A COMPREHENSIVE REVIEW OF THE AETIOLOGY OF COVID-19, ITS PATHOGENESIS, HISTOLOGICAL FEATURES, THE CURRENT AND POTENTIAL THERAPIES TO ADDRESS IT AND THE FUTURE IMPLICATIONS ON PUBLIC HEALTH.

BY

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**1.1 INTRODUCTION**

All countries,either large or small, strong or weak and irrespective of the prevailing social system exist to achieve well defined objectives which are perceived as desirable for the well-being of their citizenry. These tasks, among others, comprise the need to develop national economies for the improvements of its citizens, amongst which is a high standard of public health. Threats as seen within the context of public health, therefore is anything that constitute danger to the security of the country or anything that undermines the capacity of the country to develop and defend itself against any pandemic to promote the general well-being of its people. It is in this light that the current global scourge of COVID-19 (corona virus) which has occasioned a global lockdown cannot be over emphasized.

COVID-19 also known as coronavirus is a kind of common virus that causes infections in the nose, sinuses, or upper throat. It is therefore, a respiratory virus which spreads primarily through contact with an infected person, through respiratory droplets generated when a person, for example, coughs, sneezes and through droplets of saliva or discharges from the nose.(Rothan, H. A., & Byrareddy, S. N. 2020). It is one of the major pathogens that primarily targets the human and animal respiratory system. For reasons yet to be explained, the earlier variants of these viruses can cross species barriers causing in human’s illnesses ranging from common cold to more severe diseases such as Middle East respiratory syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) which are previous outbreaks of coronaviruses (CoVs). Both have been previously characterized as agents that are a great public health threats. (Cascella *et.,al* 2020).Equally, the COVID-19 outbreaks have quickly spread around the world. It spreads the same way other coronaviruses do, mainly through person-to-person contact. Infections range from mild to serious. This is a new pandemic and as more data is gathered with the ongoing researches, more information would become available.

Presently the COVID-19 has been declared a public health emergency of international concern in almost all countries (185 countries) of the world, including Nigerian. The outbreak has, therefore, been declared a global pandemic by World Health Organization (WHO) on 11 march, 2020 because of the ease at which this infectious disease is passing from one person to another in many parts of the world at the same time.(BBC news).

Nigeria has continued to register more people been infected with the virus on a daily basis since the index case of an Italian was reported on 25th February 2020 in addition to various returnees from outside the country, thus assuming epidemic proportion. (Dr Osagie. E, 2020). As at 12th March, 2020 16.00pm there have been 318 confirmed cases, 10 deaths and 70 recovered cases according to WHO statistics. A need therefore to review the COVID-19 situation to combat the deadly scourge becomes pertinent.

* 1. **AIM**

The aim of this paper is to:

* to elucidate strategies to effectively manage mental health in the covid-19 pandemic
* to provide meaningful information for future research related to this topic to support government decision-making on strategies to handle this public health emergency at community, national, and international levels.

**3.1 SCOPE**

To achieve the above aim, a review of the aetiology, histopathological features and the current and potential therapies to address the pandemic will be made. Also, the future of Codvid-19 on public health will be addressed.

**4.1 AETIOLOGY OF COVID-19 (CORONAVIRUS)**

Coronaviruses are positive-stranded Ribonucleic Acid (RNA) viruses with a crown-like appearance under an electron microscope (coronam is the Latin term for crown) due to the presence of spike glycoproteins on the envelope (Cascella *et.,al 2020)*. The genes are mostly expressed by a complex procedure whereby nested Messenger Ribonucleic Acid (mRNA) transcripts are produced, the regulation of which governs the progression of the replication cycle. Coronaviruses are members of the subfamily Coronavirinae in the family Coronaviridae and the order Nidovirales (International Committee on Taxonomy of Viruses). This subfamily consists of four genera —Alphacoronavirus (alphaCoV), etBetacoronavirus (betaCoV), Deltacoronavirus (deltaCoV), and Gammacoronavirus (gammaCoV) — on the basis of their phylogenetic relationships and genomic structures. (Tang *et.,al* 2020). The alphacoronaviruses and betacoronaviruses infect only mammals. The gammacoronaviruses and deltacoronaviruses infect birds, but some of them can also infect mammals. Alphacoronaviruses and betacoronaviruses usually cause respiratory illness in humans and gastroenteritis in animals. (Woo *et.,al* 2012). Genome characterization has shown that probably bats and rodents are the gene sources of alphaCoVs and betaCoVs. Members of this large family of viruses can cause respiratory, enteric, hepatic and neurological diseases in different animal species including camels, bats, cattle, cats and bats. (Cascella *et.,al* 2020) .

COVID-19 belongs to this family of coronaviruses that causes respiratory induced illnesses such as the common cold or more severe diseases such as Severe Acute Respiratory Syndrome (SARS CoV-1), Middle East Respiratory Syndrome (MERS) and Influenza (Spanish flu of 1918). Prior to 2003 members of this family were believed to cause only mild respiratory illness in humans, other coronaviruses then known being largely of importance only to the livestock industry. However, the emergence of Severe Acute Respiratory Virus (SARS-CoV) that year stimulated major research into these viruses, to the effect that many new coronaviruses have since been discovered, some with zoonotic pathogens that can cause severe respiratory disease in humans. (Burrel *et.,al* 2017).

Covid-19 is thus, a related virus strain of SARS CoV-1, termed as (SARS CoV-2) which also spreads primarily through contact with an infected person when he sneezes, coughs or generates respiratory droplets such as saliva or discharges from the nose.(Rothan, H. A., & Byrareddy, S. N. 2020) Thus, it is this new related virus strain, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), disease, discovered in 2019 in China that has brought about the ongoing 2019–20 coronavirus pandemic.

While Spanish flu, SARS and MERS seems to have been contained, the current global outbreak of Covid-19 (SARS CoV-2) has sprung up resulting into the present global pandemic. Presently the Covid-19 has been declared a public health emergency by WHO and in all countries (185) Centres for Disease Control (CDCs), Nigeria inclusive (Aljazeera). Thus, the Covid-19 has demonstrated to a very large extent how quickly a new virus can spread around the world causing wild spread fear, deaths and disruption to all nations. The disease originated from China with the virus traced through intermediary of civets to cave dwelling bats in Wuhan, Hubei Province. Although, it is unclear exactly how contagious the new coronavirus is, data has shown that it spreads from person to person among those in close contact (within about 6 feet, or 2 meters). As earlier stated, the virus spreads by respiratory droplets released when someone with the virus coughs, sneezes or talks (Rothan, H. A., & Byrareddy, S. N. 2020). It can also be spread, if a person touches a surface with the virus on it and then touches his or her mouth, nose or eyes. Expectedly therefore, recent travels from residence in an area or country with a spread of the virus are one sure way of spreading the pandemic, particularly among those with immune deficiency problems. Also, close contact with someone with the sickness or when a family member or health worker takes care of an infected person is another way of contacting the disease (U.S. Centers for Disease Control and Prevention). President Muhammadu Buhari vindicated these assertions when he put it succinctly thus, “majority of the confirmed cases in Lagos, Ogun and the Federal Capital Territory(FCT) Abuja are individuals with recent international travel history or those that came into contact with returnees from international trips”.(Muhammadu Buhari, 2020).

**5.1 PATHOGENESIS OF COVID-19**

The family Coronaviridae encompasses a broad spectrum of animal and human viruses, all characterized by a distinctive morphology. Virions are enveloped and spherical (coronaviruses), or disc, kidney, or rod shaped (toroviruses). Each particle is surrounded by a fringe or “corona” representing the bulbous distal ends of embedded envelope glycoproteins. Coronaviruses are minute in size (65–125 nm in diameter) and contain a single-stranded RNA as a nucleic material, size ranging from 26 to 32kbs in length (Fig. 1).

The severe symptoms of COVID-19 are associated with an increasing numbers and rate of fatalities especially in the epidemic region of China. On January 22, 2020, the China National Health Commission reported the details of the first 17 deaths and on January 25, 2020 the death cases increased to 56 deaths (Wang, W. *et.,al* 2020). The percentage of death among the reported 2684 cases of COVID-19 was approximately 2.84% as of Jan 25, 2020 and the median age of the deaths was 75 (range 48–89) years (Wang, M. *et.,al* 2020).

Patients infected with COVID-19 showed higher leukocyte numbers, abnormal respiratory findings, and increased levels of plasma pro-inflammatory cytokines. One of the COVID-19 case reports showed a patient at 5 days of fever presented with a cough, coarse breathing sounds of both lungs, and a body temperature of 39.0 °C. The patient's sputum showed positive real-time polymerase chain reaction results that confirmed COVID-19 infection (Rothan, H. A., & Byrareddy, S. N. 2020). The laboratory studies showed leucopenia with leukocyte counts of 2.91 × 10^9 cells/L of which 70.0% were neutrophils. Additionally, a value of 16.16 mg/L of blood C-reactive protein was noted which is above the normal range (0–10 mg/L). High erythrocyte sedimentation rate and D-dimer were also observed (Rothan, H. A., & Byrareddy, S. N. 2020). The main pathogenesis of COVID-19 infection as a respiratory system targeting virus was severe pneumonia combined with the incidence of ground-glass opacities, and acute cardiac injury (Huang *et.,al* 2020)

*Fig. 1*

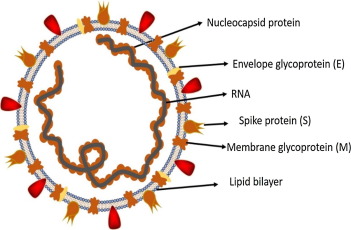
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Fig. 1. Structure of respiratory syndrome causing human coronavirus.

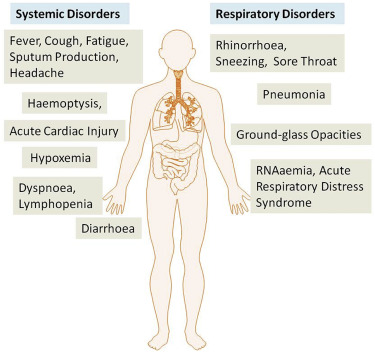
**5.11** **SYMPTOMS**

The symptoms of COVID-19 are non-specific and disease presentation can range from no symptoms (asymptomatic) to severe pneumonia and death. The symptoms appears after an incubation period of approximately 5.2 days.( Rothan, H. A., & Byrareddy, S. N. 2020) . The period from the onset of COVID-19 symptoms to death ranged from 6 to 41 days with a median of 14 days (Fehr et.,al 2017)This period is dependent on the age of the patient and status of the patient's immune system. It was shorter among patients >70-years old compared with those under the age of 70.

As of February 2020 and based on 55924 laboratory confirmed cases, typical signs and symptoms includes: fever(87.9%), dry cough(67.7%), sore throat (13.9%), head ache(13.6%), vomiting(5%), nasal congestion(4.8%), diarrhea(3.7%), arthralgia(14.8%), hemoptysis(0.9%) and conjunctiva congestion(0.8%). (WHO).

Meanwhile, a study published on January 24 in the Lancet medical journal found what is called a “cytokine storm” in infected patients who were severely ill. A cytokine storm is a severe immune reaction in which the body produces immune cells and proteins that can destroy other organs. Some experts say this could explain deaths in younger patients. Symptoms in children with infection appear uncommon, although some children with severe covid-19 have been reported.

A complete or partial loss of the sense of smell(anosmia) has been reported as a potential history finding in patients eventually diagnosed with codvid-19, but this has not been a distinguishing feature in published studies. (Rabin, R. 2020).



The systemic and respiratory disorders caused by COVID-19 infection

**5.12** **TRANSMISSION**

Many domestic and wild animals, including camels, cattle, cats, and bats, may serve as hosts for coronaviruses. (Adhikari *et.,al* 2020).Based on the first cases of the CoVID-19 disease were linked to direct exposure to the Huanan Seafood Wholesale Market of Wuhan, it is suggested that this is the likely zoonotic origin of the COVID-19. Nevertheless, subsequent cases were not associated with this exposure mechanism. Therefore, it was concluded that the virus could also be transmitted from human-to-human, and symptomatic people are the most frequent source of COVID-19 spread. (Cascella *et.,al* 2020). The possibility of transmission before symptoms develop seems to be infrequent, although it cannot be excluded. Moreover, there are suggestions that individuals who remain asymptomatic could transmit the virus.

The latest guidelines from Chinese health authorities described three main transmission routes for the COVID-19:

1. **Droplets Transmission**

Droplets transmission was reported to occur when respiratory droplets (as produced when an infected person coughs or sneezes) are ingested or inhaled by individuals nearby in close proximity.

**2) Contact Transmission,**

contact transmission may occur when a subject touches a surface or object contaminated with the virus. The virus persist on the surfaces to varying durations and degrees on infectivity.

3) **Aerosol Transmission.**

Transmission may occur when respiratory droplets mix into the air, forming aerosols and may cause infection when inhaled high dose of aerosols into the lungs in a relatively closed environment. In addition to these three routes, one study also indicated the digestive system as a potential transmission route for COVID-19 infection. Since patients had abdominal discomfort and diarrhea symptoms. (Adhikari et.,al 2020).

In a small study conducted on women in their third trimester who were confirmed to be infected with the coronavirus, there was no evidence that there is transmission from mother to child. However, all pregnant mothers underwent cesarean sections, so it remains unclear whether transmission can occur during vaginal birth. This is important because pregnant mothers are relatively more susceptible to infection by respiratory pathogens and severe pneumonia. (Rothan, H. A., & Byrareddy, S. N. 2020).

6.1 **HISTOPATHOGENESIS**

The incubation period of Covid-19 is the time between infection and the onset of clinical symptoms of the disease. Current estimates of the incubation period range from 2-11 days, and these estimates will be refined as more data become available. Based on information from other coronavirus disease variants, such as MERS and SARS, the incubation period of COVID 19 could be up to 14 days.(WHO)

Information regarding the histopathological findings in COVID-19 is limited, although several case reports have been published in recent weeks.(Cascella *et.,al* 2020),)The clinical spectrum of COVID-19 varies from asymptomatic or paucisymptomatic forms to clinical conditions characterized by respiratory failure. This necessitates mechanical ventilation and support in an intensive care unit (ICU), to multi organ and systemic manifestations in terms of sepsis, septic shock, and multiple organ dysfunction syndromes (MODS). In one of the first reports on the disease, Huang et al. averred that the patient suffered from fever, malaise, dry cough, and dyspnea. Chest computerized tomography (CT) scans showed pneumonia with abnormal findings in all cases. About a third of those (13, 32%) required ICU care, and there were 6 (15%) fatal cases. (Tian, S. *et.,al* 2019)

The case studies published in the New England Journal of Medicine (NEJM) on January 29, 2020, encapsulates the first 425 cases recorded in Wuhan (Li, Q. *et.,al* 2020). Data indicate that the patients' median age was 59 years, with a range of 15 to 89 years. Thus, they reported no clinical cases in children below 15 years of age. There were no significant gender differences (56% male). Clinical and epidemiological data from the Chinese CDC and regarding 72,314 case records (confirmed, suspected, diagnosed, and asymptomatic cases) were shared in the Journal of the American Medical Association (JAMA) (February 24, 2020), providing an important illustration of the epidemiologic curve of the Chinese outbreak. (Cascella *et.,al* 2020)

According to the Public Health England (PHE) has outlined criteria to assess possibility of COVID-19 infection in patients. These criteria are the same when the patient is deceased with the exception that the timelines given in the guidance refer to the time prior death or onset of relevant symptoms before death where known. If it is considered that COVID-19 may have been related to death by these criteria, the choice of either to perform a full postmortem or an examination is limited only to retrieving the samples required to verify COVID-19 infection. This decision must be made according to the individual case and should include the requirements of the coroner or any pertinent individuals. A staged postmortem may also be considered. This involves taking only diagnostic samples initially and later considering or a more complete autopsy after the results of these diagnostic tests are available. This staged technique is recommended if possible. (Hanley, B. *et.,al* 2020).

Arising from the above, therefore, the macroscopic features of COVID-19 are likely to be in the chest and may include pleurisy, pericarditis, lung consolidation and pulmonary oedema. Lung weight may be increased above normal. It should be noted a secondary infection may be superimposed on the viral infection that can lead to purulent inflammation more typical of bacterial infection (Hanley, B *et.,al* 2020).

A recent article described the early histopathological features in COVID-19 in two patients who underwent surgical resections for lung adenocarcinoma but were later discovered to have had COVID-19 at the time of the operation.(Tian,S *et.,al* 2019) The findings were non-specific and included oedema, pneumocyte hyperplasia, focal inflammation and multinucleated giant cell formation while no hyaline membranes were seen. Given that these patients were asymptomatic with respect to COVID-19 at the time of the operation. These are likely to reflect only early changes of acute lung injury in the infection.(Tian,S *et.,al* 2019)

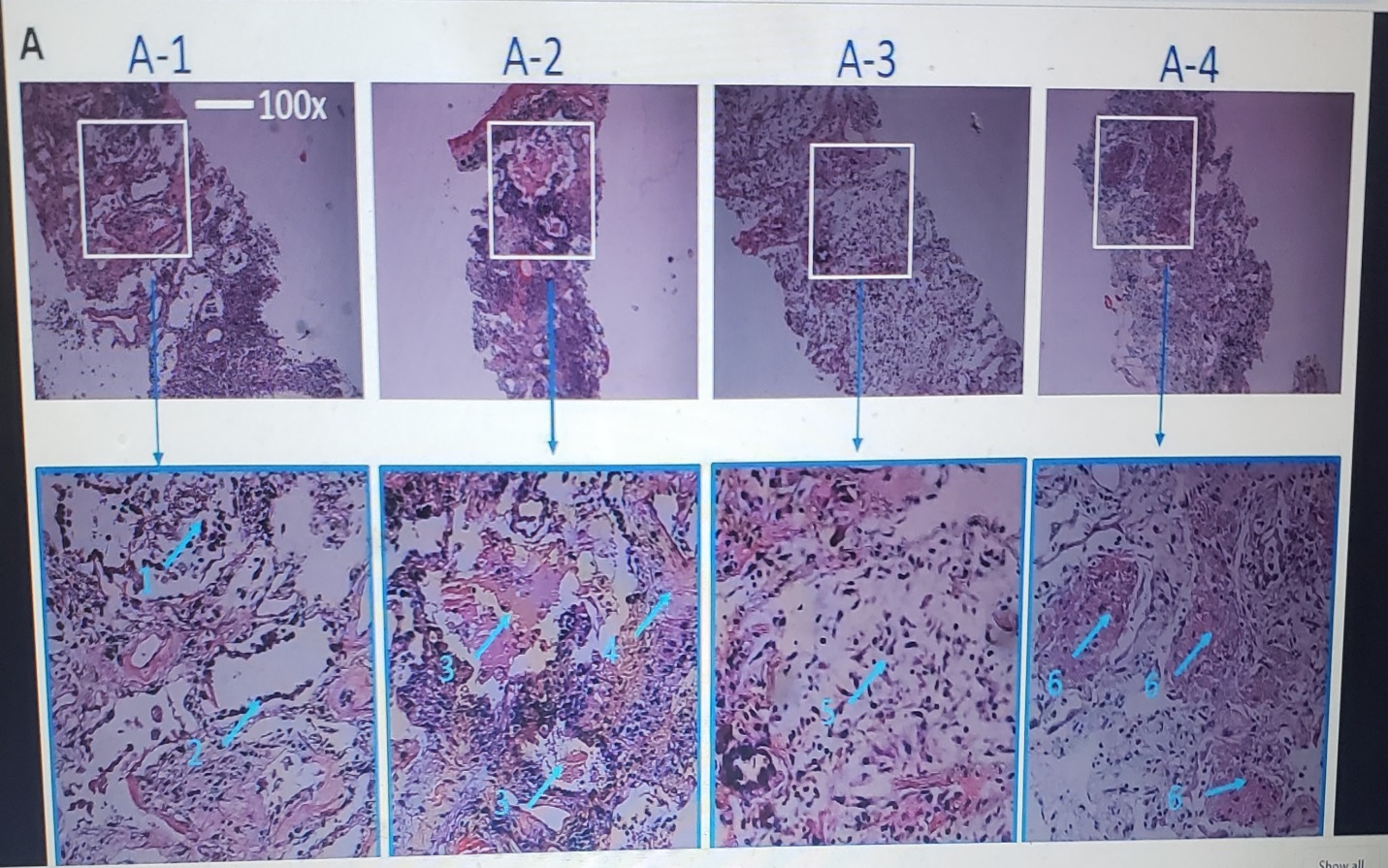
A case study of a 72-year-old man with a history of diabetes and hypertension presented with fever and cough. His throat and pharyngeal swabs were positive for SARS–CoV-2 by day 6 after the initial symptoms. Rapidly progressive respiratory failure required endotracheal intubation and mechanical ventilation 1 week after presentation,

To describe the histopathologic changes in the lung of a patient with COVID-19.

* Lung tissue was obtained by transthoracic 14-gauge needle biopsy from the left upper anterior segment, left upper lingular segment, and left lower lobe coinciding with ground-glass opacities on chest computed tomography (CT).
* throat swab samples were collected from the tonsils and posterior pharyngeal wall.
* Biopsy lung sections were analyzed with hematoxylin–eosin staining, and immunostaining for SARS–CoV-2 was conducted. The CT scans revealed patchy bilateral ground glass–like opacifications. Despite antiviral therapies, respiratory and hemodynamic instability continued and the patient died 3 weeks after diagnosis. (Zhang *et.,al* 2020)

Histopathologic examination of lung biopsy tissues and immunostaining from a patient who died of COVID-19 (×100 magnification).

The Histopathologic examination revealing diffuse alveolar damage, organizing phase (A-1); denudation of alveolar lining cells (arrow 1), with presence of reactive type II pneumocyte hyperplasia (arrow 2) (A-2); intra-alveolar fibrinous exudates (arrow 3) and interstitial loose fibrosis with chronic inflammatory infiltrates (arrow 4) (A-3); and intra-alveolar loose fibrous plugs (arrow 5) (A-4). (Zhang *et.,al* 2020)



Histopathological examination

In another case, a 50-year-old man died from severe COVID-19 infection and more marked histopathological findings were noted (Xu, Z. *et.,al* 2020) Samples were taken by postmortem biopsy, whereby multiple ground glass opacities were noted on chest X-ray although, a description of the gross postmortem findings were not given, The microscopic findings included diffuse alveolar damage with exudates. The inflammation was predominantly lymphocytic, and multinucleated giant cells were seen alongside large atypical pneumocytes, although no definitive viral inclusions were noted (Xu, Z.et*.,al* 2020).

**7.1 CURRENT AND POTENTIAL THERAPIES TO COMBAT COVID-19**

There is currently no vaccine against the ongoing COVID-19 pandemic. No known antibiotics have been found to be effective against the virus due to its being a viral infection and not bacterial. Presently, vaccines and treatments options for disease are currently being investigated around the world. However, there are some evidence that certain medications may have the potential to be effective with regard to preventing illness or treating the symptoms of disease. This implies that there is no specific cure yet for Covid-19. Treatment is therefore, based on the patients clinical conditions, focusing on the supportive care or manifested symptoms.

An efficient approach to drug discovery is to test whether the existing antiviral drugs are effective in treating related viral infections. The 2019-nCoV belongs to *Betacoronavirus* which also contains SARS-CoV and Middle East respiratory syndrome CoV (MERS-CoV) (Wang, M. *et.,al* 2020). However, researchers need to perform randomized controlled trials(CDC) in humans before potential vaccines and other treatments become available. This may take several months or longer. (Aimee Eyvazzadeh, 2020)

Giving the rapidity of the global spread of COVID-19, therefor, effective interventions for severe cases become pertinent. Although little is known about SARS-CoV-2, several insights may be gained from its more well-known family member, SARS-CoV (WangC *et.,al* 2020). They include:

1. **Remdesivir**

Remdesivir may be the most promising antiviral drug for treating COVID-19. It has in vitro and in vivo antiviral activity against a wide array of RNA viruses including SARS and MERS. (Wang, M *et.,al* 2020) It was much better at inhibiting the coronavirus that causes MERS in cell culture and improving respiratory symptoms. The drug has shown consistent promise in disabiling coronaviruses in the laboratory too. Researchers led by Vanderbilt University’s Mark Denison and the university of North Carolina at Chapel Hill’s Ralph Baric showed in 2017 that remdesivir(GS-5734) could inhibit coronaviruses that cause both SARS and MERS in human lung cells. it was also found that the drug reduced viral load and improved functions in a mouse model of SARS. A year later, members of the same research team published another study showing that Remdesivir’s effectiveness relies on coronaviruses having an intact RNA-dependent RNA polymerase. “We were looking for compounds that could broadly inhibit coronaviruses and the RNA-dependent RNA polymerase is, if not the most conserved protein in coronaviruses, definitely within the top two, so that makes it a good target for broad-spectrum antivirals,” says Maria Agostini, a postdoc in the Denison lab. New work Götte and colleagues publication on February 24 in the Journal of Biological Chemistry also indicates that the drug, which they refer to an as an analog inhibitor, exerts these effects on the MERS coronavirus polymerase via delayed RNA chain termination.

1. **Chloroquine**

Chloroquine is a potential broad-spectrum antiviral drug. It is a medication primarily used to prevent and treat malaria. It exerts direct antiviral effects, inhibiting pH-dependent steps of the replication of several viruses including members of the flaviviruses, retroviruses, and coronaviruses. It is a widely-used anti-malarial and autoimmune disease drug which has recently been reported as a potential broad-spectrum antiviral drug. It is known to block virus infection by increasing endosomal pH required for virus/cell fusion, as well as interfering with the glycosylation of cellular receptors of SARS-CoV. Besides its antiviral activity, chloroquine has an immune-modulating activity, which may synergistically enhance its antiviral effect in vivo.(Wang, M. *et.,,al* 2020).

It has the capacity to be widely distributed in the whole body, including lungs, after oral administration. It is a cheap and a safe drug that has been used for more than 70 years and, therefore, it is potentially clinically applicable against the 2019-nCoV. Therefore, the potential usefulness of this old drug in the treatment of an infectious disease that poses serious threat to public health in the era of globalisation in severe acute respiratory syndrome (SARS) cannot be over emphasised.

President Trump has frequently referred to the potential of hydroxychloroquine in White House briefings. At a recent press conference, he referred to it and said: "What do you have to lose? Take it." Also, in a video removed by Facebook for breaching its misinformation guidelines, Brazilian President Jair Bolsonaro claimed "hydroxychloroquine is working in all places". However, the Nigerian Centres for Disease Control (NCDC) has told people to stop taking it. "The WHO has NOT approved the use of chloroquine for #COVID19 management." (Jack Goodman and Christopher Giles).

Again, Covid is caused by enveloped RNA viruses, and share some clinical manifestations that are likely to be mediated by immune reactions of the host. The causative agent of SARS has recently been described as a new coronavirus. (Savarino *et.,al* 2003).

Recent studies support the idea that coronaviridae infect their target cells by an endocytic pathway and that chloroquine might inhibit their replication, Cells infected with the human coronavirus HCoV-229E and treated with nocodazole (a microtubuledepolymerising agent that blocks transport from early to late endosomes) produced decreased amounts of HCoV-229E antigens. (Savarino *et.,al* 2006).

This result indicates that endosomal transport is needed for HCoV-229E infection. Cells treated with chloroquine expressed decreased amounts of HCoV-229E antigens. Although the SARS coronavirus is distinct with unique characteristics, it is tempting to ask whether chloroquine might affect SARS coronavirus replication as well.

1. **Lopinavir and ritonavir**

Lopinavir and ritonavir are sold under the name Kaletra and are designed to treat HIV. In South Korea, a 54-year-old man was given a combination of these two drugs and had a significant reduction.in his levels of the coronavirus. According to the World Health Organization (WHO), there could be benefits to using Kaletra in combination with other drugs.

1. **APN01**

A clinical trial is set to start soon in China to examine the potential of a drug called APN01 to fight the novel coronavirus. The scientists who first developed APN01 in the early 2000s discovered that a certain protein called ACE2 is involved in SARS infections. This protein also helped protect the lungs from injury due to respiratory distress.

From recent research, it turns out that the 2019 coronavirus, like SARS, also uses the ACE2 protein to infect cells in humans. The randomized, dual-arm trial will look at the effect of the medication on 24 patients for 1 week. Half of the participants in the trial will receive the APN01 drug, and the other half will be given a placebo. If results are encouraging, larger clinical trials will be done.

1. **FAVILAVIR**

China has approved the use of the antiviral drug favilavir to treat symptoms of COVID-19. The drug was initially developed to treat inflammation in the nose and throat. Although the results of the study haven’t been released yet, the drug has supposedly shown to be effective in treating COVID-19 symptoms in a clinical trial of 70 people. (Aimee, E. 2020).

**7.11 Herbal potential therapies**

Based on the fact that COVID-19 is a viral infection, the use of antiviral medicinal plants might be useful in its prevention and management. Working with the symptoms of COVID-19 infection, which includes fever, cough, body pain, flu, cold and shortness of breath, Idayat Gbadamosi, an associate professor at the University of Ibadan, proposed that “plants with antimalarial effect, cough remedy, herbal analgesic, and medicinal plants” could be useful in the prevention of the COVID-19 infection.

In a yet-to-be-published paper on possible herbal ways of preventing the novel COVID-19, Gbadamosi, a well-published expert in ethnobotany and medicinal plants says her publication is “targeted towards boosting the immune system to help fight the coronavirus,” clearly stating that it is “not by any means a cure for COVID-19 infection”.

She further argues that :“why countries such as the USA and Europe are battling with insufficient testing equipment and spread, Nigerians should turn to nature and explore the benefits of medicinal plants as immune boosters and anti-infective with a view to migrating the spread of Covid-19 infection ” her immune boosting recipe are as follows:

1. **Herbs for respiratory tract infections:**

Herbs for the management of respiratory tract infections include Spondias mombin (yellow mombin), Garcinia kola, Calotropis procera (apple of Sodom), Nymphaea lotus (water lily) and Abrus precatorius (water lily). The remedies are prepared as leaf juice, infusion, decoction and traditional soup for therapeutic purposes. As an example, an infusion of bitter kola and garlic in clean water are used for the management of respiratory tract infections.

1. **Herbal immune boosters:**

Guava (Psidium guajava) leaf, mango (Mangifera indica) stem bark and leaf, lemon grass (Cymbopogon citratus) leaf, ginger (Zingiber officinale) rhizome, garlic (Allium sativum) bulb and cinnamon (Cinnamomum zeylanicum) stem bark are immune-boosting herbs that can be prepared in powdered form or as a decoction for oral administration. Generally, spices other than pepper are rich in antioxidants, antimicrobials; they also have anticancer properties.

Research has confirmed that eating a small amount of ginger (Zingiber officinale) daily for 11 days or more can reduce muscle pain and inflammation; ginger also aids digestion. Generally spicing food up a little adds more than just flavour. Other useful spices are onions (Allium species), black pepper (Piper guineense), guinea pepper, clove (Syzygium aromaticum) and green onions (Allium ascalonicum).

As an example, an immune-boosting recipe is as follows: Prepare a decoction of powdered turmeric (125 g), ginger (20 g), garlic (2 g), guinea pepper (a pinch), clove (a pinch), black pepper (a pinch) and coconut water (5 cups) by boiling for 20 minutes. Allow the extract to cool and filter using a fine sieve. Then add lemon (4 teaspoons) and honey (teaspoons) to the extract. Drink ½ teacup of the extract before breakfast or in between meals once daily. One preparation can last for a week if refrigerated.

1. **Natural antioxidants:**

Fruits and vegetables have antioxidant properties. In addition to vitamins A and C, they contain a polyphenol (quercetin) that have strong H+ donating activity. Phenolic acids generally act as antioxidants by trapping free radicals and some plant-derived compounds are better antioxidants than BHA (Butylated Hydroxyl Anisole).

Consequently, natural antioxidants may be useful in the treatment and prevention of chronic infections and diseases. Some Nigerian vegetables are bitter leaf (Vernonia amygdalina), jute mallow (Corchorus olitorius), spinach (Senecio biafrae), African lettuce (Launnaea taraxacifolia), and pumpkin plant (Telfaria occidentalis). The message is let food be your medicine and medicine be your food. (Majowa ,T. 2020).

**8.1 IMPLICATION ON PUBLIC HEALTH**

It has been highly contagious and caused several respiratory disease which has quickly impacted the governments and public health system which have responded by declaring a public health emergency of national and international concern as well as adopting extraordinary measures to prevent the contagion and limit the outbreak.

Millions of lives have been significantly altered and a global, multi-level and demanding stress coping adjustment process is ongoing to curb the spread of the covid-19.

The covid-19 has now achieved a pandemic status. The government is trying to manage the problem from a biomedical and psychological point of view which has disrupted pour daily activities. On April 3, 2020, the CDC issued a recommendation that the general public, even those without symptoms, should begin wearing face coverings in public settings where social-distancing measures are difficult to maintain in order to abate the spread of COVID-19. (David J Cennimo 2020)

The CDC has postulated that this situation could result in large numbers of patients requiring medical care concurrently, resulting in overloaded public health and healthcare systems and, potentially, elevated rates of hospitalizations and deaths. The CDC advises that nonpharmaceutical interventions (NPIs) will serve as the most important response strategy in attempting to delay viral spread and to reduce disease impact.

The feasibility and implications of strategies for suppression and mitigation have been rigorously analyzed and are being encouraged or enforced by many governments in order to slow or halt viral transmission. Population-wide social distancing of the entire population plus other interventions (e.g., home self-isolation, school and business closures) is strongly advised. These policies may be required for long periods to avoid rebound viral transmission.

It has impacted negatively in the social, education and religious practices as the governments both at international and national level have implemented measures to stop the spread by

* Cancellation of worship services of various faith. Many churches, mosques, synagogues and temples have offered worship through live stream amidst the pandemic.
* According to data by the UNESCO as of 25th March,2020 the government issued closure of universities due to the CODVID-19 were.
* According to data by the UNESCO as of 25th March, 2020 the federal government issued closure of universities and schools due to the CODVID-19 pandemic.

**9.1 CONCLUSION**

This study shows the current research in response to the outbreak of COVID-19. During this early period, many studies have been published exploring the epidemiology, causes, clinical manifestation and diagnosis. Extensive measures to reduce person-to-person transmission of Covid-19 are required to control the current outbreak. Epidemiology changes in Covid-19 should be monitored taking into account potential routes of transmission and subclinical infection.

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