OPEN ACCESS Freely available online

Applied Microobigoloy : Open access

Review Article

Milestone of World Pandemics: A Review on Remedy for COVID-19 Diseases to Revitalize Human Race from Deadly Corona Virus

Adedayo Olajide Ajayi*

Department of Microbiology, Adekunle Ajasin University, Ondo State, Nigeria

ABSTRACT

Viruses are group of microorganisms that can only develop intracellularly. Many animal forms like Bat, Snake, Cows, Rats and some wild animals serves as their zoonotic sources. The emergence of novel SARS-CoV-2 which is part of the Coronaviridae family from Wuhan, China in December, 2019 is a turning point of world preparedness against strange viral respiratory disease. As the world reflects on pandemics historically. Epidemics like the London plague of 1665 and Great Plague of Marseille, France of 1720 claimed millions of lives. Among the most dreadful world pandemics are "Antonine Plague" that occurred in 165AD and claimed 5 million lives in Asia, Egypt, Greece and Italy. "Plague of Justinian" occurred between 541 to 542. Similarly, "The Flu Pandemic" also known as Spanish flu occurred between 1918 to 1920. Just 100 years ago. "3rd Plague of 1855" started from China and killed 10 million Indians in less than one year." The Black Death". This was by far the worst. It occurred from 1346-1353, that was 7 years long pandemic whereby half of the world's population died. HIV-AIDS has peak record deaths between 2005- 2012. In the year 2019/2020 COVID-19 broke out severely than MERS-CoV and SARS-CoV which occurred in recent years. One possible strategy for treating SARS-CoV-2 is to control the host's immune system. Evidence shows that high levels of inflammation accompany the most severe cases of COVID-19. Control measures will consider this coupled with personal hygiene measures including hand wash, the use of face mask and physical distancing.

Keywords: COVID-19; Human Race; Milestone; Pandemics; Remedy

INTRODUCTION

Viruses are one of the groups of microorganisms that thrive in various ecological zones of our environment. They are unique in that they only replicate within the host cells to cause infection through their nucleic acid and related protein components with their encapsulated coat. The virus is not a living organism, but a protein molecule (DNA) covered by a protective layer of lipid (fat), which, when absorbed by the cells of the ocular, nasal or buccal mucosa, changes their genetic code. (mutation) and converts them into aggress multiplier cells. Viruses being a protein molecule is not killed but decay and disintegrate based on some environmental conditions like temperature and humidity. It is very fragile, in that the outer layer is made up of fat which can be dissolved by heat and above 250°C and alcohol based mixture with alcohol over 65% that is harmful to the virus [1,2]. Many animal forms like Bat, Snake, Cows, Rats and some wild animals also serves as their zoonotic sources. Bats to be used for the purpose of this study are present in most parts of the world, with the exception of extremely cold regions. They perform the vital ecological roles of pollinating flowers and dispersing fruit seeds; many tropical plant species depend entirely on bats for the distribution of their seeds. Bats are economically important, as they consume insect pests, reducing the need for pesticides. The smallest bat, and arguably the smallest mammal in nature, is Kitti's hog-nosed bat, measuring 29-34 mm (1.14-1.34 in) in length, 15 cm (5.91 in) across the wings and 2-2.6 g (0.07-0.09 oz) in mass. The largest bats are a few species of Pteropus (fruit bats or flying foxes) and the giant golden-crowned flying fox [3-5].

Bats are important reservoirs of different pathogenic agents [6]. Many of them have already caused disease outbreaks worldwide. Indeed, they are more frequently implicated in zoonotic virus emergencies such as Ebolavirus and Marburgvirus are two genera of the family Filoviridae, responsible for severe, often fatal, hemorrhagic fever diseases in humans and other primates. Recently, involvement of Bats and Snake was documented as reservoir Corona virus which causes the global pandemic of COVID 19 that broke out during the towards the end of the year 2019 through the first quarter of the year 2020. Coronaviruses (CoVs) prior to the SARS outbreak were only known to be the second cause of the common cold after rhinoviruses. At least four different species

Correspondence to: Adedayo Olajide Ajayi, Department of Microbiology, Adekunle Ajasin University, Ondo State, Nigeria; E-mail: olajide.ajayi@aaua.edu.ng

Received: February 13, 2021, **Accepted:** February 27, 2021, **Published:** March 3, 2021

Citation: Ajayi AO (2021) Milestone of World Pandemics: A Review on Remedy for COVID-19 Diseases to Revitalize Human Race from Deadly Corona Viru. Appli Microbiol Open Access.7:001.

can cause mild, self-limiting upper respiratory tract infections in humans: alphacoronaviruses HCoV-229E and HCoV-NL63, and betacoronaviruses HCoV-HKU1 and HCoV-OC43. More recently, two more additional pathogenic human-CoV were identified: Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV). SARS-CoV was first identified in China in February 2003, and 4 months later, >8000 cases had been reported with about 800 deaths in 27 different countries worldwide. SARS-CoV has a wide host range and it is associated with wildlife meat industry. The natural history of the virus involves bats as primary hosts that then transmitted it to the intermediate amplifying hosts – as mask palm civets and raccoon dogs -that then could spread it to humans. Human-to-human transmission follows and can lead to large numbers of infected patients and is considered the main route of transmission in large-scale epidemics. The novel coronavirus (2019-nCoV) from Wuhan, China, has recently caused over 500 confirmed cases of human infections and at least 17 deaths in China as at February/March, 2020 [7,8].

Pathogenesis of virus in cells to cause infection

Viruses are group of microorganisms that can only develop intracellularly. Hence, it first find and attach to a host cell. This is followed by penetration and injection of genetic material into that cell. Some form of replication will take place whereby, there will be synthesis of viral components. Copy viral DNA or RNA and make viral proteins using host cell materials. Assembly takes place, whereby, additional viral particles is built from newly synthesized viral parts. The last stage is the release, that is escape of the host cell and search for new cells to infect.

MICROBIOLOGY OF COVID-19

SARS-CoV-2 is a novel virus. Whereby we had no knowledge of its existence or immunity to this pathogen when it was first discovered in late 2019. SARS-CoV-2 spreads so rapidly, thus making unique formidable challenges associated with combating this bioterrorific virus. Nevertheless, more efforts are being made to get better understanding that profers remedy for the covid-19 pandemic. SARS-CoV-2 is part of the Coronaviridae family. Like MERS-CoV and SARS-CoV, it is a Betacoronavirus. Its likely originated in bats and can cause severe respiratory disease in humans. The genome of SARS-CoV-2 is ~30kb in size. It is an enveloped, positive-sense, single-stranded RNA virus.

The human receptor for SARS-CoV-2 is Angiotensin-converting enzyme 2 (ACE2). This enzyme is involved in the regulation of blood pressure and is expressed by cells of the heart, lungs, kidneys and intestines. SARS-CoV-2 binds to ACE2 through mushroom-shaped surface proteins called spike proteins. These spike proteins are what give the virus its crown-like appearance and are where the name 'coronavirus' comes from Yong Zhang, 2020 [9]. Many symptoms associated with COVID-19 are caused by the patient's immune system, not the virus itself.

OUTBREAK OF COVID-19

The outbreak of COVID-19 that initially appeared as a pneumonia-like infection was first detected in an hospital in Wuhan, China in December 2019 as the novel corona virus disease that was identified in that country forthwith. The pathogen responsible for COVID-19 is Severe Acute Respiratory Syndrome corona virus 2 (SARS-CoV-2), a member of the corona virus family. Its morphological appearance shows the cellular body covered with spike that looks like a crown. SARS-CoV-2 binds to ACE2 through mushroom-shaped surface proteins called spike proteins. These spike proteins are what give the virus its crown-like appearance and are where the name 'coronavirus' comes from Hagen, 2020 [10]. This etiologic agent was reported to have emanated through some laboratory works from a community known as Wuhan, China. Coronavirus diseases that spread from this source sporadically around the globe has generated a lot of controversy on foul play as bioweapon as well of carelessness of prompt report of its origin through World Health Organization (WHO).

Corona viruses are a group of viruses that can cause respiratory illness in humans. The current outbreak is caused by new (or novel) strain of corona virus, similar to the viruses that caused the Severe Acute Respiratory Syndrome (SAR) outbreak from 2001 to 2003 and Middle East Respiratory Syndrome (MERS) outbreaks from 2012 to the present time. The corona virus disease of 2019 was given the abbreviated name of COVID-19 by WHO on February 11, 2020 and later renamed "Severe Acute Respiratory Syndrome Corona virus 2" (SARS-coV-2) by the International Committee on Taxonomy of Viruses (ICTV) because the virus is a genetic cousin of the corona virus.

COVID-19 is an acronym and in its full form stands for corona virus disease of 2019. People with COVID-19 have had a wide range of symptoms, ranging from mild symptoms to severe illness which may appear within 2 to 14 days after exposure to the virus. Observable symptoms include Cough, Sore throat, Fever, Sneezing, Difficulty with breathing, Tiredness, Persistent pain or pressure in the chest and Drowsiness. Generally, other symptoms that may accompany these feelings includes running nose or nasal congestion, headache, conjunctivitis, diarrhea, loss of taste or smell or a rash on skin or discoloration of fingers or toes, aches and pains [11].

Historical perspectives of world pandemics

According to Thorpe, the presence of Yersinia pestis bacterium in skeletons found in a recently discovered plague pit proves that the Great Plague of 1665 was bubonic. Or does it? Its commonly known as the London plague.

In August 1665, from his two-room lodgings in Southwark, the chemist John Allin shared his devastating experience. A pit similar to that visible outside John Allin's window was dug and filled with plague dead in the New Churchyard Cemetery in east London. This pit was uncovered during recent work at Crossrail's Liverpool Street Station. Earlier this week, BBC news splashed a bold headline across computer screens and social media platforms: using DNA analysis, the Yersinia pestis bacterium, which causes bubonic plague, has been confirmed to be the cause of London's Great Plague of 1665. Finally, (it seemed) a long-held debate among historians as to the biomedical cause of London's early modern plague epidemics was brought to an end.

In fact, the information shared in the article instantly lessens the impact of the claim, clearly written for its shock value. Of 42 skeletons found in the plague pit, which was dated to 1665 based on pottery found among the burials, the teeth of 20 skeletons were subjected to a number of tests, including one to distinguish the presence of Yersinia pestis. The test returned positive results for five of the skeletons, meaning that these individuals were exposed

to bubonic plague shortly before their deaths. It is a significant find and is the first time that DNA evidence has supported the identification of Yersinia pestis as an agent in the Great Plague of 1665 [12].

The fact that the disease early modern Londoners called 'plague' was, in fact, what we know now as 'bubonic plague' is taken for granted. The issue has been debated for over 30 years since Graham Twigg published The Black Death: A Biological Reappraisal, which argues that the climate and conditions of Europe – and the British Isles in particular – were not conducive, to the point of impossibility, of sustaining the rat and rat flea population necessary to establish epidemics on the scale seen in the medieval and early modern periods. Since then, Twigg has been echoed by scholars like Samuel Cohn, who contended that the agent responsible for early modern plague is one entirely different than Yersinia pestis which we know to be responsible for modern plagues in China and India, including contradictory epidemioligies [13].

The writers of the medical pamphlet literature devoted to disseminating information on the perceived nature, causes, prophylactics and cure of the plague described the symptoms of the disease in lurid detail. In the early stages of illness, these symptoms included thirst, chills, shaking, headaches, nausea, loss of appetite and drowsiness, escalating in later stages of the disease to cold sweats, coughing up blood phlegm, vomiting, diarrhoea and convulsions. The most telling symptoms were those which affected the victims' skin: blains, carbuncles, blisters and those swellings that were described by Nicholas Culpepper as 'risings behind the eares, under the Arme-holes, or in the groyne, without any manifest cause knowne'. In another word, buboes. If we were to go by the symptoms described by practitioners such as plague doctor Nathaniel Hodges (1629–1688) or apothecary William Boghurst (1630/31–1685), we would find that there are a number of other diseases with similar symptoms, including anthrax, typhoid, diphtheria, typhus, even measles [14].

Throughout the plague epidemics of the early modern period, different parishes are seen to manifest one or a combination of each of these epidemiological patterns, which would strongly suggest that each epidemic was caused by multiple factors.

In 1720, a ship was quarantined at the port in Marseille because a strange infection was killing people on the ship. Deputy Mayor of Marseille lifted the quarantine to "help economy". 100,000 people died. More than half of Marseille died. This was the Great Plague of Marseille. The govt of Marseille felt they could not afford to lose all the valuable goods on the ship as it will destroy the economy. As they lifted the quarantine and moved the goods into the city of Marseille, they moved in the infection. More than half of Marseille citizens died. Marseille is a major port city in the south of France. Just as Lagos in the south of Nigeria.

By the end of the Great Plague of Marseille, the city of Marseille had 50,000 dead people (out of a total 90,000 population back then). That is like 10million people dying in Lagos. The ship left Sidon in Lebanon, picked up people at Tripoli, and Cyprus which already had infection outbreak. A Turkish man on the ship got infected first and died, then several sailors died. The ship's surgeon also died. As the ship got to Marseille, Doctors quarantined it. Now because Marseille had a very huge trading arrangement with "Levant" (a term for countries like Iraq, Syria, Lebanon, Cyprus, Turkey, Israel, Jordan, and Palestine); the govt was convinced by businessmen that the quarantine on the ship has to be removed and the goods released.

Incidence and ante-incidence of corona virus pandemic

The study of Omulo et al. shows that the emergence of antimicrobial resistance (AMR) is a complex process often involving the interplay of human, environmental and pathogen-related [15]. In sub-Saharan Africa, the endemicity of acute respiratory infections, diarrheal diseases, HIV/AIDs, tuberculosis, malaria and helminthic infections has increased the demand for antimicrobial therapies both for prophylaxis and treatment [16].

Prevention and control of corona virus pandemics

1. Heat melts fat, hence, it is so good to use water with temperature above 25°C for washing hands, clothes and everything. Similarly, hot water makes more foam and can be more ideal under this circumstances.

2. Alcohol based sanitizers or mixture formulas with over 65% alcohol dissolves fat generally. Especially the external lipid layer of the virus can be susceptible to this antigenic management.

3. Mixtures of 1-part bleach and 5 parts water can directly dissolve the protein. This is lethal to the virus from inside.

4. Oxygenated water is also valuable. This can be complementary to the use of soap, alcohol and chlorine, because peroxide dissolves the virus protein, but you have to use it pure and it hurts your skin. Basically, some of this components stated here are inclusive in formulation of standard sanitizers.

Other cautions on corona virus infection control

Bactericides and antibiotics cannot be used against virus. This is because virus is not a living organism like bacteria. It is important to avoid shaking unused clothing, sheets or cloth. Because it can glue to a porous surface for hours or days. If an individual shake it or use a feather duster, the virus molecules float in the air for up to 3 hours, and can lodge in your nose. Cool environment or artificial as air conditioners in houses and cars can also make virus molecule relatively stable. This is also paramount with dark humid environment. Therefore, dehumidified, dry, warm and bright environments will degrade Coronavirus faster. It's also good to keep nails short so that the virus does not hide there.

Various forms of diseases emerge and remerge in human environment now and defy treatment with common chemotherapeutic agents. According to Omulo et al. [17], the emergence and persistence of antimicrobial resistance is driven by varied factors including the indiscriminate use of antibiotics and variable drug efficacy and presents a major threat to the control of infectious diseases. However, the corona virus, the causative agent of COVID-19 is a novel virus that has no treatment drug nor approved vaccine for its control for relatively couple of months from the period it was first discovered during the month of December, 2019.

Chloroquine and hydroxychloroquine

One possible strategy for treating SARS-CoV-2 is to control the host's immune system. Evidence shows that high levels of inflammation accompany the most severe cases of COVID-19. Hyperactive (uncontrolled) immune responses can lead to Cytokine Storm Syndrome, Acute Respiratory Distress Syndrome and eventual organ failure. Decreasing inflammation helps keep the lungs and other organs functioning properly during viral infection.

The mechanism: immune suppression

Chloroquine and hydroxychloroquine reduce autophagy (self-regulated destruction of host cells), interfere with Toll-like receptor (TLR) signaling and decrease cytokine production. As a result, inflammation is controlled and immune responses are less severe. Evidence suggests that chloroquine and hydroxychloroquine may also interfere with the glycosylation of SARS-CoV-2 cellular receptors and prevent virus/cell fusion by increasing endosomal pH. Both of these drugs are currently FDA approved for the treatment of malaria, rheumatoid arthritis and lupus and have shown in vitro activity against SARS-CoV and SARS-CoV-2.

The data

A preliminary trial involving 36 COVID-19 patients in France showed encouraging results. 6 patients in the study were asymptomatic, 22 showed symptoms of upper respiratory tract infections and 8 showed symptoms of lower respiratory tract infections. 20 were treated with hydroxychloroquine (600 mg daily, in a hospital setting). Within 6 days, the virus was no longer detectable in 70% of samples taken from patients who received treatment. In contrast, only 12.5% of patients who did not receive the hydroxychloroquine treatment had cleared the virus.

Another trial involving 100 patients in China reported that chloroquine was effective at decreasing pneumonia and shortening the duration of disease. Larger controlled trials to determine the effectiveness of these medications as treatments for COVID-19 are taking place as we speak.

Remdesivir

Another possible strategy for treating SARS-CoV-2 is to prevent replication of the virus. If the viral genome isn't copied, the virus can't reproduce, and the infection will be cleared. It should be noted that this is not a one-size-fits-all approach. Not all antiviral medications work on all viruses. Microbes have unique, and often distinguishing, properties that must be taken into consideration when developing treatment plans.

The mechanism: inhibition of replication machinery

Remdesivir is a broad-spectrum antiviral drug that inhibits RNA-dependent RNA polymerase, the virus-encoded enzyme responsible for copying SARS-CoV-2's genetic code. Blocking an enzyme necessary for RNA replication prevents the virus from making copies of itself and allows the body to mount an effective response to eliminate it. Remdesivir has shown prophylactic and therapeutic activity against MERS-CoV in non-human primates as well as in vitro activity against SARS-CoV-2.

The data

The University of California Davis Medical Center in Sacramento, CA reported successful treatment of a female patient with COVID-19 using remdesivir. This patient had one of the first recorded community-spread COVID-19 infections in the United States. Doctors confirmed that the patient's condition was critical before treatment, but she began to show signs of improvement the day after remdesivir was administered. Samples of the patient's blood were frozen and held for testing when supplies become sufficiently available (Hagen, 2020). In the meantime, a number of clinical trials to evaluate the efficacy of remdesivir as a treatment for COVID-19 are underway in the U.S. and China. Results of these trials are expected as early as April 2020.

Monoclonal antibodies

Another strategy for treating SARS-CoV-2 is to attack the virus directly. Blocking a virus's ability to recognize, attach to or penetrate host cells will prevent infection altogether. In many cases, our bodies do this naturally through the production of antibodies. Antibodies are proteins that recognize and bind to foreign particles, called antigens, on pathogens. When an antibody binds to an antigen, it can neutralize the microbe directly, preventing host cell infection, or flag it for destruction by the immune system. Antibodies are naturally produced through exposure and recovery from infections.

The mechanism: enhance immune recognition

SARS-CoV-2 is a novel virus. That means people who haven't been infected with it have no antibodies to this virus in their immune memory banks. But people who have recovered from COVID-19 infections do, and if functional copies (called monoclonal antibodies) can be engineered and reproduced in a laboratory setting, they can serve as substitute antibodies to enhance or mimic the immune system's attack on SARS-CoV-2.

A company called Regeneron is preparing for large-scale manufacture of monoclonal antibodies targeting the SARS-CoV-2 spike protein. If they're successful, blocking spike proteins will prevent viral attachment to host cells and could cripple the virus entirely. This strategy has been especially effective at treating certain types of cancers, and clinical trials of monoclonal antibodies designed to treat a number of bacterial and viral infections including Escherichia coli, Clostridium difficile, HIV, respiratory syncitial virus (RSV) and rabies virus are currently in progress.

DISCUSSION AND RECOMMENDATION

There are diversified natural remedies experience in course of control COVID-19 outbreak control. Covid-19 was termed an incurable disease at the onset because it defied a lot of medications. No legitimate cure was found for it for a relatively long time. Nevertheless, many people embark on local covid-19 formulas convenient remedies to combat life threating infection. One if such surveyed treatment includes the use of Hydroxychloroquine 200 mg twice daily for 5 days; Azithromycin 500mg once a day for 5 days, Zinc sulfate 220 mg for 5 days. On routine basis to build up the body immunity, Vitamin C-1000 mg is usually administered. However, in confirmed cases of infection, drugs like, Chloroquine, turmeric, lemon, unripe pineapple and steam inhalation is combined. Meanwhile, this backed up spiritually with prayer.

Traditionally, (Onion and Black seed/ oil, blended together and mixed with pure honey). 1 teaspoon, morning and Night, plus 1 Tab VitaminC-1000mg daily. Though, fruit preparations that are rich source of vitamin C, like lemon, Ginger and Turmeric powder can be administered and steam inhaled for this purpose. Finally, the organism cannot survive alkaline conditions. Tangerine, pineapple, in addition to fruit earlier stated above can provide such alkaline condition to kill the virus. Apart from their vitamin C value and the anti-inflammatory properties they possessed help to strengthen the body immunity and eliminate Corona virus.

One popular herbal remedy that being effectively used during covid-19 pandemic is the Black seed/oil. Few other nourishments are used to complement the treatment. Black Seed & Oil one of the natural herbal remedies that was successfully tried for COVID-19 treatment in some instances, have some Antiviral activities: Antibacterial activities and its generally an infection killer. Based

on its medicinal properties, Black seed powder/oil have many health benefits in healing different terminal diseases ranging from hypertension, by lowering blood pressure, Arthritis and rheumatism, improves vision, Lowers Anxiety, Asthma and Cough, treats insomnia and HIV 1&2 and not for somebody who is already down with AIDS, Lowers the risk of heart disease, Shrinks Fibroid, Cures Hepatitis and other stubborn viruses It improves memory, Cures Ulcer, helps diabetics, removes stretch marks on the skin as well as Strengthens the immune system. It's an excellent plant for general well-being. Black seed has no side effect on body organs generally. Black seed can be grounded and mixed with black oil and put it inside original honey. One spoon can be administered morning and night for diseases treatment and control.

CONCLUSION

Scientifically and historically, many diseases have ravaged the world in form of pandemics in the past decades and centuries. Covid-19 which comes up with its own challenge starting from China, during the month of December, 2019 soar high during the year 2020. The controversy of its origination as bioweapon generated a lot of worries considering the high rate of spread despite the militant approach the world over take to combat the deadly surge. Nevertheless, these efforts yielded good result because scientist are finding clues on this novel virus as time passes bye and thus keeping the world at large on recovery path Extant measures were taken on daily basis to limit the spread of the virus. This include, routine personal hygiene. It is important to wash hands with clean water. Water is not very effective alone in washing the virus off our hands. Alcohol based product or sanitizers work better. But nothing beats soap-the virus detaches from the skin and falls apart very readily in soapy water. Sanitizers are however bound to provide some antigenic protection for some time.

Other measures taken in most countries to contain the spread of the pandemic is total shut down of the economy including schools, worship houses, relaxation joints, etc to avoid getting that compulsive exposure. Travel, birthdays, marriages, burial and holiday bugs were also prevented to protect our people from undue expose to unnecessary risks and hazards. People generally take all precautions while at home and while outside for any important work. The principle of disease control globally, varies with the physiology of microbes involved and some epidemiological factors including history of the world pandemics. Scientist generally plays vital role on research, enlightenment and management of covid-19 cases since the beginning of the pandemic spread till date. Some of the determined effort to overcome covid-19 include the formulation of vaccine. Similarly, some clinical data are pending whereby relevant companies and scientist isolated hundreds of virus-neutralizing antibodies from mice and recovered COVID-19 patients with hopes of initiating human trials when feasible. Covid-19 has been a big challenge to the world. Everyone have role to play as intensified in this report and sustain the post COVID-19 free society. We will overcome.

REFERENCES

1. Aminov RI. A brief history of the antibiotic era: lessons learned and challenges for the future. Front Microbiol. 2010;1:134.
2. Baras C. “The years of Darkness”. New Scientist. 2014;221:34-38.
3. Barry J.M. The great influenza: The epic story of the deadliest plague in history. New York: Viking Press, 2004:60.
4. Bramanti B, Dean KR, Walloe L, Stenseth NC. The third plague pandemic in Europe. Proceedings of the Royal Society B. Biological Sciences. 2019.
5. Bray RS. Armies of pestilence. Barnes and Nobel 2019.
6. Calisher CH, Childs JE, Field HE, Holmes KV, Schountz T. Bats: important reservoir hosts of emerging viruses. Clin Microbiol Rev. 2006;19:531-545.
7. Cantor NF. In the wake of the Plague: The Black Death and the World it Made. Simon and Schuster, 2015.
8. Centers for Disease Control and Prevention (CDC). Acquired Immunodeficiency Syndrome (AIDS): Precautions for Health-Care Workers and Allied Professionals' MMWR Weekly 32:450-451.
9. Zhang Y, Chen C, Zhu S, Shu C, Wang D, Song J, et al. (2020). Isolation of 2019-nCoV from a Stool specimen of a laboratory-confirmed case of the coronavirus disease 2019 (COVID-19). China CDC Weekly. 2020;2:123-124.
10. Hagen A. Antimicrobials and COVID-19: strategies for treating a pandemic. By a science communications specialist at ASM. 2020.
11. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet. 2020;395:507-513.
12. Coleman CM, Sisk JM, Mingo RM, Nelson EA, White JM, Frieman MB, et al. Coronavirus Susceptibility to the Antiviral Remdesivir (GS-5734) Is Mediated by the Viral Polymerase and the Proofreading Exoribonuclease. J Virol. 2016;90:8924-8933.
13. Donga E, Gardnera L. An interactive web-based dashboard to track COVID-19 in real time. The Lancet Inf Dis. 2020;20:533-534.
14. Fears JR. The Plague under Marcus Aurelius and the decline and fall of Roman Empire. Infectious Diseases Clinics of North America. 2004;18:65-67
15. Gilliam JF. The Plague under Marcus Aurelius. Am J Physiol. 1961;225-251.
16. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA. 2020
17. Omulo S, Thumbi SM, Njenga MK, Call DR. A review of 40 years of enteric antimicrobial resistance research in Eastern Africa: what can be done better? Antimicrobial Resistance and Infection Control. 2015;4.