RESPONSE STRATEGIES TO COVID-19 Cases/Outbreak & Management

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INTRODUCTION

As of 3rd June 2022, World Health Organization (WHO) reports 528,816,317 confirmed cases and 6,294,969 deaths since the onset of the pandemic[1]. Although these numbers are declining due to the introduction of various vaccines and prevention strategies, the health care system of every economy is still bearing the brunt of this global health crisis. The worldwide pandemic followed and originated in Wuhan, China, in 2019(4)[(4)]. WHO later renamed SARS CoV-2 to Covid 19 virus in February 2022 when the numerous strains emerged as communicable and highly pathogenic in humans [(2).]

Although a member of the Coronavirus family caused a global pandemic in 2020, the discovery of this group of viruses dates back to the 1960s [(1)]. The start of the 21st century came with the emergence of the two notable coronaviruses; Middle Eastern Respiratory Syndrome Corona Virus (MERS-CoV) and Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV)[(2)]. Coronavirus was formerly believed to be a benign infection that was thought to cause mild disease in immunocompetent humans [(3)]. This was until 2002 and 2003 in Guangdong province, China, when there was an outbreak of SARS-CoV [(3)]. Ten years after the SARS-CoV outbreak, there was a widespread infection of MERS-CoV ravaging especially middle eastern countries.

Although human pathogenic corona virus strains have an established zoonotic origin[(6)], no research has proven a specific animal as its first source[(2)]. However, many studies show considerable evidence that the origins of the Coronavirus have a strong link to bats. Even though the aforementioned syndromes affect the respiratory and gastrointestinal systems predominantly, their pathophysiology follows different courses. The receptors they bind to are one of the many notable differences in their pathophysiology [(7)].

The virus's acute and rapidly fatal progression made it of great concern worldwide [(8)]. The progressively rising rate of infection [(6)] made its relative risk quite significant. Its ability to spread between species and cause different disease manifestations also made it particularly challenging to control under a limited time[(9)]. This is alongside the active mutations resulting in various highly pathogenic strains [(10)] one of which is the novel omicron variant. By far of all these factors, the rapid human to human transmission warranted a global state of emergency to have the pandemic contained.

The disease burden put a huge strain on the health care system globally. While most high income countries immediately invested in establishing prevention and management strategies, the resources were sorely lacking in low income countries . This highlighted the deficiency of the health care system in third world countries as there was a large dependence on international donations. This review focuses on the response strategies available for a coronavirus outbreak. We also explore the preventive and management options currently available.

COVID-19 PREVENTION METHODS

Personal Hygiene and Mask use

As an effort to curb the spread of this virus, members of the public can reduce the chances of them getting infected by taking effective safety precautions, maintaining good personal hygiene, cultivating a regular hand washing practice, avoiding going out to crowded places and wearing a medical face mask are all simple precautionary steps that individuals can take to prevent contact with the disease.[(11)]
These preventive measures stem from studies surrounding the mode of transmission of the virus, emission of infected saliva and respiratory droplets can be curbed by maintaining social distance and also by wearing face masks, these could help against subclinical or mild COVID-19. [(12)]
For most governments, response strategies to handling the spread of the virus span early detection, early isolation and treatment, employing contact tracing techniques to curtail the spread of the deadly virus. Using data analysis skills for online geographical tracking has been effective in tracing and mapping of COVID-19 cases, allowing closer monitoring within the community. [(13)] Healthcare professionals have had to use personal protective equipment (PPE), including a gown, eye protection, gloves, face mask and a respirator as a means of precaution to reduce infection risk when in

contact with any suspected case.

Social-distancing and Lockdowns

Following the emergence and spread of the novel coronavirus, the WHO convened an Emergency Committee in January, 2020 to properly access the public health risk of the SARS-CoV 2 propagated infection[14]The Nigerian Government in response to this declaration constituted the Coronavirus Preparedness Group on January 31st although the first case recorded officially in Nigeria was not until February 27 and it was an imported case from Italy. A special Presidential Task Force on Covid-19 was established by the government on March 9, 2020, this taskforce was largely responsible for monitoring the spread, increasing awareness, indicating prevention strategies and policies that have helped. they are in charge of the phased lockdowns and coordinated other strategic aspects of the response
In the month of March 2020, schools were closed in a bid to control the spread of the virus and lockdowns were imposed in the areas of the nation with the largest cluster of infected cases at the time (including the commercial hub, Lagos, its neighbor state, Ogun and the federal capital territory, Abuja)

The global conversation around the mode of transmission of the virus influenced the implementation of self-isolation practices among travel returnees and suspected cases in Nigeria.

The Nigeria Center for Disease Control (NCDC), the primary contact for all information regarding diseases of public health concern issued a self-isolation guide [15] and publicized the implementation guidelines imposed by the government including an eight-hour curfew, social distancing in places of public gathering, increase in health hygiene practices, the use of face masks and regular hand washing [16]
Lockdowns were announced in a number of countries globally including Italy, Spain and Germany that were largely affected. China, the origin country of the disease had imposed a lockdown almost immediately and banned air and rail travels. Also, major sporting events including the 2020 Olympics in Tokyo had to be cancelled. Over the course of the year 2020, continued practice of the safety guidelines mentioned thus far resulted in reduced spread of the virus and ease of lockdowns worldwide.

While the era of lockdowns helped curb the spread of the disease, it did take a toll on globalization and global economy as most businesses could not operate properly, after sometime, there was an increased focus on the possibility of virtual work (work from home) as an avenue to allow continued functionality of systems that require large participants, many businesses have since adapted the virtual model and work with it till today. Negative mental and social changes in children, adolescent [17] and adults were noticed as a result of the lockdown. Loneliness, anxiety and depression increased during this period [18]and individuals with pre-existing health conditions could not get routine healthcare services.

Testing and Surveillance

The goal of contact surveillance for individuals exposed is to tackle the spread and curtail human to human transmission to halt disease outbreak. This means they are followed up for a period of 21 days (maximum incubation period) to ensure that if symptoms develop, they are promptly tested and treated. This has a huge potential to limit spread of infection

Sero-surveillance testing is a tool for accessing community-wide history of exposure and ongoing transmission of SARS-CoV-2, however diagnostic testing employs serological analysis on an individual-basis to check for the presence of the virus antibody to identify previous infection.

A recent surveillance technique has employed the use of wastewater to assess community transmission of COVID-19[19], this had previously been used for poliovirus surveillance.

Testing has been at the forefront of global health response strategies to clinical emergencies including the COVID-19 pandemic. Almost immediately after the onset of the virus, testing methods were employed including a heavy focus on real-time polymerase chain reaction (PCR) assays. Various sites for COVID-19 testing are medical laboratories, point-of-care (POC) centers, within the workplace, school or in the general community and generally involves specimen collection [20]

For medical uses testing usually involves collection of saliva, nasal and nasopharyngeal swabs that can be used for viral detection by healthcare professionals employing antigen tests, quantitative-PCR and isothermal amplification to detect the presence of SARS-CoV-2 proteins, although antigen tests are not as sensitive as PCR-based tests they are still aa good as PCR in detecting the virus. [20]

Vaccination

In May 2020, a resolution was released by the 73rd World Health Assembly recognizing how extensive immunization could help in curbing, containing and stopping the transmission of the COVID-19 virus. [14]. The mortality rate of this novel virus and how quickly the virus spreads resulted in fast-paced research as regards development of a vaccine, for the first time in vaccinology history public health programs approved the use of a nucleic acid vaccine. [22]
There are currently at least 18 COVID vaccines that have been approved by different regulatory bodies, about 197 were at different stages of pre-clinical development and 154 were in clinical development. [23]

There are four broad categories of COVID-19 vaccines

regardless of administering platform, and they are;

1. Whole virus vaccines,
2. Protein based vaccines,
3. Viral vector vaccines, and
4. Nucleic acid vaccines

Whole Virus Vaccines

These vaccine types are inactivated or attenuated forms of the SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) that are administered to elicit a protective immunity response. [24] They involve using weakened forms of the virus or viruses whose genetic materials have been destroyed so as to elicit an immune response, this vaccine mechanism is tried and tested and used for most available vaccines. [25]

According to the WHO, there are currently 21 inactivated and 2 live attenuated vaccines undergoing clinical trials. The advantage of live-attenuated SARS-CoV-2 vaccines are that they stimulate whole body cellular immunity without the need for adjuvants [26]. However, on the down side, these vaccines could increase the risk of generating new variants by recombination of varying forms of the virus, faeces has also been found to contain particles of the virus and there is a concern that live-attenuated forms could possibly lead to transmission of the virus [27]

Protein-Based Vaccines

The available vaccine types under this classification are protein subunit vaccines and 'virus-like particles', the protein subunit vaccines are made up of fragments of the viral antigen produced by recombinant protein techniques. [28] these are more tolerable than whole vaccines but have low immunogenicity and need adjuvants to improve immunogenicity.

The 'virus-like particles' use empty virus shell that mimic the structure of coronavirus but lack genetic material and are not as infectious as the virus [29]

There are currently 6 virus-like particles & 51 protein subunits (which is the most of any vaccine type) in clinical testing [23]

Viral Vector Vaccines

A virus replicates by infiltrating and hijacking the genome of host cells to make new viruses, these processes also result in the formation of antigens within the host cell to provide an immune response. The viral vector vaccines work with this same mechanism, a chemically weakened form of the virus is administered to elicit host immune response and cause production of SARS-CoV-2 antigens [30][31] There are two types of viral vectors, those that replicate within cells and those that cannot because some of their important genes have been disabled.[32] There are currently 21 non-replicating and 4 replicating viral vector vaccines for the SARS-CoV-2 virus in clinical development[23]

Nucleic Acid Vaccines

These vaccine forms are made up of the genetic material and not live or attenuated forms of the virus, DNA vaccines use a piece of DNA encoding the antigen, the genetic material is inserted into a bacterial plasmid which helps to store and transfer genes within cells [33] The genetic material, DNA or RNA produces antigens within the host cell, these responses trigger immune system response including killer T-cells, helper T-cells and antibody-producing B cells that support antibody production. [30]

There are currently 16 DNA and 29 RNA vaccines in clinical development [23], some SARS-CoV-2 mRNA vaccines have been approved for emergency use. It is noteworthy however that prior to the incidence of the COVID-19 pandemic, nucleic acid vaccines had not been approved, this is only the first time. As of May 8 2022, about 11 billion vaccine doses had been administered worldwide in an effort to prevent another occurrence of a global scale pandemic [34]

Vaccine Hesitancy And Effectiveness

The issue of vaccine hesitancy is not new and have long existed before the formulation of the Covid-19 vaccines. [19] Data from high income earning countries show that the rapid development of the vaccines was the major reason for hesitancy, although this was not particularly outlined in lower income countries, some hesitancy theories are founded in conspiracy theories and superstitious beliefs.[21]

A study in June 2020 and January 2021 across 15 countries including the United States, Russia, Colombia, India, Nigeria, Niger, Burkina Faso amongst others, these studies highlighted the responsiveness in lower income countries being higher compared to the USA and Russia [21]

Vaccine acceptance is influenced first by a need for personal protection, better information about perceived side effects and becoming better aware on the necessity of the available Coronavirus vaccines are factors that improved responsiveness to getting vaccinated.

In the Centers for Disease Control and Prevention (CDC) recent records monitoring vaccine efficacy, a 70% effectiveness has been shown through the Omicron-predominant period, two/three doses of the mRNA vaccine (the popular Pfizer-BioNTech and Moderna have shown a 90% risk reduction in instances of Covid-19 hospitalization and death. [19]

CLINICAL MANAGEMENT OF COVID-19

The management of Covid-19 is interdisciplinary. The role of preventive measures cannot be overstated especially considering that asymptomatic individuals can actively spread the infection. Presentation of the covid-19 viral infection includes fever, dyspnea, and dry cough [6]. Chest pain isn't so common in these patients, but a majority of them complain of other symptoms like generalized

myalgias, headaches, malaise and sore throat[35]. Also, with GI involvement, some patients present with diarrhea. Although the inflammatory process is clear, some patients present with a normal core body temperature.

Early detection remains the major determinant of prognosis in Covid-19 patients. As such, every patient would benefit from routine hospital tests like FBC, EUC, and CK [35]. The results of these tests, alongside a sound understanding of covid-19's pathophysiology, can help detect patients with an increased likelihood of the infection[36]. One of such markers is a significantly reduced lymphocyte count (emphasis on T lymphocyte)[2]. The three main methods used for laboratory detection are serology, viral culture and molecular techniques[2].

The sudden and rapid onset of the worldwide covid-19 pandemic put a lot of strain on health care. The urgency for rapid diagnostic and massive supportive management of affected patients weighed heavy on high-income nations but illuminated the health care system's shortcomings in developing countries.

While the response strategies to limit the spread are at the forefront of management, treatment of confirmed cases is also crucial to ensuring the disease burden. The treatment modalities of Covid-19 viral infection focus on abating the cytokine storm that often leads to increased morbidity and mortality. The treatment modalities include;

Supportive Therapy

The link between Covid-19 prognosis and comorbidities has been established by numerous studies. This highlights the importance of a multidisciplinary approach to efficient management[37]. The compromise of the airway that is characteristic of Covid-19 viral infection makes ventilation first-line management for these patients[3]. Studies have provided varying recommendations on the indication for invasive and noninvasive ventilation in Covid-19 patients in respiratory distress [38][38–40]. Cytokine storm seems to be central to the deterioration of covid-19 patients, hence the importance of corticosteroids in their management. The immunosuppressive effects of corticosteroids against immune hyperactivity, although desired, weren't enough to risk the side effects associated with its use[41]. This was until recent research that shows how beneficial corticosteroids prove to be in the management of the critically ill patient [42].
Targeted therapy still offers less side effect profile which is preferred to corticosteroid therapy. A drug of interest is tocilizumab, which acts by blocking IL-6 receptors and reducing tissue damage [10,43].
This is due to the major role IL-6 has been shown to play in Covid-19 mediated cytokine storm. Due to the widespread immune hyperactivity and inflammatory destruction, it is no surprise that antioxidants have been considered part of supportive therapy. Clinical trials show the benefits of ascorbic acid in the management of Covid-19 patients [43].
The anti-oxidative effects of similar vitamins like vitamin D and E can also be leveraged in clinical management.

Drug Based Therapy

A major FDA approved antiviral for the management of Covid-19 viral infection that has shown remarkable efficacy is Remdesivir[14] .
The antimalaria/anti-inflammatory drug chloroquine is one of note as it has been found to inhibit the growth of SARS-CoV-2 invitro [35]. Chloroquine's efficacy has been shown to increase when combined with remdesivir [44]. While remdesivir works to halt replicating the capacity of the virus, Chloroquine acts by increasing the pH and interfering with the Angiotensin-converting enzyme. The rationale for using Chloroquine is justified by numerous other antiviral effects (10) beyond this review's scope. One combination that has shown efficacy in one trial but is still under criticism by other studies is Hydrochloroquine and Azithromycin [10].
Ivermectin is another drug that has anti-inflammatory and anti-viral mechanisms[45]. Although controversial, some studies also show its rapid clearing effect of viral load in nasal swabs from Covid19 patients [46,47] However, the WHO has advised against the use of Ivermectin as a treatment for COVID-19 that there is insufficient scientific evidence in support of its use.
Fibrinolytic and tissue plasminogen activators have been shown to improve the long-term management outcome of covid-19 patients with dyspnea [48] as there is an increased tendency for coagulopathy in Covid-19 patients. In addition, by targeting fibrin clots in pulmonary vessels, ventilation is improved, and this greatly improves the outcome of Covid-19 patients with associated acute respiratory distress syndrome [48].

Antibody-Based Therapy

Convalescent plasma therapy is also one modality that has been quite effective in the management of critically ill covid-19 patients. The procedure is based on the presence of antibodies against the Covid-19 virus, which is transfused to the recipient. The high titers of immunoglobulins will help reduce the viral burden alongside the effect of a potent antiviral agent [14].

CONCLUSION

The covid-19 pandemic grossly illuminated the shortcomings of the health care system, with emphasis to limited resources in developing countries. Hence the importance of reviewing effective response strategies to contain such health emergency to improve present and future outcomes. As COVID-19 tend to occur in waves, adoption of preventive measures will be very useful in limiting spread of infection and the adverse health and social consequences of the disease.

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