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Review

Covid-19 infection: Successful global spread, challenges to public health surveillance, and lessons learnt

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The severe acute respiratory syndrome coronavirus-2 is a highly communicable disease that emerged in the twilight of 2019 in Wuhan, China but rapidly spread globally, resulting in a pandemic. Given its novelty, scientific information about its origin, biology, spread and preventive measures trickled over time, which could have been responsible for the successful global spread. In this paper, relevant literature related to the spread of the disease was reviewed. A list of factors associated with the successful spread among the human population was documented and the challenges with public health surveillance systems and the lessons learnt were highlighted.

Key words: Covid-19, coronavirus-2 (SARS-CoV-2 virus), pandemic, surveillance, zoonosis.

INTRODUCTION

Coronavirus disease (COVID-19) is an acute respiratory disease caused by the novel strain of coronavirus, now known as the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2 virus) (WHO, 2022; Africa CDC, 2022). It is a highly communicable disease that emerged in the twilight of 2019 in Wuhan, China but rapidly spread globally, resulting in a pandemic (Li et al., 2020). Severe acute respiratory syndrome coronavirus-2 is posited to have originated from animals, and thereafter human infection with subsequent human-to-human transmission ensues (Africa CDC, 2022). The onset of human transmission of the virus is still uncertain as the earliest cases reported in Wuhan had no epidemiological link to the seafood market (the hitherto perceived initial

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source of human infections). However, the spread was effectual, evolving into a pandemic within a short period and evading even the sophisticated surveillance systems of the most advanced countries (Li et al., 2020; WHO, 2022). For instance, the virus was detected by Polymerase Chain Reaction (PCR) in a stored sample of a patient who had pneumonia towards the end of 2019, weeks before the official January declaration of the virus outbreak in France 2020 (Stoecklin et al., 2020; Hu et al., 2021).

Surveillance involves continuous monitoring and timely reporting of diseases of public health importance with the sole aim of controlling them (Thacker and Birkhead, 2008). However, its effectiveness in the context of Covid-19 is questioned across countries as the disease spreads rapidly, defying early detection. This review discusses factors associated with the successful spread of the infection among the human population. Also, highlighted are the challenges public health surveillance systems face and the lessons learnt. This is necessary to enable better preparation in case of future infectious disease outbreaks.

SUCCESSFUL SPREAD AND EVOLUTION INTO A PANDEMIC

Severe acute respiratory syndrome coronavirus-2 belongs to the same family of pathogenic coronaviruses as the severe acute respiratory syndrome coronavirus (SARS- CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) (Brooks et al., 2013; WHO, 2022). These are all zoonotic in origin and are of public health concern. Unlike the latter two viruses, the SARS-CoV-2 rapidly spreads over the world and presents an unprecedented global health threat.[4] From the initial documented 27 hospitalized patients in December 2019, the number of confirmed cases of the novel coronavirus infection stands at 593,269,262 with associated 6,446,547 deaths globally, as at the fourth week of August 2022 (WHO, 2022; Jiang et al., 2020). This data is probably an underestimate because of incomplete data and under-reporting (due to inadequate testing), especially in the resource-constrained countries (WHO, 2022). Several factors may have been responsible for such a rapid spread.

FACTORS IMPLICATED IN THE RAPID SPREAD OF THE VIRUS

(1) The unique properties of the virus: The high efficiency of transmission of SARS-CoV-2 is due in part to the rapid attainment of higher levels in the upper respiratory tract of infected persons. It replicates intensely and attains a peak viral load in the upper respiratory tract soon after the infection; hence, the risk of pharyngeal virus shedding is relatively high earlier (Peiris et al., 2003; Zou et al., 2020; Mason, 2020). This high level is similar irrespective of disease severity; thus, asymptomatic persons or individuals with mild disease have an equal chance of transmitting the virus (Zou et al., 2020). Also, SARS-CoV-2 uses a modified spike protein to gain entry into the host cell. The spike protein has a higher avidity for the designated host cell receptor (angiotensin-converting enzyme-2 (ACE2)), resulting in an increased likelihood of infection (Zou et al., 2020; Mason, 2020; Vzorov et al., 2021).

(2) Seasonality and the mode of transmission: The disease emerged around December 2019 in Wuhan, China and spread globally (Li et al., 2020). The virus spreads directly via contact with secretions from the infected person's mouth or nose, indirectly by touching the eyes, nose or mouth after touching the viral contaminated surfaces or objects, inhalation of the virus suspended in air (airborne transmission) or contact with suspended viral particles with the eyes, nose, or mouth (droplet transmission) (WHO, 2022). The dry and cold conditions during the winter could be a significant driver of increased incidence and spread of the covid-19 disease, as observed with other respiratory viruses, because it tends to encourage staying indoors. Moreover, low relative humidity during this season enables suspended viral particles to spread farther (Audi et al., 2020).

(3) Presence of asymptomatic or mild disease: Most people infected with the virus would have mild or no symptoms but remain contagious (WHO, 2022). An estimated 86% of all infections were undocumented before the travel restrictions in China, and these cases were the source of illnesses in 79% of the documented cases (Li et al., 2020). This is unlike SARS-CoV infection; it is contagious after the onset of symptoms and mainly causes a severe lower respiratory disease; hence, easily recognized and amenable to interruption of infection chains (Peiris et al., 2003).

(4) Low immunogenicity and rapid evolution of mutant variant: Low levels of antibody against SARS-CoV-2 spike protein were documented among survivors of COVID-19 (Rogers et al., 2020). Also, since its outbreak in late 2019, several mutant strains have been reported (Harvey et al., 2021). It is thus plausible that different virus strains infect individuals on multiple occasions. Hence, it also raises concerns about whether herd immunity is attainable and, if attained perhaps through mass vaccination, whether it will protect against re-infection.

(5) Globalization and the abundance of international travel: More than ever, the world has become profoundly interconnected. Aided by the quantity of international travel, individuals (the majority of whom may have had an inapparent illness or are asymptomatic) moved across geographical territories earlier during the outbreak. Travelling enables the rapid worldwide spread of the virus

and can probably explain the retrospective evidence of the infection found before the official declaration of the disease outbreak and implementation of lockdown measures in some countries (Stoecklin et al., 2020).

(6) Control measures were daunting: compliance with the prohibition of social gathering, avoidance of handshaking, compulsory wearing of face mask, social distancing, self-isolation, stay-at-home rules etc. was difficult perhaps because it contradicts the social norms. These measures were also reported to significantly affect mental health (Andersen et al., 2021). Lockdown measures have profound global economic implications such as loss of jobs, pay cuts, inflation and economic recession. This is especially so in resource-constrained countries where baseline poverty and inflation rates are high and palliative measures were inadequate and inequitably distributed with the majority of people relying on daily income from jobs to make ends meet. Even in developed countries with better resources, inhabitants and citizens met the lockdown rules and other control measures with protests.

(7) Misinformation and disinformation: In a report, 82% of information (that is, the origin and threat of the disease, its spread, treatment and vaccine) shared on social media regarding covid-19 were false (Islam et al., 2020). Some believed these claims anyway, which could have affected compliance with control measures. Such distorted information contributed to the early widespread of the disease and increased hospitalization and death among affected persons (WHO, 2021).

CHALLENGES WITH COVID-19 SURVEILLANCE

From the public health perspective, surveillance is critical to effective disease control efforts. Therefore, achieving global covid-19 control requires a robust country-level surveillance system operated in an integrated manner. An effective surveillance system would ideally spot cases as they occur and notify relevant stakeholders to institute control measures, limiting the disease severity among those affected and curbing the spread to those at risk. The effectiveness of the surveillance systems of most countries was, however, challenged in several ways with the advent of covid-19 leading to its global spread.

Firstly, there was limited capacity for testing due to inadequate testing facilities; hence, cases of covid-19 infections were undetected, ultimately facilitating community spread (Adebisi and Rabe, 2021; Anyanwu et al., 2020). This distorted the actual estimate of the disease, undermining proper planning and resource allocation for control measures. In Nigeria, a country with over 200 million population, only 287,532 tests were conducted six months following the first case report (NCDC, 2020). The availability of point-of-care tests that can be conducted at the “bedside” to provide information on infection status rapidly would be ideal for effective surveillance. However, evidence reveals that reports from point-of-care testing devices are often not linked with laboratory information management systems (LIMS) or electronic health records (EHRs) (Hamilton et al., 2021). Besides, these test kits were scarcely deployed in the developing countries (Adepoju, 2020).

Secondly, the earlier testing criteria of a person under investigation were the presence of symptoms and travel history (Hamilton et al., 2021). Given that most cases of covid-19 infections are asymptomatic, a significant number of cases were undetected and ultimately contributed to sustained community transmission.

Thirdly, covid-19 surveillance was marred with poor reporting (low report rates, incomplete data) partly because of inadequate healthcare workers. Clinicians (often the first contact for patients in the healthcare setting and are saddled with case identification and reporting), laboratory staffs and field epidemiologists are the backbones of surveillance activity. Unfortunately, these essential workforces are inadequate, especially in resource-limited countries currently experiencing a mass exodus of health workers to high-income countries. Even in developed countries, the magnitude of the disease overwhelmed the capacity of hospitals, health care providers, and laboratories to identify and accurately report cases (Hamilton et al., 2021). Also, health facilities where case identification and notification should have been initiated are inadequate, especially in most rural areas and hard-to-reach locations in LMIC countries (Oke, 2022). Furthermore, factors such as wars, conflict, insurgency, flooding, and other natural disasters disrupted surveillance activities and other healthcare services.

LESSONS LEARNT AND RECOMMENDATIONS

(1) Health information dissemination is crucial: It was evident that misinformation and disinformation contributed significantly to the early spread of the disease, led to increased hospitalization and death among affected persons and affected the vaccine uptake (WHO, 2021). In response, several stakeholders, including the WHO, the government of countries, local and international media organizations, information units of hospitals, and social media influencers, swung into action to combat the misinformation that characterizes the covid-19 infodemic (WHO, 2021). Initiatives capable of significantly reducing the perceived reliability of fake news, such as ‘Stop the Spread’ by BBC world, ‘Reporting Misinformation’ launched by the WHO and a novel online game called ‘Go Viral’, were launched (WHO, 2021). In the current era of emerging and re-emerging diseases, most of which will require robust and well-coordinated public health actions, it is thus imperative that discussions about health information take center stage in the design and planning of intervention activities

(2) Zoonotic infections matter: Most emerging and re-

emerging infections such as SARS-CoV, MERS-CoV, Avian influenza, Yellow fever, West Nile, Ebola, Marburg, and SARS-CoV-2 are of zoonotic origin (Zoonotic Disease, 2018). It is therefore critical to step-up collaborative actions to mitigate the threat of these diseases. More research is needed to identify other potential pathogens of animal origin and better understand their biology to guide preventive interventions such as vaccine development. Also, awareness and information on the burden and risk of these diseases should be provided to the policymakers and the populace. There is also the need to improve the capacity to detect new outbreaks and monitor the circulation of these infectious agents in animals. Individual countries must, therefore, develop a robust collaboration between public health, agriculture, veterinary and forestry sectors to engender strengthened surveillance systems. Such partnerships must allow global information sharing to enable global coordinated actions.

(3) Surveillance systems need improvement: Covid-19 exposes the inadequacies in the surveillance systems at the country level and globally. Strengthening the surveillance systems to be proactive to prevent future disease outbreaks is crucial. It will require genuine commitment, political will, and adequate funding to address all aspects critical to ensuring effective surveillance such as improved diagnostic capacity, information storage and transfer facilities, and an adequate health workforce.

There is a need for urgent effort to minimize the brain drain from developing countries. The countries' government should commit to increasing budgetary allocation for health to ensure adequate functional health facilities are available and improved emolument for healthcare workers to minimize the ‘push factors’ of health workers. Meanwhile, the WHO policy on the adoption and implementation of task shifting and task sharing should be considered or scaled up to cushion the effect of workforce shortage. For instance, community volunteers and extension workers could be trained in case identification and reporting. Also, notwithstanding the legality of labour migration, it will be imperative for global stakeholders to develop policies to address the trend of brain drain in the interest of global health. Such policies could involve limiting the proportion of health migrant workers over a set period to ensure availability in home countries or developing a feasible framework to facilitate skill and knowledge transfers to economically disadvantaged countries. Furthermore, a policy ensuring countries' compliance with the budgetary allocation benchmark for health would be helpful.

CONCLUSION

Severe acute respiratory syndrome coronavirus-2 is an acute respiratory disease caused by the novel strain of coronavirus that spreads rapidly resulting in pandemic. Factors such as the emergence of the outbreak during the winter which favoured the disease spread, high efficiency of transmission, presence of asymptomatic cases, weak public health surveillance systems, misinformation, and abundance of international travel are responsible for the successful spread. Although associated with devastating consequences, the pandemic has reawakened global health stakeholders, bringing to the fore the need to prioritize zoonotic infections and also providing an opportunity to strengthen public health surveillance.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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