effectiveness of nasal irrigation are also ongoing (117, 118). This follows a pilot randomised study showing improvements in the duration of symptoms and viral shedding in patients with upper respiratory tract infections (119), with a post-hoc re-analysis with a focus on those infected with coronaviruses also showing benefit (120).

A number of other treatments focusing on the late inflammatory complications of COVID-19 (121-123) are also under review. These include tocilizumab, which is widely used in rheumatoid arthritis and blocks Interleukin-6 (IL-6), a combination of emapalumab, anakinra and sarilumab (15, 124-129), and interferons (130-133). These are currently not recommended for use outside of clinical trials. Ongoing studies are also using the plasma from affected patients along with prior titration of neutralising antibodies (62, 132, 134-136), and anticoagulants for hypercoagulability states (126, 137-140). Again, these experimental therapies cannot be recommended until more clinical trial data becomes available.

There has also been controversy surrounding BCG vaccination as possible protection against COVID-19 (141, 142). The WHO is warning against claims of effectiveness based on current ecological studies, with the South African Government and leading scientists also warning against diverting stocks away from neonatal vaccination programmes given concerns with shortages until more trial data becomes available (142-145).

There are also concerns with the inappropriate use of medicinal plants to prevent and treat COVID-19, which such use particularly prevalent in some sub-Saharan African countries as this can cause more harm than good (146-150). Safety fears are enhanced by the lack of data when used to prevent or treat COVID-19 along with other treatments that patients may be taking including antivirals, antibiotics as well as medicines for non-communicable diseases (NCDs) (146, 150). We are aware that some herbal medicines are showing promise based on in-vitro and small-scale clinical studies (64, 150-154). However, their use outside of such studies is a concern until more data becomes available especially if their use causes delay in patients seeking appropriate care from healthcare professionals as their symptoms develop (150).

The controversies and issues surrounding a number of the treatments, the redaction of recent studies, as well as concerns with trial design in a number of studies (62, 67, 92, 93, 104, 155), means it is essential that treatment recommendations should only be made once the results of robust trials are known (156).

1.3 Consequences of lockdown and other measures to prevent and treat COVID-19

There are a number of unintended consequences arising from COVID-19. These include Governments diverting personnel and resources away from priority diseases including both infectious and non-infectious diseases. Reducing antimicrobial resistance (AMR) is a key activity across countries especially among LMICs as it increases morbidity, mortality and costs (157-160). However, diverting attention away from AMR, including ongoing efforts to reduce inappropriate self-purchasing of antibiotics, which is prevalent across many countries, as well as routine immunisation programmes for existing infectious diseases, will inevitably have a significant impact on future patient care (161-173). Self-purchasing of antibiotics is a particular concern with the clinical presentation of COVID-19 overlapping with other infectious diseases including tuberculosis (TB), viral and bacterial respiratory tract infections, and pneumonia, making a differential diagnosis challenging exacerbated by limited diagnostic facilities in most communities (168, 174, 175). In hospitals, establishing antimicrobial stewardship programmes and other activities (168, 176-181) can improve antibiotic prescribing where there is little evidence of bacterial co-infection (168, 182, 183). Consequently, it is essential that such activities be introduced where necessary to guide future antibiotic prescribing among suspected COVID-19 patients (183).

We are aware that the Ebola outbreak in Guinea, Liberia, and Sierra Leone between 2014 and 2016 resulted in as many people dying from HIV/AIDS, TB, and malaria as Ebola due to reduced access to health care (161, 184, 185). There are also concerns that an appreciable reduction in the distribution of protective bed nets (75%) and medicines for treating malaria due to lockdown measures, combined with no media campaigns, could result in up to 18 million additional cases and up to 30,000 additional deaths in sub-Saharan Africa alone compared to 2018 (162, 184, 186). Whilst the latest evidence suggests that HIV positive patients do not have a higher COVID-19 infection rate, or a significantly different disease course than HIV-negative individuals (187-190), patients' fears of contracting

COVID-19 when they attend clinics, as well as limited access to health facilities and treatment during lockdown, will negatively impact on treatment and adherence to medicines as well as initial diagnosis (164, 184, 189, 191-193). Medicine supplies can potentially be addressed through differentiated service delivery and other programmes (164, 189, 194). Telemedicine and other technologies could also potentially help with consultations, with mobile technologies helping with tracking and tracing COVID-19 patients (195-197).

There are also concerns that lockdown measures will negatively impact of the management of patients with non-communicable diseases (NCDs) (31). This includes a lack of support and access to facilities to improve lifestyle management, monitor patient and regularly provide essential medicines (31). Ongoing national plans to reduce morbidity and mortality due to NCDs, especially CVD and diabetes, across continents including Africa (198-201) could also be compromised by reduced access to medicines, cancelled or missed appointments due to patients' reduced access and fear of coming into contact with COVID-19 patients in healthcare facilities, and not following lifestyle advice (31, 202, 203). However, we are aware that governments are committing extra resources to try and minimise these unintended consequences (204). Issues relating to medical supplies can again be addressed by measures to extend prescription lengths (205, 206) as well as home delivery of medicines, with concerns with consultations potentially addressed through technologies such as telemedicine (196, 207, 208).

Other serious consequences include the exacerbation of mental health conditions during lockdown, the implications for frontline healthcare workers in terms of their health and wellbeing, and anxiety of citizens about their health (209-222). Patients with COVID-19 are also at increased risk of requiring psychotropic medicines because mild-to-moderate illness may result in adverse psychological effects from the diagnosis, from the symptoms, the need for forced isolation, any associated loss of income, and the potential risk of death. This might trigger new psychiatric symptoms or exacerbate underlying psychiatric conditions. In moderate-to-severe clinical situations, there is a risk that patients could develop altered states of consciousness such as hypo- or hyperkinetic delirium, which may require treatment with psychotropic medications (223). In addition, some of the medical treatments that have been proposed for COVID-19 could contribute to onset or worsening of psychiatric symptoms. These include psychiatric disturbances with antivirals and steroids as well as depressive-dysphoric experiences with interferons (224-227).

In addition, patients with existing mental illnesses may well have difficulties with accessing regular help during the pandemic unless pro-actively addressed (228, 229). This includes continued access to medicines and treatments for those with long-term mental health conditions since sudden discontinuation should be avoided (215). Worsening of mental health may be greater in patients with conditions such as schizophrenia with challenges in continuing active case management in the community during the pandemic as well as concerns with administering long-acting injections where pertinent, and performing regular blood tests in patients prescribed clozapine (230). Pro-active and timely support is needed for all patients with mental health conditions to avoid deteriorating conditions (214-216, 231). There are also reports of an increase in gender-based violence across countries, including African countries, as a result of lockdown measures, which also needs addressing going forward (232-236).

1.4 Specific challenges of COVID-19 in Africa

COVID-19 poses a particular challenge for the African continent because of existing high prevalence rates of other infectious diseases including human immunodeficiency virus (HIV)/ acquired immunodeficiency syndrome (AIDS), TB, cholera, and malaria, along with high rates of AMR and a disproportionate burden of poverty (168, 237-243), with ongoing infectious disease initiatives appreciably challenged by COVID-19 (168, 176, 178, 244). The presence of multi-morbidity with NCDs will aggravate the situation further (245-250), with already high rates of CVD and diabetes a growing concern across Africa (198-200).

Alongside this, there are ongoing challenges with available financial and human resources across Africa (251-254) including more limited availability of healthcare personnel and hospital beds including intensive care unit (ICU) beds (198, 199, 233, 255-259). Reports suggest there were just 1.8 hospital beds per 1000 people across Africa before the pandemic, less than a third of those in France (260). Oxygen is also not widely available and single room isolation can be a rarity making nosocomial

transmission a concern. Overall, there appeared to be less than one ventilator and less than one ICU bed per 100,000 people in Africa compared with up to thirty times that number in the USA before the pandemic (261), although there is regional variation (253, 256, 259, 262). The availability of PPE across Africa was also a challenge in the early stages of the pandemic putting healthcare professionals at risk (263-266). However, this is changing with increased local production of PPE, new local designs for face masks and ventilators (267-270), as well as improved procurement processes enhanced by the recent launch of the pan-African medical supplies platform (271).

Most challenging though is over crowding and lack of running water (and therefore a lack of hand washing) among the population, with an estimated 34% to 36% of people in Africa having no access to basic household washing facilities and 30% having only limited access (243, 256, 260). This is a particular concern among refugees, who require additional efforts to help prevent the spread of the virus including education on the rationale behind lockdown activities where pertinent (272, 273).

Given these multiple issues and concerns, the UN Economic Commission for Africa (UNECA) initially estimated that the COVID-19 pandemic could potentially lead to 300,000 deaths across Africa and push 29 million people into extreme poverty (260). In mid-April, the WHO warned that there could be up to 10 million cases of COVID-19 in Africa within six months (274), rising to between 29 million and 44 million in the first year, with up to 190,000 deaths if containment measures failed (275). By the end of June 2020, there were over 303,000 COVID-19 cases among the WHO African countries with over 6000 deaths giving a CFR of 2.02% (276). Consequently, absolute numbers of COVID-19 related deaths to date are still lower in Africa compared with other continents including the Americas and Europe (5); however, this is changing as prevalence rates rise. There are also concerns with the reliability of the data among some of the African countries due to limited detection capacity and reliable tests as well as under-reporting of both deaths and prevalence rates (8, 233, 253, 277-282). For instance, there has been no official data released from Tanzania since 8 May with the President stating the pandemic has largely been defeated despite concerns with truck drivers testing positive at borders and continued ongoing concerns with under-reporting (280, 282, 283). Having said this, there have been concerns with the reliability of testing equipment (284).

Other potential factors for currently lower prevalence rates and deaths in Africa compared with other continents could be a comparatively younger population as well as rapid instigation of lockdown and other measures. which build on experiences with other infectious diseases aided by the African Union, WHO Africa and the African Centre for Disease Control (CDC), as well as sensitivity of the virus to ambient temperatures (186, 281, 285-289). The African CDC has been actively coordinating a strong multilateral response amongst African governments and other stakeholders towards COVID-19 building on the activities by the WHO in Africa and others (288, 290, 291). The establishment of National Public Health Institutes among many African countries has also improved the response to public health threats (292). Activities across Africa include developing laboratory expertise, training a volunteer health workforce, and risk communication. As mentioned, these built on Africa's experience in dealing with other infectious diseases including Ebola, HIV, malaria and TB (256, 293, 294). The United Nations has also established a knowledge hub for COVID-19 to help African countries learn from each other (295, 296). Testing has also appreciably increased in recent weeks across Africa (297) helped by Africa CDC and the WHO Africa, who have provided testing kits and training, with 48 African countries able to test for COVID-19 by 29 April 2020 compared with just two countries at the start of the pandemic (242, 298, 299).

Most African countries also rapidly instigated lockdown measures as well as social distancing to reduce the spread of the virus (233, 243, 260, 300, 301). Similar to several African countries, Ghana early on began testing travellers on arrival in the country and isolating positive cases, as well as instigating testing among its citizens. Overall, Ghana has one of the highest testing rates in Africa having performed between 110,000 and 120,000 tests by the end of April 2020 (302). The Government of Ghana also established five key objectives to reduce the spread of the virus (303, 304). Similar to most African countries, South Africa declared a national state of disaster in terms of section 27(2) of the Disaster Management Act, 2002, and implemented a phased approach to lockdown with stage 5 introduced on March 27 2020, easing to stage 4 with effect from May 1 2020, which remains in place (305, 306). Lockdown measures have now been eased among several countries following concerns about the economic and other issues including the potential for

increased violence, whilst still maintaining an active response should the need arise (253, 307, 308). However, this situation is being actively monitored in case of a spike in prevalence rates.

Medicine shortages are a particular issue in Africa where typically up to 94% of its medicines are imported (260, 309, 310), and supply issues can be exacerbated in countries with ongoing conflicts (311). However, African countries are already taking steps to address concerns with shortages before and during the pandemic including suggesting potential alternatives (312-316). There are also ongoing programmes to address the quality of medicines across Africa. The potential for substandard and falsified medications is exacerbated when prices appreciably increase and shortages occur following endorsement of potential treatments for COVID-19 in the media (97, 317-320). Government activities are likely to accelerate with the launch of the Lomé initiative placing falsified and substandard medicines on the highest political agenda with ongoing measures to strengthen the legal response to these medicines (321).

COVID-19 has accelerated discussions on local pharmaceutical production in Africa (322) with, for instance, the East African Community States seeking to support local production of essential medical products and supplies. Products include masks, sanitizers and ventilators, to address shortages in the region (323). In addition, several local companies have come forward to produce medical equipment and other products to manage the pandemic, and this will continue (324-326). This is in line with the philosophy to develop regional hubs involving several African countries to address issues of economies of scale (327).

1.5 Rationale behind the paper and the objective

Given the multiple issues and challenges facing African countries, we believe there is an urgent need to consolidate ongoing activities across Africa to address the COVID-19 pandemic and to understand its impact. Similarly, there is a need to evaluate the impact of re-directing activities away from the care of patients in other priority disease areas in Africa towards COVID-19 activities given the likely consequences on increased morbidity and mortality alongside the economic and social impact (163, 186, 285).

We are aware that several regional financial institutions, including the African Development Bank and the African Export-Import Bank, have announced significant financial support for this purpose (328, 329). The commitments of the World Bank and the International Monetary Fund also provide additional mechanisms, including suspending debts, to free resources towards the COVID-19 response (237). These measures should help address existing concerns regarding the financial impact of government measures including lockdown measures on the livelihoods of African citizens, with many currently working in the informal sector (186, 237, 330).

Containing the spread and impact of COVID-19, including the substantial economic impact, will though require a multipronged approach and co-operation among all key stakeholder groups going forward, including patients, with countries learning from each other (237). Ongoing activities include addressing the considerable misinformation about COVID-19 and potential treatments including vaccines and herbal medicines (146, 150, 331-341). The current controversies surrounding chloroquine/ hydroxychloroquine is just one example. As a result, there is a recognized need for scientific integrity and credibility when developing and discussing possible treatments for COVID-19 in line with recommendations from the Council for International Organisations of Medical Sciences (156). This is to ensure future public and physician trust in treatment recommendations, which forms an integral part of effectively dealing with COVID-19 (97, 342-346).

We are aware that early in the pandemic, Africa CDC, as well as WHO Africa and their partners, spearheaded efforts to train and sensitize African governments on the need to effectively counter and reduce the levels of misinformation (347-349). Their activities included training on risk communication and regular briefings to heads of state as well as relevant sectors of government. Additional efforts have also been provided by groups such as the International Alliance of Patients' Organizations (IAPO), which have developed resource hubs to provide reliable and updated information to mitigate against misinformation and promote preventative activities (350).

Education among patients can also help reduce any stigma associated with COVID-19 for recovering patients and their families as well as any mistrust by the people in their governments (222, 233, 351-

354). We know that countries and governments have the potential to learn from the evidence base of HIV-related stigma interventions to help address such issues, as well as previous pandemics as seen with Vietnam (5, 233, 355). Potential activities among patients and their organisations include active discussions around how stigma affects different communities, reflections on personal biases, and the instigation of institutional support programmes (355, 356). This is important as the COVID-19 pandemic has already provoked stigmatisation and discriminatory behaviours against people of certain ethnic backgrounds as well as anyone perceived to have been in contact with or recovered from the virus (351, 354, 357). Having said this, we have seen reasonable knowledge, attitudes and practices towards most aspects of COVID-19 among the public in China, Nepal, Pakistan and Paraguay although still room for improvement (358-361). Surveys in the UK and US have also shown that participants generally had good knowledge about the main means of transmission and the common symptoms of COVID-19 (362). In Cameroon, the population is also aware of the disease and preventive measures (363). Further research is ongoing regarding why some people fail to adhere to suggested preventative measures, and we will be monitoring this (364).

Consequently, the objective of this paper is to summarise and consolidate our knowledge of current activities across Africa related to COVID-19 to help provide future guidance to all key stakeholder groups. This includes following up on clinical trial activities across Africa since an early concern was that few clinical trials were being conducted across Africa (365, 366). This is beginning to change, building on examples in Burkina Faso, Kenya, Nigeria, South Africa and the WHO Solidarity Trial across several African countries (341, 367-369). By doing so, we believe we can support African countries' efforts to continue to work together to tackle the pandemic, including jointly pursuing loan waivers to help protect against the financial consequences of COVID-19 (370, 371).

This will be the first paper in this series as more information and findings become available. This builds on a recent systematic review regarding the importance of viral diseases in Africa, and the fact that different approaches will be needed across Africa to tackle COVID-19, depending on current circumstances (253, 372, 373).

2. Methodology

We adopted a mixed methods approach. This initially involved conducting a narrative review of the published literature as well as papers awaiting publication and internet references known to the co-authors. We did not perform a systematic review. We were aware that some systematic reviews have already been conducted and published in this area including potential treatments despite the lack of data from robust clinical trials (21, 23, 33, 42, 66, 82, 114, 374-378). A number of the publications surrounding COVID-19 are also currently only available in pre-publication form and not peer-reviewed. Alongside this, much of the information regarding ongoing activities across Africa are from internet sources, and it is too early to assess the impact of these, especially as COVID-19 cases appeared later in Africa than in either China or Europe.

We also did not systematically review each paper for its quality using well-known scales such as the Newcastle-Ottawa scale or the Cochrane risk of bias tool as our emphasis was on contextualizing the findings rather than performing a systematic review (379-383). However, the publications and internet sources were filtered by the co-authors to add robustness to the present paper and its suggestions.

In view of this, and to provide direction for the future, we supplemented information from the literature and internet sources with additional current information from co-authors across Africa. The co-authors include senior level personnel from governments and their advisers, lecturers and researchers from academia, and clinicians, as well as those involved with activities to enhance the rational use of medicine, undertake Health Technology Assessment (HTA), document medicine shortages, and involved with patient organisations from across Africa and wider. The co-authors were asked to provide information on the following themes or topics, where known, in their own country to supplement the ongoing literature:

- Details about the current epidemiology of COVID-19 including CFRs, national responses to date and an assessment of the effectiveness, if known
- The socio-economic impact as well as the impact on healthcare delivery in other priority disease areas including medicine and equipment shortages as well as attendance at clinics. This includes any information on the unintended consequences of COVID-19 in other disease areas if known

- How issues such as medicine shortages are being addressed and the implications for local manufacturing in the future
- Current medicines and other approaches to treating patients with COVID-19 as well as ongoing studies that address issues such as false claims and hopes. In addition, ongoing activities to address falsified and sub-standard medicines
- Key lessons for the future for all key stakeholder groups

The same questions were asked of each co-author, with country-specific replies typically consolidated where there were multiple authors in a country. The information was subsequently consolidated by two of the authors (OOO and BG) and checked with each co-author during manuscript preparation to add robustness to the findings and suggestions.

We also documented ongoing technology innovations across Africa, which we believe is important as Africa seeks to become self-sufficient in the management of patients with COVID-19 and beyond.

Documented prevalence and mortality rates will typically be based on WHO data for consistency and reliability as there have been challenges with generating up-to-date data among a number of African countries due to the availability of testing facilities and testing kits, as well as concerns with some testing kits; however, as mentioned, this is now being addressed with the help of the WHO and others (242, 284, 297, 298, 384).

The African countries chosen reflect a wide range of geographies and population sizes. We did not divide them into low- or middle-income countries as COVID-19 is likely to affect all African countries and they can learn from each other.

Statistical analysis of the different measures and initiatives and their possible impact on the epidemiology, morbidity and mortality rates, has not been undertaken as this is too early given rising prevalence rates across Africa. In addition, our principal aim was to provide a comprehensive analysis of the current situation across Africa, including the potential implications for other infectious and non-infectious disease areas within the African continent, to stimulate ongoing debates regarding potential future activities. This is important across Africa with high prevalence rates for both infectious and non-infectious diseases, We have successfully used this dual approach in previous publications to stimulate debate in important healthcare areas and situations to provide future guidance as countries seek to improve the quality and efficiency of their approaches to medicine use, including during pandemics (168, 199, 257, 385-394).

3. Findings

The findings and activities are divided into sections to meet the study objectives. These include documenting the epidemiology among a range of African countries principally based on epidemiology data provided by the WHO. The aforementioned precedes discussing ongoing strategies to limit the spread of COVID-19 as well as their subsequent impact on morbidity and mortality in populations across Africa.

The impact of COVID-19, including the unintended consequences on the healthcare system and patients, along with financial and socioeconomic issues, will be explored before documenting the subsequent impact on increased local production of pharmaceuticals and other supplies as well as any ongoing clinical studies and innovations across Africa aiming at improving future care. Finally, potential ways forward will be debated among all key stakeholder groups based on the experiences of the co-authors to provide future guidance. This includes key issues of shortages, unintended consequences, and misinformation as well as the role of patients and patient organisations in preventative measures and other interventions.

3.1 Epidemiology

There is considerable variation in the number of recorded cases, deaths and CFRs across Africa following the first reported case on February 14 2020 (233), with some countries yet to record their first deaths due to COVID-19 and some countries recording only a few deaths to date (Table 1), potentially reflecting different approaches and circumstances (Tables 2 and 2A). Table 1A in the

Appendix gives further details of the epidemiology over time as well as recovered cases where known and documented.

Table 1 – Current epidemiology of COVID-19 (up to 30 June 2020) across Africa unless stated

Country	Population (2020)	Number of Positive Cases	Number of Deaths	Case Fatality Rate (%)
Algeria (276)	43,851,044	13907	912	6.6
Botswana (276)	2,351,627	227	1	0.4
Burkina Faso (276)	20,903,273	962	53	5.5
Cameroon (276)	26,545,863	12592	313	2.5
Democratic Republic of Congo (276)	89,561,403	7039	169	2.4
Egypt (5)	102,334,404	68311	2953	4.3
Eswatini (Swaziland) (276)	1,160,164	812	11	1.4
Ethiopia (276)	114,963,588	5846	103	1.8
Ghana (276)	31,072,940	17741	112	0.6
Kenya (276)	53,771,296	6366	148	2.3
Lesotho (276)	2,142,249	27	0	0.0
Malawi (276)	19,129,952	1265	16	1.3
Namibia (276)	2,540,905	203	0	0.0
Nigeria (276)	206,139,589	25694	590	2.3
Rwanda (276)	12,952,218	1025	2	0.2
Senegal (276)	16,743,927	6793	112	1.6
South Africa (276)	59,308,690	151209	2657	1.8
Sudan (5)	43,849,260	9258	572	6.2
Tanzania (276)	59,734,218	509	21	4.1
Uganda (276)	45,741,007	889	0	0.0
Zambia (276)	18,383,955	1594	24	1.5
Zimbabwe (276)	14,862,924	591	7	1.2

NB: Population figures taken from Worldometer for Africa 2020 (395)

3.2 Ongoing activities to address COVID-19 and their impact

Different activities are ongoing across Africa to try and limit the impact of COVID-19. These are summarised in Table 2, with Table 2A in the Appendix giving additional details for those interested. As seen, prevention and treatment approaches remain broadly similar among the African countries, with a number of African countries combining approaches to provide joint guidance and updates on suggested activities, such as the East African Community (286). There are concerns though with limited activity in some countries, e.g. Tanzania, as well as fears that if lockdown measures are released too early due to financial and resource issues for citizens and governments these will appreciably enhance future prevalence rates (396).

Table 2 – Ongoing activities across Africa to help prevent the spread of COVID-19 including dates and examples

Country	Closing Borders/ Travel restrictions	Quarantine Measures/ Testing measures	Lockdown Measures	Sanitary/ PPE measures	Directives on Management and misinformation
Algeria	17 March – closure of all land borders		13 March – Partial (capital) – full others with easing after that		
Botswana	Ongoing restrictions on air travel and strict border controls (20 to 28 March)	14-day quarantine introduced and scientists trained on specimen collection (23 March)	Yes – including closure of educational institutions (18 March) and general lockdown measures (2 April)	Mandatory use of face masks in public (May 1)	Yes – Directive to reduce misinformation with the potential for fines/ prison for abuse
Cameroon	18 March - closure of borders	3 March as well as active surveillance	18 March - including school closures and ban on gatherings	Yes- including encouraging hand washing and compulsory face masks in public (18 March onwards)	i) Establishing treatment centres ii) Encouraging household production of face masks
Democratic Republic of Congo	24 March – closure of all borders and travel (International and domestic) remain suspended (6 June)	3 March – Quarantine measures	31 March – Curfew measures introduced with lockdown measures extended to 15 May (2 May)	Yes - Continued campaigns on prevention	Instigation Community Action Committees
Egypt	25 March – suspension of incoming passenger flights	Yes – early testing of suspected cases	25 March – Night time curfew and other lockdown measures	Yes – Increasing public awareness of preventative approaches	MoH developed standard treatment protocols
Eswatini (Swaziland)	27 March – Closure of borders	27 March – Mandatory quarantining at borders and contact tracing introduced	27 March – i) Partial lockdown and social distancing introduced ii) In addition, reduced numbers in omnibuses	Yes – distribution PPE to all health facilities	Yes – designating specific COVID-19 hospitals and fines or prison for spreading misinformation (27 March)
Ethiopia	Closing borders (22 March) and banning flights to more than 30 countries (20 March)	1 April – First testing labs (Northern Tigray Region)	16 March - closing schools and banning large gatherings	3 April – government and others helping with supply of PPE	
Ghana	22 March closure of all borders	Enhancing testing facilities including	16 March - Closure of schools and other measures	Early April - Mandatory masks in public places in a	Dedicated hospitals and Government fast

	(quarantining from 16 March)	suspected cases	including restrictions on burials	number of localities and patient education. 15 June - Compulsory masks	tracking testing of hand sanitisers
Kenya	25 March suspending air travel and closing borders (mass testing and quarantining before this)	Increasing testing facilities with the help of increased local production and mandatory quarantining	13 - 19 March – lockdown and other measures introduced	Mandatory wearing of face masks and increased public education	i) Expansion of hospitals and ID units to deal with COVID-19 ii) Development of treatment guidelines iii) Active programmes to address misinformation
Lesotho	30 March – Borders closed	Private industry and NGO support for testing	30 March – lockdown measures introduced	NGO and industry support to purchase PPE	National response command centre provides guidance
Malawi	1 April - suspension of international flights and increased surveillance	Increasing the number of test facilities	18 April - lockdown measures proposed but suspended	Ongoing acquisition of PPE to meet demand	Instigation of isolation centres for COVID-19 patients and recruitment of more healthcare workers
Namibia	15 March – International flights banned and 24 March Foreign travellers banned		14 March – banning large gatherings; 15 March – schools closed and 27 March – lockdown measures introduced	Individuals expected to wear masks in public	Establishment of isolation units in public hospitals to tackle severe cases
Nigeria	23 March – closure of borders and ban on flights	Protocols for testing to increase rates	23 March – closure of schools and ban on gatherings; 30 March – ban on non-essential travel	Measures include hand sanitisation and mandatory wearing of masks (23 April)	Nigerian CDC developing protocols and case management and instigation of isolation centres
Rwanda	21 March – Ban on travel including air travel	Rapid testing – speeding up identification of cases	Mid-March – lockdown including unnecessary travel outside of homes prohibited	19 April - Wearing of masks compulsory early in the pandemic	Robots are helping in hospitals to address resource and other concerns
South Africa	26 March – complete travel ban introduced (eased 4 May)	April – mass screening introduced as well as active case-finding	26/ 27 March – Stage 5 lockdown introduced including school closures	Early April – use of PPE/ hand sanitisers regulated	i) Isolation centres established ii) Spread of misinformation punishable with fines or prison iii) Length of prescriptions increased

Sudan	Early March – Travel restrictions introduced – extended 20 April	Screening at point of entry and WHO/ UNICEF helping with testing materials as currently limited	Early/ Mid-March and extended - social isolation and school closures	WHO/ UNICEF helping with PPE – concerns with appreciably increased prices in shops	One isolation and treatment centre in the capital
Tanzania	April 12 – International flights suspended	23 March – 14-day quarantining from some countries	Yes – for large gatherings – however concerns that largely ignored		12 May – WHO helping to convert a commercial site into a 500-bedded treatment centre
Uganda	20 March – Closing borders and banning international travel	20 March – Mandatory quarantine at own expense for returning personnel	20 March – Lockdown measures implemented including suspending markets– slowly releasing Mid May	Advising the public regarding hygiene measures Mandatory wearing of masks	Task Force initiated (national, regional, district) to provide guidelines
Zambia	March - Temporary closing of borders especially with Tanzania	i) Initial response included a 14-day quarantine for travellers (Mid-March) ii) Mass screening where cases identified as well as contact tracing	Lockdown measures including social distancing and closure of educational establishments	March - Mandatory wearing of masks in public places and active procurement of PPE	MoH training and recruiting health workers to help with case management 3 designated laboratories to help with testing using PCR methods
Zimbabwe	31 March – closure of borders	31 March - All returnees quarantined for 21 days	30 March national lockdown – further extended 1 May	Local production of PPE and hand sanitisers to address shortages	i) Establishment of COVID-19 Treatment Centres at one ID Hospital in Harare and one in Bulawayo ii) National Guidelines update iii) Law passed with potentially prison for fake news

3.3 Health and social impact of COVID-19 including impact on other diseases

Measures to limit the spread of COVID-19 are having a considerable impact on other disease areas including both infectious and non-infectious diseases. Table 3 contains details of the considerable healthcare and financial impact of COVID-19 as well as ongoing activities among African countries to

address these. We will be examining unintended consequences in more detail in future research projects. Similarly, there are considerable financial and socioeconomic consequences which are also being addressed, with countries having the opportunity to learn from each other

Table 3 – Healthcare, financial and socioeconomic impact of COVID-19 across Africa

Country	Healthcare, Financial and Socioeconomic impact
Botswana	<ul style="list-style-type: none"> • To date: <ul style="list-style-type: none"> ○ Healthcare services have not been seriously affected by the COVID-19; however, in ambulatory care there are fewer attendances at outpatients' clinics due to a bar on public transport ○ here has been no noticeable impact on immunization programmes, prevalent infectious diseases (TB and HIV) and NCDs ○ However, increased level of suspicion of COVID-19 in people presenting with respiratory illnesses
Cameroon	<p>Healthcare concerns include:</p> <ul style="list-style-type: none"> • Cameroon is marked by violence in the North, the North West and the South West regions with a considerable number of internally displaced persons (IDPs). The COVID -19 pandemic constitutes an additional strain on the country's resources, which is a concern for the refugee populations. • The implementation of both WHO-advised basic protective measures and national strategies have been slow especially in the crisis hit regions of the country due to other humanitarian crises with IDPs. However, with the WHO stating cloth masks should be used, this has made it easier for a majority of the population to be able to afford a mask. • Treatment centers are currently lacking ventilators • Cameroon reported three outbreaks of monkey pox between 2018 and 2020, several cholera outbreaks, measles, and polio between 2016 and 2020, with concerns for these infectious disease areas with increasing focus on COVID-19 (397-402) • However, International humanitarian agencies such as the Médecins Sans Frontieres (MSF) are forefront in the fight against COVID-19 in the crisis ridden region <p>Financial and socioeconomic concerns and ongoing strategies to address this include:</p> <ul style="list-style-type: none"> • The imposed lock down has led to a drastic reduction in economic activities, shortfalls in tax and non-tax revenues with a looming budget deficit. • To help address concerns the government: <ul style="list-style-type: none"> • Is embarking on delays in debt servicing and informing its creditors and international partners of its inability to meet current financial commitments • Shutting down businesses or other penalties selling basic commodities at increased prices or hoarding commodities to create artificial shortages to profiteer • • Despite these measures, over 92% of businesses, mostly small and medium size, are projecting appreciable downsizing of employees with the possibility of over 50% of companies collapsing in 3 months in the event of an extension of the current lockdown Despite the desire to sustain schooling through on-line classes, the poor infrastructure, low internet penetration rate, limited and fluctuating bandwidth has made this endeavour almost impossible for most academic establishments. Consequently, new approaches are needed
Democratic Republic of Congo	<ul style="list-style-type: none"> • An ongoing concern is that COVID-19 outbreak is creating significant additional pressure on an already overburdened health and social service delivery system in one of the world's poorest countries, which is exacerbating the vulnerabilities of the population (403, 404)

	<ul style="list-style-type: none"> • This builds on an epidemic of measles, with the number of deaths to date appreciably higher than seen with COVID-19. Ducombe <i>et al.</i> in their recent paper documented 311,471 reported cases following the outbreak in 2019 with 6045 reported deaths mainly among children under 5 (405) • In addition, the Republic has had to deal with its tenth outbreak of Ebola, which has been ongoing since August 2018, the largest-ever outbreak reported in the Republic and the world's second largest, with a Public Health Emergency of International Concern declared on 17 July 2019 (406) • There is ongoing testing against Ebola in the Republic, e.g. from 15 to 21 April 2020, an average of 2037 alerts were reported and investigated per day, which is ongoing Of these, an average of 196 alerts were validated as suspected cases each day (407) • Overall, the WHO reported as of 21 April 2020, a total of 3461 cases of Ebola in the Republic, including 3316 confirmed and 145 probable cases, of which 2279 patients have died giving an overall case fatality ratio 66%. Out of the total confirmed and probable cases, 56% were female and 28% were children (407)
Egypt	<p>Healthcare concerns include:</p> <ul style="list-style-type: none"> • All outpatient services closed and services limited to emergencies including surgeries. There is also shortage of blood for transfusion and ICU beds for non-COVID-19 patients • Many departments/hospitals closed due to COVID-19 infections; however, reopened after decontamination procedures • Shortage of PCR testing kits to adequately test the population <p>Alongside this:</p> <ul style="list-style-type: none"> • Ongoing fear that the virus spreads from the dead bodies of infected COVID-19 patients leading to the abandonment of corpses of some infected doctor/patients despite undertaking all recommended preventive measures • Stigma for medical doctors working in the diagnosis of asymptomatic cases due to a misconception that they are source for virus transmission <p>Financial and socioeconomic concerns and ongoing strategies to address this include:</p> <ul style="list-style-type: none"> • Paid leave to government employees with special conditions including a) Women with children less than 12 years old, b) Employees who have documented chronic disease/s, c) Employees who have been in contact with COVID-19 patients and d) Employees who return from travel outside of Egypt • Monthly financial support to people with irregular employment (408). Similarly, some NGOs have helped people in this category with supply of daily needs • The Government on 20 April announced 100 billion EGP (USD 6.4 billion) to fund a comprehensive plan to combat the pandemic, half of which is allocated to the tourism sector (408)
Eswatini (Swaziland)	<p>Health care concerns include:</p> <ul style="list-style-type: none"> • The designated isolation Hospital is currently not able to accommodate more than 16 patients. To address this, the Government has dedicated some hotels for quarantining; however, there are concerns with availability and patients are currently being quarantined at crowded homes. Hospitals are also being encouraged to make plans for isolating unstable suspected cases; however again concerns with capacity • Partial closure of the major private hospital in Mbabane affecting care • Very few ventilators were functional in government health facilities during the early stages of the pandemic with more needed as well as a shortage of hand sanitisers (although being addressed with local production)

	<ul style="list-style-type: none"> • Adequate management of patients with HIV and TB in Eswatini, which has the highest percentage of people living with HIV worldwide, and a high prevalence of TB and with approximately 70% of all TB patients co-infected with HIV(409, 410). To help reduce visits, typically stable HIV patients now receive six-monthly refills of ARVs and among those with TB, medication is provided for one to three months depending on their health and drug availability (410) • Given the risk of COVID-19, every effort should be made by hospitals and health centre staff to down-refer patients with stable NCDs to the primary care level. Patients with unstable diseases, recent emergencies related to their condition, and/or paediatric patients, are encouraged to come to hospital clinics where possible. All patients in primary care should only be administered with a one-month refill to enhance attendance and follow-up • Encouragingly, vaccination programmes have not been stopped although due to travel restrictions there are missed appointments. There are also concerns with the availability of the influenza vaccine in retail pharmacies with out-of-stock situations reported from 23 April 2020 <p>Financial and socioeconomic concerns and ongoing strategies to address this include:</p> <ul style="list-style-type: none"> • SRA-COVID-19 E90 million tax relief fund for small and medium enterprises • Zimbabweans in Eswatini have donated E10000 towards the COVID-19 Fund • Businesses in Eswatini have donated E24 million towards the COVID-19 Fund • The Banks have announced that those individuals and companies that need short term financial support or relief can approach them and each application will be assessed on a risk-based approach. In addition, the Central Bank had made provisions for businesses to obtain loans at lower interest rates to help out (411) as well as encouraging electronic payments rather than cash transactions • The Eswatini Government providing food assistance to the most vulnerable adversely affected by the COVID 19 pandemic, which will benefit over 300,000 individuals from 63,000 households across all four regions of the Kingdom (412) • Such measures will help address the potential for an appreciable number of companies laying off staff due to the virus (413)
Ghana	<p>Healthcare concerns include:</p> <ul style="list-style-type: none"> • An outbreak of meningitis in the Upper West region of the country which has killed 33 people as of 4 April had not received the same attention as COVID-19 (414). By early May, 40 deaths had occurred and over 400 cases recorded, with mass vaccination now being contemplated • Vaccination programmes including polio vaccination ceased early during the lockdown; however normal vaccination programs for babies born in hospitals are still being administered • Currently no routine follow-up of patients with NCDs • Psychologically, the lockdown has given a sense of imprisonment potentially enhancing the prevalence of mental health disorders. However, evening exercise and training under the cover of darkness has increased to help address this • Public healthcare systems have focused mainly on COVID 19 cases during the lockdown, with a shift in funding to tackle COVID-19 to the detriment of other disease areas <p>Financial and socioeconomic concerns and ongoing strategies to address this include:</p>

	<ul style="list-style-type: none"> • Free food distribution by the Government and NGOs to those in need, initially free transport for health workers, as well tax rebates for frontline workers. In addition, a 50% reduction in electricity and water tariffs and donation of salaries by Government officials as well as the Ghana Chamber of Mines to the COVID-19 National Trust Fund (415, 416) • Religious organisations have donated beds and monies to the National Trust Fund (417, 418) • The World Bank has provided US\$100 million to assist in tackling the effects of the COVID-19 pandemic (419) <p>A recent publication regarding the cost-benefits of moderate social distancing in response to the COVID-19 pandemic in Ghana suggests that the costs outweigh the benefits. Consequently, the authors believe there is an urgent need to avoid escalating social distancing policies in Ghana, re-open schools and avoid reducing healthcare activities in other infectious diseases apart from COVID-19 as well as NCDs (420)</p>
Kenya	<p>Healthcare concerns include:</p> <ul style="list-style-type: none"> • Reduced access to other healthcare services with most hospitals focusing on COVID-19, and currently no mechanisms for the management of chronic illnesses for those who are in quarantine. However, the rise in telemedicine approaches could help with identification and management of diseases (208, 421, 422) • Public health workers and community health volunteers have been mobilised and engaged to help with COVID-19 prevention • A reduced flow of patients with other disease. To address this, online consultations have been promoted and some patients including those with cancer have received letters permitting them to travel and there has been an increase in home deliveries of medicines • Some quarantine centres do not have adequate facilities for social distancing and infection prevention and control. In addition, concerns about the ability to pay for quarantining (423) • COVID-19 positive cases have been reported in densely populated areas such as slums and refugee camp (Kakuma) putting strain on the public health programmes (424) • Response to other infectious diseases, e.g. cholera outbreak in Eastern and North Eastern Kenya - although systems have now been put in place to avert further loss of life (425). At least 194 lives have also been lost and many people displaced following heavy floods in Western Kenya in April putting further pressure on healthcare systems (426) • Antenatal and postnatal programmes have also been affected in some areas in Kenya • Encouragingly, vaccination programmes are ongoing with no adverse impact reported to date. <p>Financial and socioeconomic concerns and ongoing strategies to address this include:</p> <ul style="list-style-type: none"> • US\$50 million donation from the World Bank to Kenya to tackle the COVID-19 pandemic (427), with donations also from other countries (428) • Citizens earning less than US\$300 per month have been exempted from paying taxes, with a general reduction in income tax. In addition, reduction in VAT, expedition of VAT payments and a general increase in cash flows especially for businesses (429) • Tax relief on telecommunication and other essential services as well as lowering of interest rates (429) • Food distribution to the vulnerable and low socioeconomic income groups • Money retrieved from corruption cases will also be used to fund COVID-19 activities
Lesotho	Healthcare concerns include:

	<ul style="list-style-type: none"> • There are only two hospitals designated for COVID-19 patients in Lesotho with limited number of beds and a limited number of ventilators for the entire country • The government has though prepared a number of guest houses and hotels as quarantine facilities for people coming from other countries, who are screened for 14 days • Screening has been scaled up at all of borders since there has been an influx of people entering the country through illegal borders. Screening is also being conducted in healthcare facilities and in the communities. • Initially, there were inadequate laboratory services in Lesotho, and COVID-19 tests were undertaken in South Africa. However testing has now started in the National Reference Laboratory (430) with a substantial contact tracing program in place in response to the escalation of COVID-19 cases • Currently, there are no reports on the impact of COVID-19 on the management of other infectious and non-infectious diseases, no identified medicine shortages, and vaccination programmes are progressing as normal. However, there are issues with accessing services due to shortages of public transportation and travel restrictions • There has been considerable misinformation surrounding COVID-19 which may negatively hamper the government's efforts to contain the disease and prevent its spread. The Ministry of Health is working hard to deal with this and have quickly reprimand perpetrators <p>Financial considerations:</p> <ul style="list-style-type: none"> • A concern is that prices of some basic food commodities, disinfectants and cleaning supplies have increased. However, the government has promised financial support where necessary
Malawi	<p>Healthcare concerns include:</p> <ul style="list-style-type: none"> • Additional strain on the HCP workforce to cover all disease areas and not just COVID-19 patients • Limited supply of PPE has put the lives of HCPs in danger, which resulted in a strike in many facilities across the country. This has been addressed by employing more HCPs and increasing their risk allowances (431), as well as making more PPE available. UNICEF has helped procure PPE (432) and the Jack Ma and Alibaba foundations have also helped to address supply issues (433) • The shortage of essential PPE for citizens has been compounded by an escalation of prices with the Competition and Fair Trading Commission (CFCT) of Malawi conducting price checks to help address concerns (434) • The shortage of hand sanitizers has been solved helped by the local production of hand sanitizers by many companies including institutions of higher learning in addition to supplies with the help of UNICEF. However, this has resulted in regulatory dilemma with limited availability of testing tools and protocols for such products. Measures are now in place in both the short term and long term to help solve this problem • A major concern is that concentration on COVID-19 has diverted attention away from ensuring the availability of essential medicines for other disease areas <p>Financial and socioeconomic concerns and ongoing strategies to address this include:</p> <ul style="list-style-type: none"> • Cash payments to the poor to help them survive the lockdown (435) • The United Nations launching an emergency appeal in Malawi. The UN believe US\$140 million is needed to support the country's preparedness and response for the next six months (May onwards) and target the most vulnerable, which equates to 7.5 million people, nearly half of the country's population, with approximately 70% of the population living below the international poverty level if \$1.90/ day (436)

	<ul style="list-style-type: none"> • The government has reduced the cost of fuel to mitigate against the increase in the cost of transport, which resulted from a reduction in the number of people boarding minibuses and private cars leading to an increase in the cost of transport and transporters overcharging passengers to make up for reduced numbers (437) • Schools have been closed since 23 March 2020 (438), with calls for alternative ways of engaging students including home reading and online learning; however concerns with limited resources including computers
Namibia	<ul style="list-style-type: none"> • Healthcare concerns include a lack of hand sanitisers. Consequently, the School of Pharmacy at the University of Namibia was been tasked to produced hand sanitizers for the Ministry of Health and Social Services and other governmental and non-governmental organisations • Measures to address financial and socioeconomic consequences include: <ul style="list-style-type: none"> ○ Over 8 billion Namibian Dollars have been committed by the Government to stimulate the economy, provide social protection to families and support health sector response (439) ○ The government through the Ministry of Finance has also given financial support to small/individual business owners who depended on their daily income for survival. The package was ~USD 47 per person
Nigeria	<p>Healthcare concerns include:</p> <ul style="list-style-type: none"> • Most secondary and tertiary public hospitals have shut down routine outpatient services with most elective surgeries on hold; however, facilities to interact with physicians when the need arises are being put in place including telephone services • Re-organisation of duty and call rosters to minimize the number of healthcare workers exposed to COVID-19 at any one time • Immunization clinics are continuing to function as an essential service endorsing advice from the WHO (440); however, utilization has reduced due to the lockdown • Many patients suffering from non-COVID-19 conditions are currently unable to readily access care leading to concerns with increasing inactivity as well as increased use of complementary and alternative medicines • Identification and management of NCDs has been hampered by reduced access to healthcare facilities, likely to impact negatively on medication adherence and outcomes, exacerbated by concerns with drug shortages • Increasing levels of depression/ domestic violence as the lockdown and the lack of money continues • Nigeria is currently experiencing an outbreak of Lassa fever with 979 confirmed cases as at 18th April 2020 in 27 out of the 36 states leading to 188 deaths with a case fatality of 19.2% (441); however, receiving less attention than COVID-19 <p>Financial and socioeconomic concerns and ongoing strategies to address this include:</p> <ul style="list-style-type: none"> • Tax rebates of 50%, suspension of import duties on medical equipment, medicines and PPE for treatment and management of COVID-19 for three months, effective 1 March 2020 • N1 trillion (over US\$2.5 billion) in loans to boost local manufacturing and production across critical sectors • Distribution of cash to the most vulnerable poor and families in various communities. • On April 1st, the Nigerian Electricity Regulatory Commission (NERC) suspended the payment of the new electricity tariffs scheduled to commence on April 2nd, citing poor electricity supply, wide metering gap and the impact of the COVID-19 pandemic as the basis for this gesture
South Africa	Healthcare concerns include:

	<ul style="list-style-type: none"> • Elective surgeries have been stopped, with hospitals typically only dealing with emergencies • There are ongoing programmes to educate the public on the importance of avoiding going to high level hospitals to reduce congestion. Overall, hospitals and clinics appear to be functioning although support staff such as HR, finance and some other allied staff have been sent home for lockdown to avoid transmission • Access to health facilities has also become a major challenge due to lack of public transportation during lockdown • To address concerns with the supply of medicines especially for patients with chronic conditions, a greater supply of medicines has been given to patients to avoid repeated visits to facilities and also includes prescriptions filled for up to four months or longer (205, 442) • Currently, though there appears to be no shortages for possible treatments – helped by the lack of endorsement of medicines used to treat malaria or HIV to treat COVID-19 by the South African Health Products Regulatory Authority with concerns about stockpiling of medicines and lack of evidence (108). The South African Pharmacy Council also sought to discourage stockpiling of essential medicines (443). However, shortages are likely to occur as the pandemic continues; with ongoing steps to try and reduce this address this (315, 316) • There are concerns with the decrease in the extent of HIV testing as well as collection of ARV's due to fears of contracting COVID-19 (193) • There are concerns with vaccination programmes with April 2020 showing a 22% decreases in the measles first dose and in fully immunised children under one year (173), with UNICEF South Africa generally urging parents and caregivers to get their children immunized (444). Where immunisation services have been curtailed, the risks of children dying from a vaccine-preventable disease appreciably outweigh their risks of dying from COVID-19 (172) • Increased anxiety among citizens as seen with protests in some Provinces against housing of citizens who were repatriated from China <p>Initiatives to address financial and socioeconomic issues include:</p> <ul style="list-style-type: none"> • The World Bank, International Monetary Fund, BRICS New Development Bank and the African Development Bank have been approached and are working with the National Treasury on various funding projects (445) • Tax relief, release of disaster relief funds, emergency procurement, wage support, funding to small businesses • Social relief of distress grants given to those above 18 years of age who are (445, 446): (i) Unemployed; not receiving any income or social grant; (ii) any unemployment insurance benefit, any stipend from the National Student Financial Aid Scheme or resident in a government funded or subsidised institution • Other initiatives include: <ul style="list-style-type: none"> ○ child support grant beneficiaries will receive an extra R300 in May and from June to October 2020 they will receive an additional R500 each month ○ all other grant beneficiaries will receive an extra R250 per month for the next six months; a special Covid-19 Social Relief of Distress grant of R350 a month for the next 6 months will be paid to individuals who are currently unemployed and do not receive any other form of social grant or Unemployment Insurance Fund payment, and grants increased for a number of categories s of 1 April 2020 • There has also been roll out food assistance through vouchers and cash transfers. The Department of Social Development has also partnered with
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	<p>the Solidarity Fund, NGOs and community-based organisations to distribute 250,000 food parcels across the country</p> <ul style="list-style-type: none"> • The Minister has also granted limited-time block exemptions to healthcare, banking, retail property and hotel sectors in respect of certain categories of agreements or practices between participants from the application of Section 4 (restrictive horizontal practices between competitors) and Section 5 (restrictive vertical practices between participants at various levels of the supply chain) of the Competition Act (447)
Sudan	<p>Healthcare concerns include:</p> <ul style="list-style-type: none"> • Difficulty with accessing Primary Health Care (PHC) for the treatment of NCDs services including renal dialysis due to the partially paralysed activities in the public and private sectors • Health centres/ hospitals closing down once a case is suspected or confirmed with isolation of all health care providers who came into contact with the patient • Inadequate supply of PPE for healthcare workers resulting in a good proportion on quarantine and a great reluctance among others to continue to work under the prevailing conditions. To help address this, there has been a shipment of 20,000 testing kits, 100,000 masks and 1,000 protective suits from the Jack Ma Foundation (448), and UNICEF has mobilized US\$370,000 for Infection Prevention and Control (IPC) supplies for use at points of entry to Sudan and ambulances (448) • Economic hardship with long queues at bakeries and oil stations make social distancing difficult and meaningless • Access to immunization services has been reduced in view of additional resources for COVID-19 • The Federal Ministry of Health together with the WHO has developed a US\$76 million countrywide COVID-19 preparedness and response plan to help combat concerns and the spread of the virus (448) <p>Financial and socioeconomic concerns and ongoing strategies to address this include:</p> <ul style="list-style-type: none"> • The harsh socioeconomic impacts of the pandemic are further compounded by the prevailing Sudanese Revolution and its attendant political and leadership crisis as well as Sudan still on the American State Sponsors of Terrorism list • Sudan is on the list of countries expected to have severe food shortage from COVID-19 with already 61% of the population in South Sudan in a state of food crisis in 2019 (449), with general agreement that the nation cannot sustain long-term lockdown and movement restriction with limited or no organized efforts from government to meet basic needs • However, the World Bank on April 6 activated the Contingent Emergency Response Implementation Plan (CERIP) providing US\$7.6 Million in support of the coronavirus emergency response (450) • In addition (451): <ul style="list-style-type: none"> ○ The Islamic Development Bank donated US\$50 million to Sudan's Health Ministry for the Covid-19 response ○ The United States announced on 27 March a donation of \$8 million to Sudan. This assistance will primarily provide health-related support and supplies to bolster water, sanitation, and hygiene activities
Uganda	<p>Healthcare concerns include:</p> <ul style="list-style-type: none"> • Difficulties with patients accessing ambulatory care facilities with restrictions on public and private transport alongside the curfew The Government has urged the public not to relax efforts to reduce HIV/ AIDS with the current high focus on COVID-19, with the aim of ending AIDS as a public health threat by 2030 (452), some patients with HIV will struggle to obtain their medicines. This is being addressed to some extent

	<p>by volunteers and the Ministry allowing community health workers to pick up medicines for patients (453)</p> <ul style="list-style-type: none"> • Ensuring the safety of patients in health facilities and quarantine centres, enhanced by lack of testing facilities <p>Measures to address financial and economic considerations include:</p> <ul style="list-style-type: none"> • The Ugandan president warning traders against raising the price of goods because of COVID-19 infection; however, Uganda currently has no price control and anti-profiteering laws (454) • Seeking support from the International Monetary Fund (IMF) as well as concessional loans amounting to US\$100 million for 2019/ 2020 and US\$90million 2020/ 2012 from the World Bank and seeking export promotion strategies to address concerns with high import rates (455) • Early May, the IMF approved a US\$491.5 Million Disbursement to Uganda to help address the financial impact of the COVID-19 pandemic (456) • Mobilisation of funds from the general public fund to help address the financial consequences
Zambia	<p>Healthcare concerns include:</p> <ul style="list-style-type: none"> • HCPs are already overcommitted providing services to high patient loads afflicted with other infectious diseases and NCDs. To address this, the Government has committed to recruiting an additional 8,000 health workers in 2020 to meet its target of enlisting 30,000 health workers by 2021 (457) • Inadequate supply of commodities and equipment. To address this, the government has suspended custom duties and VAT on additional medical supplies used for COVID-19 coupled with donations from external organisations (458-460) • Encouragingly, routine ambulatory and hospital care services in most parts of Zambia remain functional and routine vaccination programmes (especially for childhood illnesses) have not been disrupted in most parts of Zambia • However, the financing of healthcare is already a concern and anticipated to be further constrained by the COVID-19 pandemic should further flare ups occur. This will negatively impact on care generally <p>Financial and socioeconomic concerns and ongoing strategies to address this include:</p> <ul style="list-style-type: none"> • Epidemic Preparedness Fund amounting to ZMW57 million (approx. US\$3.1 million); Cabinet approving a COVID-19 Contingency and Response Plan with a budget of ZMW659 million (approx. US\$36.2 million) under the Disaster Management and Mitigation Unit (DMMU); and the Government mobilizing funds through the budget and engagement with international and domestic stakeholders (461) • Easing liquidity; waiver of tax penalties and interest on outstanding tax liabilities resulting from COVID-19; building new and sustainable value chains and engaging multilateral organizations including the IMF and the World Bank (462)
Zimbabwe	<p>Healthcare concerns include:</p> <ul style="list-style-type: none"> • Accessing healthcare for other conditions especially for chronic NCDs has become more challenging • Patients with fever are also not getting appropriate timely care because health workers are not comfortable managing them until they know their COVID-19 status. This has resulted in some avoidable complications building on the malaria outbreak with over 226 deaths reported since 1 January 2020 (463, 464). Consequently, there is a need in malaria areas to differentiate malaria from COVID-19 • There has been an alteration of drug dispensing protocols for patients with NCDs who are stable to provide these for 3-6 months to minimize hospital visits. The same principles also apply to patients on treatment for TB and

	<p>HIV. However, Zimbabwe had a challenge with the shortage of medicines to treat patients with NCD even before the COVID-19 pandemic. Most of the medicines for NCDs are typically procured out-of-pocket, with patients told to continue sourcing from private pharmacies if the hospital pharmacy does not have the medicine</p> <ul style="list-style-type: none"> • This is a potential shortage generally in supply and access to medicines especially with an increase in malaria cases amid the COVID-19 pandemic • The plans for mass campaigns for TCV/IPV/HPV/Vitamin A that was scheduled for May 2020 has been put on hold due to the pandemic. Vaccination though is ongoing at facilities building COVID-19 guidance (social distance at facilities). However, this is a challenge when there is a need to ensure vaccination occurs in batches and where there are issues with public transport <p>Measures to address financial and socioeconomic consequences include freezing of prices for basic commodities including food and income support</p>
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3.4 Shortages of medicines and activities to address this

There are shortages of medicines across Africa, as most medicines are imported (Table 3A). We are likely to see local production increasing as part of future strategies to address ongoing shortages as a result of COVID-19, and we will be monitoring this in the future.

Table 3A in the Appendix contains details of ongoing shortages across Africa with countries starting to implement robust strategies to help deal with these in the future.

3.5 Clinical trial activities

As mentioned, there has been limited clinical trial activity across Africa compared with higher income countries; however, this is beginning to change:

- In Botswana, there are currently no on-going clinical trials on COVID-19; however, the University of Botswana (a government-funded institution) has called for proposals on COVID-19 research, which was open until May 15, 2020
- Egypt appears to be undertaking several clinical trials with currently 14 registered clinical trials granted expedited approval by review boards utilizing different medicines and treatment modalities (465)
- Currently there are no known clinical trials commissioned in Eswatini with no demonstrable commitment to commissioning COVID-19- related clinical research activities given the current pressure on resources
- In Ghana, there currently appears to be no clinical trial research activities related to COVID-19. However, some medicinal plants with potential antiviral activity have been identified and submitted to the Centre for Scientific Research into Plant Medicine and Noguchi Memorial Institute for Medical Research for the commencement of studies/screening on their potential therapeutic anti-COVID-19/SARS-CoV-2 activities
- Kenya is currently involved in WHO clinical trials for three medicines used in combating COVID-19. A vaccine clinical trial is envisaged in the next two or three months at the Kilifi KEMRI/Wellcome Trust collaborating research site. The Institutional Review Boards have established electronic systems for protocol submissions and review feedback and expediting the review process to (3-4 days for first response) facilitate implementation.
- Three clinical trials have been registered in Nigeria but currently none have started recruiting (466). However, Nigeria has been included in the WHO SOLIDARITY trial with five treatment centres participating
- A number of clinical trials are currently ongoing in South Africa for both pharmaceutical and non-pharmaceutical interventions with the Institutional Review Boards in South Africa having established electronic systems and expediting review process to facilitate these. This includes the SOLIDARITY WHO trial with the South African research team being led by senior academics and clinicians from eight medical schools (467) as well as the BCG vaccination trial programme for healthcare workers (468) and the South African Ox1Cov-19 Vaccine VIDA-Trial, the first clinical trial for a vaccine against Covid-19 in South Africa with the first patients enrolled the week of June 23 2020 (469, 470).

- Zimbabwe is also involved in the WHO SOLITARY Trial

3.6 Technical innovations regarding COVID-19 from across Africa

There are many ongoing innovations across Africa to tackle COVID-19, and these are expected to continue. In Senegal, the Institut Pasteur, with support from the WHO, developed a USD1 COVID-19 Rapid Testing Kit to enable the country to undertake considerable testing with the government currently seeking approval for their kits to be used in other African countries (471-473). Scientists and industry partners in Ghana have also developed a test for COVID-19, a finger-prick blood test to rapidly detect antibodies, which is seen as beneficial among asymptomatic cases to reduce the spread (267).

Students at the Jomo Kenyatta University of Agriculture and Technology in Kenya developed a Mobile app to help with contact tracing, triaging and case management of COVID-19 patients (474), with other students in Kenya also developing and making ventilators to address shortages (268, 475, 476). A multidisciplinary team at Wits University in South Africa used their design and engineering skills to create face shields (477). A multi-disciplinary team from Honoris United Universities from across Africa, including doctors, engineers, and students, have developed a prototype for a new non-invasive respirator alongside face shields and splash protection masks, which can be quickly and affordably manufactured via 3D printing to address current shortages (269).

Scientists in Uganda have also developed hand-free hand sanitisers and rapid testing kits with a team at Makerere University involved in manufacturing low-cost ventilators to bolster the country's capacity in case demand increases (478-480).

The Gauteng Department of Health in South Africa has introduced an app (Mpilo) based platform that supports improved service delivery and improved patient experiences in Gauteng Health facilities (481). The University of Pretoria in South Africa has also produced an interactive app with real-time data on COVID-19 infections to help with management (482). The governments in Egypt and Ghana have also recently launched apps to help with tracing people who have come into contact with COVID-19 positive patients as well as provide advice on management (483, 484).

Scientists in Ghana have also successfully sequenced the genomes of SARS-CoV-2 from 15 of the samples obtained from confirmed COVID-19 cases through active collaboration using the Next Generation Sequencing (NGS) Core and High-Performance Computing system (485). Whilst there have been some differences in the strains between countries, all 15 genomes typically resembled (>92% similarity) the original strain isolated from China (485). Scientists from the Nigerian Centre for Disease Control (NCDC) and others from across Nigeria, including from Lagos University Teaching Hospital, have also reported sequencing of the SARS-CoV-2 from the first confirmed case of COVID-19 in Nigeria (486).

3.7 Key lessons among individual African countries and implications for the future for key stakeholder groups

Table 4A (Appendix) summarises key lessons learnt among a number of African countries going forward in the management of COVID-19 and other disease areas based on their experiences.

Boxes 1 to 6 consolidates potential activities that could be undertaken across Africa to improve the future care of patients with COVID-19 building on existing activities (Tables 2 and 2A). However, we need to be mindful of a range of healthcare issues including the unintended consequences on both health and socioeconomic circumstances. This builds on Tables 3, as well as 3A and 4A, for individual African countries as well as recommendations for all key stakeholder groups in Africa going forward in the management of both infectious and non-infectious diseases as well as clinical and economic issues surrounding fixed dose combinations (168, 198, 199, 257, 487).

A key area will be patients especially in view of their necessary compliance with any lockdown and social distancing activities as well as considerations for the unintended consequences of COVID-19. These include mental health considerations, managing maternal and childbirth challenges, the identification and management of other NCDs as well as other infectious diseases.

HTA will also be a crucial area especially given concerns with the extent of misinformation regarding COVID-19 and the implications. In addition, the need for governments to prioritise their limited resources across disease areas (488, 489), rather than devoting appreciable personnel and resources to one area to the detriment of others as seen currently with activities regarding COVID-19 (Tables 2, 2A and 3). However, there are challenges including available personnel and resources as well as typically a greater focus on medicines among HTA units rather than other technologies (490-493). This is changing with studies in Ghana evaluating the cost-benefit of moderate social distancing policies (420) and groups in South Africa HTA evaluating the cost-effectiveness of ICU versus care on general wards with patients with severe COVID-19 (494).

HTA and EBM will also be important in the development of clinical guidelines for Africa considering the costs involved with developing de-novo guidelines. Africa could certainly gain from a Pan-African guideline for the management of COVID-19 as knowledge grows to provide scientifically-based recommendations, similar to initiatives for NCDs (495). Global evidence communities including the BMJ under its Best Practice series are already adopting this approach for knowledge generation, synthesis, and translation to facilitate evidence-based decisions (75, 496), and any Pan-African initiatives should build on this. Groups such as IAPO are also important with their resource hubs to provide robust, reliable and updated information to help improve the care of patients (350). In the meantime, we are beginning to see African countries taking steps to reduce the level of misinformation and this is likely to grow (347, 348).

Box 1 – National/ regional governments and authorities

Leadership and governance

- Instigation of national/ regional pandemic planning. This includes the need for active surveillance with appropriate personnel and facilities as well as ensuring necessary healthcare workforce and structures including adequate supplies of PPE and other necessary equipment, and communication including all key stakeholder groups with reserved funds for such health emergencies. In addition, a phased approach to easing restrictions when pertinent (222). Such activities have worked well across countries (57, 497).
- Development and implementation of occupational health and safety protocols, policies and legislative frameworks taking cognisance of the risks and mechanisms of COVID-19 infection. Such protocols, policies and legislative frameworks should be consistent with national and international workplace safety policies and guidelines. Effective enforcement and monitoring mechanisms should be put in place
- Planning should take account of the impact on the mental health of patients and healthcare professionals as well as other priority disease areas and potential ways to address these. This requires a sound understanding of investment/ priority decision making and activities including health technology assessment (HTA) evidence-based medicine (EBM) principles
- Actively plan for misinformation building on the considerable levels of misinformation already seen by end June 2020 (222)
- Good communication and financial planning are vital to address concerns with any lockdown/ curfew measures especially in countries with high levels of informal sector workers/ high level of workers dependent on a daily wage for their survival
- Lead the development of care guidelines nationally as well as take part in the development of any Pan-African care guidelines. This builds on HTA/ EBM approaches
- Ensure longer term that all healthcare professionals have the necessary training to improve the management of patients with infectious diseases as well as likely co-morbidities especially among African patients. This includes instigating antimicrobial stewardship programmes as well as Infection Prevention Control groups in hospitals where these do not currently exist
- Enhance collaboration between African countries, especially those with shared borders. This builds on ongoing collaborations including the East African Community with their shared plans to tackle COVID-19 (286)
- Explore telemedicine and other similar approaches to help with diagnosis of infectious diseases and address unintended consequences especially in patients with chronic NCDs (196, 207, 421, 422) as a consequence of any lockdown, alongside investigating the potential of robots for care delivery

- Continue with measures to reduce the extent of falsified and sub-standard medicines within Africa as well as measures to address concerns with misinformation. Alongside this, seek ways to enhance local/ regional production of medicines, PPE and other equipment to reduce reliance on imports

Health care workforce (HCW)

- Strengthen health care systems including ambulatory care systems as well as policies and initiatives to improve identification and management of COVID-19, as well as other high priority disease areas (capacity building)
- Instigate practices to ensure that essential health services offered by private healthcare sector are not compromised
- Seek to address shortages of physicians where applicable including training and utilising of other healthcare professionals. This can include task shifting including a greater role for other professionals such as pharmacists (Box 4) As part of this, develop medium to long term epidemic/pandemic training for healthcare personnel to improve their preparedness and capacities for such health emergencies
- Enhance the professionalism of HCWs including initiatives to reduce inappropriate prescribing of antimicrobials where this occurs (498)
- Strengthen community systems through capacity building of community owned resources including community extension health workers as well as voluntary healthcare workers as these are typically the first point of contact in communities
- Ensure HCWs continue to have access to PPE as well as additional training (where relevant) in dealing with pandemics as the safety of HCWs and patients is critical during pandemics
- Seek to share basic best practices across countries, including what works well in COVID-19 case management, infection, prevention and control.

Financing/ Socioeconomic issues

- As most African countries currently rely on foreign input, governments need to find alternative sources of income in the future through agriculture and technology advances building on current innovations
- Minimize the socioeconomic impact through enhancing national solidarity and prioritization of social cohesion.
- Seek to protect vulnerable populations including the benefits and privileges of low-wage workers as well as address access to healthcare and support for all to reduce the burden that makes vulnerable people less able to follow public health directives
- Make it possible for small-scale business to survive periods of economic downturns occasioned by public health crisis. This can include facilitating the disbursement of interest loans to SMEs as well as reward local companies in the country with tax incentives/guaranteed bank loans to enable them recover post COVID-19

Research including unintended consequences for both infectious diseases (including AMR) and non-infectious diseases

- Promote and fund operational/national research on the impact of COVID-19 on infectious diseases (including AMR) and non-infectious diseases especially the unintended consequences (Table 3). This is particularly important in Africa where national programmes are just starting to address AMR as well as NCDs including CVD, diabetes and mental health (168, 176, 178, 198, 199, 499)
- Continue to promote research into potential risk factors for morbidity and mortality among African patients given the differences that can exist between patients in Africa and those in high income countries
- Continue with research programmes aimed at mitigating against infectious diseases (including AMR) and non-infectious diseases across countries to add to the debate about the potential impact of unintended consequences
- Instigate research into new ways to manage patients with both infectious diseases and NCDs where there are constraints on patient access including better use of new technologies including telemedicine and consultations through the internet/ mobile telephones

NB: AMR = Antimicrobial Resistance; CVD = Coronary Vascular Disease; EBM = Evidence-based medicine; HTA = Health Technology Assessment; NCDs = Non-communicable diseases; PPE = Personal Protective Equipment

Box 2 - Health Technology Assessment/ Evidence Based Medicine

Short term

- Continue reviewing of emerging medicines that could be used in the management of COVID-19 to inform and update clinical protocols
- Disseminate findings via Ministry of Health and other websites to address current levels of misinformation
- Continue to undertake research for evidence-based interventions given the current controversies surrounding a number of suggested treatments for COVID-19, and encourage greater collaboration between governments, healthcare professionals and patient organisations researching and disseminating the findings
- Strengthen HTA capabilities especially when Ministries of Health are confronted with different potential interventions to address COVID-19 coupled with limited resources. This builds on existing initiatives across Africa including Ghana, Kenya and South Africa as well as the recent cost-benefit analysis on social distancing in Ghana and ICU versus care in general wards for patients with severe COVID-19 (420, 493, 494, 500-502)
- As part of this, upgrade research into priority decision making especially given the many competing healthcare needs among patients in Africa including those with infectious and non-infectious diseases as well as co-morbidities

Longer term

- Seek to invest in personnel and resources to enhance HTA/ EBM capabilities within countries where currently limited personnel and resources to enable greater critique of evidence based potential alternatives
- Seek to establish HTA collaborations across African countries to avoid duplication building on experiences in Europe (503-505)

NB: EBM = Evidence-base medicine; HTA = Health Technology Assessment

Box 3 – Physicians (hospital and ambulatory care)

Short term

- Deployment of higher number of physicians where possible to help deal with the pandemic as well as other priority disease areas. Ensure physicians are motivated emotionally, mentally and financially to help deal with the pandemic especially given the likely impact of the virus on their mental health. Educational interventions and psychological support will be needed to ensure greater understanding of COVID-19 and its implications including better coping strategies. Psychological support could include development of support systems among all stakeholders and general community.
- Physicians need to be provided with adequate PPE and training to address current fears, with hospitals provided with adequate logistical support (PPE, ventilators, medication, non-consumables)
- Embrace alternative ways of working including devolved responsibilities as well as the use of new technologies that help improve the care of all patients during pandemics
- Introduce greater opportunities for the training and re-training of ambulatory care physicians in the management of patients with COVID-19 and any co-morbidities given the challenges that can exist with differential diagnosis. As part of this, push for the instigation of antimicrobial stewardship programmes as well as IPC groups in hospitals where these do not currently exist
- Work with others to address concerns with misinformation as well as falsified and sub-standard medicines. In addition, concerns with potential shortages and alternative approaches

Longer term

- Building on current experiences and collaborations on the best way to treat patients with COVID-19 and the aftermath including concerns with mental health disorders
- Focus on training of sufficient physicians from non-public health or circulatory medicine specialities to ensure a higher number of staff with transferable skills relevant to a pandemic that can be rapidly re-deployed

- There is an urgent need generally to employ more health personnel to augment current inadequacies across Africa. This includes exploring measures to attain and retain physicians

NB: PPE = Personal Protective Equipment

Box 4 – Pharmacists (hospital and ambulatory care)

Short term

- Seek ways to ensure that medicines, or suitable alternatives, that are deemed helpful to patients with COVID-19 are routinely available coupled with medicines for other priority disease areas
- Work with Government agencies when falsified or sub-standard medicines are suspected to reduce their supply
- In hospitals, seek to ensure that hospital pharmacists are part of COVID-19 treatment teams including ASPs and IPC teams. This means that hospital pharmacist must keep abreast on current treatment research and protocols for COVID-19 and be familiar with EBM techniques given ongoing controversies (181). In addition, should be provided with any necessary PPE including face shields and goggles
- Hospital pharmacists should be involved in educating patients/staff on COVID-19 management especially on non-pharmacological and pharmacological interventions
- Where appropriate, pharmacist should be encouraged to prepare cost-effective WHO-recommended hand sanitizers for their facilities
- In the community, pharmacists have a vital role as they are often the first healthcare professional that patients contact regarding respiratory/ influenza diseases especially in countries with high patient co-payments, concerns with access to ambulatory healthcare facilities as well as issues of affordability to pay for a physician and their medicines (168, 181, 506-508). This includes encouraging self care/ hygiene measures including the supplying and wearing of masks and the need for regular hand washing as well as trying to protect patients against stock-outs of pertinent medicines (181, 320, 509, 510)
- Community pharmacists can also discuss appropriate treatments including arguing against the need for antibiotics where this is a concern and encouraging appropriate referral where possible (168, 507, 509)
- Community pharmacists and others can also push for extended supply of medicines where appropriate as well as help engage in discussions regarding adherence to medicines using different technologies especially given ongoing concerns with adherence to medicines without

regular input from pharmacists and other professionals (181, 511, 512). Pharmacists can also suggest alternative approaches during times of medicine shortages including potential OTC treatments (513)

- Community pharmacists can also be involved in vaccination programmes given current concerns, as well as help administer a vaccine for COVID-19 when available with research suggesting that when pharmacists provide immunizations, they substantially increase the number of vaccinated people in the community (514)

Longer term

- Increase the training of Pharmacists at both hospital and community levels to be prepared/actively involved in management of COVID-19 patients as well as addressing unintended consequences including the use of technology to address issues with adherence
- Pharmacists should be part of appropriate relevant training and the development of emergency plans and workflows to deal with future pandemics and their consequences (515)

Box 5 – Other healthcare professionals in ambulatory and hospital care

Short term

- Work with other professionals to identify optimal methods to deal with the care of patients with COVID-19 both in hospitals and in the community
- This includes making sure that healthcare professionals have the necessary PPE and equipment to deal with COVID-19 patients
- Seek to instigate training regarding the proper donning and removal of PPE during routine duties and in the management of suspected/positive COVID-19 cases if not in place
- Be part of ongoing plans to help improve the management of high priority disease areas outside of COVID-19 to make sure these patients are not neglected
- Work with necessary professionals to ensure the mental health of healthcare professionals and patients is not neglected during and post the pandemic. This includes helping to address issues of stigma

Longer term

- Be part of elaborate plans to improve the management of patients with COVID-19 and other priority disease areas including re-distribution of activities to address shortages with physicians and other HCPs
- Seek to work with universities, companies and other groups to develop in-house/ in-country technologies to treat COVID-19 patients and be less reliant on imports in the future

Box 6 – Suggested activities among patients/ patient organisations

Short term

- Mobilise and engage with traditional, cultural, and other leaders who are respected and listened to in their communities to disseminate important health messages including hygiene and social distance measures associated with COVID-19 to help address current low levels of health literacy in a number of African countries. This includes addressing current misconceptions about the importance of using face masks, and how to use them appropriately, as many patients do not appreciate their need as well as helping acknowledge that some people with respiratory problems may have difficulties using mask for long, which needs to be effectively tackled
- Engage with various channels to help reassure COVID-19 patients that they pose no threat to the community after treatment, and should continue with their lives, as well as help address issues of stigma and discrimination against COVID-19 patients when these arise
- Work with government bodies to help address issues of misinformation about vaccines and treatments including misconceptions about vaccines and the consequences (341). In addition, work with all key stakeholder groups to help address the mental health issues that will arise from the current pandemic
- Patients organisations should work with regulatory authorities and professionals generally to strengthen ethical conduct and professionalism post the pandemic including promoting only evidence-based approaches across social and other media given concerns with the level of misinformation during the pandemic
- Recovered COVID-19 patients can be used as ambassadors to sensitise the populace about the reality of the pandemic, and the need to avoid stigmatization
- Social media has proved useful and can provide an efficient means for patients and patient organisations to communicate with their communities. However, this needs to be carefully managed to reduce the level of any misinformation and subsequent adverse consequences. This builds on activities with traditional, cultural, and other leaders
- Empower patients on medication safety and polypharmacy concerns as well as educate patients about self-management generally of their conditions especially patients with chronic NCDs in the absence of routine clinics
- Help explore possible telemedicine approaches to reduce reliance on clinic attendance, which in itself can be problematic outside of the pandemic if this involves extensive travel and waiting times

Longer term

- Seek to develop patient-level data bases to routinely collect data on patients to help with future planning and care delivery
- Enhance the role of patient organizations within countries where pertinent as they can play a long-term role regarding advocacy and the spreading of information not only on COVID-19 but also other diseases and concerns. Patient organisations also have a key role generally to encourage changes in behaviours that promote good underlying health to support health outcomes and reduce the risk of severe symptomatic responses to a pandemic

4. Discussion and next steps

We believe this is the first study to comprehensively document ongoing activities throughout Africa to tackle the health, financial and socioeconomic consequences of COVID-19. This is important given the high prevalence of both infectious and non-infectious diseases in Africa, the high number of people at or below the poverty level compared with other continents and higher income countries, as well as concerns with the lack of personnel, hospital beds and equipment (168, 237-242, 255, 259, 261).

There have been different activities across Africa to prevent the spread of COVID-19 and reduce mortality rates (Tables 2 and 2A). African countries have broadly followed similar multiple approaches in terms of prevention including closing borders and instigating lockdown measures including travel restrictions, social distancing and testing. Closure of borders and quarantining along with other public health measures appear successful in reducing the spread of the virus (42), and this certainly appears

to be the case among a number of the African countries. Encouragingly, to date there have been no or very few reported deaths among some of the African countries (Tables 1 and 1A), mirroring for instance the situation in other LMICs including Vietnam (5). Encouragingly as well, there have been a number of innovations coming from the African continent to help with identification and management of patients with COVID-19, which includes local production of hygiene equipment as well as low-cost ventilators (Section 3.6). Alongside this, initiatives to enhance the production of medicines in Africa to reduce their reliance on imported medicines and other essential supplies. This bodes well with dealing with future pandemics in Africa. We will continue though to monitor prevalence and mortality rates across Africa as well as potential reasons for the limited mortality up to late 2020, certainly when compared with a number of European countries and the USA, including potential issues around ethnicity and other factors.

However, extensive lockdown and other measures to help control the spread of the virus have been at a cost including the negative impact on other disease areas as well as financial and socioeconomic consequences (Table 3). This includes an increase in mental health disorders exacerbated by issues of stigma. Table 3 shows clearly the need to strengthen or enhance existing healthcare infrastructures in many countries to respond to such pandemics and indeed promote better population health and underlying lifestyle behaviours. While good health system infrastructure does not guarantee better health outcomes it increases the opportunities for them to happen (516).

Groups such as IAPO are important to reduce any stigma associated with COVID-19 (351, 352). In the process of stigmatisation, people are being labelled, stereotyped, separated, and/or experience loss of status and discrimination because of a potential negative affiliation with the disease. Stigma can drive people to hide their illness to avoid discrimination, which potentially prevents them from promptly seeking help, and could discourage them from adopting healthy behaviours, which is concerning (517). This is because such barriers could potentially contribute to more severe health problems, ongoing transmission, and difficulties with controlling infectious diseases. As a result, there are ongoing strategies to address these challenges including a greater role for patient organisations (213).

There are real concerns though if lockdown policies are eased too early due to financial and socioeconomic pressures (396), and we will be following this up in future research projects. We will also be following up the unintended consequences of COVID-19 on other infectious and non-infectious disease areas as well as vaccination programmes. In the meantime, Boxes 1 to 6 provide direction to African countries going forward as they start to ease their lockdown restrictions and address the unintended consequences of the pandemic.

Limitations

We are aware that we have not undertaken a systematic review. This is because, as mentioned, a number of quoted papers have not been formally peer-reviewed and a great deal of information regarding country activities is currently only available on the internet. In addition, cases of COVID-19 started later in Africa than in China and Europe, and it is too early to formally assess the impact of policies. A number of clinical trials regarding possible treatments for COVID-19 have also only recently started.

However, we believe the strength of our paper lies in its comprehensive approach including ongoing and planned activities from across Africa and next steps from senior level personnel, which we will be building upon as more data becomes available. This includes activities against COVID-19 and future activities to re-balance the care of patients with other infectious diseases as well as NCDs.

5. Conclusion

There have been multiple activities across Africa to try and reduce the spread of COVID-19 with its subsequent impact on morbidity and mortality with the help of international and national groups including the WHO and African CDC. This is despite concerns with available resources, personnel and equipment compared with higher income countries. To date, mortality rates appear appreciably lower than seen in a number of European countries and the USA possibly due to early lockdown and other measures including early closure of borders and quarantining of returning travellers, which is encouraging given initial concerns in Africa. However, infection rates continue to rise which is a

concern especially as lockdown measures are being eased in a number of African countries. Encouragingly, multiple activities were typically introduced early across Africa building on the experiences with other infectious diseases, with countries continuing to learn from each other. However, there are a number of unintended consequences which are likely to result in increased morbidity and mortality of other infectious diseases and NCDs. Activities are ongoing to try and reduce the impact, and we will be monitoring these in the future.

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Conflicts of Interest

Antony P Martin is employed by HCD Economics. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. However, a number of them are employed by national or regional governments in Ministries of Health or are advisers to them.

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