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Important to Know Zoonotic Disease in Northeast India

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ABSTRACT

Most people engage with animals in some manner. Any illness that may transmit from vertebrate animals to people or from humans to vertebrate animals on their own is referred to be a zoonotic disease. Zoonoses that are a hazard to human health on a global scale, such the human immunodeficiency virus, severe acute respiratory syndrome, or newly developing influenza type A viruses, may not really share many characteristics with existing, well-known zoonotic agents. This is due to the fact that before adapting to humans, these novel agents only passed through a brief zoonotic stage. Some diseases or illnesses, despite having a zoonotic origin, represent a danger to human health on a worldwide scale. Almost 60% of human diseases originate from zoonotic agents. There are many different pathogens included in this, including as bacteria, viruses, fungus, protozoa, and parasites. Animal movement and commerce, urbanisation, travel and tourism, vector biology, and anthropogenic influences have all had a substantial impact on the emergence, re-emergence, distribution, and patterns of zoonoses. With time, more zoonotic diseases—both new and resurfacing—are appearing. This Study concentrates on pertinent facts, zoonotic illnesses that may be found in Northeast India as well as other regions of India and the world, and some approaches to prevention and treatment of zoonotic diseases that have been employed in the past.

KEYWORDS: Zoonoses; Northeast India; SARS-CoV2; Protozoa; Human Immunodeficiency Virus; Pathogens

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1. INTRODUCTION

ZOONOTIC DISEASE, According to W.H.O, "A zoonotic disease (also known as zoonoses) is any disease or infection that is naturally transmissible from vertebrate animals to humans. There are over 200 known types of zoonoses and they comprise a large percentage of new and existing diseases in humans. Some zoonoses, such as rabies, are 100% preventable through vaccination and other methods."

India is the seventh-largest and most populous country in the world, and there is a wide regional difference in terms of race, religion, food preferences, personal conduct, educational attainment, and style of living. A significant portion of this population i.e. more than 70% owns cattle, which is a major factor in the transmission of zoonotic illnesses to people. (D. Das et al., 2014)[1]

The north-eastern states of India are made up of Assam, Nagaland, Manipur, Arunachal Pradesh, Sikkim, Mizoram, Tripura, and Meghalaya. Traditional sources of income for the vast majority of people in these states have been livestock and forest products. Due to topographic variances, the northeastern states experience distinct climate variations over relatively short distances, creating ideal circumstances for the spread of zoonotic illnesses.(D. Das et al., 2014; *Zoonotic Parasitic Diseases in Northeast:A Public Health Concern!!*, n.d.)[7]India represents an incredible diversity of bats with at least 117 species and 100 subspecies under 30 genera belonging to eight families. Around 62 species of bat are found to be widely distributed in different areas of northeastern States of India.(Yadav et al., 2018)[3]In some states such as the local ethnic groups have been gathering bats for food and traditional medicine in the northeastern Indian state of Nagaland for at least seven generations. These bat hunters are exposed to the saliva, blood, and excrement of the bat species Rousettus leschenaultii and Eonycteris spelaea leading to spreading of zoonotic diseases.(Dovih et al., 2021)[2]

Canine parasite zoonoses continue to be a public health concern, particularly in underdeveloped nations and communities with low socioeconomic status.(Traub et al., 2004)[4]Giardia duodenalis isolates found in people and canines living in the same area in a rural tea-growing region in northeast India.(Traub et al., 2003)[5]

More than 50 zoonoses, including bacterial, viral, and rickettsial illnesses, are thought to be responsible for 2.5 billion cases of human sickness worldwide. According to a research by the International Livestock Research Institute (ILRI), Kenya, India ranks highly among those with a high frequency of zoonotic illnesses. It is due to a number of factors, including the frequency of endemic zoonoses, protein and energy deprivation, and inadequate livestock keepers. Other factors contributing to the increased incidence of zoonoses include poverty, poor personal cleanliness, urinating in public places, a lack of drinkable water, an abundance of stray animals, high population density, and certain dietary practices.(Rajendran et al., 2019) [6]

In this REVIEW we focus on some of the relevant data and diseases of zoonotic source found in Northeast India as well as India and the world and few prevention/cure methods that had been used to treat zoonotic diseases.

2.STATISTICAL ANALYSIS

Northeast India

In the current study, the seroprevalence of human brucellosis in Meghalaya, Northeast India, was investigated. The seropositivity of brucellosis were reported to be 18.09% in Ri-Bhoi and 12.32% in East Khasi Hills, respectively which was carried out using a commercial IgM ELISA assay. According to the study, those under the age of 40 are more likely to contract brucellosis than those between the ages of 40 and 60. (Chowdhury & Chakraborty, 2017)(1).

Local ethnic groups have been gathering bats for food and traditional medicine in the northeastern Indian state of Nagaland for at least seven generations. A serological survey was conducted to investigate whether or if humans have come into contact with any probable bat-originating filoviruses, resulting in Males between the ages of 18 and 50 who had harvested bats at least 11 times making up the bulk of the hunters. Filovirus-specific nucleic acid could not be detected by PCR in any of the analyzed bat tissues.

Table 1: Basic demographic information on the human study population.(Dovih et al., 2021)(2)

Population	Age distribution	Involvement in the harvest of bats
Individuals 83(98%)	18-30 years 35% (40.2%)	0-10 times 20(25.5%)
Males 50(54.20%)	31-50 years 35% (40.2%)	11- 20 times 35(45.7%)
Females 35(40.2%)	>50 years 15% (18.8%)	>25 times 30(22.2%)

Aizawl and Guwahati, regions found in two North-eastern States of India, were chosen for the study to ascertain the prevalence of Dirofilaria immitis in stray, pet, and working dogs. Microscopy, immunological testing, and molecular tools (polymerase chain reaction and sequencing) were used as diagnostic techniques. These tests revealed 11.36, 18.02, and 13.92% of positive animals, respectively. There were no discernible differences by sex or by area, however, stray dogs were more likely to be infected than other groups (Borthakur et al., 2015)(3). A study was conducted to determine the prevalence of C. burnetii infection in Assam and Bihar's cattle and was found that Bihar had considerably higher farm and animal seropositivity percentages for Coxiella than Assam (5.4% vs 4.5%), and the size of the farm was also found to be a major risk factor.(Shome et al., 2019) (4) A study shows the prevalence pattern of Chikungunya virus in three states of Northeast India namely Assam, Arunachal Pradesh, and Meghalaya where it was found that 11.79% of the clinical samples tested positive for MAC-ELISA and/or RT-PCR. 17.86% of infections were asymptomatic. The age range of 15 to 30 years was the most afflicted, and males were more affected than girls. The most common symptom was fever (100%) with headache (72.02%) and arthralgia (41.54%) following.(Dutta et al., 2019) (5)

India

In recent years, the Indian states of Assam, Bihar, Delhi, Meghalaya, and Uttar Pradesh have all reported cases of F. buski infection in both humans and pigs. A study verified that the parasites found in both pigs and humans in Sivasagar and Sitamarhi belonged to the F. buski species.(Saikia et al., 2022) (8) In a study, anthrax suitability for India was predicted for the first time on a national scale. It was discovered that this adaptability is closely correlated with the elephant-livestock interface, which is symbolized by the existence of livestock throughout the elephant niche's whole range. While this study cannot conclusively state whether this association is caused by the unique ecology of elephants in ecotones or simply by their ability to serve as significant anthrax sentinels. (Walsh et al., 2019)(9)

Other countries

In Pennsylvania, a survey found that backyard poultry and swine owners were most knowledgeable about avian and swine influenza, while Salmonella, Brucella suis, and virulent Newcastle disease were less well-known to these groups(Diego De Stefani, Maria Patron, 2015) (6). Although the incidence of C. hepatica in rodents in Japan is unknown, mice and rats have been found to harbor either adult worms or their eggs, or even both. In addition, although the nematode was not identified as C. hepatica, hepatic capillariasis was seen in 2.25% of 400 cattle(Ochi et al., 2017)(7).

3.ZOONOTIC DISEASES

A) PARAGONIMIASIS

Many species of lung flukes in the genus Paragonimus are the source of paragonimiasis.(Blair, 2019) (1)Subacute to chronic inflammatory disease of the lungs is typical of paragonimiasis.

The symptoms, which include a persistent cough, chest pain, dyspnea, and hemoptysis, are similar to tuberculosis and lung cancer.(Yoshida et al., 2019) (2)The infection is spread to humans by the consumption of raw boar or pig meat because these animals act as paratenic hosts and may contain undercooked or pickled crustaceans that may contain Paragonimus spp. metacercariae.(Rajendran et al., 2019) (3)

According to the study, paragonimiasis has been endemic in Pfutsero, Nagaland, and half of the patients who came to the TB clinic had pulmonary paragonimiasis instead of tuberculosis.(Singh et al., 2009) (4)

B) DIROFILARIASIS

A uncommon zoonotic disease called human pulmonary dirofilariasis (HPD) is brought on by the same nematode that causes canine cardiopulmonary dirofilariasis in dogs, Dirofilaria immitis (dog heartworm)(Saha et al., 2022) (5)

Dirofilariasis is a vector-borne disease, and both its distribution and infection rates have significantly changed as a result of anthropogenic climate change.(Simón et al., 2012)(6)In India, D. immitis is mostly found in the northeastern region, and both D. immitis and D. repens have been found in the province of Delhi.(Simón et al., 2012) (7)

Most cases of ocular dirofilariasis recorded from India are those in which the worm is more frequently found in the sub-conjunctival or peri-orbital tissue.(Rajendran et al., 2019)(8)

C) ANTHRAX

Bacillus anthracis, a Gram-positive, nonmotile, spore-forming rod that is present in soil, causes anthrax, a zoonotic illness. The spores can survive for many years. (Garg & Panmei, 2018) (a)Accidental contact with an infected animal or animal products exposes humans to the sickness. The illness can manifest as cutaneous, inhalational, or gastrointestinal symptoms. Gastrointestinal anthrax is extremely uncommon, with less than 1% of cases documented.(Kamal et al., 2011) (b)Infections that are more severe from inhalation can almost always be fatal without medical help. The disease is currently receiving a lot of attention because bioterrorists may use it as a weapon.(Shadomy & Smith, 2008)(c)

D) FILOVIRUS

Animal viruses with a densely filamentous envelope known as filoviruses can cause extremely severe haemorrhagic fevers.(Beniac et al., 2018) (d)The family Filoviridae, which also comprises significant zoonotic viruses, has two genera: Ebolavirus (EBOV) and Marburgvirus (MARV). The distinctive filamentous morphology of filovirus particles measures roughly 1 m in length and 90 nm in diameter.(Dolnik & Becker, 2022) (e)

The introduction of filoviruses into human communities may be caused by elements including population expansion, the encroachment of forested regions, and direct contact with wildlife (such the intake of bushmeat). Once a person is infected, filoviruses can be transferred from person to person by coming into contact with the bodily fluids of an infected person. Individuals who do not wear the proper personal protective equipment, such as carers and healthcare professionals, are more at risk of contracting an illness.(PPE) (*Filoviruses (Filoviridae) | Viral Hemorrhagic Fevers (VHFs) | CDC*, n.d.) (f)

E) BOVINE TUBERCULOSIS

Bovine tuberculosis is prevalent and uncontrolled in India, where there are currently thought to be 218 million infected cows. The prevalence of zoonotic tuberculosis in India has been estimated by some earlier investigations to be around 10%; however, the ability of these studies to distinguish between MTBC members 8 through 10 was constrained.(Duffy et al., 2020) (9)

Human M.bovis infection is spread primarily by the consumption of unpasteurized milk and sporadically through droplet inhalation. Contrarily, M. tuberculosis infection was initially only found in humans, and any reports of its transmission to other animals—particularly cattle—were mistakenly attributed to unintentional contamination because of the animals' frequent contact with infected people, especially in areas where tuberculosis in humans is prevalent. (Refaya et al., 2020)(10)

Mycobacterium bovis, a member of the M. tuberculosis complex, is the primary cause of bovine tuberculosis (bTB), a bacterial illness that affects cattle. M. orygis, however, has reportedly been identified as the primary cause of bTB in Bangladesh. M. bovis primarily infects cattle, but it can also infect other captive wild species, such as deer, monkeys, giraffes, and wildebeests, as well as people. (Duffy et al., 2020)(Islam et al., 2020)(11)

F) GNATHOSTOMIASIS

The parasitic infection known as gnathostomiasis is brought on by the third-stage larvae of such helminths Gnathostoma spp., which become commonly found in tropical and subtropical areas. One can contract this endemic zoonosis by eating uncooked freshwater fish or shellfish.(Herman & Chiodini, 2009) (15)The most common clinical indications are localised, sporadic,, migrating swellings of the subcutaneous as well as skin tissues, which are commonly accompanied by sharp pain, pruritus, and erythema.(Rusnak & Lucey, 1993)(16)

Thus far, 74 occurrences of intraocular gnathostomiasis from 12 different countries have been documented. With 14 occurrences, India has the rare

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distinction of being one of just four countries to have recorded more than 10 instances apiece. (Pillai et al., 2012) (17)

A progressive swelling is the primary characteristics symptom of cutaneous gnathostomiasis and the one that helps with diagnosis. Scabies, larva migrans, gnathostomiasis, and head lice have all been treated with ivermectin. While being deemed safe and effective, there are certain reservations about using it on children under five or under 15 kilogrammes.(Ligon, 2005) (18)

G) HYDATIDOSIS

A major public health issue is hydatidosis, an infection brought on by the metacestode (larval stage) of an Echinococcus species. Geographically widespread in animals, E.granulosus poses an elevated danger to human health.(Rajendran et al., 2019) (12)

The Echinococcus larvae, an infectious parasite, is the primary cause of hydatid illness. Clinical signs and symptoms, radiographic and associated imaging examinations, the patients' epidemiological history, and other factors all contribute to the diagnosis of hydatid disease.(Baruah et al., 2020) (13)

Hydatid cysts (HC) most usually appear in the liver of humans (50% to 93%). Cysts can burst into the peritoneal cavity, which can lead to the development of numerous daughter cysts all throughout the peritoneal cavity, grow into fistulas into neighbouring organs or the biliary system, or they can just die on their own if left untreated.(R. Das et al., 2023) (14)

4.NOBEL APPROACH

A)Oral antivirals for Covid-19 :

The COVID-19 virus is prevented from multiplying within your body by oral antivirals like Paxlovid and Lagevrio (also known as molnupiravir). According to a study, Paxlovid and molnupiravir, two novel oral antivirals, are effective in reducing COVID-19 patient mortality and hospitalisation rates. The three oral medicines also demonstrated satisfactory overall safety by maintaining the same level of occurrence of side events.(Wen et al., 2022) (Administration for Strategic Response and Preparedness, 2022)

Paxlovid: Individuals who are either adults or toddlers and have a high probability of acquiring severe COVID-19 symptoms (12 years of age and older, weighing at least 88 pounds [40 kg]).

Lagevrio: Individuals 18 years of age and older with mild to moderate symptoms who are at high risk of developing a severe COVID-19 illness, do not have access to other COVID-19 outpatient treatment options, or those options are not appropriate for them. (Administration for Strategic Response and Preparedness, 2022)

B)Treatment for Anthrax:

Penicillin-v : Uncomplicated cutaneous anthrax can be treated with penicillin-v 250 to 500 mg orally four times a day for 7 to 10 days.(Kamal et al., 2011).

CIPROFLOXACIN : Only when a child may have been exposed to anthrax by inhalation is ciprofloxacin indicated for use in children. Fluoroquinolones have been demonstrated to produce cartilage toxicity in young animals, which is why ciprofloxacin is contraindicated for usage in paediatric patients. Although ciprofloxacin has been administered to kids of all ages, there haven't been many cases of cartilage toxicity. As anthrax is an infection that can be lethal, the advantages of using these medicines much exceed the hazards. Consequently, despite the lack of sufficient efficacy and safety studies in paediatric anthrax patients, the use of these antibiotics in children can be advised.(Benavides & Nahata, 2002)

C) Therapeutics Against Filovirus Infection :

There is an immediate need for treatments for filovirus infections. Years of investigation into filoviruses have led to the development of potential medical treatments, including direct antivirals, host-factor supporting methods, and passive immunity. In the filovirus community, monoclonal antibodies (mAbs) have a long and well-established history of usage as treatments for filoviral infection. The unprecedented 2013–2016 Ebola virus outbreak in Western Africa rekindled and accelerated the creation of numerous therapeutic antibodies, despite early research suggesting that antibodies might not be effective in treating filoviral infection. For instance, a recent clinical experiment conducted during the Ebola virus outbreak in the Democratic Republic of the Congo from 2018 to 2020 revealed a considerable level of protection from the Ebola virus single antibody treatment mAb114 and the tri-mAb cocktail REGN-EB3. Filovirus survivors produce both neutralising and non-neutralizing antibodies in response to infection. Although neutralising antibodies can directly stop viral reproduction, non-neutralizing strategies of protection, such as activation of the innate and adaptive immune response, are increasingly recognised as desirable phenotypic traits.(Murin et al., 2022)(Abramo et al., 2012)

D) Treatment for *Mycobacterium bovis* :

After receiving isoniazid (INH) treatment for 3 to 14 weeks after contracting Mycobacterium bovis spoligotype 9 infection, cattle were given a four-week break to allow INH to deplete before being challenged with M. bovis spoligotype 35. In comparison to controls exposed to the spoligotype 35 challenge 35 weeks after the original infection, post mortem examination (PME) 35 weeks later revealed partial protection against infectious challenge. Following a trend similar to that seen in the management of M. tuberculosis infection in humans, antigen-specific IFN- responses diminished over time with INH therapy. When treatment was stopped, the calves who had PME lesions were more likely to exhibit more specific IFN- responses. Two antigens, TB10.4 and Acr2, that elicited anamnestic responses in INH-treated, re-challenged calves were also found using IFN- responses, suggesting a protective immune function for both antigens. Following INH treatment, distinct IL-10 responses were seen in all calves, indicating a potential function for IL-10 in the healing of infection.(Dean et al., 2008)

E) Possible approaches for Hyaditosis :

Hepatic hydatid cyst surgical excision using a conservative or radical method has long been the suggested treatment. It is now possible to perform transhepatic percutaneous drainage of hydatid cysts that is guided by ultrasound or computed tomography. This procedure is known as puncture, aspiration, injection, and re-aspiration (PAIR). This is made possible by the availability of chemotherapy drugs that have significant activity against the Echinococcus granulosis. Albendazole or mebendazole pre- and post-intervention chemotherapy has the benefit of lowering the risk of disease recurrence and intraperitoneal infection seeding that may arise from cyst rupture and spilling happening spontaneously, during surgery or needle drainage. For patients with hepatic echinococcosis and maybe additional anatomic sites of infection such the lung, peritoneum, kidney, and other viscera who fail medication therapy alone, PAIR is a safe and effective operation. Mebendazole is less active in vitro than albendazole, and there are reports of superior clinical outcomes along with enhanced gastrointestinal absorption and bioavailability.(Smego & Sebanego, 2005)

CONCLUSION

The majority of infectious diseases that affect people are animal borne. These pathogens not only infect animals with diseases but also provide a major risk to human health. Because of the increased contact between people and wild animals, it is often the case that altered eating habits, climate change, and environmentally unfavourable human activities impact the establishment and reemergence of many zoonotic illnesses. The present COVID-19 epidemic makes clear how catastrophic zoonosis is for the human population. Research concentrating on the one health approach needs to be prioritised in order to uncover crucial intervention steps in the transmission of infections because of the close ties between animals, humans, and the environment.
granulosus complex, E. multilocularis or E. vogeli

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REFERENCES

I. Das, D., Islam, S., Bhattacharjee, H., Deka, A., Yambem, D., Tahiliani, P. S., Deka, P., Bhattacharyya, P., Deka, S., Das, K., Bharali, G., Deka, A., & Paul, R. (2014). Parasitic diseases of zoonotic importance in humans of northeast India, with special reference to ocular involvement. *Eye and Brain*, *6*, 1–8. https://doi.org/10.2147/EB.S64404

II. *Zoonotic Parasitic Diseases in Northeast:A Public Health Concern!!* (n.d.). Retrieved February 4, 2023, from https://www.pashudhanpraharee.com/zoonotic-parasitic-diseases-in-northeast-a-public-health-concern/

III. Yadav, P., Sudeep, A., Gokhale, M., Pawar, S., Shete, A., Patil, D., Kumar, V., Lakra, R., Sarkale, P., Nichol, S., & Mourya, D. (2018). Circulation of Nipah virus in Pteropus giganteus bats in northeast region of India, 2015. *The Indian Journal of Medical Research*, *147*(3), 318. https://doi.org/10.4103/IJMR.IJMR_1488_16

IV. Dovih, P., Eric Laing, D., Chen, Y., Low, D. H. W., Ansil, B. R., Yang, X., Shi, Z., Broder, C., Smith, G. J. D., Linster, M., Ramakrishnan, U., & Mendenhall, I. H. (2021). Correction to: Filovirus-reactive antibodies in humans and bats in northeast India imply zoonotic spillover (PLOS Neglected Tropical Diseases). *PLoS Neglected Tropical Diseases*, *15*(11), 1–10. https://doi.org/10.1371/journal.pntd.0009836

V. Traub, R. J., Monis, P. T., Robertson, I., Irwin, P., Mencke, N., & Thompson, R. C. A. (2004). Epidemiological and molecular evidence supports the zoonotic transmission of Giardia among humans and dogs living in the same community. *Parasitology*, *128*(Pt 3), 253–262. https://doi.org/10.1017/S0031182003004505

VI. Traub, R. J., Robertson, I. D., Irwin, P., Mencke, N., Monis, P., & Thompson, R. C. A. (2003). Humans, dogs and parasitic zoonoses--unravelling the relationships in a remote endemic community in northeast India using molecular tools. *Parasitology Research*, *90 Suppl 3*(SUPPL. 3). https://doi.org/10.1007/S00436-003-0925-3

VII. Rajendran, C., Satbige, A. S., & Kumar, D. (2019). Review on Zoonotic Parasitic Diseases of Northeast India-Epidemiology and Clinical Features. *International Journal of Current Microbiology and Applied Sciences*, *8*(2), 1–15. https://doi.org/10.20546/ijcmas.2019.802.xx

VIII. Chowdhury, S., & Chakraborty, P. pratim. (2017). Universal health coverage - There is more to it than meets the eye. *Journal of Family Medicine and Primary Care*, *6*(2), 169–170. https://doi.org/10.4103/jfmpc.jfmpc

IX. Borthakur, S. K., Deka, D. K., Islam, S., Sarma, D. K., & Sarmah, P. C. (2015). Prevalence and molecular epidemiological data on dirofilaria immitis in dogs from Northeastern States of India. *Scientific World Journal*, *2015*. https://doi.org/10.1155/2015/265385

X. Shome, R., Deka, R. P., Milesh, L., Sahay, S., Grace, D., & Lindahl, J. F. (2019). Coxiella seroprevalence and risk factors in large ruminants in Bihar and Assam, India. *Acta Tropica*, *194*, 41–46. https://doi.org/10.1016/J.ACTATROPICA.2019.03.022

XI. Dutta, P., Khan, S. A., Phukan, A. C., Hazarika, S., Hazarika, N. K., Chetry, S., Khan, A. M., & Kaur, H. (2019). Surveillance of Chikungunya virus activity in some North-eastern states of India. *Asian Pacific Journal of Tropical Medicine*, *12*(1), 1–7. https://doi.org/10.4103/1995-7645.250340

XII. Saikia, D., Prasad, Y. K., Dahal, S., & Ghatani, S. (2022). Fasciolopsis buski Detected in Humans in Bihar and Pigs in Assam, India. *Emerging Infectious Diseases*, *28*(6), 1265–1268. https://doi.org/10.3201/eid2806.220171

XIII. Walsh, M. G., Mor, S. M., & Hossain, S. (2019). The elephant-livestock interface modulates anthrax suitability in India. *Proceedings of the Royal Society B: Biological Sciences*, *286*(1898). https://doi.org/10.1098/rspb.2019.0179

XIV. Diego De Stefani, Maria Patron, and R. R. (2015). 乳鼠心肌提取 HHS Public Access. *Physiology & Behavior*, *176*(3), 139–148. https://doi.org/10.1111/zph.12686.Zoonotic

XV. Ochi, A., Hifumi, T., Ueno, T., & Katayama, Y. (2017). Capillaria hepatica (Calodium hepaticum) infection in a horse: A case report. *BMC Veterinary Research*, *13*(1), 1–3. https://doi.org/10.1186/s12917-017-1301-3

XVI. Blair, D. (2019). Paragonimiasis. *Advances in Experimental Medicine and Biology*, *1154*, 105–138. https://doi.org/10.1007/978-3-030-18616-6_5

XVII. Yoshida, A., Doanh, P. N., & Maruyama, H. (2019). Paragonimus and paragonimiasis in Asia: An update. *Acta Tropica*, *199*, 105074. https://doi.org/10.1016/J.ACTATROPICA.2019.105074

XVIII. Singh, T., Sugiyama, H., Umehara, A., Hiese, S., & Khalo, K. (2009). Paragonimus heterotremus infection in Nagaland: A new focus of paragonimiasis in India. *Indian Journal of Medical Microbiology*, *27*(2), 123–127. https://doi.org/10.4103/0255-0857.49424

XIX. Saha, B. K., Bonnier, A., Chong, W. H., Chieng, H., Austin, A., Hu, K., & Shkolnik, B. (2022). Human Pulmonary Dirofilariasis: A Review for the Clinicians. *American Journal of the Medical Sciences*, *363*(1), 11–17. https://doi.org/10.1016/j.amjms.2021.07.017

XX. Simón, F., Siles-Lucas, M., Morchón, R., González-Miguel, J., Mellado, I., Carretón, E., & Montoya-Alonso, J. A. (2012). Human and Animal Dirofilariasis: the Emergence of a Zoonotic Mosaic. *Clinical Microbiology Reviews*, *25*(3), 507–544. https://doi.org/10.1128/CMR.00012-12

XXI. Garg, N., & Panmei, K. (2018). First reported case of naturally acquired fatal anthrax from Northeast India. *Journal of Family Medicine and Primary Care*, *7*(3), 632. https://doi.org/10.4103/JFMPC.JFMPC_111_18

XXII. Kamal, S. M., Rashid, A. M., Bakar, M. A., & Ahad, M. A. (2011). Anthrax: an update. *Asian Pacific Journal of Tropical Biomedicine*, *1*(6), 496. https://doi.org/10.1016/S2221-1691(11)60109-3

XXIII. Shadomy, S. V., & Smith, T. L. (2008). Anthrax. *Journal of the American Veterinary Medical Association*, *233*(1), 63–72. https://doi.org/10.2460/javma.233.1.63

XXIV. Beniac, D. R., Lamboo, L. L., & Booth, T. F. (2018). Filovirus Filament Proteins. *Sub-Cellular Biochemistry*, *88*, 73–94. https://doi.org/10.1007/978-981-10-8456-0_4

XXV. Dolnik, O., & Becker, S. (2022). Assembly and transport of filovirus nucleocapsids. *PLoS Pathogens*, *18*(7). https://doi.org/10.1371/JOURNAL.PPAT.1010616

XXVI. *Filoviruses (Filoviridae) | Viral Hemorrhagic Fevers (VHFs) | CDC*. (n.d.).

XXVII. Duffy, S. C., Srinivasan, S., Schilling, M. A., Stuber, T., Danchuk, S. N., Michael, J. S., Venkatesan, M., Bansal, N., Maan, S., Jindal, N., Chaudhary, D., Dandapat, P., Katani, R., Chothe, S., Veerasami, M., Robbe-Austerman, S., Juleff, N., Kapur, V., & Behr, M. A. (2020). Reconsidering Mycobacterium bovis as a proxy for zoonotic tuberculosis: a molecular epidemiological surveillance study. *The Lancet Microbe*, *1*(2), e66–e73. https://doi.org/10.1016/S2666-5247(20)30038-0

XXVIII. Refaya, A. K., Bhargavi, G., Mathew, N. C., Rajendran, A., Krishnamoorthy, R., Swaminathan, S., & Palaniyandi, K. (2020). A review on bovine tuberculosis in India. *Tuberculosis*, *122*, 101923. https://doi.org/10.1016/J.TUBE.2020.101923

XXIX. Islam, S. K. S., Rumi, T. B., Kabir, S. M. L., van der Zanden, A. G. M., Kapur, V., Rahman, A. K. M. A., Ward, M. P., Bakker, D., Ross, A. G., & Rahim, Z. (2020). Bovine tuberculosis prevalence and risk factors in selected districts of Bangladesh. *PLOS ONE*, *15*(11), e0241717. https://doi.org/10.1371/JOURNAL.PONE.0241717

XXX. Herman, J. S., & Chiodini, P. L. (2009). Gnathostomiasis, another emerging imported disease. *Clinical Microbiology Reviews*, *22*(3), 484–492. https://doi.org/10.1128/CMR.00003-09

XXXI. Pillai, G. S., Kumar, A., Radhakrishnan, N., Maniyelil, J., Shafi, T., Dinesh, K. R., & Karim, S. (2012). Case report: Intraocular gnathostomiasis: Report of a case and review of literature. *American Journal of Tropical Medicine and Hygiene*, *86*(4), 620–623. https://doi.org/10.4269/ajtmh.2012.11-0719

XXXII. Ligon, B. L. (2005). Gnathostomiasis: A review of a previously localized zoonosis now crossing numerous geographical boundaries. *Seminars in Pediatric Infectious Diseases*, *16*(2), 137–143. https://doi.org/10.1053/J.SPID.2005.01.002

XXXIII. Baruah, A., Sarma, K., Barman, B., Phukan, P., Nath, C., Boruah, P., Rajkhowa, P., Baruah, M., Dutta, A., & Naku, N. (2020). Clinical and Laboratory Presentation of Hydatid Disease: A Study From Northeast India. *Cureus*. https://doi.org/10.7759/CUREUS.10260

XXXIV. Das, R., Das, N., Rajbongshi, S., Islam, B., Singh, B., & Agrawal, N. K. (2023). *LAPAROSCOPIC MANAGEMENT OF HEPATIC HYDATID DISEASE- AN OBSERVATIONAL STUDY*. 657–660. https://doi.org/10.47009/jamp.2023.5.1.138

XXXV. Wen, W., Chen, C., Tang, J., Wang, C., Zhou, M., Cheng, Y., Zhou, X., Wu, Q., Zhang, X., Feng, Z., Wang, M., & Mao, Q. (2022). Efficacy and safety of three new oral antiviral treatment (molnupiravir, fluvoxamine and Paxlovid) for COVID-19：a meta-analysis. *Annals of Medicine*, *54*(1), 516–523. https://doi.org/10.1080/07853890.2022.2034936

XXXVI. Administration for Strategic Response and Preparedness. (2022). *Treatment Options for COVID-19 | HHS/ASPR*. ASRP. https://aspr.hhs.gov/COVID-19/Treatments/Pages/Possible-Treatment-Options-for-COVID19.aspx

XXXVII. Benavides, S., & Nahata, M. C. (2002). Anthrax: safe treatment for children. *The Annals of Pharmacotherapy*, *36*(2), 334–337. https://doi.org/10.1345/APH.1A424

XXXVIII. Murin, C. D., Gunn, B. M., Parren, P. W. H. I., & Kobinger, G. P. (2022). Editorial: Antibody Therapeutics for the Treatment of Filoviral Infection. *Frontiers in Immunology*, *13*. https://doi.org/10.3389/FIMMU.2022.859919

XXXIX. Abramo, J. M., Reynolds, A., Crisp, G. T., Weurlander, M., Söderberg, M., Scheja, M., Hult, H., Wernerson, A., Emacs, A., Distribution, U. E., Makes, W., Like, A., Text, O., Editors, O. T., Interface, T. A., Sets, D. C., Look, T. R., Veterans, E., Bindings, K., … Rugg, G. (2012). Therapeutics against filovirus. *Assessment & Evaluation in Higher Education*, *37*(October), 435. https://doi.org/10.1007/82

XL. Dean, G. S., Rhodes, S. G., Coad, M., Whelan, A. O., Wheeler, P., Villareal-Ramos, B., Mead, E., Johnson, L., Clifford, D. J., Hewinson, R. G., & Vordermeier, H. M. (2008). Isoniazid treatment of Mycobacterium bovis in cattle as a model for human tuberculosis. *Tuberculosis*, *88*(6), 586–594. https://doi.org/10.1016/j.tube.2008.01.004

XLI. Smego, R. A., & Sebanego, P. (2005). Treatment options for hepatic cystic echinococcosis. *International Journal of Infectious Diseases*, *9*(2), 69–76. https://doi.org/10.1016/j.ijid.2004.08.001