Emerging Zoonotic Diseases: The Role of Urbanisation and Habitat Destruction

Zarqa Batool[1,*], Aziz Fatima[1], Ayesha Khan[1], Kaynat Abbass[2], Rizwana[1], Rabia Bashir[3], Razia Kausar[4], Zeeshan Ashraf[5] and Sarmad Rehan[4]

[1]Department of Zoology, University of Mianwali, Pakistan
[2] Department of Zoology, University of Sargodha, Mianwali Campus, Pakistan
[3]Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad, Pakistan
[4]Department of Anatomy, University of Agriculture, Faisalabad, Pakistan
[5]Department of Zoology, University of Education, Lahore, Faisalabad Campus, Pakistan
*Corresponding author: zarqashahid84@gmail.com

Abstract

Emerging zoonotic diseases are infections that transmitted from animals to humans. These infections are becoming a global concern. The habitat destruction and urbanization play a significant role in the rise of these zoonotic diseases. As population is increasing and urban areas are expanding resulting in natural habitat fragmentation that leads wild animal closer to the human settlements. This encroachment aids direct interactions between animals and human, enhancing the chances for transmission of zoonotic infectious pathogens. Deforestation, land conversion for agricultural purposes and infrastructures development further intensified the situation by disrupting the ecosystem and increasing the risk for zoonosis with direct contact to wildlife. Beside this, when natural environments are disrupted it leads to the loss of biodiversity that facilitates to the destabilizing ecosystems and make zoonosis transmission more efficient. Urban environments have densely populated areas with less sanitation and healthcare access that leads to the rapid spread of zoonotic diseases. By understanding the complex relationship between habitat destruction, urbanization and these emerging zoonotic infections is a critical sign to develop effective health strategies for the public. It is necessary to address about these societal and environmental factors to prevent future outbreaks and mitigate the impact on public health.

Keywords: Zoonotic diseases, Habitat destruction, Ecological Disruption, Health and environment, Urbanization.

Cite this Article as: Batool Z, Fatima A, Khan A, Abbass K, Rizwana, Bashir R, Kausar R, Ashraf Z and Rehan S, 2025. Emerging zoonotic diseases: the role of urbanisation and habitat destruction. In: Abbas RZ, Akhtar T and Arshad J (eds), One Health in a Changing World: Climate, Disease, Policy, and Innovation. Unique Scientific Publishers, Faisalabad, Pakistan, pp: 217-224. https://doi.org/10.47278/book.HH/2025.310

A Publication of Unique Scientific Publishers

Chapter No: 25-030

Received: 30-Feb-2025
Revised: 14-Apr-2025
Accepted: 29-May-2025

Introduction

The diseases or infections that are spread from domestic and wild animals to human beings are called zoonotic diseases (Ferreira et al., 2021). According to the World Health Organization (WHO) zoonotic diseases are caused by emerging zoonosis that is newly evolved pathogen that could be present already but presently discovered and widely spread through numerous availability of hosts and vectors. oonosis comes out from combination of two Greek words, "zoon" meaning animal, while "nosos," meaning illness (World Health Organization, 2020). merging infectious diseases (EIDs) are those diseases that were first observed in a particular population but have now spread globally, primarily due to zoonosis (White & Razgour, 2020).

Oonotic diseases impose a significant warning to the human health, with a potential to be life-threatening, which categorizes them as a critical public health issue. Beyond their harmful effects on humans, the 13 most common zoonoses globally cause deceased rate up to 2.7 million while disease of 2.4 billion annually, disproportionately affecting the most vulnerable livestock workers in low- and middle-income countries. Furthermore, these diseases also have a negative impact on animal health, leading to decreased productivity in livestock (Grace et al., 2012). Approximately 75 % of pathogens discovered in humans are zoonotic, originating from domestic and wild animals (White & Razgour, 2020). According to the WHO, wildlife is anticipated to be the main origin of the next human pandemic, while certain zoonotic diseases from wildlife, like rabies and avian influenza, have been recognized for a long time. A notable instance is the *Ebola* virus that was identified as being associated with African cave-dwelling bats after years of research.

The risk of zoonotic diseases transmission is increased by human activities such as wildlife trade, habitat destruction, urbanization, Human-wildlife conflict and tourism by disrupting ecosystems, bringing humans and animals into closer proximity, facilitating animal migration and reducing biodiversity (Esposito et al., 2023). A variety of factors play a role in the emergence of zoonotic diseases as well as the environments associated with these diseases and the hosts that act as their reservoirs are evolving at an accelerated pace. The key drivers of this change include the modernization of agricultural practices, particularly in developing countries, habitat destruction, human encroachment,

and climate change (Jones et al., 2013; Woolhouse et al., 2005; Morse, 1995). It is crucial to evaluate and understand how these changes influence the connections between diseases and their hosts, as well as the interactions between hosts and other animals, humans, and wildlife. Gaining insight into these factors and their impacts will aid in developing strategies for mitigation and facilitate a swift and effective response, as these interactions are central to the emergence of diseases (Wang & Crameri, 2014).

Humans have introduced numerous changes to the globe, from its previous natural form into its present one. These changes are leading to human diseases and the one that is negatively impacting this alteration is urbanization. Almost 50% of the human population lives in urban areas; this percentage is increasing. A complex link between urbanization, deforestation, and habitat fragmentation has a combined impact on the loss of biodiversity and disease outbreaks (Mackenstedt et al., 2015). The urbanization plays a vital role in emergence of zoonotic diseases by habitat destruction, displacement of wildlife into urban areas, increased rodents and insects, growth of diseases- carrying vectors (such as ticks, mosquitoes) and poor public health infrastructure (Esposito et al., 2023).

Habitat destruction causes biodiversity loss, climate change and leads to transportation routes from isolated regions to population areas (Bedenham et al., 2022). The modifying dynamics for possibly new, emerging, and re-emerging zoonosis, climate change has made it easier for certain disease vectors to spread their compatible conditions. The most important factor influencing the re-emergence of infections in new areas during the next 20 years will be climate change (Cutler et al., 2010). The climate and habitat changes significantly influence the dispersal of vectors when viruses that were once confined to specific geographic areas are introduced into naive populations of susceptible animals and humans. This expansion of vectors into newly formed habitats is leading to the geographical spread of zoonotic diseases such as dengue virus, and West Nile encephalitis. Consequently, previously isolated vectors are now coming into contact with one another, exposing agents to new potential vectors (Sambri et al., 2013).

Globalization is also growing, as seen by the movement of people, animals, and their goods across the world. The strictest control measures are challenged by the unpredicted spread of pathogens made possible by this movement. Additionally, human development and tourism lead to ongoing human intrusion into natural areas, exposing people to new ecological settings and new zoonotic exposures (Cutler et al., 2010).

1. Types of Zoonosis

The zoonotic infections, which are spread from animals or microbes to humans, fall into four major groups and represent a major risk to hygiene (Abebe et al., 2020). The details of several zoonotic illnesses are as follows:

i. **Bacterial Zoonotic Diseases**

Once believed to be eradicated or under control, many zoonotic disorders, particularly bacterial zoonotic infections, can reappear. The development of antimicrobial resistance due to the overuse or misuse of antibiotics is another public health concern that is spreading throughout the world (Salam et al., 2023). These diseases have an adverse effect on trade, tourism, and the world economy. In most developed countries, antibiotic-resistant zoonotic bacterial infections are particularly important for vulnerable groups, such as the elderly, young, pregnant, and individuals with compromised immune systems (Cantas & Suer, 2014).

Zoonosis is a disease that affects both people and animals, and they can be spread by household pets or wild animals. The zoonotic pathogens can be found in large quantities in animals and their by-products. Dogs are among the animals that can spread a number of zoonotic illnesses to their owners. In order to lower the number of zoonotic diseases in the human population, dog owners should be educated about these illnesses and how they spread. To reduce zoonotic diseases, a number of preventative and treatment measures have been implemented (Sandhu & Singh, 2014). The dog owners should wash their hands after direct contact with animal waste.Other infections caused by protozoa are spread orally through feces, but the majority of bacterial and viral infections are spread from dogs to humans through dog bites. Therefore, it is important to thoroughly wash vegetables and cook meats to ensure food cleanliness and reduce the incidence of zoonotic illnesses (Ghasemzadeh & Namazi, 2015).

ii. **Virus-Induced Zoonotic Diseases**

Of the 1400 known human diseases, about 64 percent are zoonotic, meaning they come from vertebrate nonhuman hosts. Viruses and prions account for less than 5% of all human infections. The viruses that are members of the RNA viral families *Bunyviridae*, *Flaviviridae, Togaviridae*, and *Reoviridae* cause more than half of the known viral zoonosis. Curiously, most zoonotic viral illnesses share the characteristic of being hard for individuals to get from one another. Under most conditions, humans are dead-end hosts (Heeney, 2006).

The global economics, trade, and tourism have all been impacted by zoonotic viral illnesses that have historically posed a major threat to public, animal, and environmental health. The multifactorial determinants are linked to highly consequential viral infections as COVID-19, Ebola and avian influenza (Ullah et al., 2023). Pathogen spill over from animals to humans (Figure 1), a broad host range, various cellular tropisms, and shifting host-agent-environment dynamics are all crucial drivers. “One Health,” which tackles the complex interactions between human, animal, plant, and environmental health, is the collective term for these disease-causing elements (Zortman et al., 2023).

iii. **Pathogenic Zoonotic Disease**

The bacterial zoonosis that is transmitted by ticks and the spirochete *Borrelia burgdorferi* is responsible for it. The primary hosts of *B. Burgdorferi* are the masked shrew (*Sorex cinereus*), short-tailed shrew (*Blarina brevicauda*), eastern chipmunk (*Tamias striatus*), and white-footed mouse (*Peromyscus leucopus*). The vector of the disease is the black-legged tick, *Ixodes scapularis*, which is found throughout most of North America (Vuong et al., 2017). Widely dispersed and exceptionally resilient, short-tailed shrews, stern chipmunks, and white-footed mice are common in fragmented and degraded ecosystems and have the ability to dominate populations of low-diversity vertebrates (Ostfeld, 2009).

There is more diversity in birds and mammals, but the spirochete that causes Lyme disease is poorly stored in many other species. Additionally, because blacklegged -ticks appear to prefer feeding on small rodents (Ponchon, 2008).

iv. Zoonotic Disease Induced by Fungi

The fungal zoonosis is an infectious illness that can infect humans after infecting animals. The vast majority of recently emerging or re-emerging zoonotic infections. These pose a serious threat to the world and are spread by mushrooms, either directly or indirectly. Emerging infections are those that affect a population in a geographic area for the first time. Because they can spread by saprozoic and zoonotic transmission, fungi pose a serious threat to society (Naz et al., 2023)

The Nipah virus, a novel paramyxovirus closely related to the Hendra virus, first surfaced in Peninsular Malaysia's northern region in 1998 (Chua, 2003). Early control measures like fogging mosquitoes and Japanese encephalitis vaccination for pigs didn't work. Following an autopsy, it was discovered that nine of the fifteen individuals who perished at the Ipoh epicentre had contracted the Nipah virus. Unfortunately, pig farmers who sold their animals to other farms around the nation have been impacted by the outbreak (Looi & Chua, 2007).

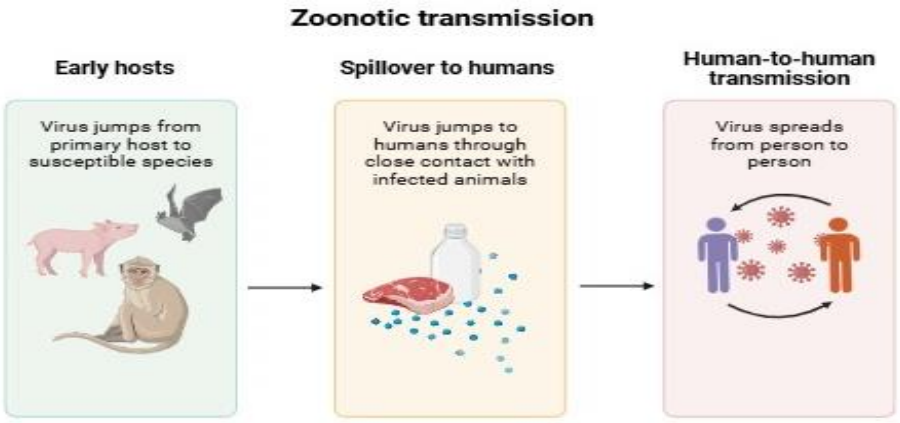

Fig. 1: Zoonotic transmission from primary hosts (animals) to the final (human) host.

2. Urbanization and Zoonotic Diseases

i. **Urbanization trends and Projections**

Urbanization is the change of rural areas into urban settlements as well as redistribution of people from rural to urban areas. As cities act as important entry and exit points for both domestic and foreign migrants, hence strategic planning and administration of cities and urban systems must take migration into account. Almost 55% of the world's population occupied urban areas by 2018, making urban areas more populated than rural ones. The urbanization is expected to account for 68% of the world's population by 2050, up from 30% in 1950 (Ahmed et al., 2019).

Increased trade, movement of people, animals, and food frequently creates favourable conditions for the transmission of infectious illness, such as zoonosis. Between 2018 and 2050, it is anticipated that there will be 2.5 billion more people living in cities worldwide. Over the previous ten years, an average of 1.2 million new urban people moved into cities each week. The current fast expansion is occurring in Asia and Africa. In contrast, American cities increased by just 1% year between 2005 and 2010 (Neiderud, 2015).

The emerging infectious diseases present additional hazards and difficulties as a result of the growth of new, contemporary cities. Numerous studies conducted in China, East and Southeast Asia, and Africa have identified the causes and effects of urbanization as being closely related to a number of infectious and communicable diseases. These include environmental degradation brought on by air and water pollution, increased number of people per area, rural-urban migration and changes in pre-urban land uses (Ahmed et al., 2019).

ii. Increased Human-animal Interface in Urban Areas

The human life is at risk due to increased human-animal interactions, which allow for the emergence and reappearance of numerous infectious diseases (Debnath et al., 2021). The onset of agricultural activity and human modification of the environment 6 million to 11,000 years ago marked the beginning of the spread of zoonotic diseases across the interface, as well as increased rodent activity near settlements and animal domestication, leading to increased human-animal contact with pathogens (Sahu et al.,2021). In addition to drastically altering environmental circumstances, the extensive movement of people and food items, especially animal products, is creating favourable conditions for the (re)outbreak of infectious vectors with ever-increasing epidemiological complexity food items i.e., meat and dairy products are the main cause of spreading zoonotic diseases (Ahmed et al., 2019).

Many adaptable species are now becoming inhabitants of pre-urban and urban areas due to the availability of more food (waste and pet food) and places for shelter than their natural habitat. This urbanisation is responsible for zoonotic vector-borne infections, as adaptable species are the host for such infectious pathogens (Bradley and Altizer, 2007).Furthermore, pet animals are also suitable hosts for these infectious agents, from where zoonotic diseases easily get entered into the human population (Mackenstedt et al., 2015). Almost 75% of human diseases are zoonotic that spread through domestic and adaptable wildlife animals (Taylor et al., 2001).

For example, humans suffer from cystic echinococcosis (a disease in which fluid-filled cysts form in the lungs or liver) by ingesting eggs of *Echinococcus granulosus* from the infected carnivores (dogs), causing morbidity and can be fatal. Insect vectors, i.e., ticks, mosquitoes, fleas, etc., also play a role in the transmission of zoonotic diseases (Lyme disease, malaria, plague, etc.) into the human population (Mackenstedt et al., 2015).

iii. **Role of urban Planning and Infrastructure in Disease Prevention**

The urban settings with their morphological and functional features along with risks can also result in protection and promotion. In the

view of Ottawa Charter with action plans "Health in All policies" (WHO, 2006) both living standards and the environment are the most significant factor for Health determination. With proper strategies risk factor can be lessened. Organized, properly managed and well planned cities can outweigh the risks, not only this but also enable individuals to efficiently participate in everyday life opportunities with their good health (D'Alessandro et al., 2017).

Lifestyles strategies of urban planning can be improved by upgrading the existing areas, designing new settlements as well. Practical actions include reduce soil consumption, development of green belts, mobility options enhanced by city designs, implementation of solid waste disposal management programs, ensuring good quality food also providing just and equitable public serves, developing water management systems working with water recycling and recovering with its purification, use of technology to mitigate indoor and outdoor air pollution and to aware stakeholders about the usage of low emission materials with proper equipment, well maintained building infrastructure as well (McMichael, 2000).

The local governments should directly be a part of city's health planning policies by ensuring surveys that aim at the introduction of qualitative and quantitative performance tools, linked computer systems with health affecting (environmental) factors, case studies to find problems and their solutions then addressing the findings with public by using web platforms are all significant parameters to prevent diseases in urban areas (D'Alessandro, et al., 2017).

iv. Destroying Habitats and Zoonotic Infections

a. Loss of Biodiversity, Changes in Land use, and Deforestation

In Asia, the relationships between land use change and the spread of zoonotic diseases are intricate, continuous, and not always clear-cut. All zoonotic disease outbreaks are caused by ecological conditions, but land use changes are influenced by political-economic factors. These factors also affect biodiversity and ecological conditions, which in turn affect zoonotic infection outbreaks (Connolly et al., 2021; Hassell et al., 2017). Sea is home to the world's tropical forests for about 15% population, which are geographic regions for biodiversity. Half of the known zoonoses have appeared after 1940, coinciding with a significant loss of tropical forests. Increased rate of deforestation has led to the transmission of zoonotic infections among human beings (Jones et al., 2013). Industrial agricultural growth, timber harvesting, the extraction of minerals and fossil fuels, the building of dams and roads, the need for wood fuel, urbanization, and the conversion of smallholder agricultural lands with a variety of crops to monoculture plantations are the main causes of deforestation and the corresponding changes in land use in SEA and southern China (Davis et al., 2020; Patz et al., 2004). The production of agricultural commodities like oil palm and pulpwood is typically the primary driver of the massive transformation of forest to agribusiness in emerging nations, particularly in SEA (Meyfroidt et al., 2013,).

Frequent occurrence and transmission of zoonotic illnesses are intimately linked to biodiversity loss (Keesing et al., 2010). The loss of biodiversity weakens an ecosystem and increases the likelihood that infections may infect humans. A host's interactions with a pathogen or with other species that serve as vectors or reservoirs may be impacted by changes in biodiversity (Kenney-Lazar and Ishikawa, 2019).

Climate Change's Effects on Disease Outbreak and Habitat loss

Climate change poses the biggest threat to both human and animal populations because it affects the population dynamics, reproductive success, and densities of some species. Additionally, the current limits of agricultural activities may be expanded by climate change, increasing the likelihood of species interactions that would not normally take place there (Sutherst, 2004). The livestock excrete a wide variety of bacteria having zoonotic potential. The food crops that are watered with contaminated water increase the risk of human infection since these infections can spread through food and water. Because they can spread disease outbreaks, densely populated urban areas, especially those with inadequate sanitation are a serious public health concern. The climate change has a significant impact on the spread of disease (Chua et al. 2000). Because they extend periods of vegetation growth and increase habitat availability, which in turn provide zoonotic pathogens and associated vectors with better living conditions that support survival and reproduction, variable temperatures are believed to play a role in the rise in zoonotic disease cases. Furthermore, the region's permafrost is thawing due to rising temperatures, which has sparked concerns that this could reveal ancient human graveyards and result in the reappearance of vectors that transmit fatal diseases. The climate change may have an effect on the regional distribution of insect-borne diseases (Singh et al., 2011).

3. Public Health Response and Prevention Strategies

Since people and animals share an ecosystem, many of the same germs can infect both. Controlling the animal source of the causative agents, for instance, might effectively avoid the majority of zoonotic diseases, including brucellosis, anthrax, and rabies, in humans. Through tainted food and direct touch, humans and animals can contract drug-resistant bacteria (Clayton et al., 2013). Environmental contamination, ecosystem degradation, antimicrobial resistance (caused by antibiotic abuse), and contaminated food intake (caused by eating animal products, fruits, vegetables, and tainted water) origin, fruits, vegetables, and tainted water) are all pertinent issues that cannot be managed and resolved by a single industry (Erkyihun, 2022). Therefore, a well-coordinated One Health approach in the human, animal, and environmental sectors is needed to successfully address these concerns. As a result, the strategies listed below are essential for preventing certain diseases (Erkyihun, 2022).

i. Vaccination and Treatment Options

The most beneficial advancement of the 20th century is the formation of vaccines as public health achievement against numerous zoonotic infections. The vaccination of humans, domestic animals, as well as wild animals (transmitting diseases in domestic animals) greatly reduce the risk of zoonoses among the humans (Carpenter, et al., 2022).

There are still two options in animal health in the event of an emergency: mass animal slaughter or vaccination. Unfortunately, vaccines

are not always available. This is especially true when dealing with a truly new disease that is also zoonotic, like the Nipah virus infection for which there is currently no vaccination because the causing factor is unknown; the only way to treat this situation is to kill and destroy the afflicted and affected animals. Although a vaccine to prevent Nipah virus infection in pigs has recently been produced humans in Bangladesh and other countries are primarily at risk from direct contact with the reservoir, fruit bats, or their secretions (Paul-Pierre, 2009).

ii. **Education and Awareness Campaigns**

Even if the average life expectancy worldwide is rising and the relative impact of infectious illnesses is decreasing, preventable communicable diseases continue to pose a serious threat to a sizable section of the population. The impact of infectious diseases varies depending on socioeconomic conditions. As a result, these global summary statistics obscure significant national variations and run the risk of prematurely diverting resources from the prevention of avoidable disease (Hasanov, et al., 2017).

iii. **Urban Planning and Habitat Conservation Strategies**

Humans can contract zoonotic diseases from their local surroundings. The variety of infections spread is influenced by the species and number of each host species as well as the host communities overall, particularly in the case of parasites. Given the intricacy of parasite life cycles, particularly those caused by zoonotic vector-transmitted infections, which frequently involve multiple hosts; it is clear that urbanization may help spread some parasites but not others to the extent that it totally stops their life cycle (Wilcox & Gubler, 2005).

iv. **One Health Approach, (Human, Animal, environment)**

At the local, regional, national, and international levels, One Health (OH) approach (Figure 2), is a cooperative, multi sectorial, coordinated, and Trans disciplinary approach that motive to achieve prime health outcomes by accepting the interdependence of people, animals, plants, and their shared environment (Aggarwal & Ramachandran, 2020).

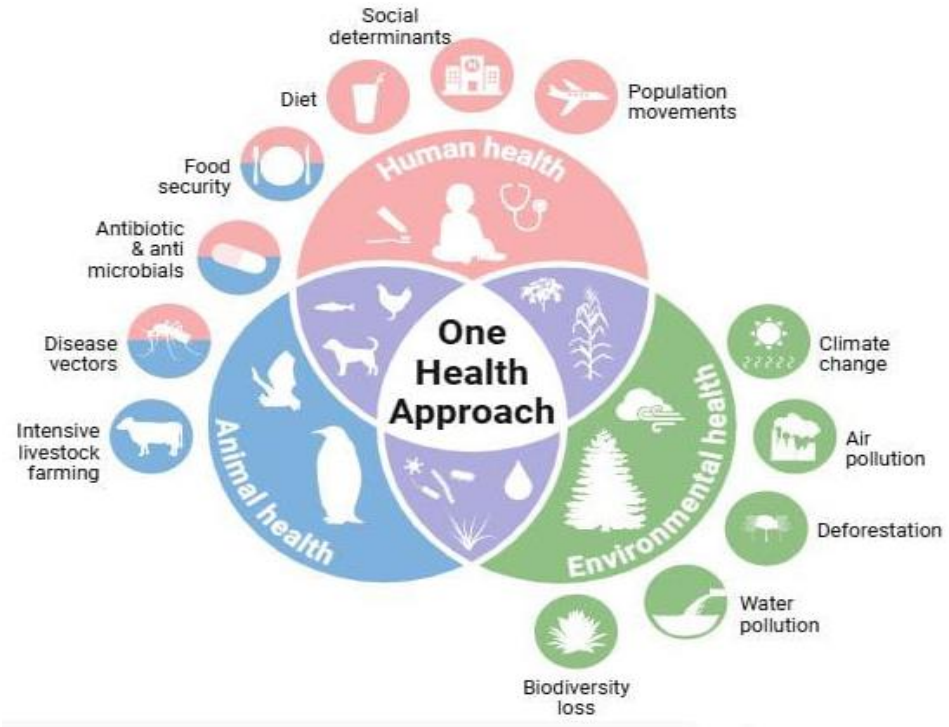

Fig. 2: One health approach describing to save human, animal and environmental health.

In accordance with World Health Organization (WHO) in recent decades has raised concerns about the public health risk posed by zoonosis. As a result, these agents have the ability to start epidemics at any time. Given this, we may say that the risk of zoonosis, especially in work environments, has likely been understated in previous years (Rabozzi et al., 2012).

v. Policy Recommendations for Mitigating Emerging Zoonotic Diseases

To slow down the spread of zoonotic illnesses, a variety of approaches are required, including local, national, and worldwide policy initiatives. Drawing from studies and trends in infectious disease control, the following policy recommendations aim to effectively mitigate the suffering caused by emerging zoonotic diseases (World Health Organization, 2011):

i) Expand public education campaigns on the dangers of zoonotic diseases, how to avoid them, and the value of cleaning and immunization.
ii) Conduct educational campaigns targeting at-risk groups such as farmers, wildlife workers and communities with frequent contact with animals.
iii) Educate people on how to identify, prevent and treat zoonotic disease.
iv) Strengthen collaborative research projects, response coordination and data exchange.
v) Stricter regulations are required to control the worldwide transportation of animals and animal products in order to prevent the spread

of zoonotic illnesses.

vi) Stricter biosecurity laws should be implemented in farms, slaughterhouses, and live animal marketplaces.

vii) Improving cleanliness, vaccinating cattle, and regulating the trade in wildlife and exotic animals are all part of this (Bekele, et al., 2018).

viii) Address environmental problems that lead to the spread of zoonotic illnesses, such as habitat deterioration, deforestation, and climate change.

ix) Create regulations to lessen ecological deterioration and climate change. Encourage conservation efforts such wildlife habitat preservation, reforestation programs, and sustainable land use technology.

x) Create and enhance national and worldwide surveillance efforts to detect zoonotic illnesses early. This includes increased surveillance of the populations of people, animals, and nature.

xi) Develop databases and real-time tracking systems that incorporate data from several industries, including agriculture, health, and the environment, in order to detect and forecast disease outbreaks (Tsai et al., 2010).

Conclusion

Emerging zoonotic infections are linked to habitat destruction and urbanization as these factors have a direct relation with each other. As human population is expanding, cities are growing as well, natural habitats are being cleared for the sake of development and forcing wildlife closer into a direct contact with humans. This ecosystem disruption facilitates the pathogens for transmission from animals to the humans. Dense population and frequent interactions of animals to humans in the urban environments promotes these infections to spread. Furthermore, loss of biodiversity makes pathogens thrive easier by reducing the natural barriers for disease transmission. The climate change along with urbanization, exacerbates these risks due to migration patterns of animals and ecosystem alteration. To reduce the threats of emerging zoonotic diseases, it is crucial to focus on sustainable urban planning, habitat conservation and implementation of warning systems for such outbreaks. It is important to address about these factors, safeguard public health and prevent future pandemics.

References

Abebe, E., Gugsa, G., & Ahmed, M. (2020). Review on major food-borne zoonotic bacterial pathogens. *Journal of Tropical Medicine, 2020*(1), 1-19.

Aggarwal, D., & Ramachandran, A. (2020). One health approach to address zoonotic diseases. *Indian Journal of Community Medicine*, *45*(1), 6-8.

Ahmed, S., Davila, J. D., Allen, A., Haklay, M., Tacoli, C., & Fevre, E. M. (2019). Does urbanization make emergence of zoonosis more likely? Evidence, myths and gaps. *Environment and Urbanization*, *31*(2), 443-460.

Arshad, M. I., Wensman, J. J., & Munir, M. (2023). Immunopathogenesis and infection characteristics of zoonotic viral diseases. *Frontiers in Cellular and Infection Microbiology*, *13*, 1198392.

Bedenham, G., Kirk, A., Luhano, U., & Shields, A. (2022). The importance of biodiversity risks: Link to zoonotic diseases. *British Actuarial Journal*, *27*(10), 1-9.

Bekele, A., Alemu, D., Teklewold, T., Moore, H. L., Hodge, C., & Berg, S. (2018). Strategies for animal disease control in Ethiopia: A review of policies, regulations and actors. *Journal of Veterinary Medicine and Animal Health*, *10*(12), 256-265.

Bradley, C. A., & Altizer, S. (2007). Urbanization and the ecology of wildlife diseases. *Trends in Ecology & Evolution*, *22*(2), 95-102.

Cantas, L., & Suer, K. (2014). The important bacterial zoonoses in "one health" concept. *Frontiers in Public Health*, *2*(144), 1-8.

Carpenter, A., Waltenburg, M. A., Hall, A., Kile, J., Killerby, M., Knust, B., & Vaccine Preventable Zoonotic Disease Working Group. (2022). Vaccine preventable zoonotic diseases: challenges and opportunities for public health progress. *Vaccines*, *10*(993), 1-19.

Chua, K. B. (2003). Nipah virus outbreak in Malaysia. *Journal of Clinical Virology*, *26*(3), 265-275.

Clayton, B. A., Wang, L. F., & Marsh, G. A. (2013). Henipaviruses: an updated review focusing on the pteropid reservoir and features of transmission. *Zoonoses and Public Health*, *60*(1), 69-83.

Connolly, C., Keil, R., & Ali, S. H. (2021). Extended urbanisation and the spatialities of infectious disease: Demographic change, infrastructure and governance. *Urban Studies*, *58*(2), 245-263.

Corrales, N. U. (2023). The Significance of Education in the Preparedness for Zoonotic Diseases. In *Epidemic Preparedness and Control*. IntechOpen.

Cutler, S. J., Fooks, A. R., & Van Der Poel, W. H. (2010). Public health threat of new, reemerging, and neglected zoonoses in the industrialized world. *Emerging Infectious Diseases, 16*(1), 1-8.

D'Alessandro, D., Arletti, S., Azara, A., Buffoli, M., Capasso, L., Cappuccitti, A., & Zuccarello, P. (2017). Strategies for disease prevention and health promotion in urban areas: the Erice 50 Charter. *Annali di Igiene Medicina Preventiva e di Comunita*, *29*(6), 481-493.

Davis, K. F., Koo, H. I., Dell'Angelo, J., D'Odorico, P., Estes, L., Kehoe, L. J., & Tatlhego, M. (2020). Tropical forest loss enhanced by large-scale land acquisitions. *Nature Geoscience*, *13*(7), 482-488.

Debnath, F., Chakraborty, D., Deb, A. K., Saha, M. K., & Dutta, S. (2021). Increased human-animal interface & emerging zoonotic diseases: An enigma requiring multi-sectoral efforts to address. *Indian Journal of Medical Research*, *153*(5-6), 577-584.

Erkyihun, G. A., & Alemayehu, M. B. (2022). One Health approach for the control of zoonotic diseases. *Zoonosis*, *2*(1), 1-11.

Esposito, M. M., Turku, S., Lehrfield, L., & Shoman, A. (2023). The impact of human activities on zoonotic infection transmissions. *Animals*, *13*(10), 1-18.

Ferreira, M. N., Elliott, W., Kroner, R. G., Kinnaird, M. F., Prist, P. R., Valdujo, P., & Vale, M. M. (2021). Drivers and causes of zoonotic diseases: An overview. *Parks*, *27*(27), 15-24.

Gehlot, E. M. (2022). Recent links between zoonosis and a catastrophic global climate change. *International Journal of Environment and Climate Change*, *12*(11), 3657-3670.

Ghasemzadeh, I., & Namazi, S. H. (2015). Review of bacterial and viral zoonotic infections transmitted by dogs. *Journal of Medicine and*

Life, *8*(4), 1-5.
Grace, D., Mutua, F. K., Ochungo, P., Kruska, R., Jones, K., Brierley, L., & Phuc, P. (2012). Mapping of poverty and likely zoonoses hotspots. Zoonoses Project 4 Report to Department for International Development, UK.
Hasanov, E., Zeynalova, S., Geleishvili, M., Maes, E., Tongren, E., Marshall, E., & Horton, D. L. (2018). Assessing the impact of public education on a preventable zoonotic disease: rabies. *Epidemiology & Infection*, *146*(2), 227-235.
Hassell, J. M., Begon, M., Ward, M. J., & Fevre, E. M. (2017). Urbanization and disease emergence: dynamics at the wildlife–livestock–human interface. *Trends in Ecology & Evolution*, *32*(1), 55-67.
Heeney, J. L. (2006). Zoonotic viral diseases and the frontier of early diagnosis, control and prevention. *Journal of Internal Medicine, 260*(5), 399-408.
Jones, B. A., Grace, D., Kock, R., Alonso, S., Rushton, J., Said, M. Y., & McDermott, J. (2013). Zoonosis emergence linked to agricultural intensification and environmental change. *Proceedings of the National Academy of Sciences, 110*(21), 8399-8404.
Jones, K. E., Patel, N. G., Levy, M. A., Storeygard, A., Balk, D., Gittleman, J. L., & Daszak, P. (2008). Global trends in emerging infectious. *Nature*, *451*(7181), 990-993.
Keesing, F., Belden, L. K., Daszak, P., Dobson, A., Harvell, C. D., Holt, R. D., & Ostfeld, R. S. (2010). Impacts of biodiversity on the emergence and transmission of infectious diseases. *Nature*, *468*(7324), 647-652.
Kenney-Lazar, M., & Ishikawa, N. (2019). Mega-plantations in Southeast Asia: landscapes of displacement. *Environment and Society*, *10*(1), 63-82.
Looi, L. M., & Chua, K. B. (2007). Lessons from the Nipah virus outbreak in Malaysia. *Malaysian Journal of Pathology*, *29*(2), 63-67.
Mackenstedt, U., Jenkins, D., & Romig, T. (2015). The role of wildlife in the transmission of parasitic zoonoses in peri-urban and urban areas. International Journal for Parasitology: *Parasites and Wildlife*, *4*(1), 71-79.
McMichael, A. J. (2000). The urban environment and health in a world of increasing globalization: issues for developing countries. *Bulletin of the World Health Organization*, *78*(9), 1117-1126.
Meyfroidt, P., Lambin, E. F., Erb, K. H., & Hertel, T. W. (2013). Globalization of land use: distant drivers of land change and geographic displacement of land use. *Current Opinion in Environmental Sustainability*, *5*(5), 438-444.
Morse, S. S. (1995). Factors in the emergence of infectious diseases. *Emerging Infectious Diseases*, *1*(1), 1-9.
Naz, G., Rasheed, M., Sarwar, A., Mehmood, S., Farooq, W., Imran, U., & Urwa, J. (2023). A one-health approach to combat common pet-associated fungal zoonosis. *Zoonosis,* (pp. 587-598). Unique Scientific Publishers, Faisalabad, Pakistan.
Neiderud, C. J. (2015). How urbanization affects the epidemiology of emerging infectious diseases. *Infection Ecology & Epidemiology, 5*(1), 27060.
Patz, J. A. (2004). Unhealthy landscapes: policy recommendations on land use change and infectious disease emergence. *Environmental Health Perspective*, *112*(10), 1092-1098.
Paul-Pierre, P. (2009). Emerging diseases, zoonosis and vaccines to control them. *Vaccine*, *27*(46), 6435-6438.
Ponchon, A., Chambert, T., Lobato, E., Tveraa, T., Gremillet, D., & Boulinier, T. (2015). Breeding failure induces large scale prospecting movements in the black-legged kittiwake. *Journal of Experimental Marine Biology and Ecology*, *473*, 138-145. https://doi.org/10.1016/j.jembe.2015.08.013
Rabozzi, G., Bonizzi, L., Crespi, E., Somaruga, C., Sokooti, M., Tabibi, R., & Colosio, C. (2012). Emerging zoonosis: the "one health approach". *Safety and Health at Work*, *3*(1), 77-83.
Sahu, R., Das, D. P., & Nayak, S. (2021). Emergence of zoonoses at human-animal interface. *International Journal of Current Microbiology and Applied Sciences*, *9*(3), 2894-2905.
Salam, M. A., Al-Amin, M. Y., Salam, M. T., Pawar, J. S., Akhter, N., Rabaan, A. A., & Alqumber, M. A. (2023). Antimicrobial resistance: a growing serious threat for global public health. *Healthcare*, *11*(13), 1-20.
Sandhu, G. K., & Singh, D. (2014). Level of awareness regarding some zoonotic diseases, among dog owners of Ithaca, New York. *Journal of Family Medicine and Primary Care*, *3*(4), 418-423.
Sambri, V., Capobianchi, M., Charrel, R., Fyodorova, M., Gaibani, P., Gould, E., & Rossini, G. (2013). West Nile virus in Europe: emergence, epidemiology, diagnosis, treatment, and prevention. *Clinical Microbiology and Infection*, *19*(8), 699-704.
Singh, B. B., Sharma, R., Gill, J. P. S., Aulakh, R. S., & Banga, H. S. (2011). Climate change, zoonoses and India. *Revue Scientifique et Technique-OIE*, *30*(3), 779-788.
Sutherst, R. W. (2004). Global change and human vulnerability to vector-borne diseases. *Clinical Microbiology Reviews*, *17*(1), 136-173.
Taylor, L.H., Latham, S.M., Woolhouse, M.E., 2001. Risk factors for human disease Emergence. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, *356*(1411), 983-989.
Tsai, P., Scott, K. A., Gonzalez, M. C., Pappaioanou, M., & Keusch, G. T. (2010). Sustaining global surveillance and response to emerging zoonotic diseases.
Ullah, M., Li, Y., Munib, K., & Zhang, Z. (2023). Epidemiology, host range, and associated risk factors of monkeypox: an emerging global public health threat. *Frontiers in Microbiology*, *14*, 1-15. https://doi.org/10.3389/fmicb.2023.1160984
Vuong, H. B., Chiu, G. S., Smouse, P. E., Fonseca, D. M., Brisson, D., Morin, P. J., & Ostfeld, R. S. (2017). Influences of host community characteristics on Borrelia burgdorferi infection prevalence in blacklegged ticks. *PloS One*, *12*(1), 1-17.
Wang, L., & Crameri, G. (2014). Emerging zoonotic viral diseases. *Revue Scientifique et Technique, 33*(2), 569-581.
White, R. J., & Razgour, O. (2020). Emerging zoonotic diseases originating in mammals: a systematic review of effects of anthropogenic land-use change. *Mammal Review*, *50*(4), 336-352.
Wilcox, B. A., & Gubler, D. J. (2005). Disease ecology and the global emergence of zoonotic pathogens. *Environmental Health and Preventive*

Medicine, *10*(5), 263-272.

Woolhouse, M. E., Haydon, D. T., & Antia, R. (2005). Emerging pathogens: the epidemiology and evolution of species jumps. *Trends in Ecology & Evolution*, *20*(5), 238-244.

World Health Organization (2006). Health in all Policies. Available on: http://www.euro.Who.int/__data/assets/pdf_file/0007/188809/Health-in-All-Policies-final.pdf

World Health Organization (2011). FAO/OIE/WHO joint scientific consultation on influenza and other emerging zoonotic diseases at the human-animal interface, 27-29 April, 2010, Verona, Italy: consultation summary 2010.

World Health Organization (2020). WHO Health Topic Page: Zoonoses. World Health Organization, Geneva. Available from: https://www.who.int/topics/zoonoses/en/Retrieved on, 20-07.

Zortman, I., de Garine-Wichatitsky, M., Arsevska, E., Dub, T., Van Bortel, W., Lefrançois, E., & Binot, A. (2023). A social-ecological systems approach to tick bite and tick-borne disease risk management: Exploring collective action in the Occitanie region in southern France. *One Health*, *17*(2023), 1-9.