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Coronavirus Disease (COVID-19): Pathogenicity, Transmission, Epidemiology, Diagnosis, Case Management and Public Health Response

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The spread of Coronavirus Disease 2019 (COVID-19) to almost every part of the globe making it a global pandemic as resulted to be a global crisis with urgent need of innovative research ideas, mechanisms and strategy to treat, curtail, contain and prevent the spread of the disease. Covid-19 caused by a novel virus SARS-CoV-2. Leaders around the world have being engaging researchers and scientists for possible vaccine for COVID-19. This pandemic has caused instability in social, economy and psychological balance around the world which has resulted to a new way of life (new normal) which might not return to former normal soon. COVID-19 was declared as a global health emergency that poses threat to humanity, hence, it becomes imperative to abridge and ameliorate its effect, as we await the flattening of the pandemic curve and vaccine development. This review summarizes and provides meaningful information for recent and future research related to the viral origin, epidemiology, transmission, pathogenicity, clinical manifestation and diagnosis, management, prevention and control of coronavirus. All countries in the world and all concerned stakeholders should increase the awareness and provide necessary strategies holistically at the community, state, region, national and international levels to combat this disease.

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1. INTRODUCTION

Coronavirus disease-2019 (COVID-19) has caused major economic losses and fatalities to humans. The etiological agent of COVID-19 has been identified as a novel coronavirus, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), belonging to the family *Coronaviridae* [1]. Covid-19 has been identified as cause of respiratory illness, gastro-enteric disorder, neurological complication and death globally, hence, it has been declared as a Public Health Emergency of International Concern [2].

The World Health Organisation confirmed that the outbreak of the coronavirus pandemic was associated with the Huanan, South China Seafood Marketplace, but no specific animal association was identified [3]. Susceptibility seems to be associated with age (it is more severe for adults over the age of 60 years), sex (men are more at risk of death resulting from COVID-19) and other underlying health conditions [4]. The current curative approach for COVID-19 involves the treatment of symptoms associated with the disease and placement of patient on life support equipment. There is no human vaccine yet to prevent of this disease [5].

2. VIRAL ORIGIN

SARS-CoV-2 is a positive-sense single stranded enveloped virus belonging to the *Sarbecovirus* subgenus, genus *Betacoronavirus* and family *Coronaviridae.* The genome is single stranded positive-sensed RNA enveloped virus of zoonotic origin [6]. It required non-structural proteins 12 (nsp12), a RNA dependent-RNA polymerase as an important machinery for the viral genome replication and transcription processes [7].

3. EPIDEMIOLOGY

The emergence of COVID-19 has evolved various stages namely; local outbreak, community communication, widespread stage (epidemic) and worldwide (pandemic) [8].

On 29 December 2019, the first four cases of an acute respiratory syndrome of unknown etiology were reported in Wuhan City, Hubei Province, China among people linked to a local seafood market [9]. The secondary source of infection was found to be human-to-human transmission via close contact [9]. The infected people with no history of exposure to wildlife or visiting Wuhan increased in number and more cases of infection were reported among medical experts [9]. It became clear that the COVID-19 infection is contracted through exposure to the virus in which both immune-suppressed and normal populations are at risk of contracting this virus [10].

The novel virus causing COVID-19 has been reported to have higher levels of transmissibility and pandemic risk compare to SARSCoV, as the effective reproduction number (R) of this novel virus (2.9) is estimated to be higher than the reported effective reproduction number (R) of SARS (1.77) even at this early stage [11]. The world health organisation has stated the average incubation period of the virus to be 7 days and may range from 2 to 14 days [12]. The spread of COVID-19 is relatively fast and has spread to almost every part of the world since the outbreak occur in December, 2019 at China [13].

4. TRANSMISSION OF COVID-19

Some animals serve as reservoir hosts for coronaviruses, this include wild and domestic animal such as camels, cattle, cats, and bats. Although there are exceptions, this includes SARS and MERS, which are mainly spread through close contact with infected people through respiratory droplets from coughing or sneezing. COVID-19 early patients were reported to have some link to the Huanan Seafood Market in Wuhan, China, suggesting that these early infections were due to animal-to-person transmission [14,15,16]. The three main transmission routes for the COVID-19 include droplets transmission, contact transmission, and aerosol transmission. Droplets transmission occurs when respiratory droplets (as produced when an infected person coughs or sneezes) are ingested or inhaled by individuals in close proximity. Contact transmission occurs when a subject touches a surface or object contaminated with the virus and subsequently touches their mouth, nose, or eyes. Aerosol transmission occurs when respiratory droplets mix into the air, forming aerosols, and causing infections while inhaling a high dose of aerosols into the lungs in a relatively closed environment [16]. Recent studies indicated that the digestive system serve as a potential transmission route for COVID-19 infection through faecal contamination [17,18,19]

Some patients had gastro intestinal discomfort and diarrhea symptoms, researchers analyzed four datasets with single-cell transcriptomes of digestive systems and found that ACE2 was highly expressed in absorptive enterocytes from the small intestine (ileum) and large intestine (colon). The SARS virus is transmitted aerogenically with an incubation time of 2 to 14 days with a mean of 5 days [18,20,21].

5. CLINICAL MANIFESTATION AND PATHOGENESIS

Covid-19 is known to be associated with enteric, lung and respiratory diseases in humans [14]. Pneumonia caused by SARS Covid-19 is characterized by diffused edema resulting in hypoxia [22]. The form of the disease depends on a host of factors which includes: Immune status, age and underline health conditions, such as diabetes, hypertension, heart disease, cancer, chronic lung disease [17,23,24]. The binding of the virus to angiotensin-converting enzyme-2 (Recently, the receptor involved in the entry of the SARS virus into the cell was reported to be the angiotensin-converting enzyme 2 (ACE2) on the surface of respiratory tract epithelium which may contribute to the dysregulation of fluid balance that causes the edema in the alveolar space [25,26,27]. Significantly high blood levels of cytokines and chemokines are noted in patients with COVID-19 infection [25,27]. The association of worsening clinical progression with declining viral loads and the onset of an immunological response, plus the presence of markedly elevated cytokines levels suggest that severe lung damages are largely immune-pathological in nature [28]. The maximum incubation period is assumed to be up to 14 days, whereas the median time from onset of symptoms to intensive care unit (ICU) admission is around 10 days [29,15]. Clinical findings reveals the presence of the virus in the respiratory tract specimens of 1–2 days before the onset of symptoms, and it can persist up to 8 days in moderate cases and up to 2 weeks in severe cases [30,19].

6. CLINICAL SIGNS AND SYMPTOM

The most commonly reported symptoms include: Chest pain, fever, dry cough, myalgia or fatigue and other respiratory issues [31,32]. Other symptoms include: repeated shaking with chill, headache, sore throat, diarrhea, hemoptysis, vomiting, runny nose and loss of sense of taste or smell [33,20]. In patients with some underlying disease, the disease tends to develop rapidly into acute respiratory distress syndrome, septic shock, metabolic acidosis, which are hard to correct and coagulation dysfunction, ultimately leading to death [28,34] The following procedures have been suggested for diagnosis for patient who shows infection symptoms and clinical signs, they include; performing real-time fluorescence (RT-PCR) to detect the positive nucleic acid of SARS-CoV-2 in sputum, throat swabs, and secretions of the lower respiratory tract samples [29,35,24]. China reported that young people were more likely to have milder cases of the disease [36,31,15]. The coronavirus infection is more severe in people of middle age compare to young people below 20 years of age [17,36]. The corona virus disease causes more harm to the elderly and those with underlying health in the United States. It was reported that 38% of people hospitalized for Covid-19 in the United States were between 20 and 54 years old. Half of those ending in intensive care were younger than 65 [17]. Approximately 80% of deaths are in people older than 65 [30]. Officials in Europe are noting the same trend, with report that half of the serious cases in France and Netherland are in people under age of 50. More of coronavirus infections among young adults could mean more risk to older people. The older people are at risk of death resulting from Covid-19 infection [18, 31,14].

In Africa, the demographic factors and lack of adequate regional monitoring limit the number of recorded cases. Middle–aged and elderly patients with pre-existing ailment and diseases such as cancer surgery, cirrhosis, hypertension, heart diseases, diabetes, and Parkinson's disease are prone to increasing death rate. However, some patients with no pre-existing health conditions are also reported to suffer severe symptoms and even death [17,15,32].

7. PREVENTION AND CONTROL

Several public health control measures that may prevent or slow down the spread of Covid-19 have been put in place, this includes containment and quarantine of cases [17]. Currently, there is no specific antiviral or vaccine treatment to protect against COVID-19. The best we can do for now is to ensure preventive and precautionary measures in preventing the spread of the infectious viral disease [37,21]. People with COVID-19 must seek medical care to help relieve symptoms [31]. Regarding infected patients with COVID-19, it has been

recommended to apply appropriate symptomatic treatment and supportive care [38]. Medical staff, veterinary staff and other personnel dealing with humans and animals infected with high risk viruses must take precautions to protect themselves and to avoid spreading the infection [39,40,32]. The preventive and precautionary measures are meant to control the source of infection, block transmission and prevent further spread [32,41]. Precautions and recommendations by the World Health Organization to curtail COVID-19 include;

- When sneezing or coughing, do not cover nose and mouth with bare hands but use a tissue or a mask instead and then throw in trash after use [22].
- Wash your hands properly and frequently with alcohol based sanitizer or soap. Washing of hands should be done often with soap and water for at least 20 seconds, especially after going to the bathroom; before eating, and after blowing your nose, coughing, or sneezing [41]. Even if there are viruses present on hands, washing hands can block the viruses from entering respiratory tract through nose or mouth. Avoid touching your eyes, nose, and mouth with unwashed hands [17].
- Be sure to wear the mask used correctly. Just in case you come in contact with an infected person, wearing a mask can prevent you from inhaling virus-carrying droplets directly [41].
- Social distancing should be inculcated [17].
- Strengthening ports of entry, quarantine and strict monitoring of the temperature of entry and exist of passengers [39].
- Epidemiological investigation and close contact management should be carried out for cases, clusters, and contacts to identify the source of infection and implement targeted control measures, such as contact tracing [17,22].
- Boosting your immunity is also an important way to strengthen the body against the virus [29,30]. Maintain a balanced diet, ensure adequate nutrition, maintain oral health hygiene, exercise regularly and have a regular sleep schedule, quit smoking, limit alcohol consumption, stay in good spirit and ensure indoor ventilation [18].
- 2019-nCoV is mainly transmitted by droplets and contacts, therefore medical surgical masks must be worn properly, avoid irresponsible or inappropriate antimicrobial treatment, especially in combination with broad-spectrum antimicrobials [30, 24].
- Stigmatization hurts everyone by creating more fear or anger towards ordinary people, instead of the disease that is causing the problem [42]. We can fight stigma and help not to hurt others by providing social support. [20,22].
- Stay safe and healthy.

8. CONCLUSION

Over the years, the emergences of many pandemic have caused a wide variety of human and veterinary diseases. COVID-19 may continue to emerge evolve causing human pandemic outbreaks owing to their ability to recombine, mutate, changing their genetic configuration infecting multiple species and cell types. Future research on COVID-19 will continue to investigate many aspects of viral replication and pathogenesis, transmission, therapeutic vaccine, zoonotic origin, immunity host range and their pathogenesis. Defining the mechanism in which SARS-CoV2 cause's diseases and understanding the host immunopathological response will significantly improve our ability to design suitable vaccines and reduce disease burden globally. Government agencies, major stakeholders and world leaders should incorporate latest resourceful outcomes of related scientific researches into public policies at the community, regional, and national levels to curtail and prevent the further spread of the deadly coronavirus disease.

9. RECOMMENDATIONS

Nations of the world and concerned international organization should encourage and fund researches to prevent the emergence such pandemic in the future. New guidelines should be issued by world health organization to all airport authorities and airlines in the world to mitigate and prevent the spread of COVID-19 and other emerging fast spreading disease to all nooks and crannies of the world.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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