Recent updates on Zoonotic Diseases in the Indian Subcontinent: A Review

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***Abstract*—**According to the World Health Organization (WHO), Zoonotic diseases are those that are naturally transferred between vertebrate animals and humans as well as infections that are shared between vertebrates and humans. The zoonotic diseases include viral (rabies, yellow fever, influenza, Kyasanur forest disease, etc.), bacterial (anthrax, brucellosis, plague, leptospirosis, salmonellosis, etc.), rickettsial (tick typhus, scrub typhus, murine typhus, etc.), protozoal (toxoplasmosis, leishmaniasis, trypanosomiasis (scabies, myasis, etc.). The WHO classifies South East Asian zoonotic diseases into three categories: endemic, re-emerging, and emerging diseases with epidemic potential. 816 of the 1407 human diseases are zoonotic, or able to spread naturally from animals to people. These include protozoa, 208 viruses, 287 helminths, 317 fungi, 538 bacteria and rickettsia.

In this article, we focus on the recent updates of the Zoonotic diseases in the Indian subcontinent, their epidemiology, impact, control and treatment. The public health stakeholders in India as well as in Southeast Asia should emphasize on understanding the eco-epidemiology of the discussed zoonotic

diseases for taking preventive actions.

Keywords -

Zoonotic diseases (ZD), animals, Humans, Health, Rapid spread, re-emerging

I. INTRODUCTION

Infectious diseases that can be spread spontaneously between humans and wild or domestic animals are known as zoonoses. The bulk of developing infectious diseases in humans are zoonotic in origin, according to Cleaveland et al. [1] 868 (61%) of the pathogens are categorised as zoonotic, and 175 pathogenic species were thought to be linked to developing illnesses. A total of 132 (75%) of the 175 developing pathogens were zoonotic. [2]

Globally In the last 25 years, 38 new pathogens have emerged, with 75 percent of them originating as animal disease producing agents. According to reports, 80% of bioterrorist agents are zoonotic and could be used as biological weapons. Furthermore, zoonotic diseases account for the vast majority of infectious diseases. The term "emerging infectious disease" first appeared in the 1980s, when major outbreaks occurred all over the world. [3]

India is dealing with the advent of novel infections as well as an overburdened health infrastructure. [4] It is necessary to improve the effectiveness of health sectors during outbreaks in order to strengthen people's immunity against unknown future threats caused by the reemergence or "knocking" of zoonotic diseases in the country. There are a number of factors that contribute to the prevalence of zoonotic diseases in different sections of the country. **Figure 1** shows the geographical risk map for emergence and re-emergence of high-priority Zoonoses and neglected Zoonoses in India, since 1951. [5]

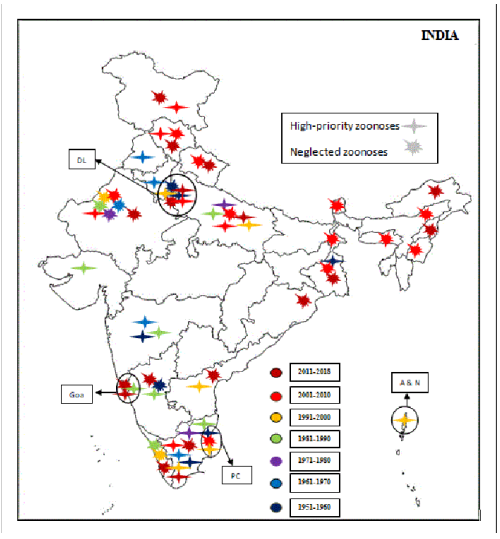

Figure1. Geographical risk map for emergence and re-emergence of high-priority Zoonoses and neglected Zoonoses in India, since 1951 (past 68 years). [5]

Factors affecting the emergence of zoonotic diseases:

Changes in pathogen and/or host ecology, according to Schrag and Wiener [6] are principally responsible for the majority of emerging diseases, while those originating from evolutionary changes alone are fairly rare. 'Ecological changes' encompass a wide range of processes, including changes in agricultural methods, urbanization, globalization, and climate change. [7]

Impact

Zoonoses have a wide range of consequences for human and animal health. Though the impact of zoonoses is difficult to quantify, metrics such as illness prevalence, incidence, morbidity, mortality, and economic loss can be used to assess it. [8]

Control

For zoonoses control, the following four surveillance types can be used:

•Detection and identification of pathogens by pathogen surveillance.

•Serological surveillance involves monitoring immune responses to detect the presence of infections in the blood of humans or animals.

•Syndrome surveillance, which uses data analysis to determine the likelihood of diseases based on symptoms. This type of analysis-based surveillance cannot be utilised to detect infections.

•Risk surveillance to identify risk variables that contribute to disease spread. This control approach cannot be utilised to determine the clinical features and prevalence of multifarious diseases. [9]

Epidemiology

The rising zoonotic mortality and morbidity as a result of anthroponosis indicates that the pathogens have already broken through the host-species barrier. The spread of Zoonoses to other non-endemic regions has made it difficult to monitor, map, and predict. Phylogenetically similar hosts (anthroponosis) experience higher pathogen adaptations and transmissions.

This article lists a variety of zoonotic diseases that are spread throughout the world, including the Nipah virus, H4N1, SARS coronavirus, Rabies, and MERS under the heading of viral zoonoses. Followed by dermatophytosis, basidiobolomycosis, histoplasmosis, sporotrichosis, cryptococcosis, emergomycosis under fungal zoonoses. Protozoan diseases including malaria, leishmaniasis, toxoplasmosis, and giardiasis and finally, Infections caused by bacteria, such as nocardiosis, anthrax, tuberculosis, and actinomycosis.

RECENT DISEASES THAT SPREAD THROUGH ZOONOTIC AGENTS -

Viral Diseases

Nipah disease

Epidemiology

Nipah virus was discovered recently and belongs to the genus *Henipavirus* in the family *Paramyxoviridae*. [10] It is named after the village in peninsular Malaysia in which it was isolated for the first time from a human victim. [11] The incubation period can vary from four to 45 days (Table 1). One hundred twelve

species of bats have been detected in India, of which 39 have been detected within the state of Kerala. Thirty-one bat species that occur in India have been sampled for Nipah virus and 11 of these species have been identified as having antibodies that react to Nipah virus serological tests. However, almost all sampling of these species occurred outside of India.

Impact

Encephalitis is an infection of the brain that causes fever, headache, sore throat, myalgia, and vomiting. The most severe cases develop encephalitis and seizures that progress in 24–48 h to a coma situation. Fatality is estimated in between 40% and 75% of cases, depending on the outbreak. [12] In May 2018, an outbreak of Nipah virus began in Kerala, > 1800 km from the sites of previous outbreaks in eastern India in 2001 and 2007. Twenty-three people were infected and 21 people died (16 deaths and 18 cases were laboratory confirmed)

SARS-coronavirus

Epidemiology

Severe acute respiratory syndrome (SARS) is a febrile respiratory illness primarily transmitted by respiratory droplets or closes personal contact, and is caused by the SARS-Coronavirus (SARS-CoV) (Table 1). [13] In February 2003, a physician from Guangdong Province, ill with atypical pneumonia, visited Hong Kong and stayed overnight in a hotel. The agent that caused his severe acute respiratory syndrome – SARS-CoV – was transmitted to at least ten persons, who subsequently initiated outbreaks in Hong Kong, Singapore, Vietnam, and Canada. [14] In India, the first case of COVID-19 was reported on January 30, 2020. As of June 20, 2020, 395,048 laboratory-confirmed cases and 12,948 deaths were reported from India. [15]

Impact

The major clinical features on presentation include persistent fever, chills/rigor, myalgia, dry cough, headache, malaise, dyspnea, sputum production, sore throat, coryza, nausea and vomiting. Moreover, infections identified after the primary SARS epidemic was brought under control were associated with restaurants that prepared and served civet meat. [16,17,18] In addition to masked palm civets and bats, other animal species might have been involved in the evolution and emergence of SARS-CoV. [19,20] In India, the findings of the first national population-based serosurvey indicated that 0.73 per cent of adults in India were exposed to SARS-CoV-2 infection, amounting to 6.4 million infections in total by the early May 2020.

Rabies

Epidemiology

Rabies is one of the deadliest zoonotic diseases caused by the rabies virus (Table 1). Every year about 30,000–70,000 human deaths occur throughout the globe. [21] Rabies virus was introduced into North America by infected dogs in the early 18th century, with subsequent spillover to a variety of wild terrestrial mammals. [22] In India, rabies is region specific but not host specific, as is apparent from the phylogenetic trees. The RV isolates formed distinct clusters which were ordered by geography. RV isolates of buffalo origin from the state of Punjab, in northern India, formed two distinct clusters (GC1 and GC2). The grouping of isolate R141 from southern India with GC2 shows the possibility of migration of RV reservoirs (pet dogs) within the country due to the changing socioeconomic conditions in India.

Impact

Though rabies is a preventable viral zoonosis by vaccines still it remains an important public health issue in the developing countries which is evident from the fact that globally this devastating disease is responsible for more than 60,000 human deaths, while approximately 15 million people receive rabies post-exposure prophylaxis (PEP) annually. [23] The most common symptoms of rabies include excitation, solicitude, anxiety, bewilderment, hallucination, and hydrophobia. [24] Rabies in India estimated that in India a total of 18,500 human deaths occur as a result of rabies each year.

Monkeypox

Epidemiology

Monkeypox is an infectious zoonotic disease caused by the monkeypox virus (MPXV), which belongs to the Orthopoxvirus genus of the Poxviridae family, the same genus as that of the smallpox virus. [25-26] Though no monkeypox case has been reported from India, till mid-June, 2022, yet, considering the rate of spread to the non-endemic countries, there is an urgent need of better understanding of the monkeypox virus and disease epidemiology to help clinicians, public health specialists, and policymakers to be prepared for any eventuality

Impact

No case of monkeypox virus and disease has been reported from India in the ongoing outbreak; however, there is a need for better preparedness. Strict surveillance at port of entry and early identification, isolation, and case management are the key to response.

Table 1 Viral parasite that cause human disease [10-26]

Disease	Etiological agent	Mode of transmission	Host
Nipah	NiV (Paramyxovirus)	be transmitted to humans from animals (such as bats or pigs), or contaminated foods	Fruit bats (Pteropus spp.)
Rabies	Lyssavirus	Direct contact with saliva or nervous tissue from an infected animal (rabid animal)	All mammals, dog, cat, sheep, goat, horse
SARS	Coronavirus	Direct contact with the saliva , blood , urine, mucous, feces, or other body fluids of an infected animal	Ten mammalian laboratory species

Monkeypox	Monkeypox virus	Close contact with lesions, body fluids, respiratory droplets and contaminated materials such as bleeding	Monkey, human

Fungal Diseases

Dermatophytosis

Epidemiology

Dermatophytosis is an integumentary mycotic disease prevalent in over 145 countries of the world including India. [27] It is significant occupational zoonoses of dairymen, animal handlers, livestock farmers, pet owners, veterinarians, and others caused by a group of highly specialized pathogenic fungi known as "dermatophytes," which are the most common agents of superficial mycoses in animals and humans. [28-31] Dermatophytes are the most common agents of superficial mycoses in animals and humans, and are a public health menace. [32] Table 2 shows various fungi that Cause Human Disease, etiology, their mode of transmission and host.

Impact

The majority of zoonotic dermatophytes are contracted through contact with sick pets and cattle. The most common way that a human becomes infected is through close contact with an infected animal, however contamination of the environment can also spread to humans indirectly. [33] More than 50–70% of human mycotic infections in Kolkata City, West Bengal, India, are caused by animal hosts, primarily pets. The prevalence of more than 50–70% cases of human mycotic infections via animal hosts, primarily pets, was described by authors like Day et al. and Moretti et al. [34]

Different regions of the world had a noticeable predominance of zoophilic dermatophyte-caused superficial mycoses.[35,36] The zoophilic species *Microsporum canis, Trichophyton mentagrophytes,* and *T. verrucosum* were the most prevalent agents of infection found. [37,38,39] The prevalence of skin infections is increased by people's frequent contact with domestic animals due to nomadism, animal farming, domestic livestock rearing, or pet ownership. [40]

Penicilliosis

Epidemiology

Penicillium marneffei is the only dimorphic species of the genus Penicillium and is the etiological agent of penicilliosis marneffei. This opportunistic fungal infection occurs among human immunodeficiency virus (HIV)-infected and other immunocompromised patients in several regions of Southeast Asia. Areas where *P. marneffei* infection is known to be endemic include Thailand, southern China, Taiwan, Hong Kong,

Malaysia, Indonesia, Viet Nam, Myanmar (Burma), and Manipur state in India. [41, 42,43]

Impact

In India, *P. marneffei* is discovered to have a natural host in the bamboo rat *C. badius*. This fungus naturally infects C. badius, according to studies. The Indian states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, and Nagaland are home to *C. badius*.
P. marneffei infection is a significant endemic opportunistic infection that affects the lungs, lymph nodes, liver, kidney, skin, and bone in people with acquired immunodeficiency syndrome. *P. marneffei* infection is a sign that the patient likely has HIV infection. Depending on the host reaction, the pathology can be granulomatous, suppurative, mixed, necrotizing, or anergic. [44]

Trichophyton

Epidemiology

The zoophilic Trichophyton species include *T.simii, T. mentagrophytes, T. verrucosum* and *T.interdigitale* as described by de Hoog et al.
Trichophyton simii is primarily a zoophilic dermatophyte that very frequently causes clinical infections in man and occurs as a saprobe in soil. The first record of animal dermatophytosis (ringworm) due to *T. simii* in India was by Pinoy in a monkey imported in France from India [45] on the other hand *T. mentagrophytes* is primarily a zoophilic dermatophyte that frequently infects humans and may also survive in soil.

Impact

Strains of *Trichophyton interdigitale* are zoophilic and human. *T. rubrum* and *T. interdigitale* are currently the most common dermatophytes found in human ringworm lesions in India. *T. interdigitale*-related clinical infections in animals have not yet been documented. All ruminants in India develop clinical infections due to the dermatophyte *T. verrucosum.* [46]

Blastomycosis

Epidemiology

Dogs, humans, and possibly other mammals are susceptible to *Blastomycosis*, a devastating fungal disease brought on by the thermally dimorphic fungus *Blastomyces dermatitidis*.
There are roughly 10 canine cases of *Blastomyces dermatitidis* for every human case. One incidence of canine blastomycosis has been documented from India in a Mongrel dog that was discovered dead on the campus of the Indian Veterinary Research Institute in Izatnagar, Bareilly (Uttar Pradesh). [47]

Impact

Infection was diagnosed by histopathological demonstration of thick-walled, broad-based yeast cells typical of *B. dermatitidis* in tissue sections of necropsied lung lesions. Other animals including cats are very less commonly affected. No case of blastomycosis in cats or other animals in India could be traced in the literature search.

Table 2 Fungi that Cause Human Disease [27-47]

Disease	Etiological agent	Mode of transmission	Host
Dermatophytosis	*Microsporum spp*	Direct contact with infected animals	All domesticated animals, humans
Penicilliosis	*Penicillium marneffei*	Opportunistic infection	Bamboo rats *C. badius*
Trichophyton	*Trichophyton simii, T. mentagroophytes*	Soil contact	Monkeys, domestic animals
Blastomycosis	*Blastomyces dermatitidis*	Inhalation of airborne conidia	Rodents, dogs, cats, cattle

Protozoan diseases

Toxoplasmosis

Epidemiology

Toxoplasmosis, a ubiquitous protozoal disease caused by *Toxoplasma gondii*, is one of the most common parasitic infections of man and other warm-blooded animals, with definite hosts being felines. Average seroprevalence of *T. gondii* infection in India has been reported to be 24.3%, the lowest being in the northern parts of India and the highest in the south. [48] Table 3 shows Protozoans that Cause Human Disease, etiological agent, mode of transmission and host specificity**.**

Impact

Accidental ingestion of feline feces can cause infection in humans. Rapid cellular infection establishment leads to tissue cysts containing bradyzoites. Acutely infected cats release a significant number of Fields oocysts once every two weeks. By consuming infected rodents, birds, or small animals, cats catch the disease. The parasite is transmitted in the cat's feces in the minute oocyst form. Infected mature cats are less prone to shed *toxoplasma* than uninfected ones. [49, 50] The production of tissue cysts that are infectious through the secondary consumption of infected tissues can occur in other host species as a result of ingesting infectious oocysts from cat feces or contaminated soil, water, or other materials. [51, 52]

Giardiasis

Epidemiology

The life cycle of *Giardia* is direct, and the infective stage of the parasite, the cyst, is encysted when released into the feces and is immediately infectious. [53] *Giardia intestinalis* is prevalent in children and

HIV-positive patients, as per epidemiological studies. Epidemiology and phylogenetic analyses offered supporting evidence for the zoonotic hypothesis of *Giardia* transmission in canines in a tea-growing village in northeastern India. [54, 55]

Impact

Giardia lamblia and *Giardia intestinalis*, causes giardiasis in humans and most mammals. Thus, giardiasis is considered a zoonotic disease. Giardiasis is frequently associated with pets and companion animals. [56] Giardiasis is a disease of concern because of the high prevalence and disease burden of the infection, propensity in causing major outbreaks and emergency responses, and effects on growth and cognitive functions of infected children. It is also a common disease in livestock and companion animals; thus, it is of veterinary health importance. [57]

Leishmaniasis

Epidemiology

The leishmaniases are a group of diseases caused by protozoan parasites from more than 20 *Leishmania* species. These parasites are transmitted to humans by the bite of an infected female phlebotomine sandfly, a tiny 2-3 mm long insect vector. It's a disease affecting 88 countries across the world, and is endemic to the entire planet. [58] Cutaneous leishmaniasis (CL), which is brought on by *Leishmania tropica*, was only ever reported in occasional cases from Punjab, Delhi, Haryana, and Gujarat. [59,60] It is endemic in Rajasthan's western Thar desert. There have been reports of new foci of infection in several regions of India; for instance, Kerala State had no CL cases documented prior to 1988, but there have been numerous cases since then. In light of a recently identified CL reservoir area in south India, this is of significant public health importance. To find potential vectors and the reservoir host, more research is needed. [60-70]

Impact

Visceral leishmaniasis (VL) is endemic in 75 countries across Asia, Africa and the Americas. India accounts for 18% of the global burden of kala-azar in 2020. It is present in 54 districts across four states - Bihar, Jharkhand, Uttar Pradesh and West Bengal. Sporadic cases are also reported in other states including Assam, Gujarat, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya Pradesh, Haryana, Puducherry, Sikkim, Tamil Nadu and Uttaranchal. High *Leishmania*-HIV coinfection has been reported in the state of Bihar in India. People with the disease have a high chance of developing the full-blown clinical disease. Much progress has occurred in India in the past decades. [71]

Malaria

Epidemiology

Malaria is a parasitic infection spread by anopheline mosquitoes that is brought on by the genus *Plasmodium*, which also includes the parasites *P. vivax, P. falciparum, P. malariae*, and *P. ovale*. The parasites that cause malaria in birds (*P. gallinaceum*) and rodents (*P. berghei* and *P. chabaudi*) are also found in nature. Anopheles mosquitoes transmit zoonotic malaria. The main *P. knowlesi*-transmitting species in Asia is found in northeast India. When examining treatment resistant-associated marker genes in *P. falciparum* in the Andaman and Nicobar Islands, Tyagi et al. discovered co-infections with *P. knowlesi* infection. The range of the Anleucosphyrus complex generally resembles that of the long-tailed macaque

(*M. fascicularis*). In India, where human settlements are close to woods, it is important to understand the role that monkeys play in the epidemiology of *P. knowlesi* transmitted malaria in India. [72]

Impact

Macaca fascicularis (the long-tailed or crab-eating macaque), *Macaca nemestrina* (the pig-tailed macaque), and *Trachypithecus obscurus* are hosts to *Plasmodium knowlesi* in their natural state (dusky leaf monkey or spectacled langur). The major known vectors are *Anopheles leucosphyrus* species, some of which can feed on both humans and monkeys. It has yet to be conclusively proven that *P. knowlesi* can be transmitted directly from one infected person to another uninfected person through mosquito vectors. When people enter forests, infections from humans seem to be spread by monkeys. Human-to-human transmission might happen in regions with a lot of mosquito vector density. *P. knowlesi* malaria epidemics have not been documented yet. [73]

Table 3 Protozoans that Cause Human Disease [48-73]

Disease	Etiologic agent	Mode of transmission	Host
Toxoplasmosis	*Toxoplasma gondii*	Ingestion of oocycts passed by cats in their feces	Domestic cats and humans
Giardiasis	*Giardia intestinalis*	Cysts transferred through faeces	Humans and most mammals, livestock
Malaria	*Plasmodium spp*.	Bite of female anopheles' mosquito	Infected female anopheles' mosquitoes and humans
Leishmaniasis	*Leishmania spp*.	Bite of female phlebotomine sandflies	Sandflies and humans

Bacterial Diseases

Anthrax

Epidemiology

Anthrax is a zoonotic illness caused by *Bacillus anthracis*. It is known to occur generally in underdeveloped regions of India. Ecologically, Chhattisgarh shows striking parallels and Orissa, as far as potential proneness and risk of anthrax outbreaks in the human population in the coming years:

Chhattisgarh and Orissa rank almost similar on human development indices (HDIs). [74] Table 4 shows Bacteria that cause human diseases, etiological agent, mode of transmission and host specificity.

Anthrax can be transmitted to humans through close contact with infected animals. Most cases in India have occurred in agricultural laborers who have a history of handling animal meat or skin of infected animals. The cutaneous form of illness had a benign course. *Bacillus anthracis* can cause serious illnesses in people such as malignant pustule, gastroenteritis, and pneumonitis. [75]

Nocardiosis

Epidemiology

Nocardiosis, an uncommon infection of the past, is being increasingly reported in recent years with the rise of immunosuppressed patients. In India, very few centers have reported this disease. Fish including teleost, shellfish, rainbow trout, blueback salmon, and pacific oyster are all affected by *Nocardia spp*. [76] Wounds are the main method of transmission. Humans, ruminants (cattle and goats), cats, and marine creatures have all been found to have Nocardia. [77]

Impact

Human nocardiosis is characterized by skin infections, pneumonia, and ulcers.[78] Among different Nocardia species *N. farcinica, N. brasiliensis,* and *N. otitidiscaviarum* are closely associated with human infections. [79] Generally, immunosuppressed patients are more vulnerable to the disease.

Tuberculosis

Epidemiology

Tuberculosis (TB), a disease caused by *Mycobacterium* species too, can cause disease in animals. The widespread distribution of animal TB, however, and the lack of or inconsistent application of control methods are present in underdeveloped nations. India has very little information on the zoonotic aspects of bovine TB. The majority of *M. bovis* infections affect Central Indians, who live in a region with a high TB endemicity. People in a community with a high TB prevalence and high crowding index are what distinguish Central India in particular. Their current eating habits (eating raw meat and drinking raw milk) and the common use of subpar sanitary standards may be contributing factors that favor the spread of bovine TB in this population

Impact

The first case of *M. tuberculosis* in cattle was reported in India in 1969 as a result of a study that covered a nine-year period of postmortem examinations of cattle. Based on morphological evidence, 35 incidences of tuberculosis were found in 875 autopsied cattle. Another study from a dairy farm in North India found M. tuberculosis in 8 cases out of 30 cattle lung samples. There has only ever been one case of mycobacterial infection in cattle documented in India. [80-81]

Brucellosis

Epidemiology

In India, brucellosis is a serious and growing issue for the welfare of animals. Due to the unsanitary environment and poverty, conditions are favorable for widespread human infection. *B. melitensis* and *B. abortus* are the species that India is most concerned about. [82]
Among India, brucellosis is a somewhat prevalent disease, with sero-prevalence rates as high as 8.5% in dairy workers and 4.97% in individuals exposed to animals. 4.2% of women who had abortions tested positive for the illness. [83]

Impact

The most frequent brucellosis consequence is bone and joint involvement. Though it only happens in 2% of patients, Brucella endocarditis is the main cause of death complications. About 5-7% of *B. melitensis* infection cases result in central nervous system invasion. Despite being uncommon, skin-related complications have been documented.

Campylobacteriosis

Epidemiology

One of the most pervasive infectious disorders is the *Campylobacter jejuni* infection. A significant reservoir and route of pathogen transmission to humans is poultry. Contact with animals and overseas travel are other risk factors. It is entirely unknown how often Campylobacteriosis is in Indian fauna. The isolates were all recognised as being *C. jejuni*. Infection among the Indian population is spread by Campylobacter spp. from chickens. [84]

Impact

Campylobacter spp. are an important cause of bacterial gastroenteritis frequently isolated from animal, poultry and environmental samples. It was found to be associated with 5.7% of diarrhea in children in South India and 5.1% in North Indian children. However, a recent study in north Indian children discovered that those who had previously experienced diarrhea caused by Campylobacter were more likely to develop Guillain-Barré Syndrome (GBS). According to studies, campylobacter infections that cause diarrhea in south Indian children typically involve many microbes. To gain understanding of the function of campylobacteria infection in Indian children, future community-based investigations are necessary. [85]

Table 4 Bacteria That Cause Human Disease [75-85]

Disease	Etiology	Animal Host	Major Organs Involved
Bacterial zoonoses			
Anthrax	*Bacillus anthracis*	Cattle, horses, sheep,	Skin, respiratory

		pigs, bison	organs, or GI tract
Tuberculosis	*Mycobacterium bovis, Mycobacterium caprae, Mycobacterium microti*	Cattle, sheep	Respiratory organs bone marrow
Brucellosis	*Brucella abortus Brucella melitensis, Brucella suis, Brucella canis,*	Cattle, goats, sheep	Fever, usually high in the afternoon, back pain, joint pain, poor appetite, and weight loss
Campylobacter enteritis	*Campylobacter jejuni, Campylobacter coli*	Cattle, sheep, dogs, ferrets, and pigs	Enteric disorder
Nocardiosis	*Nocardia farcinica*	Fishes including teleost, shellfish, rainbow trout, blueback salmon	Skin infections lungs (pneumonia) and ulcers

II. DISCUSSION

The large number of people and animals in India raises the risk of zoonoses spreading and human-animal contact. there is a need for bolstering surveillance and a robust laboratory network to detect infections early in both humans and animals and to initiate fast containment measures before an outbreak turns into an epidemic. Veterinarians, healthcare professionals, and other sectors should all be included in the "one health" strategy.

In addition, it calls for strong public health infrastructure, skilled frontline staff, IEC activities, and early zoonotic disease diagnosis, treatment, prevention, control, and management. An attempt is being made to close this gap with the current special supplement. The National Health Mission requires that state programme implementation plans, starting at the district level and moving upward, incorporate measures of prevention, early identification, and containment.

Instead of focusing on underlying reasons, popular responses to the appearance of Emerging Zoonotic Diseases frequently address the immediate source. For instance, some have proposed closing wildlife trade.

However, since the factors that encourage the eating of wild animal meat would endure even after a global health emergency, this is likely to transfer the interface to another location, out of the regulators' view. We believe that such prohibitions could result in the expansion of illegal, uncontrolled wildlife markets and an uptick in poaching, making it impossible to track market dynamics, create surveillance networks, and put risk reduction strategies into place.

Therefore, we call for more humane methods of animal harvesting and production that put health and not just productivity first. This will enhance environmental harmony and animal welfare in addition to lowering the danger for EZDs.

III. SUMMARY AND CONCLUSION

Zoonoses can be categorised based on their etiologic agent, which can be viral, bacterial, parasitic, or mycotic. An active effort is being made to improve surveillance for quick, efficient containment and early detection of the same. Lack of knowledge, cultural practices and poor hygiene are some of the factors that contribute to outbreaks of these diseases via zoonoses. These outbreaks frequently call into question the viability of alternative livelihoods and demand hasty, unsustainable reforms that communities are ready to discard after the outbreaks have passed. We hope that the human-wildlife interfaces communities to invest in health education and raise zoonotic disease awareness at this time. In summation, an integrated health approach should take place to provide decision makers with a firmer foundation to help build evidence-based disease prevention and control plans that involve complex animal - environmental systems

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