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The Emergence of Zoonotic Diseases: Its Impact and Prevention

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ABSTRACT

With the surge in population density, humans and animals remain mutually reliant on each other for survival. This interdependency exposes us to pathogenic organisms, resulting in afflictions termed Zoonotic disease or Zoonoses. Zoonoses are estimated to account for 58% to 61% of all communicable diseases globally; and also account for up to 75% of emerging human pathogens. More than 70% of zoonotic emerging infectious diseases affecting human health originate in wildlife, including SARS, Ebola, and now COVID-19. Hence, it is crucial to recognize the importance of zoonotic conditions and its natural reservoirs. This article reviews Zoonotic diseases in various aspects, throwing light on common zoonotic conditions like SARS, MERS, Ebola, Zika Virus, Zoonotic Tuberculosis, Avian influenza, and their natural hosts. In-detailed analysis of COVID-19 infection, its emergence, outbreak, and transmission and its preventive measures have also been reviewed, along with the current opinion on herd immunity in protecting the vulnerable section of the society. Furthermore, the article emphasizes the importance of education regarding the zoonotic disease to the people in professions like farmers, butchers, and zookeepers as they pose a high occupational risk for the zoonotic disease, and their insufficient knowledge can instigate disease spread. The article also aims to review the present understanding of the zoonotic disease, emphasizing the significance of the "one health" approach and possible limitations in controlling the epidemic and pandemic of the disease expanse.

KEYWORDS

Zoonoses; SARS; COVID-19

INTRODUCTION

Humans coexist with animals and the environment in a sophisticated, interdependent manner for food and livelihood. The interface between humans, animals, and the environment is the source of disease impacting public health and the socio-economic well-being of the world. Such disease, which is transmissible from animals to humans through direct and indirect contact, is referred to as Zoonotic disease or Zoonosis [1].

The emergence and outbreak of zoonotic disease is a complex process in which a series of external factors pave the way for pathogens to expand and adapt to a new niche. These drivers can be ecological, political, economic, and social forces working at the local, national, and global levels. Regions, where these factors are most prevalent and aggregated, have the risk of most intense disease events and are considered zoonotic disease "hotspots" [2].

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Zoonotic disease emergence occurs in stages having different drivers at each step, and so various control measures accordingly. It starts with an initial series of spillover events, a repeated small outbreak in people, and pathogen adaptation to human-human transmission [2]. For instance, Human immunodeficiency virus 1 (HIV-1) emerged from chimpanzees in Africa, spilling over to human repeated before becoming global spread [3]. The initial stage of emergence was bush meat hunting, which was its primary driver, followed by increased urbanization and road expansion in central Africa in the 1950s. The dispersal of index cases harboring prototype HIV-1 infections transmissible from person to person was the second phase of its emergence [2].

In the present situation, the novel SARS-CoV-2 coronavirus emerged in the city of Wuhan, China, in December 2019 and has since caused a large scale COVID-19 pandemic and spread to more than 70 other countries, is the product of natural evolution. Based on genomic sequence analysis, the most likely origins for SARS-CoV-2 followed one of two possible scenarios. In the first scenario, the virus evolved to its current pathogenic state through natural selection in a non-human host and then transmitted to humans. The emergence of other coronavirus outbreak like SARS and MERS occurred when humans contracted the virus after direct exposure with a non-human host like civets (SARS) and camels (MERS). In the other proposed scenario, a non-pathogenic version of the virus transmitted from an animal host into humans and then evolved to its current pathogenic state within the human population [4].

This review aims to analyze various aspects of Zoonotic diseases, its emergence, and outbreak and possible limitations in the present understanding for controlling the epidemic and pandemic of the disease spread.

Zoonotic Diseases

Animals furnish numerous aids to humankind. They provide food, fiber, livelihood too many people across the globe. However, many times animals can carry pathogenic germs that can spread to humans and cause disease. These are known as Zoonotic diseases or Zoonosis. In other words, these pathogens intrinsically develop the ability to infect both animals and humans and hence can be transmitted between them. Zoonotic diseases are caused mainly by viruses, bacteria, parasites, and fungi, which are transmitted to humans, causing mild to severe illnesses and even deaths. In many cases, animals may appear healthy even if they carry the pathogenic germs and make people sick [5].

There are different ways of transmission of zoonotic diseases between animals and humans. They can be through direct, indirect, and vectors. The transmission from direct contact can be through infected animals' bodily fluids like saliva, blood, urine, mucosal contact, feces, to name a few or being bitten by the infected animal.

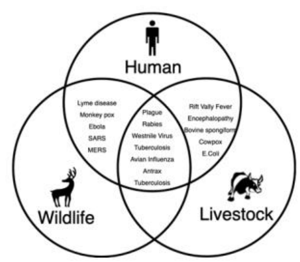

Figure 1: Represents the example of zoonotic diseases and their affected population.

Virus/Family	Natural Host
Chikungunya (*Togaviridae*)	African Primates
Crimean-Congo Hemorrhagic Fever (*Bunyaviridae*)	Hares, Large Herbivores (unknown)
Mers Coronavirus (*Coronaviridae*)	Bats, Camels
Ebola (*Filoviridae*)	Fruit Bats
Hanta (*Bunyaviridae*)	Rodents, Shrews, and Bats
Hendra and Nipah (*Paramyxoviridae*)	Fruit Bats
Hepatitis E (*Hepeviridae*)	Pigs
HIV (*Retroviridae*)	African Primates
Influenza A (*Orthomyxoviridae*)	Aquatic Birds, Bats
Lassa (*Arenaviridae*)	Rodents
Lymphocytic Choriomeningitis (*Arenaviridae*)	Rodents
Menangle (*Paramyxoviridae*)	Fruit Bats
Sars Coronavirus (*Coronaviridae*)	Horseshoe Bats
Rabies (*Rhabdoviridae*)	Bats
Rift Valley Fever (*Bunyaviridae*)	Unknown
West Nile (*Flaviviridae*)	Birds

Table 1: Table on the reservoir of zoonotic infection.

Indirect contact can happen when a person breathes in dust particles and small droplets of an infected animal's saliva or consuming contaminated food products or contact with contaminated water, soil, objects, or clothing.

Disease vectors are organisms that transmit disease between animals and between animals and humans, but do not suffer the disease. They are usually insects that feed on the blood of humans and animals and spread the infection between them [6].

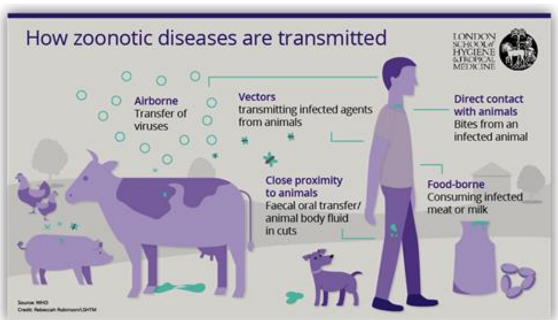

Figure 2: Depicts the common pathway of zoonotic disease transmission.

Emergence and Outbreak of Zoonotic Infections

The emergence of zoonotic disease

The human population is rapidly expanding and requires more space for survival, which results in daily interaction with animals. Apart from this climate change, globalization and urbanization also cause the emergence of diseases caused by humans. Pathogens are less prone to the rise in themselves, and rapidly mutating viruses are shared among the emerging pathogens [7].

McMichael suggested five categories that promote the emergence of infection [8]. They are land use and environmental changes; demographic changes; host conditions; human consumption behavior; and other behaviors such as social and cultural interaction, sexual habits, and drug use. Furthermore, factors within the pathogen, such as the capacity to evolve through mutations, are essential for disease emergence.

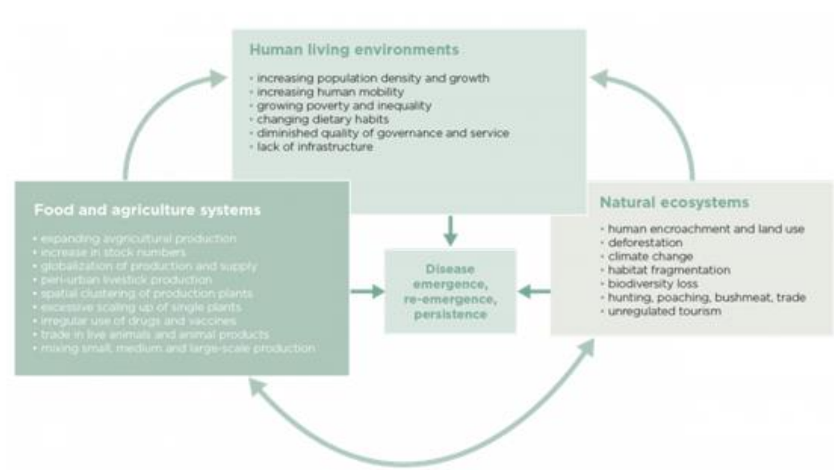

Figure 3: Overview of disease interaction at the human-animal-environment interface that causes the emergence of zoonotic disease.

In the last few decades, viruses played a significant role in the emergence of diseases like SARS, MERS, EBOLA, and the recent one being COVID-19. About 44% of the illnesses emerging in humans are viral. RNA viruses are prone to emergence because of their rapid replication and high mutation rates and large viral populations. However, the increased evolutionary pressure of having to adapt to both invertebrate and vertebrate hosts creates a lower rate of mutation in vector-borne viruses. Most of their variations are synonymous [7].

Reservoirs of Zoonotic Infection

Each year, about 1 billion cases of human illness attributable to the zoonotic disease, identifying wild reservoirs of zoonotic pathogens, as one of the essential persistent public health priorities [3]. A natural pool, known as a disease reservoir, is the group of organisms or any specific environment in which pathogen takes hostage and multiplies; in other words, the pathogen primarily depends on the host for its survival.

The reservoir is usually a living host animal or a plant that will harbor the pathogen by causing the disease or just existing. The reservoir can also be an environment external to an organism, such as a volume of contaminated air or water [9]. Many infectious agents, specifically which cause emerging diseases, often take multiple hostages or, in other words, infect various reservoirs. Infectious agents that can affect more than one host species are ubiquitous.

Indeed, 62% of all the human pathogens come under zoonoses, and 77% of livestock pathogens and 91% of domestic carnivore pathogens infect multiple hosts [9]. Therefore, managing a reservoir of multi host-pathogen plays an essential role in managing disease control.

The Outbreak of Zoonotic Disease

Humans are being exposed to new zoonotic diseases or re-emerging past zoonotic diseases with the destruction of animal habitats and sprawling the human population. With the globalization of markets and increased worldwide travel, the zoonotic disease, which was previously limited to specific geographical locations, can quickly become epidemic or pandemic? Therefore, WHO emphasis on coordinated worldwide responses to any new emerging infection so that epidemic or pandemic can be prevented or controlled.

In the past few decades, with the accelerating global changes, a surprising number of zoonosis has emerged like avian influenza, Ebola virus disease, Zika virus disease, Nipah virus disease, Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Disease (MERS) and now, the new coronavirus disease (COVID-19).

Of these, SARS, MERS and COVID-19 are all caused by beta coronaviruses of the coronavirus family. Despite the phylogenetic similarity among the viruses, all three have created very different outcomes.

Zika virus

Zika virus (ZIKV), a flavivirus mainly transmitted through mosquitos in the genus Aedes, was first discovered in 1947 in Uganda in rhesus monkeys followed by humans in 1952 in both Uganda and the United Republic of Tanzania. From the 1960s to the 1980s, Zika infections have been reported across Africa and Asia, typically accompanied by mild illnesses. However, the first massive outbreak Zika infection was published on the island of Yap in 2007, as the virus moved from south-east Asia across the Pacific [10]. This outbreak was followed by another massive outbreak in French Polynesia in 2013 and countries and territories surrounding the Pacific. In March 2015, Brazil reported an outbreak of rash illness, soon identified as Zika virus infection. In July 2015, it was found to be associated with Guillain-Barré syndrome [11].

The virus has been isolated in monkeys, and antibodies have been detected in domestic sheep, goats, horses, cows, ducks, rodents, bats, orangutans, and carabaos. However, there is still insufficient information regarding the animal reservoir and amplification host, including domestic animals and the vectors of ZIKV as well as the vector capacity of the genus Aedes genus Anopheles [12].

Rabies

Rabies is a vaccine-preventable zoonotic viral disease that occurs in more than 150 countries and territories. Rabies, the most lethal zoonotic disease, is caused by multiple strains of lyssavirus, most often by rabies virus (RABV). In 1956, a pathogenic virus was discovered in the brains of fruit bats (Eidolon helvum) in Nigeria [13]. The serological tests identified it as related to, but distinct from, RABV. A similar result was found after a South African man died from a rabies-like illness following a bat bite in 1970 [13]. It was then later reported that each strain of lyssavirus tends to maintain specific reservoir species for which these strains have adapted—for instance, raccoon strain in raccoons, skunk strain in skunks, canine rabies in canids. The typical reservoir species for the virus are bats, skunks, foxes, and raccoons in North America; however, it can cause rabies in any mammal species. For example, these strains of the virus can infect any species of animal and cause rabies and can get established in different host species (e.g., skunk rabies in dogs) [14]. Except for Antarctica, Rabies infection has been reported in all the continents with over 95% death rate in Asian and Africa. Rabies has been one of the Neglected Tropical Diseases (NTD) that has predominantly affected poor and vulnerable populations who live in remote rural locations. Approximately 80% of human cases occur in rural areas. Although effective human vaccines and immunoglobulin's exist for rabies, they have not been readily available or accessible to those in need. Globally, rabies deaths are rarely reported, and children between the ages of 5 and 14 are frequent victims.

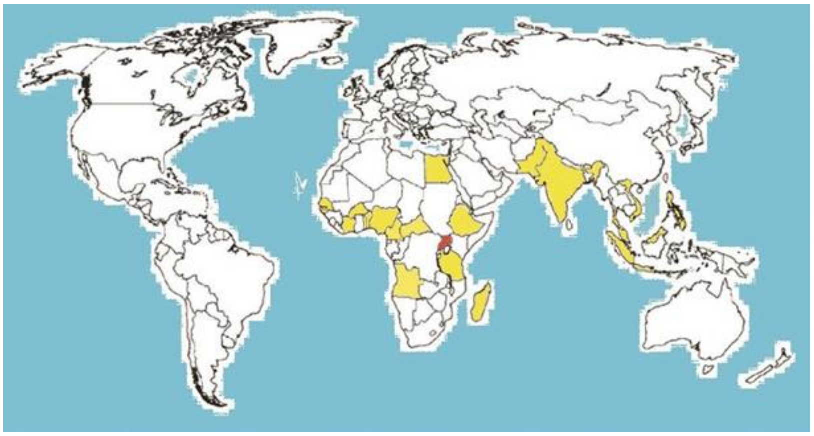

Figure 4: World map depicts the areas where ZIKV infections were reported in the pre-epidemic period.

Avian influenza

There are four types of Influenza Virus: A, B, C and D. According to the CDC, Avian influenza is the disease caused by infection with avian influenza Type A viruses. Wild aquatic birds – particularly certain wild ducks, geese, swans, gulls, shorebirds, and terns – are the natural hosts for most influenza type A viruses. Influenza A virus has been divided into subtypes based on two proteins on the surface of the virus: Hemagglutinin (HA) and neuraminidase (NA). So far, there are 18 known HA and 11 NA subtypes, and hence many different combinations are possible [15].

These viruses occur naturally among wild aquatic birds worldwide, serving as a primary natural reservoir and transmitted to poultry and other bird and animal species [16].

Ecological and phylogenetic suggest that wild waterfowl are the primary reservoirs for influenza A viruses transmitted to other host animals such as pigs, chickens, and horses leading to outbreaks among these species. Many times these viruses get established in these new hosts and cause epidemics and epizootics. These Viruses can also get transmitted cross-species. For instance, humans and pigs or between chickens and humans occurred in 1997 in Hong Kong [17].

Zoonotic tuberculosis

According to WHO, it is a form of the disease caused by *Mycobacterium bovis*. Cattles are the primary reservoirs of *M. bovis* about the zoonotic exposure of humans. However, it can infect many other animals and become a disease reservoir in wildlife. The main routes of *M.bovis* transmission from an infected animal to humans are thought to be through the ingestion of raw milk and inhalation of aerosol from a diseased animal, mainly in settings where pasteurization of milk is not widely established. However, in the communities, particularly with the livestock workers are characterized by more significant risk practices that facilitate zoonotic TB transmission. The other sources of zoonotic infection include the consumption of unpasteurized milk, cohabitation with animals, and the incidence of immunosuppressive disease [16,18].

SARS

According to WHO, SARS-Coronavirus was first identified in 2003 in China, which is thought to be an animal virus from an uncertain animal reservoir, perhaps bats, that spread to other animals (civet cats). It was then transmitted to humans in the Guangdong province of southern China in 2002. The epidemic of SARS affected 26 countries, and more than 8000 cases were reported in 2003. The second outbreak happened in 2004, with only four occurrences and no mortality without further transmission [19]. As the disease appeared in the Guangdong province of southern China, this area is considered a potential zone of re-emergence of SARS-CoV (World Health Organization, 2012).

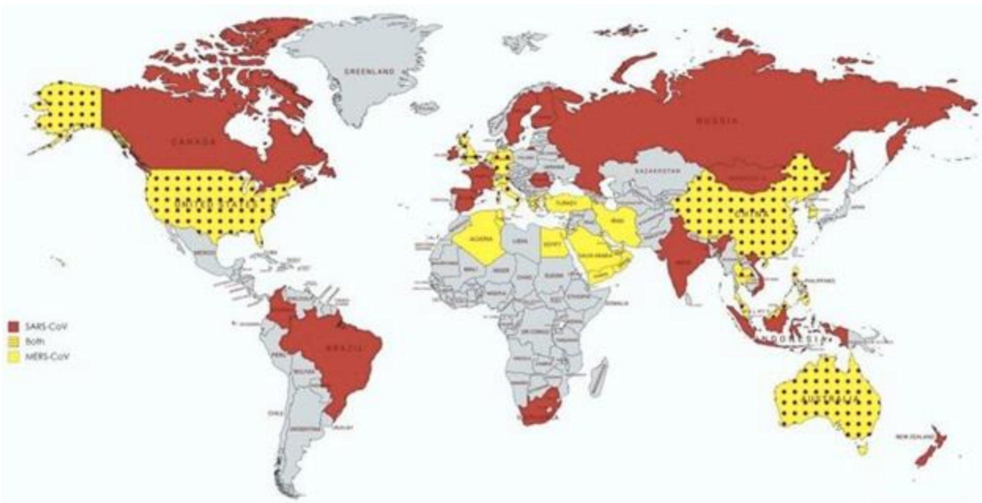

Figure 5: World-map depicts countries with SARS-CoV and MERS-CoV outbreaks. Red and yellow colors represent the global distribution of only MERS-CoV and SARS-CoV, respectively. The yellow-red dotted pattern shows the incidence of both viruses in the countries.

MERS

The Middle East respiratory syndrome is another zoonotic disease coming from the coronavirus family. According to the CDC, the virus was first reported in 2012 in Saudi Arabia, coming from an animal source. [18] Reported that new MERS cases had close contact history with dromedary camels. Ben et al. also said that MERS-CoV RNA was detected in camels from Saudi Arabia, Qatar, and Egypt had more than 99% similarity to human MERS-CoV in genomic sequences. Furthermore, Serological evidence confirmed a high prevalence of MERS-CoV infections in camels in the Middle East, Africa, and Spain [18]. However, Ben et al. reviewed that Bats are most probably the natural host for MERS-CoV. It is hypothesized that bat MERS-like CoV infected camels or some other as yet unidentified animal several decades ago. Over the period, the virus evolved and adapted with accumulating mutations in camels and then was transmitted to humans very recently.

Ebola

Ebola virus disease, formally known as Ebola hemorrhagic fever, is another pathogenic zoonotic disease which, according to Centre’s for Disease Control and preventions, is a rare but severe, often fatal illness in humans. Discovered in 1976, when two consecutive outbreaks of fatal hemorrhagic fever occurred in different parts of Central Africa, the first outbreak happened in the Democratic Republic of Congo, in a village near the Ebola River, and the second outbreak occurred in the south of Sudan. It was initially thought that these outbreaks were a single event where an infected person who traveled between the two locations transmitted the virus to another person. However, scientists later discovered that two of the outbreaks were caused by two genetically distinct viruses: Zaire ebolavirus and Sudan ebolavirus. After this discovery, scientists concluded that the virus came from two sources and spread independently to people in each of the affected areas. The 2014-2016 Ebola outbreak in West Africa began in a rural setting of southeastern Guinea, spread to urban areas and across borders within weeks, and became a global epidemic within months. African fruit bats are likely to be involved in the transmission of the virus or even maybe the reservoir host. However, scientists continue to search for conclusive evidence for the bats' role in spreading the virus [15].

Emergence and Outbreak of COVID-19

In the year 2019 December, WHO received the information on the epidemic by the Chinese government about several cases of pneumonia with unfamiliar etiology in the country? The outbreak was initiated from the Hunan sea-food market in the Wuhan City of China and rapidly infected more than 50 people where live animals are sold, such as bats, frogs, snakes, birds, marmots, and rabbits. On 12 January 2020, the National Health Commission of China released further details about the epidemic, suggested viral pneumonia. The sequence-based analysis of viral isolates from the patients reveals as a novel coronavirus, which was further named as SARS-CoV-2 or COVID-19 [20]. COVID-19 is thought to be transmitted from the animals, though it has not yet been clear exactly from which animal [16,20].

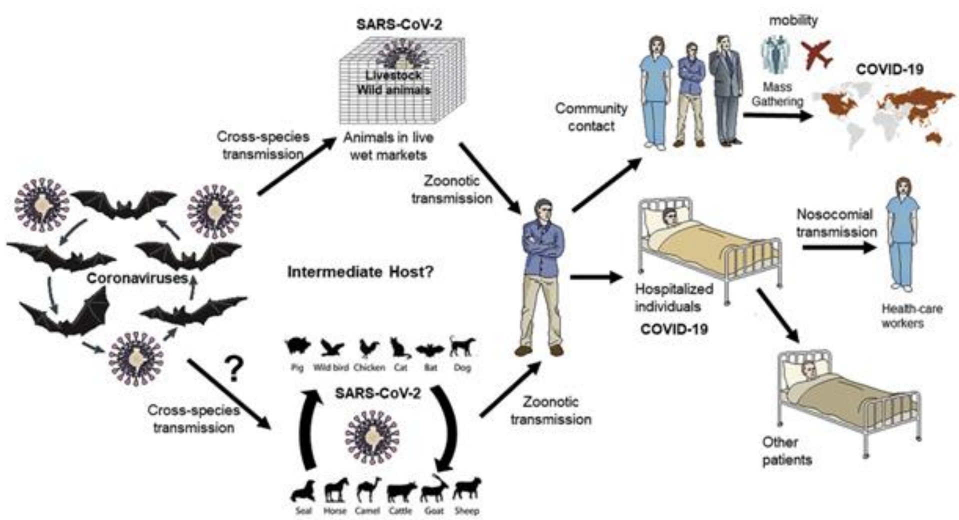

Figure 6: Depicts the hypothesized origin of the virus and a generalized route of transmission.

Réservoir for SARS-CoV-2

The transmission rate of any infectious diseases highly depends on reservoir hosts. Coronaviruses have already been reported in bat, pig, cow, and several other species. There are reports which provide evidence of its presence in birds. Molecular analysis and their phylogenetic analysis have been shown by [21] conveyed that proximity virus of SARS-CoV-2 was from bats with 96% similarity suggesting novelty of SARS-CoV-2. However, there are no reports on how this virus mutated and its time frame. They also indicate an intermediate host or reservoir before the SARS-CoV-2 gained entry into the human population. From the shreds of evidence so far, it is proposed that civets would have been the intermediate host before getting spilled into humans. It is a top priority to identify the intermediate host to control the spread of disease [21].

The novel coronavirus has also been isolated from fecal matter and blood apart from lung and or pharyngeal fluid. This fecal isolation of the virus implies that SARS-CoV-2, transmitted through the droplet, might also be transmitted through the fecal route. However, the immune-pathogenesis of this novel virus is probably different from the previous strain of coronaviruses. The fecal-oral course is prevalent among birds for the transmission of avian viruses [21].

The risks of the spread of the SARS-CoV-2 through the bird to humans are implausible at its present form. Qinghai Lake is a prevalent breeding site for migratory bird species in China. Possibilities exist that this novel virus may acquire the ability to infect animals, including the migratory birds. Therefore, it is essential to find the reservoir of this novel coronavirus within the other animals, including the migratory birds, if there are any [21].

Structure and Life Cycle of COVID-19

The coronavirus genome encodes four major structural proteins: the spike (S) protein, nucleocapsid (N) protein, membrane (M) protein, and the envelope (E) protein. The S protein is responsible for facilitating the entry of the coronavirus into the target cell. It is composed of a short intracellular tail, a transmembrane anchor, and a large ectodomain consisting of a receptor binding S1 subunit and a membrane-fusing S2 subunit (Figure 70) [22].

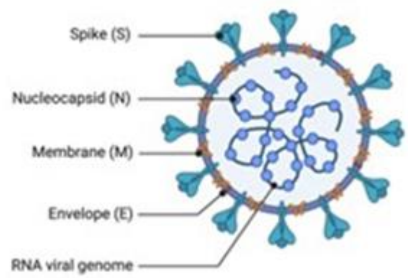

Figure 7: Structure of virus.

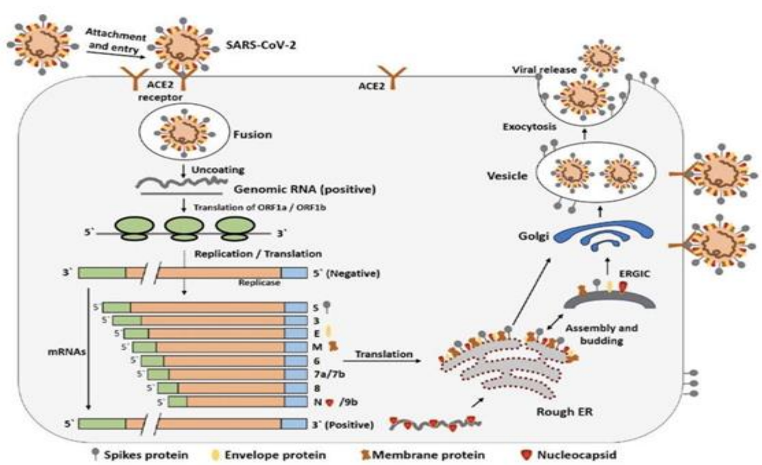

Figure 8: Depicts the life cycle of SARS-CoV-2 in host cells begins when S protein binds to the cellular receptor ACE2 (Angiotensin-Converting Enzyme 2).

ACE-2 is a type I transmembrane metallocarboxy peptidase with homology to ACE, an enzyme long-known to be a key player in the Renin-Angiotensin system (RAS) and a target for the treatment of hypertension. After receptor binding, the conformation change in the S protein facilitates viral envelope fusion with the cell membrane through the endosomal pathway. Then SARS-CoV-2 releases RNA into the host cell. Genome RNA is translated into viral replicase polyproteins pp1a and 1ab, which are then cleaved into small products by viral proteinases. The polymerase produces a series of sub-genomic mRNAs by discontinuous transcription and finally translated into relevant viral proteins. Viral proteins and genome RNA are subsequently assembled into virions in the ER and Golgi and then transported via vesicles and released out of the cell [20].

Human to Animal Transmission

Human and animal relationships are likely to continue globally over the next several decades with practices like animal husbandry, companion animal market, and also with climate change and ecosystem disruption, anthropogenic development of habitats, to name few. As the human-animal connection increases, so makes the threat of pathogen spread. There are several factors which risk the spread of infection from human to animals [23]. With the human population expansion, different species interact in a way and rate which has not been previously encountered, which results in "pathogen pollution" which means bringing a foreign disease into a new locality due to human involvement.

For instance, Ash et al. (2010) [33] reported that African painted dogs, which are an Endangered Carnivore, had been infected with human strains of *Giardia duodenalis*. Researchers believe that pathogen pollution occurred through open defecation in and around national parks by tourists and residents. So, Zoonotic transmission may be possible in captive populations due to the close interaction with humans.

Human to Animal Transmission of COVID-19: Reports so far

As COVID-19 infection is widely distributed in the human population, there could be a possibility that particular animals are more susceptible to the disease when they are in close contact with the infected person. The first case was reported in the USA, New York, where a Tiger at the Bronx Zoo tested positive for COVID-19. It has been reported that the tiger might have contracted from the infected zookeeper [24]. Another case was reported in Belgium, where a pet cat was tested positive for COVID-19 from the infected owner. SARS-CoV-2 was found in the cat's feces. The cat developed diarrhea, vomiting, and respiratory difficulty [25]. According to the World Organization for Animal Health (OIE), Minks have also been tested positive for COVID-19. Studies are underway to understand better the suitability of different animal species to the COVID-19 infection and to assess infection dynamics in the susceptible animal species. According to OIE, preliminary findings from the experimental infection studies showed that poultry and pigs are not vulnerable to the COVID-19 infection. Conclusions of the laboratory settings suggest that, of the animals investigated so far, cats are the most susceptible to COVID-19 infection, and cats can be affected with clinical disease. In an experimental setting, cats were able to transmit the virus to other cats, and also, the ferrets were susceptible and were able to spread the disease to other ferrets. However, they appeared to be less affected by a clinical condition. According to OIE, Ferrets might serve as a suitable model for further studies like for the development of vaccines and drugs. Egyptian fruit bats were also infected with the COVID-19 but did not show any sign of the disease.

However, according to WHO and OIE, currently, there is no evidence that animals are playing the epidemiological role of spreading of human infection with COVID-19. Still, because of the virus's zoonotic nature, WHO recommends that people who are sick with COVID-19 and people who are at risk limit contact with their companion and other animals. When handling and caring for animals, necessary hygiene measures should always be implemented. The ways include hand washing after managing animals, their food, or supplies, as well as avoiding kissing, licking, or sharing food.

By collaborating effectively with individuals from many fields, public health professionals can easily prevent outbreaks of diseases and protect people's health.

One Health Strategy

It is essential to connect medical doctors, veterinarians, public health inspectors, and food quality inspectors to control the spread of diseases. According to the CDC, one health is an approach which states that people's health is closely connected to the health of animals and our shared environment. One health is becoming more critical in recent years because of the increased interaction between humans, animal plants, and the environment. The surge in population brought people a lot closer to animals and their environment, which results in the secure transmission of disease between animals and humans. Along with this change in the climatic condition, intensive farming and deforestation provide new opportunities for the transfer of disease between animals and humans. Furthermore, through travel and trade, the movement of people and animal and animal products has increased, which lead to the spread of disease across the border quickly [15].

Many a time, animals share our susceptibility to diseases and environmental hazards. For instance, birds often get affected by the West Nile virus before people in the same area harbor the infection with West Nile virus infect [15]. Bird flu, also known as avian influenza, is a viral infection that affects not only birds but also humans and other animals that come in contact with the carrier. According to WHO, H5N1 was first reported in 1997 and has killed nearly 60% of those who got infected.

As a result of this, one health is gaining recognition globally as an effective way to fight the disease at the human-animal-environment interface, including zoonotic disease. To achieve this professional in human healthcare like doctors, nurses, public health practitioners, and epidemiologists need to collaboratively work, communicate and coordinate with animal healthcare workers (veterinarians, paraprofessionals, agricultural workers) and with professionals in environmental science like ecologist and wildlife expert [15]. Three major international organizations, WHO, the UN Food and Agriculture Organization (FAO), and the World Organization for Animal Health (OIE), have started to put this vision into practice by consolidating a formal partnership to combat human-animal-environment health risks, strengthening their joint action in May 2018 [26]. These efforts need to replicate in the academic and public health level. University of Washington's center for one health and Global health department at Harvard University recently promoted the cross-education of its practitioners by collaborating with veterinarians [26].

The Center for disease control and Prevention is also following one health approach against some zoonotic disease. An example of this is the response to the Rift Valley fever, the outbreak in East Africa in 1997 [15]. CDC's development of a new vaccine protects animals from getting infected with RVF, which in turn limits the transmission of disease to the human and is promising in one health approach. NASA's use of satellite images to monitor changes in the ocean temperature provides health officials with the vital information they can use to predict when RVF outbreaks are most likely to occur so they can take action to prevent these outbreaks.

Zoonotic Risk: Farmers, Butchers, and Zookeepers

Some professions have a significant risk for the exposure of zoonotic infections than others like veterinarians, farmers, culling personnel, slaughterhouse workers, and farmers as they are the people who are in constant contact with the animals. According to the first clinical characterization provided by Chen and colleagues from The University of Hong Kong Shenzhen Hospital (Shenzhen, China), nearly half of the first patients affected by COVID-19 were working at the wet market where the virus originated [26]. Even though the occupational risk of zoonotic infection is well documented for the professions who directly handle the animals, the lack of understanding and education among the workers is the reason for the spread of infection. The survey conducted by Naveen Prabhakar et al. revealed that most of the butchers had insufficient knowledge about zoonotic diseases and did not follow strict hygiene conditions [26].

Naveen Prabhakar et al. has also reported that human activities like working with animals sheds, inappropriate disposal of animal waste, slaughtering and skinning of diseased animals, inappropriate disposal of pathogenic material from animals and poor personal hygiene practices contribute to recurrent outbreaks of zoonotic diseases in humans [27]. Lack of awareness about the zoonotic diseases among butchers has always been one of the primary reasons for the outbreak of zoonotic diseases in people.

They also noted that with proper education about the risk of zoonotic disease transmission and limiting hazardous exposure during slaughtering by wearing protective attire and applying good hygienic practices can reduce the transfer of the disease.

Therefore, these occupational categories deserve special attention as they are notably higher risk of getting exposure to zoonotic diseases. The recent outbreak of the coronavirus infection serves as an excellent example of how close interactions between the health of humans, animals, and the environment can lead to a deadly epidemic [26]. So, the one health approach should be embraced as a framework for public health action against zoonoses.

Preventive Measures

According to WHO, simple precautions like personal hygiene play an important role in reducing the chance of spreading the infection? Regularly and thoroughly washing hands with soap or alcohol-based hand rub, maintaining good respiratory health, and maintaining social distancing is of utmost importance to stop the spread of infection. Apart from this, many different approaches are implemented to tackle the disease. One such method is Herd Immunity.

Herd Immunity and COVID-19

Ever since the SARS-CoV-2 outbreak happened in Wuhan, China; different approaches are being implemented to control the spread of disease. One such implementation is "Herd Immunity." Herd immunity refers to the exposure of pathogens into the population or animal group [28]. When a large percentage of the population becomes immune to the disease, the spread of the infection slows down or stops. In other words, it is indirect protection (herd protection) of vulnerable people from infection when a sufficiently large population is immune to the disease [29,30]. On an individual level, a person can develop immunity by producing antibodies that recognize the infection from pathogens such as SARS-CoV-2, which causes COVID-19. An individual can build up these antibodies naturally by getting exposed to the virus in getting sickened by the virus or with a vaccine that induces the same response without getting an infection [31].

Immunity often means that an immune person neither gets the repeated infection nor can pass the infection to others. Herd immunity does work for some diseases. For instance, herd immunity was successfully implemented against the H1N1 virus (swine flu) through vaccinations and natural protection [32].

If there are several reasons why "Herd Immunity" may work to control the spread of COVID-19 infection, there are also reasons why it may not work to stop the spread of COVID-19 disease.

A study conducted at the University of Amsterdam revealed that those who survived the corona virus could become reinfected within six months, pitching doubt on herd immunity. According to the scientist van der Hoek, at the University of Amsterdam, corona virus immunity is short-lived. There is frequent reinfection at 12 months post-infection and a significant reduction in antibodies level as soon as six months post-infection. Therefore, achieving herd immunity may be challenging due to its expeditious loss in protecting immunity [33]. Furthermore, there is no vaccine for SARS-CoV-2, which is the safest way to practice and achieve herd immunity in the population.

PROSPECTS

Human and animal relationships are likely to see an upsurge in the days to come. Despite the present understanding of the emergence of infectious disease, there is still a void in the knowledge of ecosystem disease regulation and how human actions may affect illness directly or indirectly in the long term [7]. Another major challenge in managing zoonotic infections is the lack of active alliance between the animal and human health sectors under the "One Health" approach. Therefore, better understanding and implementation of "One Health" should be there to manage global health threats in the future.

There is also insufficient transparency between the timely emergences of zoonotic infections to international agencies like World Health Organizations, who are responsible for global health security. So, because of this, the situation becomes difficult for these organizations to study the epidemiology and disease progression and, as a result, lose the golden hours to research and comprehend the methods which may or may not work to control the epidemic or pandemic of disease (World Health Organization). Furthermore, concerning the present coronavirus pandemic, further research needs to be done on herd immunity before implementing until the vaccines are developed.

CONFLICT OF INTEREST

There is no conflict of Interest.

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