EBAUB Journal Volume 3 January 2021

ISSN: 2617 - 8338

EBAUB Journal
An Academic Journal of
EXIM Bank Agricultural University Bangladesh

Prevalence of Zoonotic Diseases in Bangladesh

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ARTICLE INFO

Received date: Sept. 29, 2020
Accepted date: Dec.13, 2020

ABSTRACT

Zoonotic diseases (Zoonoses) are infectious diseases of animals that can naturally be transmitted to humans. The results of the prevalence and effects of zoonotic diseases in humans and animals of Bangladesh are analyzed from the published literatures and presented here. It appears from the literature that there are about 1415 human pathogens of which 61% are zoonotic. The major zoonotic bacterial diseases recorded in Bangladesh are Anthrax, Tuberculosis, Brucellosis, Salmonellosis, Campylobacteriosis and Leptospirosis. During the period 2009 to 2012, anthrax caused death of hundreds of cattle and more than 650 cases of cutaneous anthrax in humans including fatalities in two humans associated with anthrax. The major reported viral zoonotic diseases in Bangladesh include Avian influenza, Rabies, Nipah virus infection, Japanese encephalitis, Rotavirus and Dengue fever. Avian influenza is caused by highly pathogenic H5N1 in humans and poultry in Bangladesh and about seven humans affected with H5N1 but all of them have recovered. Rabies is considered as a prior zoonosis in Bangladesh and it is mainly transmitted to humans and food animals mainly through dog bite. Nearly 100,000 people had been infected and at least 2000 died of rabies in 2009 in Bangladesh. Nipah virus infection is an important emerging infectious disease has been recognized since 2001 in Bangladesh. The dermatomycosis has been reported in 9.3% cattle, 18.6% goats and 25.2% in contact humans. The major zoonotic parasites recorded in cats in Bangladesh include *Paragonimus westermani* (9.09%), *Dirofilaria immitis* (9.09%), in dogs include *Diphyllobothrium latum* (13.3%), *Diphylidium caninum* (16.69%), *Echinococcus granulosus* (9.17%), *Ancylostomum caninum* (9-100%). The prevalence of zoonotic protozoan diseases recorded in humans in Bangladesh include amebiasis (*E. histolytica* 4.71%), giardiasis (21% in children & 51% in malnourished children), cryptosporidiasis and visceral leishmaniasis (kala-azar). This study along with adequate veterinary public health (VPH) action can be helpful for prevention and control of these zoonoses. “One Health” concept for control of zoonotic diseases will may be a great weapon to reduce the both human and animal health hazards.

Key words: Animals, Bacterial, Birds, Fungal, One Health, Zoonotic diseases

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To Cite: Alam, J. & Rahman, M. T. (2021). Prevalence of zoonotic diseases in Bangladesh. *EBAUB J*., 3, 36-48.

1. INTRODUCTION

Zoonotic diseases are common throughout the world and constitute an important threat to human health in developing countries like Bangladesh (Islam et al., 2014). Zoonoses are diseases and infections that are naturally transmissible between vertebrate animals and man (WHO, 2006). They exert dual impacts on human population that are livestock dependent. This could be either through direct risk of infection by zoonoses or through reduced production by the livestock resulting in food insecurity and poverty (Molyneux et al., 2011). It is estimated that over 600 million people worldwide are livestock-dependent, and represent up to 70% of the marginalized and poor population (FAO, 2004). Zoonotic diseases continue to represent an important health hazard in most parts of the world, where they cause considerable expenses and losses for the health and agricultural sectors. Even though the situation is improving in the industrialized world, zoonoses prevention and control will remain an area of major concern in most developing countries including Bangladesh (Islam et al., 2014).

The human and infectious diseases have extremely close relationship since their creation and the world will continue to witness epidemics till the life exists on earth. About one infectious disease has been experienced every year during recent past and the scientists has reported that out of total 1415 known infectious diseases of human 868 (61%) are of zoonotic importance (Anon, 2011a). The most recent outbreaks especially Severe Acute Respiratory Syndrome (SARS), West Nile Virus (WNV), Highly Pathogenic Avian Influenza (H5N1) Swine Flu, Nipah virus and Anthrax have proved a strong association of human and livestock including wild life. This increased human-animals interface has put livestock producers, consumers of livestock products, and traders and processors of livestock products at higher risk of contracting zoonotic diseases while contributing significantly to the total disease burden (Pal et al., 2011).

Nearly half of all humans' infectious diseases known today can be classified as emerging and about 75% of emerging infectious diseases are caused by zoonotic pathogens (Samad, 2011). Emerging diseases are that (a) have been recently recognized or evolved, (b) have recently increased in incidence or prevalence, (c) have recently expanded in geographic or climatologic range or (d) have transpired from animal populations into humans. This differs somewhat from reemerging infectious diseases, which are diseases that have been discovered previously in a species often at enzootic levels but for some reason, have significantly increased in incidence at a given point of time or in a specific geographic region (Anon, 2011b).

Zoonoses have affected human health throughout times. A possible epidemic of bubonic plague was described in the Old Testament, in the First Book of Samuel. The so called Black Death emerged in the 14th century and caused vast losses throughout Asia, Africa, and Europe. The epidemic, which originated in the Far East, killed approximately one third of Europe's population. Rabies was described in Mesopotamia, in hunting dogs, as early as 2,300 BC. Recognizable descriptions of rabies can also be traced back to early Chinese, Egyptian, Greek, and Roman records. Ancient accounts and modern hypotheses suggest that Alexander the Great, who died in Babylon in 323 BC, died of encephalitis caused by West Nile virus, a virus that has a wild bird reservoir.

The prevalence of zoonotic diseases has changed along with human history. According to one theory, 10,000 years ago when humans were hunter-gatherers there were less zoonotic diseases. This was because the groups moved frequently and so large sewer and garbage dumps which could attract animals like rats and support diseases did not form. Animals, except for dogs, were also not domesticated and so there was less contact in that way. Furthermore, the small size of the groups lent itself better to parasites and chronic diseases than epidemics that could quickly spread. It was the transition to an agrarian lifestyle that allowed zoonotic diseases greater opportunity to jump species to the increased crowding.

Zoonotic diseases have both direct and indirect effects on livestock health and production. The direct impact of zoonoses can be considerable with illness, monetary loss, adverse effect on morale of personnel, unfavorable publicity and legal implications. Indirect effects occur as a result of the risk of human infection, barriers to livestock trade, the added costs associated with control programs, marketing produce to ensure it is safe for human consumption and the loss of market awing to reduce consumer confidence (Anon, 2011c). A recent retrospective study of 335 emerging infections episodes over a 64-year period (1940-2004) emphasized the role of wildlife as a source of emerging infections, although research efforts have so far been focused toward either humans or economically related species (Daszak et al., 2007).Considering the conditions stated above, the review has been prepared to know the prevalence of zoonotic diseases along with the impacts of zoonotic diseases on human and to figure out the possible ways for prevention and control of the zoonoses in Bangladesh, has been discussed with following headings.

2. ZOONOTIC DISEASES

2.1. Major Bacterial Zoonotic Diseases

Bacterial zoonotic diseases can be transferred from animals to humans in many ways: (i) The transfer may occur through animal bites and scratches; (ii) zoonotic bacteria originating from food animals; (iii) farmers and animal health workers (i.e., veterinarians); (iv) vectors, frequently arthropods, such as mosquitoes, ticks, fleas, and lice; (v) soil and water recourses. The major zoonotic bacterial diseases recorded in Bangladesh are Anthrax, Tuberculosis, Brucellosis, Salmonellosis, Campylobacteriosis and Leptospirosis (Table 1), of which only Anthrax has been reported as clinical outbreaks form in both the humans and cattle (Samad, 2011).

Table 1 Existing bacterial zoonoses with hosts in Bangladesh (Source: Samad, 2011)

Diseases	Hosts
Anthrax	Cattle, sheep, goats, camels, deer, elephants and other herbivores
Tuberculosis	Non-human primates, cattle, sheep, dogs, swine, psittacines
Brucellosis	Cattle, sheep, goats, buffaloes, stray dogs
Salmonellosis	Mammals, birds, reptiles
Campylobacteriosis	Poultry and cattle
Leptospirosis	Dogs, cattle, swine

2.1.1. Anthrax

The word anthrax is derived from the Greek word, 'anthrakis' (or 'coal') in reference to the black skin lesions victims develop. The disease occurs worldwide and is enzootic in certain African and Asian countries including Bangladesh. It is caused by *Bacillus anthracis* which are mainly released from infected carcasses and form resistant spores affecting on exposure to air.

This organism causes acute infectious disease in mainly wild and domestic herbivores. Humans are infected when they are exposed to infected animals carcasses or by handling infected animal products (hides and skin, wool, bone, flesh) or by inhaling anthrax spores from contaminated animal by-products and contaminated soil (Dixon et al., 1999; Thappa &Karthiklyan, 2001; Samad, 2008).

Anthrax infection in human can occur in three forms: cutaneous which affects the skin; inhalation, which affects lungs and ingestion which affects the digestive tract. Anthrax is endemic in Bangladesh and periodic outbreak of this malady in cattle have been a concern in this country from long time and Anthrax spore vaccine is used under field condition to control the disease. Published reports of anthrax in animals in Bangladesh date back to 1948 (Mohan & Ali, 1948). However, sporadic anthrax outbreaks in cattle and humans (Samad & Haque, 1986) and elephant (Mustafa, 1984) have been reported in Bangladesh. During 2009 to 2012, more than 25 outbreaks of anthrax have occurred simultaneously in both cattle and humans and more than 650 humans cases recorded in 15 districts during summer and monsoon seasons (April to October) from Bangladesh (Table 2).

Table 2 Reported anthrax outbreaks in animals and humans in Bangladesh

Year	Districts	No. of outbreaks	No. of animal cases	No. of human cases	References
1982-'83	Sirajgonj	02	62	27	Samad, 2011
1984	Dhaka (Zoo)	01	1(Elephant)	0	
2009	Sirajgonj, Pabna	03	-	55	
2010	Tangail, Sirajgonj, Pabna, Lalmonirhat	12	166	920	
2011	Sirajgonj, Pabna, Tangail, Bogra, Meherpur	11	-	122	
2012	Sirajgonj, Kushtia, Bogra, Tangail	08	-	106	
2013	Sirajgonj, Tangail, Meherpur, Chuadanga	05	-	327	IEDCR, 2013
2014	Sirajgonj, Narayanganj, Meherpur, Tangail	04	-	225	IEDCR, 2014a
2015	Meherpur, Narayanganj, Rajshahi, Kushtia	04	-	189	IEDCR, 2015
2016	Sirajgonj	02	-	106	The Daily Star,2016
	Total	52	229	2077	

An investigation of 25 anthrax outbreaks in 414 human cases showed 378 (91%) had cutaneous (Fig. 1), 27 (6%) had gastro-intestinal and 11 (3%) had concurrent cutaneous and gastro-intestinal anthrax (Anon, 2011b).

Majority of the patients developed cutaneous anthrax (Fig. 2) had history of butchering sick animals, handling raw meat, contact with animal skin or were present at slaughtering sites (Herrimen, 2016). Inadequate livestock vaccination coverage, lack of awareness of the risk of anthrax transmission from animal to humans, social norms and poverty contributed to these outbreaks (Chakraborty et. al., 2012).

This was the first time in Bangladesh that two human fatalities occurred among patients with anthrax about two weeks after onset of symptoms. These two death cases were in two different outbreaks, one in Bogra (70-yearold male) in July 2011 and the other in Tangail (40-year-old male) in August 2011 and both the patients had symptoms of

concurrent cutaneous and gastro-intestinal anthrax. History showed that both of them participated in butchering sick animals (Anon. 2011c). These were the largest anthrax outbreaks in the nation's history which resulted in the government declaring a red alert on 5th September 2010 throughout the country.

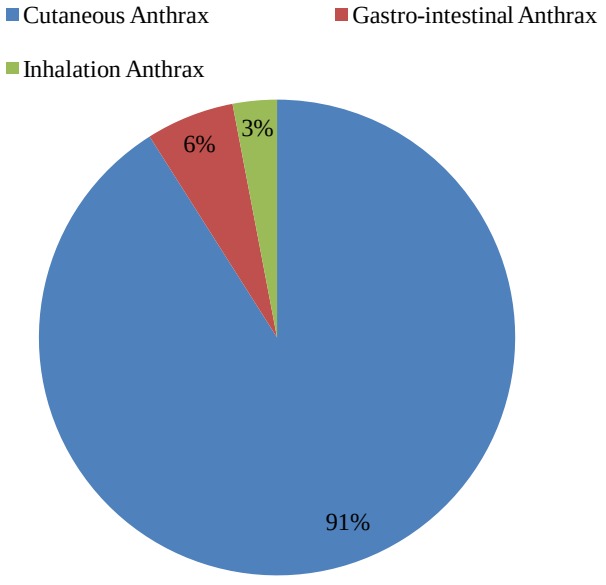

Fig. 1 Proportion of different anthrax forms in human in Bangladesh (Source: Anon, 2011b).

Fig. 2 Sign of Cuteneous anthrax in human (Source: Chakraborty et al., 2012).

2.1.2. Tuberculosis

Tuberculosis (TB) is caused by acid-fast bacillus of the *Mycobacterium* and the most common species are *M. tuberculosis* (man, non-human primates, cattle, dogs, swine, psittacines), *M. bovis* (cattle, dogs, swine, man) and *M. avium* (birds, swine, sheep). All the three species are capable of causing disease in man although *M. tuberculosis* is by far the most common. Human tuberculosis is the world's second commonest cause of death from infectious disease after HIV/AIDS. Bangladesh ranked 6th among 22 most TB affected countries (225/100,000 cases in 2009) in the world, with 300,000 new cases and 70,000 deaths reported every year (WHO, 2005). Nationwide tuberculosis prevalence survey in Bangladesh 2007 to 2009 detected an overall adjusted prevalence 79.4% per 100,000 persons (Anon, 2010a). In this study, 3085 human and 649 cattle of different sexes and ages were examined to determine the prevalence and risk factors associated with human and bovine tuberculosis. Out of 3085 human, 300 were shown positive reaction to human tuberculosis and out of 649 cattle, 15 were shown positive reaction to bovine tuberculosis. So the overall prevalence was 9.7% in human and 2.34% in cattle. Age-wise prevalence of tuberculosis in human revealed that the prevalence was highest (19.4%) and found in age group 20≤29 years old human (Table 3). Prevalence was gradually decreasing with higher age group and lowest prevalence was recorded in the ≥60 years age group (Sarkar et al., 2015).

Table 3 Prevalence of tuberculosis based on age in human (Source: Sarkar et al., 2015)

Age group (years)	Selected human No.	TB positive cases	Percentage %
20-29	371	72	19.4
30-39	504	78	15.5
40-49	1130	114	10.1
50-59	900	33	3.7
60 and above	180	03	1.7

Sex-wise prevalence of tuberculosis in human showed that higher prevalence was recorded in female (11.2%) than in male (8.6%). Over the three study years slightly similar prevalence was found in the year 2009 (10.4%) and 2011 (10.3%), (Table 4). Lower prevalence was found in the year 2010 (8.7%) than 2009 and 2011.

Table 4 Prevalence of tuberculosis based on year in human (Source: Sarkar et al., 2015)

Year	Selected human No.	TB positive cases	Percentage (%)
2009	959	100	10.4
2010	1165	101	8.7
2011	961	99	10.3

Monthly distribution of tuberculosis in human revealed that highest prevalence was found in the April month (15.03%) and lowest prevalence was found in the July month (5.7%) (Sarkar et al., 2015).

2.1.3. Brucellosis

Brucellosis remains one of the most common zoonotic diseases worldwide with more than 500,000 human cases reported annually. The disease occurs worldwide in both animals and humans, except in those countries where bovine brucellosis has been eradicated by using vaccination and/or method of screening and culling (Samad, 2008). Five out of the nine known *Brucella* species can infect humans and the most pathogenic and invasive species for human is *Br. melitensis* (sheep, goats), followed in descending order by *Br. suis* (swine), *Br. abortus* (cattle, sheep) and *Br. canis* (dogs), and accordingly, *Br. melitensis*, *Br. suis* and *Br. abortus* are listed as potential bio-weapons (Seleem et al., 2010).

Brucellosis in animals, mainly affects reproduction and fertility, causes late abortion, reduces survival chances of newborns and reduces milk yield (Samad, 2008). In humans it can causes undulant fever, abortion and orchitis. Serum samples were collected from 550 ruminants (105 buffaloes, 188 cattle, 127 goats, and 130 sheep) of five different regions (Mymensingh, Gaibandha, Bogra, Bagherhatt, and Sirajgonj). The numbers of positive reactors by I-ELISA was three out of 105 (2.87%) in buffaloes, five out of 188 (2.66%) in cattle, four out of 127 (3.15%) in goats, and three out of 130 (2.31%) in sheep in the five different regions of Bangladesh (Rahman et al., 2011).

It is generally transmitted to consumers through raw milk and milk products (cheese), but the human-to-human transmission of the infection does not occur. The importance of brucellosis is not known precisely, but it can have a considerable impact on human and animal health, along with wide socio-economic impacts, especially in countries where rural income relies largely on livestock breeding and dairy products. Some specific occupational groups including farm workers, Veterinarians, animal caretakers and butchers (Table 5) are considered at higher risk to brucellosis. Brucellosis in humans is characterized by extreme weakness, joint and muscle pain, headache, undulant fever, hepatomegaly, splenomegaly and night sweats.

Table 5 Prevalence of brucellosis in human in different professions in Bangladesh

Year	Area	Sample size	Positive	Sample type	Prevalence (%)	Reference
1983	Dhaka, Mymensingh,Tangail	190	21	Milker, Livestock & crop farmer	11.1	Rahman et al., 2011
1988	Mymensingh,Tangail	116	25	Goat farmer	21.6	Rahman et al., 2011
2009	Mymensingh	50	03	Livestock farmer	6	Nahar & Ahmed, 2009
2010	Mymensingh	210	07	Livestock farmer, butcher, milker	3.3	
Overall		566	56		9.9	

2.1.4. Salmonellosis and Colibacillosis

Salmonellosis (*Salmonella* food poisoning and enteric paratyphosis) is a public health concern because most of the strains of *Salmonellae* are potentially pathogenic to humans and animals worldwide. There are over 1800 food-poisoning serotypes of *Salmonella* exist in the world and about 5 million human cases of salmonellosis are diagnosed annually in the United States (Bob, 2011) and problem may be more severe in Bangladesh.

Salmonellae are common commensalisms of mammals, birds, reptiles and are excreted in feces. Host-adapted strains may cause disease like *S. dublin* in cattle, *S. pullorum* in chickens, but most human food-poisoning *Salmonellae* do not cause clinical disease in animals. Infection in animals is maintained by recycling slaughterhouse waste as animal feed, fecal oral spread and fecal contamination of hatching egg (Borhanuddin et al., 1986).

A study of water from different sources shows that highest no. of bacteria found in river water (Table 6). The causative agent of colibacillosis, *Escherichia coli* isolated form humans and animals have been characterized in Bangladesh (Ali et al., 1998).

Table 6 Bacterial status of water in Bangladesh (Source: Samad, 2011)

Sources of samples	No. of samples tested	Species of bacteria identified (%)	
		Salmonella spp.	*Salmonella* spp.
River water	100	25	60
Pond water	100	10	40
Tape water	100	04	15
Tube-well water	100	00	02

2.1.5. Campylobacteriosis

Campylobacteriosis is an important zoonotic disease, associated with bacterial gastro-enteritis and may be responsible for as many as 400 to 500 million human cases emerging worldwide annually.

Although the genus *Campylobacter* is composed of 17 described species, clinical disease is primarily with *Campylobacter jejuni* and *C. coli*.

Microbio-chemical investigation of 300 diarrheic stool samples of children in Bangladesh showed 58 (19.33%) had

Campylobacter infection, of which 40 (68.97%) isolates had *C. jejuni* (Fig. 3), 5 (8.62%) had *C. coli* infection and the 13 (22.41%) remain unidentified (Talukder et al., 2008).

The *C. jejuni* has been identified to be associated with predominantly watery diarrhea and isolated in frequencies varying from 17 to 26% in Bangladesh (Debnath et al., 1986; Haq & Rahman, 1991; Datta et al., 2003; Talukder et al., 2008).

Transmission is generally occurred by the feco-oral route, through contamination of food and water, and direct contact with infected fecal material.

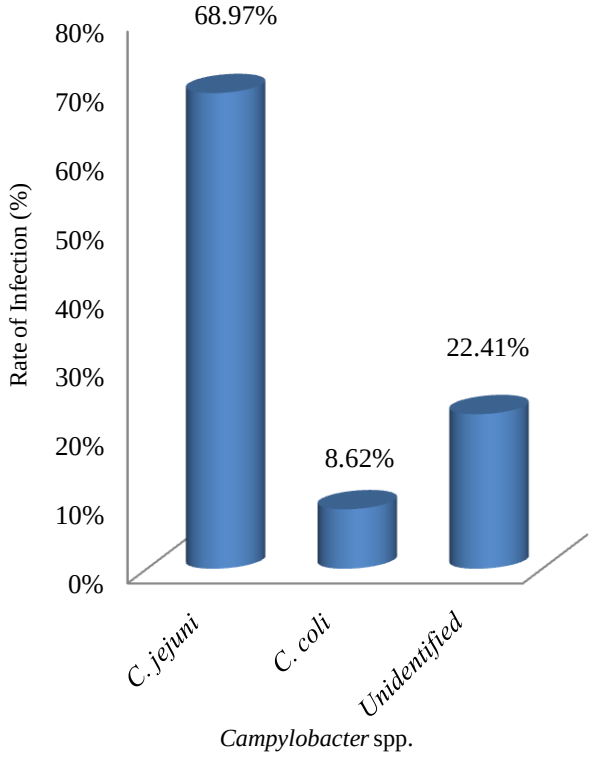

Fig. 3 Comparative study of prevalence of different *Campylobacter spp.* in human (Source: Samad, 2011)

Poultry and cattle are the reservoirs for human infection, which is acquired by ingesting contaminated raw milk, under-cooked chicken or other food contaminated in the kitchen. Disease in humans is characterized by acute gastro-enteritis (diarrhea) with or without blood, abdominal pain and fever, and also may cause pseudo-appendicitis and rarely septicemia and arthritis.

2.1.6. Leptospirosis

Leptospirosis is a zoonotic disease, caused by pathogenic leptospires belong to the species *Leptospira interrogans*, which is sub-divided into more than 200 sero-vars. The main natural reservoirs for human infection vary with serovar: *L. canicola* in dogs, *L. hardjo* in cattle, *L. pomona* in swine, and *L. icterohaemorrhahiae* in rats. Infection usually results when water or soil contaminated with the urine of an infected animal comes in contact with human skin or mucous membrane. Clinical manifestations of leptospirosis can range from a selflimited febrile syndrome to a fatal illness, characterized by hemorrhage, renal failure and jaundice. So far, there is evidence on the occurrence of leptospirosis in Bangladesh (Anon, 2011d) which was conducted in connection to dengue fever and 17.55% of dengue-negative patient's sera showed positive reaction for leptospirosis. It has also been found that the case fatality rate among leptospirosis patients (5%) was higher than among dengue fever patients (1.2%).

Although leptospirosis has been reported in most of the neighboring countries of Southeast Asia, the work on this disease is not done in Bangladesh where diagnostic tests for leptospirosis are not available. However, environmental factors such as floods, humidity and water contamination are amenable to the spreading of the disease in both man and animals in Bangladesh.

2.2. Major Viral Zoonotic Diseases

There are more than 5,000 viruses known to man and they are evolving every day. Some important zoonotic virus diseases are associated with human deaths globally every year in Bangladesh (Table 7). Most of the statistics on the morbidity and mortality rates are taken from WHO reports.

Table 7 Major viral zoonotic diseases in Bangladesh (Source: Samad, 2011)

Diseases	Hosts
Avian influenza	Poultry, Wild birds
Rabies	Dogs, cattle, sheep, goat , swine, buffaloes
Nipah virus infection	Bats
Japanese encephalitis	Pig, cattle, dogs
Rotavirus	Buffaloes, calves, kids, broilers
Contagious echthyma	Goat
Dengue fever	Non-human primates

2.2.1. Avian Influenza

Avian influenza (AI) is an important emerging infectious disease, caused by Highly Pathogenic Avian Influenza (HPAI) virus (H5N1) affecting birds and mammals including humans. The first officially announced AI outbreak caused by H5N1 in Bangladesh occurred in 27 March 2007. Since then the virus has spread to 51 out of 64 districts and more than 480 outbreaks have been officially reported and more than two million birds have been culled. The status of AI outbreaks in chickens (Biswas et al., 2008) and its risks in backyard chickens (Biswas et al., 2009) has been reported from Bangladesh. The country's poultry sector is currently worth Tk. 250 billion (US $ 3.5 billion) and AI had cost Tk. 55 billion (US $ 757.9 million) due to outbreaks of AI in 2007. Bangladesh is a high risk country for an

influenza pandemic because of its dense human population, widespread backyard poultry raising and endemic H5N1 infection in poultry. Avian influenza in our country is spread by migratory birds. About 21 species of migratory birds capable of carrying the virus visit the country annually every winter. In addition to chicken, this disease has been recorded in ducks, pigeons and non-migratory wild birds (mostly crows) in Bangladesh. Finally it infects the human and causes influenza like symptoms.

Till now Bangladesh has confirmed 7 human patients (Table 8) affected with avian influenza or bird flu. As Bangladesh is a densely populated country, contamination with avian influenza virus is very simple. But the matter of fortune is that only a few people have been affected with this dangerous virus.

After infected with this virus high fever, aching bones, joints and muscles, bleeding from the nose, blocked nose, chest pain, headache, runny nose, stomach pain, diarrhea etc symptoms have been seen in the human patients.

Table 8 Avian Influenza infected human cases with its affected area in Bangladesh (Source: WHO, 2014)

Onset Date	Age	Area
27 Jan 2008	16-month old boy	Kamalapur, Dhaka division
8 March 2011	1-year-old girl	Kamalapur, Dhaka district, Dhaka division
1 March 2011	2-year-old boy	Dhaka district, Dhaka division
26 Feb 2012	40-year-old man	Dhaka City, Dhaka division
7 March 2012	26-year-old man	Dhaka City, Dhaka division
7 March 2012	18-year-old man	Dhaka City, Dhaka division
11 Feb 2013	2-year-old boy	Chittagong division

Table 9 Prevalence of Avian Influenza in birds in recent years in Bangladesh (Source: OIE, 2019)

Years	Total outbreaks	Susceptible	Cases	Deaths	Destroyed	Slaughtered
2007	28	98226	19284	19284	78942	00
2008	289	1524997	286863	286863	1208400	00
2009	324	1581085	290644	290644	1260707	00
2010	354	1772744	308648	308648	1434362	00
2011	523	2454113	405862	405862	2018517	00
2012	546	2576800	419494	419494	2127572	00
2013	549	2744471	431981	431981	2282756	00
2016	01	-	40	40	-	00

Bangladesh has about 220 million chickens and 37 million ducks, of which 185 million are backyard poultry with minimum bio-security (Biswas et al., 2009). A study from 2007 to 2016 shows highest outbreaks in 2013 having total no. of 549 (Table 9).

2.2.2. Rabies

Rabies is a highly fatal viral infection of the central nervous system which occurs virtually in all warm blooded animals and humans and is transmitted by the bite of affected animals. Dogs, cats, jackals and other wild animals are the carriers of this infection but in Bangladesh most of the rabies cases in both humans and animals are due to dog bites. Rabies virus laden saliva gets enter via bite, scratch or abrasion. Rabid dogs shed virus in saliva 5 to 7 days before showing clinical signs, whereas cat does so for only three days before signs (Bob, 2011). Among the domestic animals, cattle and goats are most commonly affected with rabies in Bangladesh.

Rabies is being considered as a priority zoonosis in Bangladesh. Sporadic incidence occurs in all parts of the country throughout the year. Bangladesh has human population of about 160 million, 22.90 million cattle and 36.90 million goats and prevalence is highest in goat 1.96% (Table 10). A large number of stray dogs compared to lower number of pet dogs in Bangladesh have made rabies infection a more common than elsewhere.

Table 10 Prevalence of rabies in different animal species in Bangladesh

Hosts	No. of population tested	Positive cases	(%)	References
Human	100000	2000	2	Ali et. al., 1982
Dog	100	7	7	
Cattle	2608	43	1.65	Islam et al., 2014
Buffalo	2266	25	1.1	
Sheep	239	03	1.25	
Goat	917	18	1.96	

According to the Bangladesh Government reports, dogs bite nearly 100,000 people and at least 2,000 died of rabies in 2009, the highest per capita rate in the world. The number of deaths in animals is unknown but probably the higher than

the figure for human cases. In 2006, 170 cases of clinically diagnosed rabies were admitted into IDH, Dhaka (Haque et al., 2018). From these, most cases came from the rural areas 152(62%) (Fig. 4).

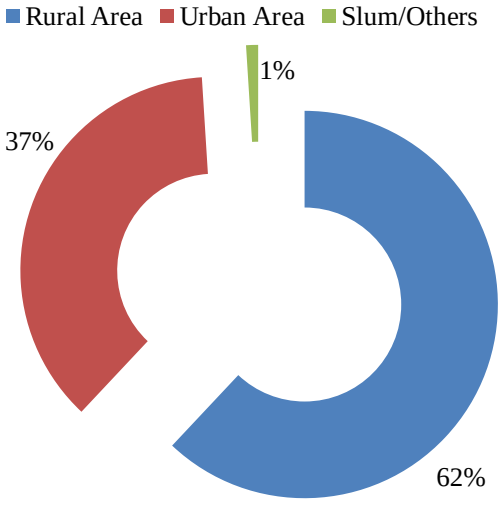

Fig. 4 Proportion of prevalence of rabies in different areas (Source: Haque et al., 2018).

About 52% cases were children under 20 years of age, 28% were in the age group of 20 to 40 years (Fig. 5). Male contribute to about 70% (114/170) of cases in all age groups and female is 30% (Fig. 6). Stray animal and rabid animal contributed 131(77%) & 25(16%) respectively, of which dog was the main animal (Fig. 7). None of the pet animal was vaccinated. Vaccination status of stray animals was not known.

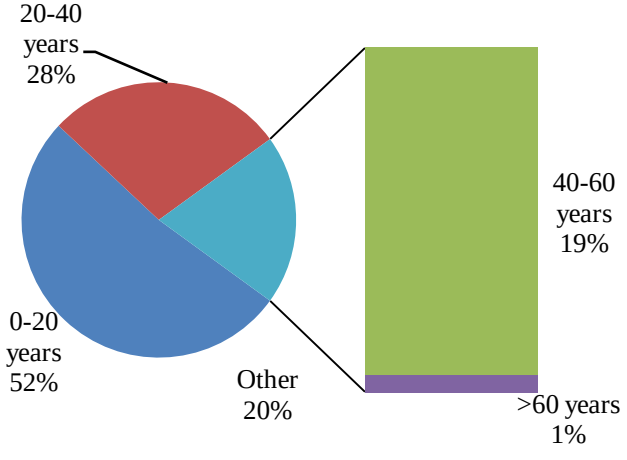

Fig. 5 Prevalence of rabies in human based on age (Source: Haque et al., 2018).

About 92.9% (158/170) of cases gave the history of dog bite, pet animals were involved in only 12(7.1%) cases. The other animals involved were cat 9(5.3%), Jackal 1(0.6%), Mongoose 2 (1.2%). One hundred & forty five (85.3%) persons had bite on limbs. Fourteen (8.2%) & 11 (6.5%) cases had bite on face & or head or neck, and trunk respectively. Only 5 cases had both limb and trunk bite.

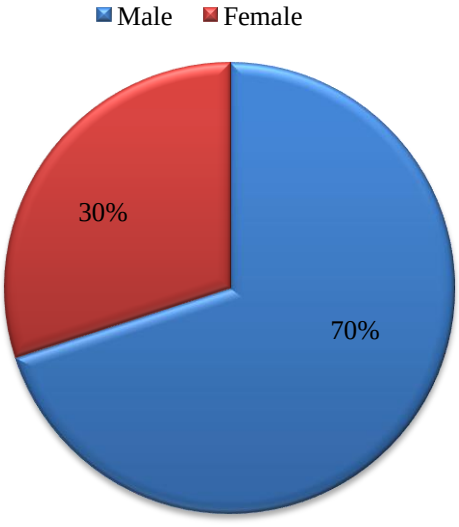

Fig. 6 Prevalence of rabies in human based on sex (Source: Haque et al., 2018).

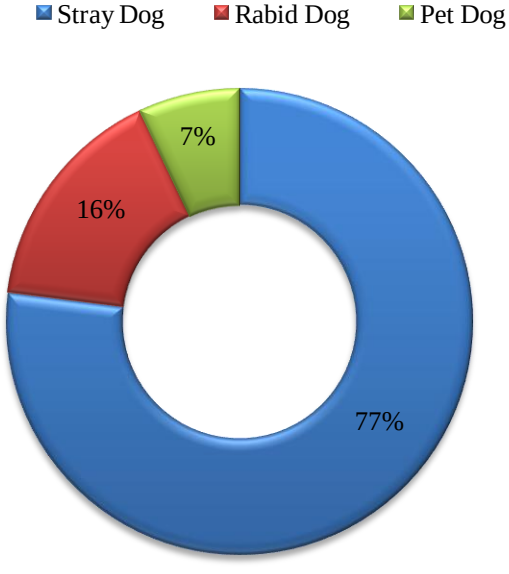

Fig. 7 Comparative study of dog types spreads rabies (Source: Haque et al., 2018).

2.2.3. Nipah Virus Infection

Nipah virus (NiV) infection is an important zoonotic Emerging Infectious Disease (EID) that causes fatal disease in humans, characterized primarily by fever and encephalitis. Nipah virus is a member of the genus *Henipavirus*, a new

class of virus in the family Paramyxoviridae. It usually spreads by bat when it contaminates the date juice, fruits. Human eat these contaminated foods and get infected.

The recurrent outbreaks of NiV infection have been recognized since 2001 in Bangladesh (Gurley et al., 2007; Luby et al., 2009a) and human beings infected with NiV as a result of consuming date palm sap that had been contaminated by infected fruit bats (*Pteropus giganteus*) that lives in Bangladesh and the blood samples of this bats and the neighboring Indian bats have antibodies to NiV infection (Hsu et al., 2004; Harcourt et al., 2005; Luby et al., 2009b).

Accordingly, the Nipah outbreak sites lie within the range of *Pteropus giganteus* species of bats. Apart from pigs and humans, Nipah virus is also prevalent in other domestic animals like horses, goats, sheep, cats and dogs. Since 2001, human outbreaks and clusters of cases have been reported periodically in Bangladesh (Table 11).

Table 11 Morbidity & mortality rate of human due to nipah virus infection in recent years in Bangladesh

Year	Districts	Morbidity	Mortality	Percentage	Reference
2001	Meherpur	13	09	69	Anon, 2005
2003	Naogaon	12	08	67	Anon, 2007
2004	Manikganj, Rajbari, Faridpur	78	41	53	Anon, 2010a
2005	Tangail	12	11	92	Blum et al., 2009
2007	Thakurgaon, Kushtia	15	08	53	Hosain et al., 2008
2008	Manikganj, Rajbari, Shatkira and Jessore	11	09	82	Luby et al., 2009a
2010	Faridpur	08	07	88	Montgomery et al., 2011
2011	Lalmonirhat	45	38	84	Wahed et al., 2011
2012	Joypurhat, Rajshahi, Natore, Rajbari and Gopalganj	12	10	83	WHO, 2005
2013	Manikganj, Nilphamari, Mymensingh, Pabna	24	21	88	IEDCR, 2013
2014	Faridpur, Rangpur, Magura, Naugaon	27	14	52	IEDCR, 2014
2015	Faridpur, Naugaon, Panchaghor	09	06	67	IEDCR, 2015

2.2.4. Others Viral Diseases:

There has been no evidence of Ebola virus in Bangladesh (The Daily Star, March 08, 2015). Bangladesh confirmed on Tuesday its first case of the Zika virus in an old sample of blood on Mar 22, 2016 (The Reuters, 2016).

2.3. Protozoal Diseases

The prevalence of zoonotic protozoan diseases recorded in humans in Bangladesh include amebiasis (*E. histolytica*), giardiasis (21% in children & 51% in malnourished children), cryptosporidiasis in diarrheic patients) and visceral leishmaniasis (kala-azar) (Table 12).

Table 12 Major Protozoal Zoonotic Diseases in Bangladesh

Diseases	Host	No. of population tested	Positives	Percentage (%)	Reference
Amoebiasis	Children	289	231	80	Haque et al., 1997
Balantidiasis	Cattle	1108	19	1.71	Haque et al., 1999
Cryptosporidiasis	Calves	208	29	14	Rahman et al., 2010
	Humans*	165	14	8.48	Rahman et al., 1990
Giardiasis	Humans	2534	322	12.71	Haque et al., 2007
Leishmaniasis	Humans	131480	2986	2.27	Bern et al., 2005
	Cattle	399	66	16.54	Samad et al., 1993
	Sheep	117	33	28.21	Samad et al., 1997
	Goat	415	49	11.81	Samad et al., 1997
Toxoplasmosis	Pregnant Woman	447	186	41.61	Samad et al., 1999
	Cat	24	08	33.33	Samad et al., 1999

2.4. Parasitic Diseases

The major zoonotic parasites recorded in cats in Bangladesh include *Paragonimus westermani* (9.09%), *Dirofilaria immitis* (9.09%), in dogs include *Diphyllobothrium latum* (13.3%), *Diphylidium caninum* (16.69%), *Echinococcus granulosus* (9.17%), *Ancylostomum caninum* (9-100%). Prevalence of nematode parasites in humans and animals have been reported from Bangladesh (Samad, 2000), but dogs and cats are the main reservoirs of the zoonotic nematodes for humans (Table 13).

Table 13 Major Parasitic Zoonotic Diseases in Bangladesh (Source: Samad et al., 2011)

Family of parasites	Species of parasites	Host	No. (+ve)	No. tested	Percentage (%)
Trematodes	*Paragonimus westermani*	Cat	02	22	9.09
Cestodes	*Diphyllobothrium latum*		08	60	13.3
	Diphylidium caninum	Dog	10	60	16.67
	Echinococcus granulosus		11	120	9.17
Nematodes	*Ancylostoma caninum*	Dog	60	60	100
	A. tubaeforme		08	22	36.36
	Dirofilaria immitis	Cat	02	22	9.09
	Toxocara cati		10	22	45.45
	Toxocara canis	Dog	14	60	23.33
	Trichuris vulpis		08	60	13.8

2.5. Fungal Diseases

The dermatomycosis is the major zoonoses in Bangladesh. Dermatomycosis (ringworm) is a zoonotic disease distributed worldwide and caused by fungi of three genera (Microsporum, Trichophyton and Epidermophyton), belonging to the group referred to as dermatophytes (Fig. 8). It has been reported in 9.3% cattle, 18.6% goats and 25.2% in contact humans.

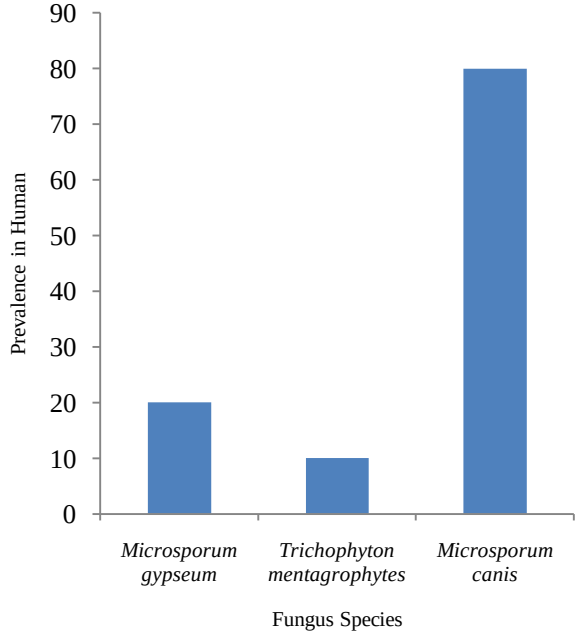

Fig. 8 Prevalence of different fungal species in human (Source: Samad, 2011).

2.6. Prevention and Control of Zoonoses

The phases for adequate VPH action, as devised by WHO experts (Bogel et al., 1990) and tested by specific practical measures in different situations, have been identified. The following operational policies have been recognized as suitable, effective methods of zoonoses control:

- Surveillance
- Control in animals
- Control of infective media
- Prevention in man
- One health

The "One Health" concept was introduced at the beginning of the 2000s (Fig. 9). In a few words, it is summarized an idea that had been known for more than a century; that human health and animal health are interdependent and bound to the health of the ecosystems in which they exist (OIE, 2019).

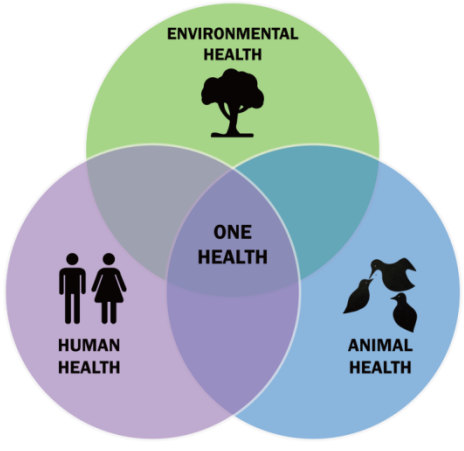

Fig. 9 "One Health" concept to prevent zoonotic diseases (Source: Wikipedia).

This Strategic Framework provides the platform for initiatives for prevention, early warning and control emerging, re-emerging and high impact infectious diseases at the human–animal–ecosystem interface in Bangladesh. It also outlines the mechanism whereby diseases will be prioritized for action, but does not identify which diseases should be included in activities. Although this document focuses on infectious diseases, there is also a need to develop a framework to include issues that relate to human health and sustainable agriculture. Once this is developed and in place the potential of joining the two programme areas under the same institutional arrangements must be explored. A successful and sustainable One Health approach in Bangladesh will require:

- Improving health outcomes for the people, animals and environment of Bangladesh.
- Recognizing the interplay between factors related to people, animals and the environment in determining disease outcomes.
- Applying a multi-disciplinary focus on prediction, prevention and response to disease.
- Promoting multi-sectoral collaboration and communication to engage partners and stakeholders, including communities.
- Emphasizing equitable partnerships and recognition of the individuals, institutions and civil societies engaged.
- Focusing on the importance of establishing the necessary institutional mechanisms to effectively deliver the outputs.
- Incorporating processes to correct capacity deficits for collaborating partners.
- Recognizing that achieving success depends on long-term engagement and commitment.
- A framework that is adaptive and responsive to change.

3. CONCLUSION

Prevalence of zoonotic diseases is much higher in Bangladesh as a great portion of people are largely dependent on livestock. The major bacterial zoonoses are anthrax, tuberculosis, brucellosis, collibacilosis, campylobacteriosis where anthrax is most devastating both in human and animals. Rabies, avian influenza, nipah, rotavirus are most important viral zoonotic diseases but rabies and nipah are more dangerous having highest morbidity and mortality rate. Also there are some others protozoal, fungal and parasitic zoonotic diseases are present in Bangladesh. The impacts of zoonotic diseases are mostly prominent among the people who are associated with livestock and other wild animals though others peoples are also sufferer. Peoples are infected from animals which are the natural reservoirs of diseases and develop different fatal diseases like cutaneous anthrax, rabies, nipah virus infection, tuberculosis, orchitis, diarrhea, skin diseases etc. Prevention and control of zoonoses can be enhanced by the combined action of both public health and veterinary public health department which is said "One Health" approach.

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