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Review Article

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Review on Epidemiology and Zoonotic Importance of Coronavirus Disease 2019

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Abstract

The Corona Virus Disease 2019 (COVID-19) pandemic poses a significant threat to the global public health systems. Its crisis is affecting the entire world economy and that of Africa including Ethiopia. The first known coronavirus (CoVs), the avian and human were isolated in 1937 and mid-1960s respectively. Based on the large number of infected people that were exposed to the wet animal market in Wuhan City, China, in December, 2019 suggested that this is likely the zoonotic origin of COVID-19. The aim of this paper is to review the epidemiology and public health importance of COVID-19.CoVs are spherical, single stranded, enveloped RNA and virions have large peplomers that make it look like a crown. CoVs are four sub types such as alpha, beta, gamma and delta. COVID-19 is beta sub type and caused by SARS-COV-2. According to available information, SARS-CoV-2 is inferred to be a recombinant virus that originated from bats and was transmitted to humans, possibly using the pangolin as the intermediate host. SARS-CoV-2 transmission is through droplets, whereby small droplets spread in the surrounding air by the coughing and sneezing of infected individuals. CoVs spike protein binds to host ACE2 receptor to initiate the infection process through host immune responses. Common symptoms are pneumonia, fever, cough, sore throat and dyspnea. The standard tool of diagnosis are by reverse transcription polymerase chain reaction (RT-PCR), combination of symptoms, history, risk factors and a chest Computed Tomography (CT) scan showing features of pneumonia. Even if there is no specific antiviral treatment recommended for COVID-19 and no vaccine is currently available, it can be treated with antiviral, antimalarial, anti-inflammatory, and active plasma antibodies. The most effective ways to prevent COVID-19 are maintain physical distance from animals and human, refrain from touching eyes, nose, and mouth, frequent hand washing with soap or disinfection with sanitizer.Eventhough COVID-19 is highly transmittable and pathogenic viral infection; there is shortage information about the virus. Therefore further review and investigations are required to know detail about nature of virus. Strengthening food control and market hygiene activities in live food market will be essential to protect people from COVID-19 and other zoonotic diseases.

Keywords: COVID-19, SARS-CoV-2, Zoonotic

Introduction

Animals play an important role in public health arena, and that they are significantly affecting human health evolving zoonosis and pathogens' mutation. With a significant representation of more than 75% of the newly emerging diseases, viral zoonosis are among the top challenges threaten public health [1]. In December, 2019, a series of pneumonia cases of unknown cause emerged in Wuhan, Hubei, China, with clinical presentations greatly resembling viral pneumonia. Deep sequencing analysis from lower respiratory tract samples indicated a novel coronavirus, which was named as coronavirus disease 2019 (COVID-19) [2].

Coronaviruses (CoVs) have long been recognized as important veterinary pathogens, causing respiratory and enteric diseases in mammals as well as in birds [3].CoVs are an RNA virus, with a typical crown-like appearance under an electron microscope due to the presence of glycoprotein spikes on its envelope [4]. They are in the Coronaviridae family that are divided in 4 genera: alpha, beta, gamma and delta that cause disease varying from mild to severe in human and animals [5]. The virus that causes COVID-19 is nominated as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [2].

COVID-19 has quickly become widespread, resulting in an epidemic throughout China, followed by a pandemic, an increasing number of cases in various countries throughout the world [6]. The culinary habits of Chinese people involve the consumption of wild animal meat. The common motivation that is responsible for the human consumption of wild animal meat in China is due to their believed medicinal value as well as the health promoting effects associated with the consumption of certain wild game animal meats and their products [7].

It is not the first time that a CoVs causing an epidemic has been a significant global health threat in November 2019, an outbreak of CoVs with severe acute respiratory syndrome (SARS)-CoV started in the Chinese province of Guangdong in 2002 and again in September 2012 the Middle East respiratory syndrome (MERS)-CoV appeared [8].Coronavirus are common in many different animal species, including camels, cattle, cats, and bats. Animal CoVs can infect humans and, as a result, may spread among humans during epidemics such as SARS, MERS, and pandemic COVID-19 [9- 11].

Based on the large number of infected people that were exposed to the wet animal market in Wuhan City where live animals are routinely sold, it is suggested that this is the likely zoonotic origin of the COVID-19. Person-to-person transmission occurs primarily via direct contact or through droplets spread by coughing or sneezing from an infected individual [12].Clinical characteristics involve fever, dry cough, fatigue, sore throat, rhinorrhea, conjunctivitis headache, myalgia, dyspnea, nausea, vomiting and diarrhea. In a subgroup of cases, by the end of the first week, COVID-19 may develop to pneumonia, pulmonary failure and death [13]. Ribonucleic acids (RNA) of SARS-CoV-2 can be checked by reverse transcriptase-polymerase chain reaction (RT-PCR)[14].

Currently, there are no effective or specific treatments for COVID-19. Treatment is supportive, mechanical ventilation and oxygen supplementation in the event of respiratory distress. Primary prevention measures, based on promoting hygiene measures, physical distance, avoid eating of raw and undercooked meat and fish, restrictions of travel and movement of people, home isolation to prevent transmission[15].Sinceit is newly emergingvirus with high transmission rate within a short period of time and further investigation is not undertaken, there is gap of information about COVID-19. Therefore the objective of this review is:

- To explain occurrence, distributionand public health importance of COVID-19.

Literature review

Historical background of coronavirus

The first known coronavirus, the avian infectious bronchitis virus, was isolated in 1937 and was the cause of devastating infections in chicken[16]. Human CoVs were first identified in the mid-1960s. The four common CoVs that typically cause mild upper respiratory infections in people include: 229E (alphacoronavirus), NL63 (alphacoronavirus), OC43 (betacoronavirus), HKU1 (betacoronavirus)[17]. SARS-CoVin the Guangdong state of China occurred for the first time in 2002 and 2003 [18 and 19]. Approximately ten years after SARS this time, another highly pathogenic CoV, MERS-CoVhas emerged in the Middle East countries in 2012[20].In December 2019 it was reported that a cluster of patients with pneumonia of unknown cause was linked to a local Huanan South China Seafood Market in Wuhan, Hubei Province, China[21]. A few weeks later, in January 2020, deep sequencing analysis from lower respiratory tract samples identified a novel virus severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as causative agent for that observed pneumonia cluster. The disease became pandemic within a few months of its emergence, indicating high transmission abilityascompared with SARS and MERS [22].

Etiology

Coronaviruses are a group of large, enveloped, positive-sense, single-stranded RNA viruses belonging to the order Nidovirales, family Coronaviridae, subfamily Coronavirinae. They are separated into four genera as follows: Alpha, Beta, Gamma and Delta CoVs. Alpha and Beta - CoVs only infect mammals, but Gamma and Delta - CoVs mostly infects birds. Human CoVs consists of Alpha- CoVs (229E and NL63), Beta-CoVs (OC43 and HKU1), MERS-CoV, SARS-CoVand SARS-CoV-2[21]. The causative agent of COVID-19 is called SARS-CoV-2 and its genetic analysis revealed that it is closely related to SARS-CoV and within the genus Beta CoV, subgenus Sarbecovirus. SARS-CoV and MERS-CoVs were also part of the Beta CoV genus, but SARS-CoV-2 is different from these two at genetic level [23].

Morphology: Coronaviruses are spherical or pleomorphic, 150 to 160 nm in size, single stranded, enveloped RNA and covered with club shaped glycoprotein [2]. They encode five structural proteins in their genomes. These are the Spike (S), Membrane (M), Envelope (E) glycoproteins, Hemagglutinin Esterase (HE) and Nucleocapsid (N) protein. All envelope proteins and N protein is present in all virions but HE is only present in some beta CoVs (Lissenberg et al., 2005). COVID-19 differs from other CoVs by encoding an additional glycoprotein that has acetyl esterase and hemagglutination properties [24].CoVs are so named because of their characteristic solar corona (crown-like)appearance when observed under an electron microscope. This appearance is produced by the peplomers of the spike glycoprotein radiating from the virus lipid envelope[25].The spike glycoprotein is a major antigen responsible for both receptor binding and cell fusion and the transmembrane glycoproteinis involved in budding and envelope formation; the Membrane protein has also been found to play a pivotal role in virion assembly[26].

Life cycle: Coronaviruses are covered by spike proteins that contain a variable receptor-binding domain (RBD). This RBD binds to angiotensin-converting enzyme-2 (ACE-2) receptor found in the lungs, heart, kidneys, and gastrointestinal tract [27]thus facilitating viral entry into target cells. The receptor binding affinity of the SARS-CoV-2 S- protein is 10 times higher than that of the SARS-CoV. Virus entry takes place either by fusion with the plasma membraneor by endocytosis, and the subsequent fusion of membranes in endosomes [28]. Once inside the host cell, the viral RNA is translated in the cytoplasm producing polyproteins and structural proteins. After translation, the replication of the genome occurs. New virus particles are formed in the membranes of the Golgi apparatus and theendoplasmic reticulum, after which the vesicles harboring the viral particles are fused

with plasma membranes for the release of the virus [29].

Coronavirus are capable of adapting quickly to new hosts through the processes of genetic recombination and mutation in vivo. As others RNA viruses, CoVs rely on RNA-dependent RNApolymerase (RdRp) to replicate the virus genome. The intrinsic error rate of RdRp is approximately 1,000,000 mutation/site/ replication, resulting in continuous point mutations. Point mutations alone are not sufficient to create a new virus, however; this can only occur when the same host is simultaneously infected with two coronavirus strains, enabling recombination[30].

Epidemiology

Geographical distribution of coronavirus: The WHO documented that the COVID-19 outbreak originated from 'wet markets' in South China, selling meat of wild animals [31]. Disease cases are rapidly increasing in other countries across all continents except Antarctica, outpacing the rate and numbers of China. These cases were initially believed to be attributed to the migration of infected people from China to other parts of the world[32].

However, local transmission in several countries such as; Italy, Germany, Spain, UK, France, USA, South Korea,Japan and in many other countries are becoming so high, which has driven more significant outbreaks outside of mainland of China, resulting in a massive worldwide pandemic.Ethiopia is the second most populous nation in Africa, next to Nigeria. According to WHO alert Ethiopia will be one of the seriously affected countries in Africa [33].

It is very intriguing to note that the SARS outbreak in Southern China in 2002 and the current outbreak of COVID-19 happened in winter due to exposure to live animals sold in markets. Primary examinations revealed some environmental specimens were positive for COVID-19 in Huanan Seafood Market, Wuhan [31].

Risk factors

COVID-19 infection droplets can travel 1–2 meters and later put down on surfaces. Droplets normally do not extend more than 2 meters and do not hang on in the air. The virus could stay viable on surfaces for days in desirable environmental conditions but are ruined in less than a minute by regular disinfectants, such as sodium hypochlorite and hydrogen peroxide [34]. Based on our current understanding from other beta CoVs, including SARS and MERS, CoVs can survive, and remain infectious, from 2 hour up to 9 days on inanimate surfaces such as metal, glass, or plastic, with increased survival in colder and dryer environments [35].

On Feb. 28, 2020, the Government of Hong Kong announced that a pet dog of a COVID-19 case had tested positive for the virus. Oral and nasal swabs had tested weak positive by real time RT-PCR and two subsequent follow-up tests were also positive. Experts, including the OIE, concluded that the dog has a low-level of infection. The dog has not shown any clinical signs of illness. It is likely a case of human to animal transmission. There is currently no evidence that dogs can spread the infection[17].A recent study found that pigs, ferrets, cats, and non-human primates have ACE2 receptors that are favorable for COVID-19 binding. The finding demonstrated that the susceptibility of ferrets, cats, dogs, and different domestic animal species to SARS-CoV-2 by experimental inoculation and reported that SARSCoV-2 replicates poorly in dogs, pigs, chickens, and ducks, but efficiently in ferrets and cats [36].

Previous outbreaks of beta CoVs in humans involved direct exposure to animals other than bats. In the case of SARS-CoV and MERS-CoV, they were transmitted directly to humans from civet cats and dromedary camels respectively [37]. Bats are ideal reservoir hosts for CoVs, as viruses are persistently present in bats and being asymptomatic. They travel across the forests in search of food and transmit the virus to a variety of hosts they come in contact with [38]. In China, bats are not only sold for food purposes in live-

animal markets, but they are an integral part of Traditional Chinese Medicine [39].

In the current COVID-19 pandemic, laboratory findings confirmed that SARSCoV-2 is also 96% identical to the bat CoV at the genomic level, and hence bats may be the primary source of this zoonotic spillover [40]. It is, therefore, believed that the SARS-CoV-2 also originated from bats and, after mutating, was able to infect other animals [27].The mutation increased the RBD affinity to ACE-2 in humans. Not only from bats, coronavirus has been isolated from Malayan Pangolins (*Manis javanica*; a long-snouted, ant-eating mammal sold illegally for use in traditional Chinese medicine) also, and RBD in S protein of SARS-CoV-2 was nearly the same as that of Pangolin-CoV, and thus pangolins might be the intermediate host of SARS-CoV-2 [41]. The analysis of samples from Malytan pangolins obtained during anti-smuggling operations from Guangdong and Guangxi Customs of China respectively found novel CoVs representing two sub-lineages related to SARS-CoV-2 [42].

Outbreak: The first outbreak of SARS-CoV occurred in 2002 [43], the second MERS-CoV in 2012, followed by the novel Wuhan, China Coronavirus “2019- noble CoV” [44],which has become the third coronavirus to emerge in the human population, and has threatened the entire world. The WHO declared the novel coronavirus “2019-nCoV” outbreak as a global public health emergency [45].Similar to the SARS epidemic, COVID-19 outbreak has occurred during the Spring Festival in China, which is the most famous traditional festival in China, during which nearly 3 billion people travel countrywide. These conditions caused favorable conditions for the transmission of this highly contagious disease and severe difficulties in prevention and control of the epidemic. The period of the Spring Festival of China was between January 17 and February 23 in 2003, when the SARS epidemic peaked, while the period of the festival was between January 10 and February 18 in 2020 [46].Genome changes resulting from recombination, gene exchange, gene insertion, or deletion are frequent among CoVs, and this will take place in future outbreaks as in past epidemics and pandemic [47].

Transmission: Coronaviruses are zoonotic, and can be transmitted from animal to animal, human to animal, and human to human[47]. COVID-19 was originated from bats, snakes, seafood.In the beginning, an association with a seafood market selling live animals in Wuhan, where most of the earlier patients having pneumonia had worked or visited, was recognized. However, as the epidemic disease grew, person-to-person transmission became the principal means of spread[45]. The infection is spread using large droplets produced during coughing and sneezing by symptomatic cases but may also happen from asymptomatic individuals before starting of their symptoms [49]. SARS-CoV-2 is obtained either by breathing of the droplets or touching surface tainted by them and then touching the nose, mouth and eyes. Cases may be contagious for as long as the symptoms continue and even after clinical improvement [2].There is no evidence for the sexual transmission of SARS-CoV-2; however, the possibility of fecal transmission has been reported but not all, suggesting that a possible fecal-oral transmission occurs [50].

Pathogenesis

The intra- or inter-species transmission of β-CoVs requires a viral interaction with the host cell receptors, and the subsequent invasion of the host cells. The genome of the coronavirus spike protein specifically binds to the host cellular receptors to initiate the infection process [37]. Furthermore, studies using human, pig, and civet cell lines have allowed SARS-CoV-2 infection and replication, indicating that the virus makes use of the ACE2 receptor for infection [14].

Binding of the SARS-CoV-2 to the ACE-2 receptors in the type II pneumocytes in the lungs triggers a cascade of inflammation in the lower respiratory tract. It has been demonstrated that when the SARS-CoV-2 spike protein binds to the ACE-2 receptorthe complex is proteolytically processed by type 2 transmembrane protease (TMPRSS2) leading to cleavage of ACE-2 and

activation of the spike protein, thus facilitating viral entry into the target cell[27].ACE2 is highly expressed in the lungs; a vast surface area makes the lung tissue highly susceptible to SARS-CoV-2 infection [51].

In addition to the lungs, the ACE2 receptor is also expressed in the endothelial cells of intestine, the virus might pass through the mucous membranes, especially nasal and larynx mucosa then enters the lungs through the respiratory tract. The virus would also attack the targeting organs that express ACE2, such as, heart and renal system [52].Viral entry and cell infection trigger the host's immune response, and the inflammatory cascade is initiated by antigen-presenting cells (APC). The process starts with the APC performing two functions:presenting the foreign antigen to CD4+-T-helper (Th1) cells, and releasing interleukin-12 to further stimulate the Th1 cell. The Th1 cells stimulate CD8+-T-killer (Tk) cells that will target any cells containing the foreign antigen. In addition, activated Th1 cells stimulate B-cells to produce antigen-specific antibodies[27].

Clinical Signs

It has been observed a broad spectrum of clinical presentation for COVID-19, ranging from asymptomatic or mild to severe cases with severe acute respiratory distress, which may require intensive care[53]. COVID-19 lasts up to 6 weeks depending upon the individual's immunity and the disease intensity. A variable incubation period has been reported for the infection to establish completely; a second exposure to the viral inoculum may decrease the incubation time. An incubation time of 3 to 27 days (average 14 days) has been reported by different sources. Individuals of all ages may acquire SARS-CoV-2 infection, although middle age and older individuals are the majority[54]. There is no specific clinical feature that can yet reliably distinguish COVID-19 from other viral respiratory infections[2]. The main COVID-19-associated symptoms are: fever, cough, dyspnea, headache, sore throat and rhinorrhea[54]. Pneumonia appears to be the most frequent serious manifestation of infection, characterized by bilateral infiltrates on chest imaging. In addition to respiratory symptoms: muscle ache, headache, chest pain, diarrhea, haemoptysis, sputum production, nausea and vomiting, confusion, and anorexia were also observed in a proportion of the patients[55].The clinical form varies from enteritis in cattle, horses and swine, upper respiratory tract disease in cattle, dogs, felines [56].

Diagnosis

Epidemiological history comprising cases having a contact history with individuals of fever or respiratory symptoms who have a contact history with patients from the epidemic city/adjacent area[57].Nasal secretions, blood, sputum, and bronchoalveolar lavage (BAL) collected from suspectedpatients are used as clinical specimens. The samples are subjected to specific serological and molecular tests specific for COVID-19 for laboratory diagnosis. Serological tests employ enzyme linked immunosorbent assay (ELISA) or Western blots that detects specific COVID-19 proteins. Molecular approaches are based on RT-PCR or Northern blot hybridization targeting specific COVID-19 genes[58].

Viral antigens present in the clinical specimens are detected by using direct immune fluorescent assay (IFA). A systematic study showed that viruses could be detected in oral swabs, anal swabs and blood samples of the patients, and the anal swabs and blood could test positive when oral swab tested negative. Furthermore, a trend of shift from more oral positive in the collected samples during the early period of patient infection to more anal positive during later period of infection was also found [59]. The lung X-ray generally shows bilateral infiltrations but may be normal in the early phase of the disease. The chest computed tomography (CT) is more sensitive and specific. Lung CT scans generally demonstrate infiltrates, ground-glass opacities and subsegmental consolidation. Less common abnormalities contain pleural effusion/thickening, and lymphadenopathy[60]. In patients with COVID-19, the white blood cell count can vary. Leukopenia, leukocytosis, and lymphopenia have

been reported, although lymphopenia appears most common. Elevated lactate dehydrogenase, ferritin and aminotransferase levels have been described[61].

Treatment

As an emerging virus, there is no effective drug or vaccine approved for the treatment of SARS-CoV-2 infection yet. The first step is to guarantee sufficient isolation to stop spread for other contacted individuals, cases and healthcare workers. Currently, supportive care is provided to the patients, including oxygen therapy, antibiotic treatment, and antifungal treatment, extra-corporeal membrane oxygenation (ECMO) [50]. To search for an antiviral drug effective in treating SARS-CoV-2 infection, seven drugs were evaluated, namely, ribavirin, penciclovir, nitazoxanide, nafamostat, chloroquine, remdesivir (GS-5734) and favipiravir (T-750) against the infection of SARS-CoV-2 on Vero E6 cells *in vitro* [44].

Application of an anti-inflammatory drug such as baricitinib, together with an antiviral drug, has also been recommended to treat COVID-19. High doses of ascorbic acid (vitamin C) are suggested for the prevention of the COVID-19 disease. Type I interferon can inhibit viral replication[29].Antibiotics and/or antifungals are required if co-infections, such as Mycoplasma and Chlamydia, are suspected or proven. Prolonged macrolide therapy, as a modulator of immune function, is being evaluated [57].

The use of convalescent plasma for the treatment of COVID-19 has been suggested. However, the absence of multiple trials on a large scale, and the concern that antibodies may demonstrate donor dependent titters and specificities, are the main deficits of convalescent plasma therapy [62]. Currently, a tremendous amount of research is in progress to develop a vaccine against COVID-19; however, vaccine development is time consuming process, and the newly introduced vaccine will require several safety evaluations. Even after the preparation of an effective vaccine, under the present pandemic situation, human trials will be a big challenge for researchers[52].

Prevention and control

There are several challenges in the management and control of CoVs. A wide range of CoVs with a highly mutable single-stranded RNA genome are found in many mammalian and avian sources that closely interact with each other, as well as with humans [63].Prevention is, so far, the best practice in order to reduce the impact of COVID-19 considering the lack of effective treatment. The best prevention is to avoid exposure to the virus [64].

In order to achieve this goal, the main measures are the following: uses face masks, cover coughs and sneezes with tissues that are then safely disposed of (or, if no tissues are available, use a flexed elbow to cover the cough or sneeze) [65] regular hand washing with soap or disinfection with hand sanitizer containing at least 60% alcohol (if soap and water are not available), avoid contact with infected people or animal, maintain an appropriate distance, refrain from touching eyes, nose, and mouth. In case of symptoms, seek medical care early follow advice given by your healthcare provider [66].

The most effective way to prevent viral zoonosis is for humans to stay away from the ecological niches of the natural reservoirs of the viruses [65].Efforts for rapid diagnosis, strict vigilance, appropriate isolation, and quarantine procedures to halt its further spread, enhanced surveillance and monitoring, strengthening of medical facilities and intensive care units, networking programs, rapid communication and providing updates, knowledge awareness of its public health risks to the general population, high efforts to develop effective vaccines and therapeutics/drugs are being explored optimally [39].

Status of covid 19 in Ethiopia

Ethiopia is the second most populous nation in Africa, next to Nigeria. According to WHO alert the country will be one of the seriously affected

countries in Africa. Since first evidence of the COVID-19 pandemic was reported in the country in March 14, 2020 in Addis Ababa [67].Developing countries like Ethiopia, are in an economic, financial and resource constraints to control the already existing life-threatening infectious diseases. Moreover, the current modalities of case detection, diagnosis and quarantine for COVID 19 are resource demanding, which adds direct and indirect economic burden to the countries with weak economic background[68].

In Ethiopia, measures were adopted on March 16th and further sharpened on March 20 when there were only 5 confirmed cases. On April 10th, a five-month state of emergency was declared. In terms of the stringency of the measures, at least on paper, our calculations show that the preventive measures adopted by the country place it in the most stringent category [69].Immediately after the first confirmed case of COVID-19, the Government of Ethiopia took several public health measures to prevent increased levels of infection[70; 71].

These include closing schools, restricting use of public transportation, banning large meetings, and suspending sporting and religious gatherings. A state of emergency has been put in effect and staying at home and working from there has been strongly advised [72]. In many countries there is strong monitoring strategy for international travelers. The good example is in Ethiopia, there is 14 days mandatory quarantine for international travelers [73].At current levels of infection, public health measures still hold promise to slow and ultimately contain the spread of COVID-19. If effective, such measures can prevent a partial or total shutdown of economic activities in the country [74].

The effort of the Ethio-telecom to provide preventive messages during phone calls is strategic and likely to reach a larger segment of the population than, for example, television transmissions. This is supported by findings from a recent qualitative study in Ethiopia among urban and rural adolescents which found that the main and often only source of information they received on COVID-19 prevention [75]. In Ethiopian context, health extension workers assigned to the community with a specific catchment population to monitor the health of the community for COVID-19 in a regular basis using the case definition in facilitating and identifying the cases [73].At the time of writing (October19, 2020), there are 89,860 confirmed cases based on 1,403,894 tests. There have been 43,149 recoveries and 1,365 deaths [76].

Zoonotic importance of coronavirus

Zoonoses are those diseases and infections which are naturally transmitted between vertebrate animals and man. COVID-19 is an acute respiratory disease caused by a newly emerged zoonotic coronavirus. Human infections with zoonotic CoVs including SARS-CoV, MERS-CoV, and a COVID-19, Wuhan China, have raised great public health concern globally[13]. South China Wet Seafood wholesale market in Wuhan, Hubei Province, China, restaurants are famous for offering various small and large domestic animals, wild animals, and live animals including poultry, rabbits, bats, snakes, pangolins, turtles, hedgehogs, badgers, and marmots for human consumption [53; 44].

Repeated human-animal interactions either in the market or in the animal industry without using proper environmental biosecurity were considered as the significant risk factors for the emergence of zoonotic diseases, particularly in the rural communities of southern China [77]. These CoVs are transmitted from animal to animal, animal to human, and human to human [78].Bats have been reported as being the rich source of Coronaviruses. SARS and MERS viruses have zoonotic transmission, originating from bats using palm civets and camels, respectively, as the intermediate hosts. Human SARS-CoV infection originated from the direct contact between humans and civets in markets or restaurants [59]The recent reports have suggested that SARS-CoV-2 is a modified coronavirus of bat origin which came to humans as a result of zoonotic transmission [8].

Coronavirus isolated Malayan pangolins (Pangolin-CoV) showed 100%, 98.2%, 96.7% and 90.4% amino acid identity with COVID-19 in the E, M, N and S genes, respectively[17]. A pangolin is an endangered mammal considered to be a delicacy in China and also used in traditional medicine. It is illegal to trade or sell pangolins however it is one of the world's most heavily trafficked animals. CoVs have previously been found in pangolins [79].

A CoVs identified from the Malayan pangolin has been shown to have a 99% similarity with SARS-CoV-2. The RBD of pangolin-CoV has only a one amino acid difference with that of SARS-CoV-2; the infected pangolins exhibit pathological symptoms similar to humans suffering from COVID-19, and their blood circulating antibodies can react with the spike protein of SARS-CoV-2 [59].Recent studies indicate that more than 500 CoVs have been identified in bats in China. To be noted that serological studies conducted in rural population living close to bats natural habitat in caves revealed a 2.9% bat-CoV seroprevalence, demonstrating that human's exposure to bat-CoVs might be common. Bats are rare in markets in China but hunted and sold directly to restaurants for food. The current most likely hypothesis is that an intermediary host animal has played a role in the transmission[53].This intermediate host can serve as the zoonotic source of human infection and play the role of an amplifying host by allowing the virus to replicate transiently and then transmitting it to humans to amplify the scale of human infection[59].

Presumably, the intermediate animal hosts of SARSCoV-2 should be among the wildlife species sold and killed at the Huanan Seafood Wholesale Market, with which many of the initial cases of COVID-19 were associated, indicative of a probable animal-to-human transmission event[22].SARS-CoV- 2 infections were reported in dogs that were living in close contact with SARS-CoV-2 positive owners. Two cats, one from Belgium and another from Hong Kong, were also tested positive for SARS-CoV-2 [80]. Recently, a Malayan tiger maintained in the Bronx Zoo of New York City, NY, USA was also tested positive for SARS-CoV-2.The "Big cat" is suspected to be infected by SARS-CoV-2 positive asymptomatic zookeeper. These carnivores were tested for SARS-CoV-2 when they started showingsigns of mild respiratory illness [81].

Socio-economic impact of coronavirus

Coronavirusare the most frequent infectious diseases and are common triggers for constituting major biological, clinical, and socio-economic problems worldwide [13]. COVID-19 increased direct and indirect economic costs through global supply chains, reduced demand for goods and services. Business closures could reduce economic output in advanced and major emerging economies by 15% or more; other emerging economies could experience a decline in output of 25%[82].Efforts to reduce social interaction to contain the spread of the COVID-19 are disrupting the daily lives and adding to the economic costs[83].

Increasing rates of unemployment are raising the prospects of widespread social unrest and demonstrations in developed economies where lost incomes and health insurance are threatening living standards [84].COVID-19 leads to disruption of the world economy through global value chains, the abrupt falls in commodity prices, fiscal revenues, the enforcement of travel and social restrictions in many African countries are the main causes of the negative growth. Exports and imports of African countries are negatively dropped. To fight against the spread the virus and medical treatment will lead to an increase of public spending in Africa[85].

Tourism is an important sector of economic activity for many countries in Africa, will be heavily affected by COVID-19 with the generalization of travel restrictions, closing of borders and social distancing. International Air Transport Association (IATA) estimates the economic contribution of the air transport industry in Africa at US$ 55.8 billion dollars, supporting 6.2 million jobs and contributing 2.6% of GDP. These restrictions affect international airlines including African giants Ethiopian

Airlines, Egypt air, Kenya Airways, South African Airways and the rest countries[86]. Countries dependent on tourism could be affected more severely, while countries with large agricultural and mining sectors could experience less severe effects [82].

Coivd-19 pandemic will ultimately create a shortage of medicines and health equipment. Africa's biggest suppliers of medicines are the European Union and Asia. However, the drug manufacturing companies in these countries have come to a halt because of the drastic eradication measures taken in the heavily affected countries. Therefore, if the pandemic is at its high stage, it will be difficult for these countries to treat their patients. The health crisis could have an impact on treating other diseases in Africa[87].

Conclusion and Recommendations

Coronavirus Disease 2019 was first recognized in a cluster of human pneumonia cases associated with the South China Seafood Market in Wuhan City and is therefore thought to have originated from an animal source at this market. The causative agent is a modified coronavirus, known as SARS-CoV-2. COVID-19 emerged as zoonotic outbreak and has acquired pandemic status. Person to person transmission primarily occurs when an infected person sneezes through the respiratory droplets. These droplets can settle in the mouth or nasal mucosa and lungs of people with inhaled air. The major clinical manifestations of this virus include fever, cough, shortness of breath and pneumonia.It is an emerging pathogen, without any effective drug available for treatment at the moment. Based on the above conclusions the following recommendations are forwarded:

- ❖ Avoiding close contact with people and farm or wild animals by keeping physical distance.
- ❖ Frequent hand-washing with soap or disinfecting with sanitizer especially after direct contact with people, animals or their environment should be implemented.
- ❖ Legislation should be employed to prohibit the trade of wild animals, the potential intermediate hosts of COVID-19.
- ❖ Further studies are required to understand about nature of virus and various hosts of COVID-19 to control zoonotic transmission and avoid the outbreak of such viral infections in the future.

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