Commentary

Prospects of telemedicine during and post COVID-19: highlighting the environmental health implications

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Abstract

The outbreak of the coronavirus disease 2019 (COVID-19) in late 2019 had severe implications on the normal course of events across the globe. The imposition of lockdown, quarantine, and isolation measures by most countries to curtail the spread of the coronavirus led to the rapid development of information, communication, and technological (ICT) solutions to minimize the effect of the lockdown, and as an alternative to normal day-to-day physical interactions. Telemedicine involves the delivery of health care services by qualified health professionals using ICT for the exchange of valid information where distance is a critical factor, thus enhancing access to health care services. The use of ICT as a tool to improve access to health care services and for tackling the raging pandemic was one of the options embraced and considered by many countries. Indeed, there are indications that the use of telemedicine as a complementary option to current traditional medical practice will continue in the post-COVID period. The shift to telemedicine has severe health and environmental health implications and should be done with caution. Poor management of generated electronic waste was found to be responsible for environmental pollution and health hazards affecting major organs of the human body. Countries, especially those in the developing world, lack infrastructure for effective implementation of policies required to appropriately manage electronic waste. Therefore, it is highly imperative that adequate measures are put in place to mitigate the potential hazardous effects of the shift to telemedicine.

Key Words Telemedicine, prospect, COVID-19, environmental, health

Background to the COVID-19 pandemic

The coronavirus disease (COVID-19) started in Wuhan City in China in late December 2019 and has gradually spread to over 213 countries since onset[1]. The disease is caused by a highly contagious novel virus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) that belongs to the family of coronaviridae[2]. The virus is transmitted directly from person to person; contact with contaminated surfaces and body fluids; and the inhalation of aerosols containing the virus. Coronavirus primarily affects the respiratory system but may affect other systems, especially the gastrointestinal and renal systems[2]. The clinical presentation of the disease varies from asymptomatic to different degrees of illness severity[2].

The World Health Organization (WHO) declared the coronavirus as a pandemic in March 2020 and over 21,896,155 cases and 774,539 deaths have been recorded globally as of 18 August, 2020[3,4]. South Africa, Egypt, Nigeria and Ghana, are the countries with the highest number of cases in the African continent[4]. However, it is widely believed that the number of cases in the African continent are under-reported due to the limited availability of testing compared to other developed countries[5,6]. The global case fatality ratio is approximately 3.5%[4].

There is presently no definitive treatment for the disease; however, several efforts are ongoing towards the development of suitable vaccines. Effective preventive measures to reduce the spread of the virus are cough etiquette, maintenance of social distancing, regular hand hygiene, and the use of facemasks.

Consequential shift to information communication and technology (ICT)

Many governments enforced total or partial lockdown to reduce the concentration of persons in public meeting places with the aim of curbing the spread of the virus. Atalan reported that the lockdown had a positive effect on reducing the spread of the pandemic and improving air quality because of reduced levels of pollution[7]. However, it also had negative impact on the mental health and economic activities of the populace[7]. The lockdown caused adverse socioeconomic consequences as it led to the closure of schools, hospitals, and business offices, reduced local and international business travel among others, while only a few essential services were allowed to operate. Approximately 1.2 billion children were prevented from entering classrooms in around 186 countries, while most companies and businesses were temporarily shut down during the period[8]. This necessitated the need for an alternative means of ensuring social bonding and interactions, running businesses and religious programs, and providing health and educational services. This development paved the way for the optimization and use of ICT-based options. Reports showed a significant increase in the use of various language applications (apps), virtual tutoring, video conferencing, social platforms, and e-learning platforms during the COVID-pandemic[8,9].

Telemedicine in the COVID-19 pandemic era

Telemedicine involves the delivery of health care services by qualified health professionals using ICT for the exchange of valid information for education; the prevention, diagnosis, and treatment of diseases; health research and the evaluation

of interest in the advancing health of individuals and communities, in cases where distance is a critical factor[10]. Telemedicine already exists in some developed countries, although its use has not been widely accepted, partly because of the inertia to move away from traditional methods of health care delivery. Telemedicine has also been used to enhance access to health care services in developing countries where access to health care has been a challenge[11,12]. M-health, for instance, was used to improve the access of pregnant women to reproductive health care and has been shown to be effective in tackling issues of accessibility to health care service centres[12].

The crucial prospects of telemedicine in health care service delivery came to force during the COVID-19 pandemic in both developing and developed countries[13-16]. The efficacy of telemedicine in tackling the COVID-19 pandemic has also been well established in many other countries, such as China, United States, and Singapore, where there were considerable levels of infrastructure to support telehealth[15,16].

In addition, the increasing number of COVID-19 cases has caused a huge strain on the health care systems in most countries. The fact that health care workers are exposed to high risk of infection by COVID 19 patients in the course of managing these patients made visits to hospitals to seek care for other ailments non-desirable for patients[17].

Telemedicine was successfully used to address different aspects of health care services and delivery during the COVID-19 pandemic. Studies have reported its use in triaging and screening COVID-19 symptoms; contact tracing; the monitoring of COVID-19 symptoms, the provision of specialized care for hospitalized COVID-19 patients; the provision of mental health services and support to COVID-19 patients, their care givers and frontline health care workers with psychological issues; the monitoring of recovering COVID-19 patients and the provision of essential health care services for non-COVID-19 patients such as those with hypertension and diabetes mellitus[15]. O'Leary[18] also reported the development of various apps to slow the spread of COVID-19. These apps are used to track the spread and symptoms of COVID-19. All these apps require a smartphone as the app uses information from the user's phone to determine if they have been in contact with any person with the virus[18]. In the same vein, Song et al.[15] reported the efficacy of telemedicine during the COVID-19 pandemic in reducing spread of coronavirus among health workers, patients and the community. Quarantined health care workers have also used telemedicine options to offer their expertise without being physically present with their patients.

Evidently, telemedicine has thus helped not only in providing and improving care, but also in curtailing the spread and transmission of infection among health care workers and patients. This was helpful in reducing the burden of caring for COVID-19 patients among health care workers, especially those on the frontline.

The prospects of telemedicine post-COVID-19

Telemedicine has caused a paradigm shift from the conventional practice of medicine. Vidal-Alaball et al. posited that telemedicine is not only capable of providing support to health care systems in the midst of the pandemic, but advocates for its continued use even after the pandemic[19]. These authors reported that China, South Korea, Spain,

United States, Japan and many European countries are at different stages of experimenting and implementing telemedicine. In the same vein, O'Leary reiterated the fact that there is a strong likelihood that business, organizations, culture, and society will be forever changed as ICT solutions generated will be used even in future settings and post-COVID-19 [18].

It is believed that the practice of telemedicine in clinical practice will outlive this present pandemic, even in developing countries. Telemedicine will help to reduce the cost of health care service delivery; reduce time spent in the hospital; and allow for the close monitoring and follow-up of patients. Telemedicine will also contribute positively to the realisation of the right to health and the attainment of the United Nations Universal Health Coverage (UHC) Agenda under the Sustainable Development Goals (SDGs). Goal 3.8 specifically aims to improve access to health care services for all by ensuring that people are able to receive health care services whenever the need arises.

However, despite the advantages of telemedicine, there are certain legal and ethical issues that may arise[11]. One such issue is determining the extent of liability in cases that end up in litigation, especially since health care practitioners are unable to examine patients physically, as normally performed in conventional medical practice[11]. This may be further complicated where reliable and dependable infrastructure is not constantly available by service providers. The legal and ethical liability issues are, however, not the focus of this work. Our aim is to focus on the severe health and environmental issues that are likely to arise from the increased practice of telemedicine and the consequential reliance on ICT-based services.

Telemedicine is likely to necessitate the increased use of electronic and electrical devices, software, and other forms of technology. Whilst embracing technological advancements in health care may appear to be a positive development, it is not without challenges to human health and the environment. Some of the foreseen challenges include the increased importation of electronic waste (e-waste) by way of used electronic devices and the consequential problem of the disposal and management of these devices once they reach their end of life and become waste, thus posing severe challenges to human health and the environment.

Weighing the burden of e-waste against the prospects of telemedicine

E-waste is the most common type of domestic waste worldwide. In 2019, the WHO reported that 53.6 million tonnes of e-waste were produced globally, showing a steady rise over recent years[20]. Africa is the fourth leading continent with a high burden of e-waste generation in the world[20]. Peculiar factors that contribute to this burden are the lack of importation policies that are supposed to regulate the qualities of imported goods, the illegal smuggling of goods across the borders, the donation of substandard or outdated electronic gadgets to Africa, and a poor socioeconomic status that favours preference for the purchase of second-hand equipment compared to brand new equipment with long life cycles.

E-wastes contain hazardous substances such as toxic metals and organic chemicals; hence, these materials need to be managed and disposed of appropriately. The adverse effects of e-waste on human health may occur from the direct effect

of the waste and end-products of recycling on the body or indirectly via the environmental pollution of air, water and soil. Failure to manage e-waste in an environmentally sound manner will result in diseases in humans that may affect genomic, respiratory, neurodevelopment, reproductive and endocrine systems[21]. The majority of the e-waste generated is not formally recycled due to the lack of adequate infrastructure and the absence or non-implementation of policies regulating these processes.

The burning of e-waste as a means of disposal usually leads to the release of toxic substances such as mercury, cadmium, lead and polychlorinated biphenyl compounds, which are harmful to human health and the environment[21,22]. Furthermore, resorting to primitive recycling methods for the disposal of e-wastes may cause serious human health hazards, particularly in children. These methods may affect the central nervous, immune, reproductive and digestive systems of children, as these systems are still developing. Some of these hazards might be irreversible. Individuals and scavengers involved in the informal recycling of e-wastes do not take the necessary precautionary measures such as the wearing of protective clothing, masks and goggles and therefore directly expose themselves and the immediate environment to hazardous by-products of these e-wastes. E-waste can affect various organs systems of the body causing numerous dysfunctions such as thyroid disease, impaired lung function, acute and chronic kidney disease, mental and behavioural abnormalities, as well as a delay in the growth and development of children[21]. Poor pregnancy and perinatal outcomes, such as stillbirth, abortion, prematurity, intrauterine growth retardation (IUGR), low birth weight (LBW), and congenital abnormalities, have all been associated with exposure to e-wastes[22]. Exposure to e-wastes may lead to an increase in some non-communicable diseases such as hypertension and chronic kidney disease (CKD) in the future. This is because LBW and IUGR that may occur following the exposure of pregnant women to e-wastes have been associated with the development of hypertension and CKD later in life[23].

Telemedicine is ICT driven and requires electrical gadgets such as computers, smart phones, printers, speakers, notebooks, tablets, routers and cameras for its successful implementation and execution. With the implementation of telemedicine across various countries, the demand for these electrical devices and the generation of e-waste will inevitably increase. This is likely to further compound the existing burden of e-waste, especially in developing countries in Africa.

Whilst telemedicine may be a preferred option in health care service delivery during and even after the COVID-19 pandemic, there is a need for caution in its adoption. There is little or no doubt that the potential health hazards of reliance on telemedicine are huge. Countries, especially those in the developing world, should however, be careful to ensure that they do not bite off more than they can chew by exposing their populations to more health hazards in the future while trying to solve immediate health problems.

This study focused only on the environmental health implications of telemedicine. Other issues arising from telemedicine, including legal and ethical liability issues, may be a focus of future studies relating to prospects and challenges of telemedicine.

Conclusion and recommendations

Due to the successful use of various forms of telemedicine options during the present pandemic, it is obvious that this form of medicine may become one of the tools that will be used in the delivery of health care services beyond the pandemic. This will be a welcome option to complement the traditional delivery of health care and a means of improving access to health care in line with the United Nations UHC Agenda under the SDGs. It is, however, imperative that adequate measures are put in place to mitigate the potential hazardous effects which its introduction may have on human health, in the long term. We, therefore, recommend the adoption of the following measures by countries desiring to adopt the telemedicine option during and after the COVID-19 pandemic:

Governments should formulate where necessary, and adequately implement, policies that will regulate the quality of electronic gadgets that will be imported into their countries.

Governments should establish, or at the minimum, create an enabling environment, for investments in e-waste recycling. This will ensure that informal activities become well regulated in an environmentally sound manner.

Health education of the populace should be provided to cover the potential health hazards of e-waste and recycling, especially the unregulated forms.

Conflict of interest

The authors declare no conflicts of interest.

Authors' contributions

Both of the authors were involved in conceptualization, literature searches and writing the manuscript.

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