Review of Contemporary Philosophy
ISSN: 1841-5261, e-ISSN: 2471-089X
Vol 22 (1), 2023
pp. 4264 - 4273

Emerging Zoonotic Diseases: A Comprehensive Review of Their Origins, Epidemiology, Transmission Dynamics, And Public Health Implications on A Global Scale.

[1]-Ayman Mohammed Hussain Hussain,[2]-Abdulaziz Mohammad Yousef Alzeer,[3]-Ahmed Mohammed Hussein Alsomali,[4]- Hassan Ahmed Mohmmed Muyini,[5]-Jaber Ali Ahmad Madkhali,[6]- Bandar Saleh Rashed Alkharaan,[7]-Saeed Ghurmallah Saeed Al Ghamdi,[8]-Abdul Wahab Muhammad Sahqi,[9]- Abdullah Mohammed Almarshud ,[10]-Abbasid Rashes Zaid Bin Gangnam,[11]- Easa Saiban Mawikli,[12]- Ali Abdulaziz Almuslim,[13]-Fahad Mousa Ahmed Zahrani ,[14]-Saleh Abdulsalam Alenazi ,[15]-Mutlaq Khalid Saleh Al Mahlasi

[1] Ksa, Ministry Of Health, Riyadh First Health Cluster
[2] Ksa, Ministry Of Health, Riyadh First Health Cluster - Al Muzahmiyah General Hospital
[3] Ksa, Ministry Of Health, Albirk General Hospital
[4] Ksa, Ministry Of Health, Jazan Health Cluster
[5] Ksa, Ministry Of Health, Jazan South Sector
[6] Ksa, Ministry Of Health, First Health Cluster Al-Hazm Health Center
[7] Ksa, Ministry Of Health, Public Health Department
[8] Ksa, Ministry Of Health, Al-Bahah, Al-Makhwa General Hospital
[9] Ksa, Ministry Of Health, Qassim Health Cluster Alrabieia
[10]Ksa, Ministry Of Health, Casablanca Ii Health Center
[11]Ksa, Ministry Of Health, Jazan Health Cluster
[12]Ksa, Ministry Of Health, Al-Qababneh Health Center
[13]Ksa, Ministry Of Health, Jeddah Second Health Cluster
[14]Ksa, Ministry Of Health, The Second Health Gathering In Riyadh
[15]Ksa, Ministry Of Health, Riyadh Second Health Cluster -Hotat Sudair Hospital

Abstract

Background: Emerging zoonotic diseases, originating from animal hosts, represent a significant global health threat, profoundly impacting human health and economies. This review examines the epidemiology of zoonoses, highlighting their origins, transmission mechanisms, and public health implications.

Methods: A comprehensive literature review was conducted, analyzing data from various sources, including the World Health Organization (WHO) and peer-reviewed journals, to classify zoonotic diseases by their etiological agents—bacterial, viral, parasitic, fungal, and prion-based.

Results: Results indicate that over 60% of new human diseases are zoonotic, with a significant burden on low- and middle-income countries, where impoverished populations are particularly vulnerable. The study categorizes zoonoses into direct and indirect transmission routes, with notable examples such as rabies and avian influenza. The findings underscore the complex interplay between human, animal, and environmental health, emphasizing the importance of the One Health approach in addressing zoonotic threats.

Conclusions: Conclusions drawn from this review suggest that effective surveillance, prevention, and control measures are crucial for mitigating the risks associated with zoonotic diseases. The increasing

incidence of zoonoses, exacerbated by factors such as climate change and human encroachment on wildlife habitats, calls for urgent global collaboration in research, policy-making, and public health initiatives.

Keywords: Zoonotic diseases, Epidemiology, One Health, Public health, Transmission mechanisms.

Received: 13 october 2023 **Revised:** 27 November 2023 **Accepted:** 11 December 2023

1. Introduction

Humans, animals, and the environment significantly influence the origin and spread of several infectious illnesses [1]. The majority of contagious diseases impacting people are derived from animals. The publication "Asia Pacific Strategy for Emerging Diseases: 2010" stated that over 60% of new human diseases are zoonotic, with over 70% of these viruses originating from animal species. In recent decades, newly discovered human diseases have originated from animals and are directly linked to animal-derived foods [3].

The phrase "Zoonoses" originates from the Greek words "Zoon," meaning animal, and "nosos," meaning sickness. The World Health Organization (WHO) defines zoonosis as any illness or infection that is naturally transmissible between vertebrate animals and humans, or vice versa. Approximately 61% of human pathogens are zoonotic in origin [4,5].

Zoonoses represent a significant public health issue and a direct threat to human health that might potentially result in mortality. The 13 most prevalent zoonoses significantly affect impoverished livestock workers in low- and middle-income nations, resulting in around 2.4 billion instances of disease and 2.7 million human fatalities annually, with detrimental consequences for human health. Many of these illnesses impact animal health and diminish cattle productivity [6].

2. Classification of Zoonoses

Zoonotic illnesses are induced by many infections. Zoonoses are categorized by etiology into bacterial zoonoses (e.g., anthrax, salmonellosis, tuberculosis, Lyme disease, brucellosis, and plague), viral zoonoses (e.g., rabies, AIDS, Ebola, and avian influenza), parasitic zoonoses (trichinosis, toxoplasmosis, trematodosis, giardiasis, malaria, and echinococcosis), fungal zoonoses (ringworm), rickettsial zoonoses (Q-fever), chlamydial zoonoses (psittacosis), mycoplasma zoonoses (*Mycoplasma pneumoniae* infection), protozoal zoonoses, and diseases caused by acellular non-viral pathogenic agents (transmissible spongiform encephalopathies and bovine spongiform encephalopathy) [7].

The previous taxonomy of zoonoses included the names anthropozoonoses, zooanthroponoses, amphixenoses, and euzoonoses [8]. Anthropozoonoses are illnesses originating in animals that may be transferred to humans, exemplified as rabies. Zooanthroponoses denotes illnesses transferred from humans to animals, such as TB in felines and primates. Amphoonoses are illnesses capable of bidirectional transmission between humans and animals, exemplified as staphylococcal infection. In some parasite infections, humans serve as the definitive host. These parasitic disorders are referred to as Euzoonoses, including infections caused by *Taenia solium* and *Taenia saginata*.

Both Gram-negative and Gram-positive bacteria may cause zoonoses. Bacteria are the predominant cause of zoonotic illnesses based on etiology. It is estimated that around 42% of zoonotic infections derived from bovine sources are bacterial, 22% viral, 29% parasitic, 5% fungal, and 2% prion in origin [9]. Both DNA and RNA viruses are implicated in zoonoses; however, RNA viruses are more often associated with zoonoses than DNA viruses [10].

Pathogens may be transferred to humans either directly or indirectly from animals. Diseases transferred directly from animals to people via mediums such as air are referred to as direct zoonoses [11]. A quintessential example of direct zoonoses is avian influenza, a viral affliction that transmits from animals to people via droplets or fomites. Infected animals may directly transmit viruses to vulnerable people via bites, as shown by rabies, one of the most lethal zoonotic illnesses. It is induced by a rabies virus classified within the Rhabdoviridae family. When a rabid animal (such as a dog, bat, monkey, skunk, raccoon, or fox)

bites a person, the virus is transmitted straight into the human body via saliva. Pathogens may also be transferred to humans by vectors, as shown in Dengue fever. While arthropods such as mosquitoes and ticks are often regarded as the only vectors, any animal capable of transmitting infections to humans may be classified as a vector [12].

Zoonotic illnesses are categorized based on the ecology in which infections circulate. For instance, some zoonoses are categorized as synanthropic zoonoses and exoanthropic zoonoses. Synanthropic zoonoses exhibit an urban (domestic) cycle in domestic and synanthropic animals, exemplified by urban rabies and zoonotic ringworms. Exoanthropic zoonoses often include a sylvatic cycle in natural foci outside human environments, as shown with arboviral diseases, animal rabies, and Lyme disease [13]. Nonetheless, several zoonoses may propagate in both urban and natural cycles, including yellow fever, Chagas disease, and dengue fever. Moreover, some zoonotic illnesses may be spread by arthropods, food, rodents, and certain water sources [14].

Numerous zoonotic infections may reproduce in and persist on decomposed organic matter, resembling saprophytes, and the illnesses produced by these agents are referred to as sapronoses. Instances of sapronoses include fungal infections, including coccidioidomycosis, histoplasmosis, and aspergillosis, as well as bacterial infections such as legionellosis [15]. The World Health Organization's expert council on zoonoses defines "saprozoonoses" as infections that possess both a vertebrate host and a non-animal reservoir or developmental site, such as soil, plants, and organic materials. Disease transmission sometimes requires several vertebrate hosts, as seen by human taeniasis. These zoonoses are referred to as cyclozoooses. Metazoonoses, such as arbovirus infections, include both vertebrate and invertebrate hosts [16].

The majority of zoonotic illnesses are conveyed to humans from animals. Certain findings indicated that animals may also get infections from people [17-20]. These illnesses are referred to as reverse zoonoses. Pathogen examples include methicillin-resistant Staphylococcus aureus (MRSA), Campylobacter spp., Salmonella enterica Serovar Typhimurium, influenza A virus, Cryptosporidium parvum, Ascaris lumbricoides, and Giardia duodenalis. Furthermore, zoonotic illnesses resulting from infections that are sporadically transferred from people to animals and subsequently from animals back to humans are termed reverse zoonoses [21].

3. Zoonoses in Domestic Animals

Domestic animals significantly contribute to the spread of many illnesses to people and often act as amplifiers of infections originating from wild animals [22]. The beneficial correlation between domestic animals and humans in affecting disease diversity was first proposed long ago [23]. Approximately 60% of human infectious illnesses originate from vertebrate animals. The domestication of certain vertebrate animals has increased direct human interaction with them [25]. The potential transmission routes of zoonotic bacteria, viruses, parasites, or fungi include direct contact, ingestion, inhalation, conjunctival exposure, or biting [24].

Domestic animals such as cattle, sheep, goats, dogs, cats, horses, pigs, and others serve as reservoirs for viruses associated with zoonotic diseases and are capable of transmitting these illnesses to people [26]. Pathogens may be spread by direct touch or via food of animal origin. Instances of zoonotic diseases transmissible to humans from domestic animals encompass anthrax, rabies, tuberculosis, brucellosis, campylobacteriosis, leptospirosis, toxoplasmosis, balantidiasis, ancylostomiasis, toxocariasis, listeriosis, bovine pustular stomatitis, rotavirus infection, and Q fever [10,26,27].

Among the zoonotic illnesses transmitted by domestic animals, anthrax, produced by Bacillus anthracis, has considerable public health significance. B. Anthracis is a soil-dwelling bacterium capable of spore production, enabling its prolonged environmental survival. Anthrax may be transferred to people by direct contact with infected animals (such as cattle and goats) or their byproducts (including meat, skin, hides, or bones). [28]. Human-to-human transfer occurs, but seldom. Annually, around 2,000 to 20,000 individuals worldwide are impacted by anthrax cases. Individuals from India, Bangladesh, Pakistan, the

United States, Zimbabwe, Iran, Iraq, South Africa, and Turkey are sometimes impacted. In humans, it may manifest as malignant pustule, gastroenteritis, or pneumonitis; conversely, rapid mortality accompanied by systemic lesions may occur in animals. Mortality rates in intestinal anthrax range from 25% to 65%, but in pulmonary anthrax, they may escalate to 100% [29]. Developing nations reliant on agriculture are still seeing detrimental impacts from anthrax.

Tuberculosis is the most significant zoonotic disease among bovine zoonoses with substantial public health implications. The illness has substantially contributed to huge economic losses in animal agriculture. It is induced by *Mycobacterium bovis*, *M. Tuberculosis*, or seldom *M. Caprae* [30-32]. *Mycobacterium* are acid-fast saprophytic organisms found in soil, distinguished by the presence of mycolic acid in their cell walls. They are facultative intracellular pathogens as well. Although bovine TB has been significantly eradicated in affluent nations, some regions of the world continue to confront severe zoonotic consequences. Human TB is the second leading cause of mortality behind AIDS. Approximately 5–10% of all human TB cases are attributable to M. In the bovis cohort, 25% of the patients were pediatric cases. Approximately 53% of all cases indicated that the preferred location for TB is the extra-pulmonary tract [26]. The majority of people get TB via the handling or milking of unpasteurized contaminated milk or by aerosols from the coughs of sick animals [33]. Significantly, M. Bovis infection may also occur in the human urogenital tract and may affect animals via respiratory secretions from humans, functioning as reverse zoonoses [34]. Nonetheless, direct interaction between infected animals and humans, whether farm workers, veterinarians, slaughterhouse employees, or rural inhabitants, presents a considerable danger.

Brucellosis is a prevalent bacterial zoonotic disease, resulting in approximately 500,000 human cases globally each year. The World Health Organization classifies the illness as a neglected zoonosis [35]. Among the twelve species of the genus *Brucella*, *Brucella melitensis* is included. Abortion, *B. Suis*, and *B. Canines* are zoonotic. The predominant mode of brucellosis transmission to humans is by the ingestion of unpasteurized milk or dairy products, but human-to-human transmission is rare [36]. Transmission by aerosol inhalation and contact with secretions has also been documented [37]. In humans, brucellosis mostly results in influenza-like illnesses, pneumonia, and other consequences such as meningitis, endocarditis, septicemia, profound weakness, myalgia and arthralgia, severe headache, fever, and nocturnal diaphoresis. Brucellosis in animals' results in miscarriage, lameness, abscess formation, decreased milk supply, and reduced survival rates of neonates [10,38]. Workers on dairy farms, caretakers, slaughterhouse employees, veterinarians, and rural residents are at elevated risk for brucellosis infection.

Rabies is a very lethal zoonotic illness caused by the rabies virus, which is classified under the Rhabdoviridae family. Annually, around 30,000 to 70,000 human fatalities transpire worldwide. While dogs are the primary vectors of the rabies virus, other wild animals such as cats and jackals also serve as carriers for its transmission [39]. In poor nations, individuals are impacted by rabies due to bites, mostly stemming from the issue of stray dogs [40]. In developed nations, bats, foxes, and several other wildlife are accountable for the spread of rabies [40]. The severity and gravity of the lesion, its anatomical position, and the viral load might affect the incubation time of rabies, which may range from four days to many years [41-43]. The clinical manifestations of rabies include furious, classical, encephalitic, paralytic, and dumb forms, often influenced by viral tropisms, brain locations, dissemination, variable immune responses, or other possible processes [43-48]. The predominant symptoms of the condition include agitation, concern, worry, confusion, hallucinations, and hydrophobia [27].

4. Zoonotic Diseases of Pets, Companion Animals, and Avian Species

Approximately 14–62% of pet owners let their dogs in their beds, thereby increasing the risk of zoonoses [49]. Companion and pet animals have proliferated in recent decades; yet they also serve as a significant reservoir of pathogenic pathogens. The rising prevalence of pets and companion animals has jeopardized human health owing to the potential transmission of illnesses. Many households now keep exotic pets alongside conventional ones. Consequently, individuals with significant body mass are susceptible to contracting novel zoonotic diseases from pets, companion animals, and exotic birds and mammals.

A range of infectious illnesses, including viral, bacterial, parasitic, and fungal, are linked to pets and companion animals [50]. Zoonotic diseases commonly linked to pets and companion animals include brucellosis, campylobacteriosis, chlamydiosis, cat scratch fever (Bartonella henselae), ehrlichiosis, giardiasis, hantavirus, hookworms, influenza, rabies, Lyme disease, Rocky Mountain spotted fever, leptospirosis, monkeypox, pasteurellosis, Q fever, plague, roundworms, salmonellosis, staphylococcosis (MRSA), cryptococcosis, toxoplasmosis, and tularemia. A variety of zoonoses, including salmonellosis, staphylococcosis, and rabies, are prevalent among many pets and companion animals [51, 52].

Currently, avian species such as canaries, finches, sparrows, parrots, parakeets, and budgerigars are prevalent in both developed and developing nations [53]. Similar to domestic pets, these game, and ornamental birds may also serve as potential vectors for zoonotic diseases such as *Coxiella burnetii*, *Coxiella psittaci*, *Salmonella* spp., *Listeria monocytogenes*, *Erysipelothrix rhusiopathiae*, *Mycobacterium* spp., Lyme disease, as well as various viruses including fowl pox virus and Newcastle disease virus [54]. Numerous infections can induce severe illnesses in humans, including salmonellosis, chlamydiosis, and avian influenza A H5N1. Moreover, there exists a diverse array of bacterial zoonoses in-game and ornamental birds, including *Pasteurella* spp., *Klebsiella* spp., Yersinia spp., *Pseudomonas* spp., *Staphylococcus aureus*, and *Escherichia coli* [55-57]. Evidence indicates the spread of *Escherichia coli* O157:H7 (enterohaemorrhagic) to humans via food sourced from animals initially derived from wild passerines, such as European starlings [58].

Pathogen transmission from these animals happens via direct or indirect contact. Transmission may occur in domestic settings, outdoor environments, pet stores, hospitals, or several other locations. Transmission often occurs when these animals and birds are shown at exhibits and contests [59,60]. Typically, animal bites or scratches serve as pathways for people to acquire infections such as pasteurellosis and cat scratch illness [61]. The most prevalent dog-associated zoonotic illness is rabies, caused by the rabies virus, which results in the deaths of tens of thousands of people each [62]. Likewise, pet-associated MRSA poses a significant health threat to humans worldwide [63].

Cat-scratch illness is a significant zoonosis linked to pets. The causative agent of the illness is *Bartonella henselae*. Cat-scratch illness is a prevalent infectious ailment that is often non-threatening. Horizontal transmission of the illness occurs between cats; however, humans may infrequently get the virus from arthropod vectors such as fleas and ticks. Moreover, the predominant transmission modalities in humans include feline licking of open wounds or injuries resulting from bites and scratches. The disease's incubation period ranges from 3 to 14 days. Multiple lesions characterized by swelling and erythema, accompanied by elevated, circular regions, may manifest, and purulent exudate may develop at the injection site. Additionally, the lymph nodes next to the bitten or scratched location, especially in the cervical region, are often enlarged [64]. Maintaining pets with proper cleanliness, along with regular vaccinations and medical examinations, is essential to safeguard them against zoonotic illnesses.

5. Consequences of Zoonoses

Zoonoses significantly affect both human and animal health. The effect of zoonoses, although difficult to measure, may be evaluated using metrics like illness prevalence, incidence, morbidity, mortality, and economic loss [65]. Zoonoses significantly impact both human livelihood and well-being. The afflicted people encounter obstacles that adversely impair their employment performance and, therefore, their capacity to sustain their families. Such circumstances are often seen in underdeveloped African and Asian nations. In some instances, the impacted persons may remain isolated from society, hence increasing their susceptibility to mental health disorders. Antibiotic resistance is a worldwide health concern that adversely affects the management of bacterial zoonoses. Patients afflicted with illnesses caused by antibiotic-resistant bacteria need specialized care, and costly medications, and often impose a significant strain on the healthcare system, particularly in poor nations.

Mortality of animals due to zoonotic illnesses may result in substantial economic detriment to the livestock industry of any nation. Even in the absence of mortality, animal health and production may still be adversely affected. This may result in a substantial reduction in animal products, including meat, milk, and

eggs, perhaps exceeding 70%. The diminished availability of high-protein animal-derived foods, including milk, meat, and eggs, adversely impacts human health and nutrition [66]. Zoonotic infections, including brucellosis and toxoplasmosis, may result in infertility, abortion, and compromised child vitality. This may result in significant economic losses for farmers and the whole nation.

Zoonotic illnesses, including BSE, avian influenza, and anthrax, may impede the global movement of animals and animal products (meat, milk, and eggs) and their byproducts. The economy is significantly impacted by measures necessary for the management and eradication of zoonoses, including monitoring, diagnosis, isolation, and quarantine, restrictions on animal movement, treatment and immunization programs, inspection of meat and milk, and biosecurity protocols. Between 1995 and 2008, the worldwide economic repercussions of zoonotic epidemics surpassed 120 billion USD [67]. The economic costs in the UK attributable to zoonotic illnesses were substantial [68]. In 2007, the UK had a severe issue with food-borne pathogens, namely *Campylobacter* spp., non-typhoidal *Salmonella*, *Escherichia coli* VTEC O157, *Listeria monocytogenes*, and norovirus, which resulted in significant economic losses [69]. Moreover, several nations experienced significant economic losses as a result of outbreaks of zoonotic foodborne diseases. For instance, Ireland has experienced significant economic detriment owing to Salmonella infection in its swine products [70].

The SARS pandemic significantly affected the world economy, impacting several industries, including tourism. The economic repercussions of SARS in Singapore, China, Hong Kong, and Taiwan were significant. Furthermore, the onset of highly pathogenic avian influenza markedly decreased travel to Mexico, leading to economic detriment for the nation [71]. Similarly, India incurred economic losses owing to the tourist restrictions imposed by the plague epidemic in 1994 [70]. Moreover, Chile has incurred significant economic losses as a result of the outbreak of highly virulent avian influenza [72]. European Union countries experienced significant economic losses due to the closure of chicken export markets during the outbreak of highly virulent avian influenza.

BSE is a significant developing zoonosis. Following outbreaks of BSE in the UK, the majority of European nations prohibited the importation of British beef. The expense of executing comprehensive control measures, including the culling of all sick cattle and the killing of at-risk animals, was expensive [73]. The BSE epidemic in Toronto, Canada, led to a 0.5% reduction in the city's GDP. The illness was identified in millions of animals, prompting other nations to prohibit international commerce with Canada [74]. The identification of BSE in the U.S. in 2003 prompted other nations to prohibit the importation of American beef, resulting in significant economic losses.

Brucellosis is a significant zoonotic disease with economic implications. Brucellosis in cattle caused yearly economic losses in Kenya, Argentina, and Nigeria [75-77]. The current COVID-19 pandemic has profoundly affected the world economy. COVID-19 has profoundly affected various areas of society, including health, education, finance, travel and hospitality, and sports. The travel sector is set to incur substantial revenue losses as a result of the pandemic [78]. Millions of individuals are projected to encounter acute poverty owing to the stagnation in growth caused by this epidemic [79]. The One Health idea is crucial for addressing new and re-emerging zoonoses, managing the impact of zoonotic illnesses on people, animals, and environmental factors, and striving for a world devoid of zoonotic disease risks.

6. Conclusions

Most human infectious illnesses originate from animals. These infections not only induce illnesses in animals but also pose a significant risk to human health. In several instances, modified dietary practices, climate change, and ecologically detrimental human activities contribute to the introduction and reemergence of various zoonotic illnesses due to heightened interactions between people and wildlife. The catastrophic effects of zoonosis on humanity are seen in the ongoing COVID-19 epidemic. Due to the significant interconnection of animals, people, and the environment, research emphasizing the one health approach must be emphasized to uncover essential intervention measures in disease transmission. Comprehensive active surveillance including all elements of the one health approach must be established to promptly and properly identify zoonoses, enabling the implementation of effective control measures.

References

[1] Thompson, A.; Kutz, S. Introduction to the Special Issue on 'Emerging Zoonoses and Wildlife'. Int. J. Parasitol. Parasites Wildl. 2019, 9, 322.

[2] World Health Organization. Asia Pacific Strategy for Emerging Diseases: 2010. Manila: WHO Regional Office for the Western Pacific. Available online: https://iris.wpro.who.int/bitstream/handle/10665.1/7819/9789290615040_eng.pdf.

[3] Slingenbergh, J. World Livestock 2013: Changing Disease Landscapes; Food and Agriculture Organization of the United Nations (FAO): Rome, Italy, 2013; p. 2.

[4] World Health Organization. WHO Health Topic Page: Zoonoses. Available online: https://www.who.int/topics/zoonoses/en/.

[5] Taylor, L.H.; Latham, S.M.; Woolhouse, M.E. Risk factors for human disease emergence. Philos. Trans. R. Soc. Lond. B Biol. Sci. 2001, 356, 983–989.

[6] Grace, D.; Mutua, F.; Ochungo, P.; Kruska, R.; Jones, K.; Brierley, L.; Lapar, L.; Said, M.; Herrero, M.; Phuc, P.M.; et al. Mapping of poverty and likely zoonoses hotspots. In Zoonoses Project 4. Report to the UK Department for International Development; International Livestock Research Institute: Nairobi, Kenya, 2012.

[7] Chomel, B.B. Zoonoses. In Encyclopedia of Microbiology, 3rd ed.; Elsevier Inc., University of California: Davis, CA, USA, 2009; pp. 820–829.

[8] Hubálek, Z. Emerging human infectious diseases: Anthroponoses, zoonoses, and sapronoses. Emerg. Infect. Dis. 2003, 9, 403–404.

[9] McDaniel, C.J.; Cardwell, D.M.; Moeller, R.B.; Gray, G.C. Humans and cattle: A review of bovine zoonoses. Vector Borne Zoonotic Dis. 2014, 14, 1–19.

[10] Bae, S.E.; Son, H.S. Classification of viral zoonosis through receptor pattern analysis. BMC Bioinform. 2011, 12, 96.

[11] Mortimer, P.P. Influenza: The centennial of a zoonosis. Rev. Med. Virol. 2019, 29, e2030.

[12] Huang, Y.J.S.; Higgs, S.; Vanlandingham, D.L. Arbovirus-mosquito vector-host interactions and the impact on transmission and disease pathogenesis of arboviruses. Front. Microbiol. 2019, 10, 22.

[13] Pavlovsky, E.N. Natural Nidality of Transmissible Diseases with Special Reference to the Landscape Epidemiology of Zooanthroponoses; University of Illinois Press: Champaign, IL, USA, 1966.

[14] Beaty, B.J.; Marquardt, W.C. The Biology of Disease Vector; University Press of Colorado: Niwot, CO, USA, 1996.

[15] Somov, G.P.; Litvin, V.J. Saprophytism and Parasitism of Pathogenic Bacteria—Ecological Aspects; Nauka: Novosibirsk, Russia, 1988. (In Russian)

[16] Schwabe, C.W. Veterinary medicine and human health. In Veterinary Medicine and Human Health; The Williams & Wilkins Company, 428 E. Preston St.: Baltimore, MD, USA, 1964.

[17] Olayemi, A.; Adesina, A.S.; Strecker, T.; Magassouba, N.F.; Fichet-Calvet, E. Determining Ancestry between Rodent-and Human-Derived Virus Sequences in Endemic Foci: Towards a More Integral Molecular Epidemiology of Lassa Fever within West Africa. Biology 2020, 9, 26.

[18] Cerdà-Cuéllar, M.; Moré, E.; Ayats, T.; Aguilera, M.; Muñoz-González, S.; Antilles, N.; Ryan, P.G.; González-Solís, J. Do humans spread zoonotic enteric bacteria in Antarctica? Sci. Total Environ. 2019, 654, 190–196.

[19] Adesokan, H.K.; Akinseye, V.O.; Streicher, E.M.; Van Helden, P.; Warren, R.M.; Cadmus, S.I. Reverse zoonotic tuberculosis transmission from an emerging Uganda I strain between pastoralists and cattle in South-Eastern Nigeria. BMC Vet. Res. 2019, 15, 1–7.

[20] Messenger, A.M.; Barnes, A.N.; Gray, G.C. Reverse zoonotic disease transmission (zooanthroponosis): A systematic review of seldom-documented human biological threats to animals. PLoS ONE 2014, 9, e89055.

[21] County of Los Angeles Public Health. Overview of Zoonoses. Available online: http://www.lapublichealth.org/vet/guides/vetzooman.htm.

[22] Morand, S.; McIntyre, K.M.; Baylis, M. Domesticated animals and human infectious diseases of zoonotic origins: Domestication time matters. Infect. Genet. Evol. 2014, 24, 76–81.

[23] McNeill, W.H. Plagues and People; Anchor Press: New York, NY, USA, 1976.

[24] Klous, G.; Huss, A.; Heederik, D.J.; Coutinho, R.A. Human–livestock contacts and their relationship to the transmission of zoonotic pathogens, a systematic review of the literature. One Health 2016, 2, 65–76.

[25] Pearce-Duvet, J.M. The origin of human pathogens: Evaluating the role of agriculture and domestic animals in the evolution of human disease. Biol. Rev. 2006, 81, 369–382.
[26] Samad, M.A. Public health threat caused by zoonotic diseases in Bangladesh. Bangladesh J. Vet. Med. 2011, 9, 95–120.
[27] Ghasemzadeh, I.; Namazi, S.H. Review of bacterial and viral zoonotic infections transmitted by dogs. J. Med. Life 2015, 8, 1–5.
[28] Goel, A.K. Anthrax: A disease of biowarfare and public health importance. World J. Clin. Cases 2015, 3, 20–33.
[29] Kamal, S.M.; Rashid, A.K.; Bakar, M.A.; Ahad, M.A. Anthrax: An update. Asian Pac. J. Trop. Biomed. 2011, 1, 496–501.
[30] Torgerson, P.R.; Torgerson, D.J. Public health and bovine tuberculosis: What's all the fuss about? Trends Microbiol. 2010, 18, 67–72.
[31] Bayraktar, B.; Bulut, E.; Barış, A.B.; Toksoy, B.; Dalgıc, N.; Celikkan, C.; Sevgi, D. Species distribution of the Mycobacterium tuberculosis complex in clinical isolates from 2007 to 2010 in Turkey: A prospective study. J. Clin. Microbiol. 2011, 49, 3837–3841.
[32] Bayraktar, B.; Togay, A.; Gencer, H.; Kockaya, T.; Dalgic, N.; Bulut, E. Mycobacterium caprae causing lymphadenitis in a child. Pediatr. Infect. Dis. J. 2011, 30, 1012–1013.
[33] Moda, G.; Daborn, C.J.; Grange, J.M.; Cosivi, O. The zoonotic importance of Mycobacterium bovis. Tuber. Lung Dis. 1996, 77, 103–108.
[34] Ocepek, M.; Pate, M.; Žolnir-Dovč, M.; Poljak, M. Transmission of Mycobacterium tuberculosis from human to cattle. J. Clin. Microbiol. 2005, 43, 3555–3557.
[35] Hull, N.C.; Schumaker, B.A. Comparisons of brucellosis between human and veterinary medicine. Infect. Ecol. Epidemiol. 2018, 8, 1500846.
[36] WHO. The Control of Neglected Zoonotic Diseases: From Advocacy to Action: Report of the Fourth International Meeting Held at WHO Headquarters, Geneva, Switzerland, 19–20 November 2014; World Health Organization: Geneva, Switzerland, 2015; p. 44.
[37] Corbel, M.J.; Alton, G.G.; Banai, M.; Díaz, R.; Dranovskaia, B.A.; Elberg, S.S.; Garin-Bastuji, B.; Kolar, J.; Mantovani, A.; Mousa, A.M.; et al. Brucellosis in Humans and Animals; WHO Press: Geneva, Switzerland, 2006.
[38] Rahman, M.S.; Han, J.C.; Park, J.; Lee, J.H.; Eo, S.K.; Chae, J.S. Prevalence of brucellosis and its association with reproductive problems in cows in Bangladesh. Vet. Rec. 2006, 159, 180–182.
[39] Krebs, J.W.; Mandel, E.J.; Swerdlow, D.L.; Rupprecht, C.E. Rabies surveillance in the United States during 2003. J. Am. Vet. Med. Assoc. 2004, 225, 1837–1849.
[40] Tang, X.; Luo, M.; Zhang, S.; Fooks, A.R.; Hu, R.; Tu, C. Pivotal role of dogs in rabies transmission, China. Emerg. Infect. Dis. 2005, 11, 1970–1972.
[41] Liu, Q.; Wang, X.; Liu, B.; Gong, Y.; Mkandawire, N.; Li, W.; Fu, W.; Li, L.; Gan, Y.; Shi, J.; et al. Improper wound treatment and delay of rabies post-exposure prophylaxis of animal bite victims in China: Prevalence and determinants. PLoS Neglect. Trop. Dis. 2017, 11, e0005663.
[42] World Health Organization. Rabies vaccines: WHO position paper. Wkly. Epidemiol. Rec. 2018, 93, 201–220.
[43] Ghosh, S.; Rana, M.S.; Islam, M.K.; Chowdhury, S.; Haider, N.; Kafi, M.A.H.; Ullah, S.M.; Shah, M.R.A.; Jahan, A.A.; Mursalin, H.S.; et al. Trends and clinico-epidemiological features of human rabies cases in Bangladesh 2006–2018. Sci. Rep. 2020, 10, 1–11.
[44] Plotkin, S.; Orenstein, W.; Offit, P.; Edwards, M.K. Vaccine. In Plotkin's Vaccines, 7th ed.; Elsevier: Philadelphia, PA, USA, 2017; pp. 918–942.
[45] Jackson, A.C. Human rabies: A 2016 update. Curr. Infect. Dis. Rep. 2016, 18, 38.
[46] Mitrabhakdi, E.; Shuangshoti, S.; Wannakrairot, P.; Lewis, R.A.; Susuki, K.; Laothamatas, J.; Hemachudha, T. Difference in neuropathogenetic mechanisms in human furious and paralytic rabies. J. Neurol. Sci. 2005, 238, 3–10.
[47] Hemachudha, T.; Laothamatas, J.; Rupprecht, C.E. Human rabies: A disease of complex neuropathogenetic mechanisms and diagnostic challenges. Lancet Neurol. 2002, 1, 101–109.
[48] Dimaano, E.M.; Scholand, S.J.; Alera, M.T.P.; Belandres, D.B. Clinical and epidemiological features of human rabies cases in the Philippines: A review from 1987 to 2006. Int. J. Infect. Dis. 2011, 15, e495–e499.
[49] Chomel, B.B.; Sun, B. Zoonoses in the bedroom. Emerg. Infect. Dis. 2011, 17, 167–172.
[50] Halsby, K.D.; Walsh, A.L.; Campbell, C.; Hewitt, K.; Morgan, D. Healthy animals, healthy people: Zoonosis risk from animal contact in pet shops, a systematic review of the literature. PLoS ONE 2014, 9, e89309.

[51] Day, M.J. Pet-Related Infections. Am. Fam. Physician. 2016, 94, 794–802.
[52] Jacob, J.; Lorber, B. Diseases transmitted by man's best friend: The dog. Infect. Leis. 2015, 3, 111–131.
[53] Boseret, G.; Losson, B.; Mainil, J.G.; Thiry, E.; Saegerman, C. Zoonoses in pet birds: Review and perspectives. Vet. Res. 2013, 44, 36.
[54] Moro, C.V.; Chauve, C.; Zenner, L. Vectorial role of some dermanyssoid mites (Acari, Mesostigmata, Dermanyssoidea). Parasite 2005, 12, 99–109.
[55] Dorrestein, G.M. Bacterial and parasitic diseases of passerines. Vet. Clin. North Am. Exot. Anim. Pract. 2009, 12, 433–451.
[56] Jorn, K.S.; Thompson, K.M.; Larson, J.M.; Blair, J.E. Polly can make you sick: Pet bird-associated diseases. Cleve. Clin. J. Med. 2009, 76, 235–243.
[57] Zaman, S.B.; Sobur, M.A.; Hossain, M.J.; Pondit, A.; Khatun, M.M.; Choudhury, M.A.; Tawyabur, M.; Rahman, M.T. Molecular detection of methicillin-resistant Staphylococcus aureus (MRSA) in ornamental birds having public health significance. J. Bangladesh Agril. Univ. 2020, 18, 415–420.
[58] Kauffman, M.D.; LeJeune, J. European starlings (Sturnus vulgaris) challenged with Escherichia coli O157 can carry and transmit the human pathogen to cattle. Lett. Appl. Microbiol. 2011, 53, 596–601.
[59] Belchior, E.; Barataud, D.; Ollivier, R.; Capek, I.; Laroucau, K.; De Barbeyrac, B.; Hubert, B. Psittacosis outbreak after participation in a bird fair, Western France, December 2008. Epidemiol. Infect. 2011, 139, 1637–1641.
[60] Vanrompay, D.; Harkinezhad, T.; Van de Walle, M.; Beeckman, D.; Van Droogenbroeck, C.; Verminnen, K.; Leten, R.; Martel, A.; Cauwerts, K. Chlamydophila psittaci transmission from pet birds to humans. Emerg. Infect. Dis. 2007, 13, 1108–1110.
[61] Chomel, B.B. Emerging and Re-Emerging Zoonoses of Dogs and Cats. Animals 2014, 4, 434–445.
[62] Burgos-Cáceres, S. Canine rabies: A looming threat to public health. Animals 2011, 1, 326–342.
[63] Faires, M.C.; Tater, K.C.; Weese, J.S. An investigation of methicillin-resistant Staphylococcus aureus colonization in people and pets in the same household with an infected person or infected pet. J. Am. Vet. Med. Assoc. 2009, 235, 540–543.
[64] Klotz, S.A.; Ianas, V.; Elliott, S.P. Cat-scratch disease. Am. Fam. Physician 2011, 83, 152–155.
[65] Meslin, F.X. Impact of zoonoses on human health. Vet. Ital. 2006, 42, 369–379.
[66] ARÁMBULO III, P.V.; Thakur, A.S. Impact of zoonoses in tropical America. Ann. N. Y. Acad. Sci. 1992, 653, 6–18.
[67] Cascio, A.; Bosilkovski, M.; Rodriguez-Morales, A.J.; Pappas, G. The socio-ecology of zoonotic infections. Clin. Microbiol. Infect. 2011, 17, 336–342.
[68] Bennett, R.; IJpelaar, J. Updated estimates of the costs associated with thirty four endemic livestock diseases in Great Britain: A note. J. Agric. Econ. 2005, 56, 135–144.
[69] Martins, S.; Häsler, B.; Rushton, J. Economic Aspects of Zoonoses: Impact of Zoonoses on the Food Industry. In Zoonoses—Infections Affecting Humans and Animals; Sing, A., Ed.; Springer: Dordrecht, The Netherlands, 2015; pp. 1107–1126.
[70] World Bank. People, Pathogens and Our Planet: The Economics of One Health; World Bank: Washington, DC, USA, 2012; Available online: http://documents.worldbank.org/curated/en/2012/06/16360943/peoplepathogens-planet-economics-one-health.
[71] MARSH Report. The Economic and Social Impact of Emerging Infectious Disease. Available online: http://www.healthcare.philips.com/main/shared/assets/documents/bioshield/ecoandsocialimpactofemerginginfectiousdisease_111208.pdf.
[72] Keusch, G.T.; Pappaioanou, M.; Gonzalez, M.C.; Scott, K.A.; Tsai, P. National Research Council. Sustaining Global Surveillance and response to emerging zoonotic diseases. In Committee on Achieving Sustainable Global Capacity for Surveillance and Response to Emerging Diseases of Zoonotic Origin; The National Academies Press: Washington, DC, USA, 2009.
[73] Rassy, D.; Smith, R.D. The economic impact of H1N1 on Mexico's tourist and pork sectors. Health Econ. 2013, 22, 824–834.
[74] Wright, C. A good example of successful crisis management: The avian influenza outbreak in Chile-What actually happened and what can be learned from their experience. Poult. Int. 2004, 43, 34–39.
[75] Burroughs, T.; Knobler, S.; Lederberg, J. The emergence of zoonotic diseases: Understanding the impact on animal and human health: Workshop summary. In the Emergence of Zoonotic Diseases: Understanding the Impact on Animal and Human Health: Workshop Summary; Burroughs, T., Knobler, S., Lederberg, J., Eds.; National Academy Press: Washington, DC, USA, 2002.

[76] Mitura, V.; Di Piétro, L. Canada's beef cattle sector and the impact of BSE on farm family income 2000–2003. In Agriculture and Rural Working Paper Series Working Paper No. 69; Canada Statistics, Agricultural Division: Ottawa, ON, Canada, 2004.
[77] Coffey, B.; Mintert, J.; Fox, S.; Schroeder, T.; Valentin, L. Economic Impact of BSE on the US Beef Industry: Product Value Losses, Regulatory Costs and Consumer Reactions; Kansas State University: Kansas, MO, USA, 2005.
[78] Food and Agriculture Organization of the United Nations (FAO). The Monetary Impact of Zoonotic Diseases on Society, Evidence from Three Zoonoses in Kenya. Available online: http://www.fao.org/3/i8968en/I8968EN.pdf.
[79] Samartino, L.E. Brucellosis in Argentina. Vet. Microbiol. 2002, 90, 71–80.

الأمراض الحيوانية المنشأ الناشئة: مراجعة شاملة لأصولها، وعلم الأوبئة، وديناميكيات الانتقال، وآثارها على الصحة العامة على المستوى العالمي

الملخص

الخلفية :تمثل الأمراض الحيوانية المنشأ الناشئة، التي تنشأ من العوائل الحيوانية، تهديدًا كبيرًا للصحة العالمية، مع تأثيرات عميقة على صحة الإنسان والاقتصادات. تستعرض هذه المراجعة علم وبائيات الأمراض الحيوانية المنشأ، مع تسليط الضوء على أصولها وآليات انتقالها وآثارها على الصحة العامة.

الطرق :تم إجراء مراجعة شاملة للأدبيات، وتحليل البيانات من مصادر متنوعة، بما في ذلك منظمة الصحة العالمية (WHO) والمجلات المحكمة، لتصنيف الأمراض الحيوانية المنشأ حسب عواملها المسببة — البكتيرية، الفيروسية، الطفيلية، الفطرية، المعتمدة على البريون.

النتائج :تشير النتائج إلى أن أكثر من 60% من الأمراض البشرية الجديدة هي أمراض حيوانية المنشأ، مع عبء كبير على البلدان ذات الدخل المنخفض والمتوسط، حيث تكون الفئات السكانية الفقيرة عرضة بشكل خاص. تصنف الدراسة الأمراض الحيوانية المنشأ إلى طرق انتقال مباشرة وغير مباشرة، مع أمثلة بارزة مثل داء الكلب وإنفلونزا الطيور. تؤكد النتائج على التفاعل المعقد بين صحة الإنسان والحيوان والبيئة، مما يبرز أهمية نهج "الصحة الواحدة" في مواجهة التهديدات الحيوانية المنشأ.

الاستنتاجات :تشير الاستنتاجات المستخلصة من هذه المراجعة إلى أن المراقبة الفعالة، وإجراءات الوقاية، والرقابة ضرورية للتخفيف من المخاطر المرتبطة بالأمراض الحيوانية المنشأ. إن زيادة وقوع الأمراض الحيوانية المنشأ، الناجمة عن عوامل مثل تغير المناخ والتهام البشر لمواطن الحياة البرية، تستدعي التعاون العالمي العاجل في الأبحاث، وصنع السياسات، ومبادرات الصحة العامة.

الكلمات المفتاحية :الأمراض الحيوانية المنشأ، علم الأوبئة، الصحة الواحدة، الصحة العامة، آليات الانتقال.