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Access to Water and the SARs-Cov-2 Pandemic: Opportunities and Threats in a Post-Pandemic Era for sub-Saharan Africa

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Abstract: The emergence of SARs-Cov-2 has severely impacted the progress made so far on the sustainable development goals in Sub Saharan Africa. The current ineffective water and healthcare sectors in many African countries could serve as a deterrent to an impending crisis. This mini review aims to highlight the opportunities and threats to the water and healthcare sector in a post-pandemic era. Recent studies indicate that the virus has been found in water bodies including wastewater and sewage and this could serve as a potential medium for mutation of the virus. In addition, SSA has poor waste management implementation and sanitation especially within rural and densely populated areas. This coupled with a lack of adequate supply of potable water can see SSA fall back in achieving the SDGs. The struggle against climate change and recently Covid-19 will devastate the socio-economic development of many countries within the SSA region. Climate change has impacted water accessibility and quality and Covid-19 requires an adequate water supply to reduce human-to-human transmission. It will see severe stress on already existing stresses in the water and health sectors which can eventually lead to a system collapse. Urgent attention is therefore required through the design and implementation of programs aimed at building resilience to climate impacts and preparing for future pandemics.

Keywords: Covid-19, Sustainability, Sub-Saharan Africa, Sanitation, Water access

1. Introduction

The emergence of the SARs-Cov-2 (Covid-19) pandemic in 2019 has since spread globally with hundreds of million confirmed cases and millions of deaths globally [1]. This has raised important public health concerns by the World Health Organization thereby declaring the coronavirus outbreak a global pandemic on March 11, 2020 [2, 3]. Several earlier studies show that the risk of infection is higher when a person is in close proximity to an infected person [4, 5, 6, 7]. In addition, transmission mode can be direct and indirect depending on the circumstances [8]. Direct transmissions are often via bio-aerosol through the air in the form of droplet nuclei and other body fluids including mother to child while indirect transfers are mostly via fomites or the surfaces of furniture in the environment of an infected person [9, 10]. The spread of the disease has been associated with poor air quality and climate change, poor sanitation, and hygiene (lack of handwashing) due to the presence of the virus in wastewater, excreta, and other mediums in the environment.

Prior to the commencement of the distribution of vaccines, most countries result in non-pharmaceutical measures as the only effective way of limiting the spread of the virus. Non-pharmaceutical measures like hand washing, use of hand sanitizers and face masks, physical distancing, and a total or partial lockdown including the ban on local and international travels have been implemented to slow the rate of human-to-human transmission of the virus [3, 11]. Although these measures have proved to be effective in slowing the rate of transmissions, they are unable to eliminate the virus. In addition, some of the measures have exacerbated already existing socio-economic and environmental impacts such as hunger and food insecurity, poverty, health, and water access.

Importantly, Sub-Saharan Africa (SSA) has in the past experienced a surge in the number of cases with overwhelming rates of viral transmission in some southern African countries. Several sectors including health, education, food security, economy, water, and the environment have been identified amongst the worst affected by the pandemic [12, 13, 14, 15]. The poor adherence to non-pharmaceutical measures has been attributed to the surge in cases in Nigeria [16]. Although, there has been a new variant of the virus that is leading to the surge in cases in many countries

[17], poor adherence to WHO guidelines by the population are likely fostering human-to-human transmission. This shows the importance of WASH services and other non-pharmaceuticals measures in the struggle to bring the pandemic to an end.

Access to water, sanitation, and hygiene (WASH) services has become paramount in the struggle to eliminate the virus, with most countries encouraging regular handwashing with soap under running water [3]. Although access to soap and water for sanitation and personal hygiene is universal in high-income countries, it remains a basic need many do not have in low and middle-income countries [11]. In addition to access to safe potable water for sanitation and hygiene practices, waste management in SSA countries and other developing countries has become challenging. Handling waste especially wastewater and sewage from hospitals and Covid-19 isolation centers has been poor, thereby emerging as a possible route to breeding a more variant and resistant virus. Furthermore, the presence of the virus has been detected in the water and wastewater system [15, 18, 19], which further necessitates the need to pay attention to these mediums that can likely reverse the progress made in tackling transmission and possible spread of the virus.

Most SSA countries lack adequate and effective collection and treatment of wastewater from homes, hospitals, industries, and more recently, the covid-19 isolation centers. This can make it difficult for water and health managers to tackle the viral and bacteriological spread of pathogens in the environment [20]. This mini-review is aimed at prominence the opportunities and threats of climate change and Covid-19 in a post-pandemic era. In addition, it also highlights the need for scientists, water, and environmentalist including government agencies, the private sector, and non-governmental organizations in investigating the presence of SARs-Cov-2 in wastewater and other mediums within the environment. Findings from such investigation can provide a better understanding of the virus mutation and possible ways to manage wastewater, especially those from Covid-19 isolation centers.

2. Contamination routes of Covid-19 transmission in SSA environment

The known transmission route of SARS-CoV-2 has been via saliva droplets from an infected person [21]. These droplets (diameter > 5-10 µm) and droplet nuclei (diameter < 5µm) have been passed through sneezing and coughing from an infected person within a distance of less than 2m [3, 21]. A study by Stadnytskyi [22] has however shown that there is a probable transmission via speech droplets in addition to sneezing and coughing. Consequently, [23] reported that respiratory droplets from an infected person can settle down on nearby fomite, thereby enabling a potential common route of transmission of the virus. Although the fomite transmission route will depend solely on the surface characteristics, which plays a role in the virus survival time, poor adherence to non-pharmaceutical measures will be the major concern SSA countries will have to address. For instance, Chen [18] detected the virus on the outer layer of a surgical mask after seven days, and with the commonly reuse of surgical and non-surgical face masks amongst people in SSA, the transmission of the virus through this medium becomes imminent.

Fecal transmission of the virus should become worrisome, particularly in remote villages where open defecation is paramount and areas where humans have been handling human and animal excreta. In addition, the virus has been known to survive for up to 2 days in feces at room temperature and up to 4 days in the stool of diarrheal patients [21]. A study by Usman [24] indicates that the virus can aerosolize during flushing resulting in airborne transmission which can be prevalent in hospitals and isolation centers where toilets facilities are shared. This poses a serious concern in many SSA countries due to poor sanitation and dependence on public and shared sanitation facilities. In addition, a study in Paris on wastewater shows that an increase in the viral genome units reflected the rise in the number of Covid-19 fatal cases [25]. Furthermore, the coexistence of the virus in sewage systems has been identified and has drawn the attention of wastewater managers [26, 27, 28, 29]. Therefore, the need to understand these possible transmission routes, especially in the context of developing countries in order to reduce the possible transmission of the virus.

2.1. Water access and sanitation in combating disease transmission

Water, sanitation, and hygiene (WASH) services have been key to the struggle against the Covid-19 pandemic. However, the provision of water to the general populace in developing countries is yet to be attained [30, 31]. Water is considered a fundamental human right that has relatively been achieved in high-income countries but remains a major challenge in low and middle-income countries [3, 31, 32]. For example, in 2017, more than 785 million people still lack access to potable water supply for drinking and 2.5 billion are without access to improved sanitation services [31]. This fact is in itself an indication that the progress towards attaining SDG-3 (good health and wellbeing), SDG-5 (gender equality), SDG-6 (clean water and sanitation), and SDG-10 (reduced inequality) is far from realization. Furthermore, the proximity to water sources has proven to correlate with sanitation and hygiene behaviors [33]. In addition, Cutis [34] in a study showed that women with access to piped water supplies in their homes in Burkina Faso were three times more likely to perform

regular sanitation and handwashing than women who must walk outside their homes to access water. Therefore, makes access to water is a vital issue that needs to be addressed alongside the pandemic. In fact, water can be used as a tool to foster the fight against public health by fostering sanitation and hygiene.

The continuous rise in anthropogenic activities through industrialization, urbanization, and agricultural activities have contributed to the contamination of water sources especially in rural communities thereby making access to potable water supplies a major challenge in many SSA countries [35]. These activities have led to an increase in point-source pollutants in drinking water sources through direct leachate from dumpsites, sewage and septic tanks, industry waste discharge, and agricultural chemicals [36]. Consequently, the cost and affordability of developing water service supplies have left millions of rural dwellers with no alternatives other than contaminated water sources. These socio-economic divides have increased inequalities amongst communities with devastating consequences on public health and sustainable development. Furthermore, inequality amongst both rural and urban communities has also played an important role in the deprivation of water. The socio-economic divide in developing countries is considered a driving force in exacerbating inequalities and depriving millions of people of access to potable water [37].

Since the presence of pathogenic viruses in aquatic ecosystems including lakes, rivers, groundwater, and other drinking water sources has raised concerns regarding impacts on the environment and human health [38], there is a need to understand ways through which WASH can be used to combat the transmission of diseases in the environment. The provision of WASH services has been utilized as a tool to combat disease transmission in many developed countries, therefore this can be replicated to aid developing countries in combat and reduce the outbreak and transmission of diseases.

2.2. WASH as a tool to combat disease in SSA

To effectively combat the spread and reduce the rate of human-to-human transmission, the WHO has encouraged the use of non-pharmaceutical measures such as regular handwashing, use of face coverings, hand sanitizers, and maintaining physical distance [3, 39]. These non-pharmaceutical measures can be categorized as sanitation and personal hygiene measures and although they are not new to us, they, however, require the use of an adequate supply of water to effectively reduce transmission of the diseases. The use of Water, Sanitation, and Hygiene (WASH) services in addition to adequate waste management practices can serve as a barrier to human-to-human transmission of diseases including covid-19 [11, 40]. Although the use of WASH services is one of the effective ways to reduce the transmission of diseases, it has been received with several setbacks in developing countries. This is however as implementing WASH services requires an adequate supply of water and other sanitation services which are often unavailable in developing countries. For instance, most SSA countries face water availability and water accessibility issues, thereby depriving the populace of the right to water resources needed for combating the pandemic. Consequently, the inadequate supply of water coupled with the presence of the virus in the environment can potentially exacerbate the spread and transmission of SARs-CoV-2 in the environment [41, 42].

3. Climate change and SARs-CoV-2 Nexus and its impacts on Sustainable Development

The impact of climate change on water, food security, energy, health, inequality, poverty, and other developmental sectors in most developing countries is becoming a major challenge towards attaining the Sustainable Development Goals (SDGs). Currently, more than two-thirds of the population in Africa must leave their homes to access water for domestic and agricultural uses [20]. Most rural communities in SSA are saddled with water accessibility challenges and extreme climate events have further exacerbated this issue leading to health, sanitation, and hygiene issues [43]. Previously, climate change has been a major contender with sustainable development. However, Covid-19 has recently been shown to be another contender that will undermine the realization of the SDGs in many developing countries. Tackling both challenges will definitely reverse the progress made so far in the SDGs.

Already climate change has exacerbated inequality in the allocation of resources within the environment. Climate change has also undermined the realization of the Millennium Development Goals (MDGs) and can likely undermine the SDGs if concerted efforts are not taken in key areas suggested by the United Nations [31]. Climate change has formed a synergy with the pandemic to further exacerbate already existing difficulties vulnerable people in SSA are facing. Climate change affects the availability, accessibility, and quality of water in many SSA countries, and likewise, the pandemic requires the use of water as a non-pharmaceutical measure to reduce the transmission of the virus. This will exert pressure on an already stressed water sector. Water managers will now have to deal with both the provision of water and managing wastewater that possibly contains SARs-Cov-2 [18, 44, 45]. With SSA countries lacking adequate wastewater treatment facilities, the fate of SARs-CoV-2 in the

environment becomes uncertain. This will likely have an enormous impact on the sustainable development of SSA.

4. Fate and future of sub-Saharan Africa in a post-pandemic era

There is an already existing burden in Sub-Saharan Africa by infectious diseases such as malaria, tuberculosis, Lassa fever, and Ebola [46]. These diseases have continued to devastate an already existing poor and dilapidated water and the healthcare sector which is likely to be overwhelmed by climate change and the emergence of the Covid-19 pandemic. Although most countries have seen an increase in funding, this does not commensurate with the severity of climate change impacts and the pandemic, hence is considered insufficient to boast the sectors to the standards obtained in the global north. For instance, remuneration for frontline workers and provision of protective personal equipment (PPEs) have not been effective in most countries resulting in healthcare workers threatening to go on strike. In addition, many countries have to face a rising number of cases of Lassa fever, cholera, child mortality, and morbidity. The recent surge in the number of cases indicates that SSA countries must race to find lasting solutions the health sector is facing. With the new variant transmitting faster than the previous known virus, impacts are likely to become severe on other sectors like education, health, water, food security, socio-economic, and tourism [47]. This will translate to a significant setback on sustainable development with devastating consequences on vulnerable communities and people.

Prior to the Covid-19 pandemic, the healthcare sector in most SSA countries have been underfunded, with insufficient infrastructure and equipment necessary to cater to a pandemic such as Covid-19 [48]. The provision of basic protective equipment (PPEs), testing centers, infrastructure and skilled personnel needed to cater for a rising number of cases is becoming a challenge, especially with the surge in the number of affected frontline workers. The government of SSA countries must as a matter of urgency devote resources and manpower to help address the impending outbreak. A well-functioning healthcare system is built on several factors like well-trained and motivated manpower, well-maintained infrastructure, reliable supply of PPEs, adequate supply of drugs, backed by consistency in funding, healthcare plans, and evidence-based policies [14]. These are key factors that are yet to be addressed in most developing countries, and with the recent surge in the number of cases, community transmission will likely be imminent. Paintsil [14] suggested that SSA countries must restructure their healthcare system to be able to effectively fight the spread of Covid-19 and in addition, prepare for any future epidemic or pandemic. In order words, the ability of SSA to address the current challenges and develop a more effective health and water sector will to a large extent depend not only on the measures put in place now but also on the region's ability to design and fund programs aimed at strengthening the sectors.

Developing countries must utilize the current challenges (climate change and the pandemic) to restructure their water, health, and other key sectors to be able to withstand any future threat. For instance, to better plan and prepare for a post-pandemic SSA, there is a need to improve every country's epidemic preparedness infrastructure, establish and maintain infectious disease prevention and control practices, make financial commitments towards the global health security agenda (GHSA) alongside financial commitments towards research and partnership with research institutions nationally and internationally [14].

4.1. SSA challenges and opportunities for the water and health sector in a post-pandemic era

Developing countries have since seen a surge in the number of cases which has revealed the need to overhaul both the health and water sectors. The pandemic has shown that the healthcare sector is underfunded, lacks adequate infrastructures and remuneration for manpower. This is in addition to the lack of research and synergy between research institutions and the healthcare sectors. Similar challenges are observed in the water sector, although the situation in the water sector might be slightly worse than in the health sector, particularly around funding, research, and infrastructural development [20]. Water is required for hygiene and sanitation which is one of the non-pharmaceutical measures in limiting the outbreak and spread of diseases, but access to water (which is meant to be a fundamental right of every citizen) is a major challenge in many developing countries [11]. For instance, the lack of potable water has led to the outbreak of cholera, typhoid, dysentery, and other water-related diseases [43] which in turn impacts severely on the already poor state of the health sector. This means that addressing water and environmental quality can likely decrease the stress on the healthcare and other developmental sectors in society.

The pandemic has brought opportunities to these sectors, particularly the health sector. For example, several efforts have been made towards the provision of infrastructure to isolate infected persons in Nigeria (isolation centers). These infrastructures if maintained will contribute to the healthcare preparedness and response for future threats. In addition, the pandemic has brought about an increase in funding to the health sector which has helped in the provision of PPEs and other necessary supplies

needed in the sector. Studies into the fate and survival of the virus in the environment indicate that opportunities for research are already in progress. There is also a collaboration between several organizations which is something most developing countries lack. These opportunities if maintained after the pandemic can see a tremendous improvement in not just the health sector, but also other sectors that have been lagging back due to little or no attention. Water policies and programs have been enacted by many states in Nigeria and if these policies are backed by actions, the goal on the water can be met before the 2030 United Nations deadline.

A post-pandemic era where programs and policies backed by actions in all SSA will further enhance Africa's Road to development. Currently not much has been achieved particularly in achieving some of the SDGs, however, there are several lessons learned as a result of the pandemic and if these lessons are taken seriously even after the pandemic, then Africa can make significant progress in achieving at least over 60% of the SDGs. Findings from several studies indicate that for SSA to have functional, effective water and healthcare sector, there has to be adequate funding, provision of infrastructure, research and innovations, national and international collaborations, participation from the government, individuals, and private sectors, and a synergy between all the developmental sectors (Fig. 1).

The full extent of the impacts of Covid-19 remains immeasurable, but the need to move forward with research and innovation in order to treat, vaccinate and prepare for the future is already clear [49]. In addition, the focus on the transmission of the virus amongst vulnerable areas, particularly rural areas and densely populated areas is necessary to avoid community transmission [37]. Therefore, the allocation of resources for infrastructural development, research, implementation of policies and programs aimed at improving these sectors become paramount to building resilient water and health sector. Therefore, key areas of research that needs urgent attention include but are not limited to:

1. Emerging contaminants in water sources including pesticides, hormones, micro-plastics, and SARs-CoV-2 virus and other pathogens.
2. Climate change impacts water quality, access, and availability both in rural and urban areas.
3. Waste management and integrated management of domestic, industrial, and agricultural waste.
4. The presence and survival of SARs-CoV-2 virus in water bodies, fomites, and in feces of both humans and animals.
5. Collaboration between the key developmental sectors including the nexus between these sectors.
6. Treatment and preparedness for endemic diseases now and in the future

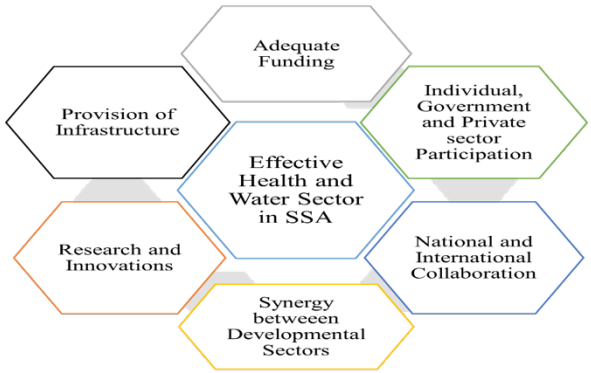

Figure 1: Generic presentation of the approaches to achieving an effective post-pandemic healthcare and water sector

5. Conclusion

The pandemic has exposed most sectors, particularly the heath and water sectors in many SSA countries. In this short review, the challenges of the water and health sectors were reviewed, and opportunities were highlighted. One of the key points highlighted is any country that utilizes the current pandemic to restructure the water and healthcare sector will be able to plan and prepare for a post-pandemic future. The key to preparing for a post-pandemic future is to provide adequate infrastructure, funding, and research that will proffer solutions to the current challenges. There is also a need for synergy between all the sectors if SSA wants to meet up with the 2030 SDG targets. Overcoming the current challenges associated with the pandemic as well as climate change will require the government (both national and international), private sector, and individuals to decide and implement programs and projects aimed at sustainable development and resilience building.

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