Chapter 1: Introduction

Over the last two decades, the poultry industry has become a distinctive sub-sector for promoting agricultural growth by contributing to the cheaper animal proteins to reduce the malnutrition of the people of Bangladesh (Rahman et al., 2017).

20-22% of the total animal protein comes from the poultry (Hamid et al., 2017). This sector generates a career with a quick profit for the new entrepreneur having low capital (Shamsuddoha and Sohel, 2004). According to the United States Department of Agriculture (USDA), March 20 report 2019, one million entrepreneurs and eight million people involved in the Bangladeshi poultry sector commercially attain 10.2 billion eggs and 1.5 million poultry meat annually (USDA, 2019). By following the estimation, by 2021, the country's requirement is 17 billion eggs, 2 million tons of poultry meat, 85.8 million day-old-chicks (USDA, 2019). In a year, with a 15% increased rate of poultry farming, 70,000 are constructed, in which 16 grandparent farms, 206 breeder farms, and most of the left are small scale farms carrying 500-2500 birds (One Health Poultry Hub Project, 2020, M.A. Hoque, Personal communication, CVASU). The current farm statistics in Kishoreganj District are 2,000 broiler farms, 500 Sonali farms and 2000 layer farms (Regional Manager, New Hope Feed Mill Bangladesh Ltd., Personal communication 2020).

This promising poultry sector is being challenged by many constrains such as different diseases (Akidarju, 2010), poor bio-security and poor nutrition (Wong et al., 2017). The commonly reported poultry diseases in Bangladesh are infectious bursal disease, salmonellosis, Newcastle disease, avian influenza, infectious bronchitis, coccidiosis, colibacillosis, visceral gout and fowl cholera (Al Mamun et al., 2019; Hasan et al., 2017; Talukdar et al., 2017; Islam and Samad et al., 2004; Islam et al., 2003).

The aforementioned diseases reduce production potential, cause huge mortality and thus cause economic loss of poultry farmers in Bangladesh, for example classical strain IBD virus causes 10 to 50% , but vvIBD virus can cause 50 to 100% mortality (Dey et al., 2019), likewise ND causes up to 100% (Sedeik et al., 2019); similarly colibacillosis and salmonellosis can cause 0.26 to 1.7% mortality (Vandekerchove et

al., 2004) and visceral gout 3-6% (Ghodasara et al., 2015). Poultry diseases like colibacillosis, salmonellosis, campylobacteriosis and avian influenza pose serious public health threat (Hermans et al., 2012; Dale and Brown, 2013; Swayne and King, 2013; Javed et al., 2017; Nga et al., 2019).

Poor farm hygiene, bio-security and poor vaccine coverage along with bird level factors (age, weight, production type etc.) are important factors associated with the occurrences of poultry diseases (Feighner and Dashkevicz, 1987; Julian, 2005; Permin and Bisgaard, 2013; Apopo et al., 2020).

In Bangladesh poultry farmers are heavily biased towards the usage of antibiotics to manage different poultry diseases in the lieu of improving farm hygiene and bio-security standard and the full coverage of vaccine (Masud et al., 2020). Antibiotics are used as prophylaxis and growth promoter (Shivagami et al., 2020). Therefore, antibiotics are indiscriminately used without consultation of registered veterinarians which lead antibiotics to become resistant against different bacterial pathogens (Oluwasile et al. 2014). Maintaining drug withdrawal period is rarely practiced and therefore there is chance of transmitting antibiotic residues to humans through consumption of poultry meat and eggs which in turn lead organisms to develop resistance (Anon, 2018).

In Bangladesh the surveillance programme through government veterinary hospitals on poultry diseases is poorly structured and therefore it is difficult to get true picture of common poultry diseases in the country. Hence, the present small study reflects the occurrence of common poultry diseases in KishoreganjSadarupazilla along with the surrounding areas.

Based on the aforementioned background the present study was therefore conducted with the following objectives: i) to estimate the prevalence common poultry diseases and disease conditions in Kishoreganj by using the cases presented at the Kishoreganj District Veterinary Hospital, ii) to know the distribution more prevalent diseases or disease conditions in poultry in Kishorganj, iii) to describe observable clinical signs and post-mortem lesions and histopathological findings of the selected

diseases or disease conditions in poultry and iv) to describe the pattern of antibiotic prescription against the selected poultry diseases and disease conditions.

Chapter 2: Materials and methods

The study was carried out at Kishoreganj District Veterinary Hospital (KDVH) which is one of the most eminent veterinary establishments for poultry cases in Bangladesh. The district Veterinary hospital was well equipped with one operation theater, a postmortem room, and laboratory facilities e.g., coproscopy, available laboratory reagents like formalin, potash, boric powder. The hospital service was facilitated by one district livestock officer, one additional district livestock officer, one veterinary surgeon and one veterinary field assistant. Having hands-on training on different poultry cases as a part of the internship is usually very satisfactory. The internship duration at this placement was 34 days, starting from October to November, 2019.

During the study period a total of 719 poultry cases in different types, averaging 21 cases per day were presented at the hospital. Of 719 cases 600 cases were chickens; however, 552 chicken cases were used for this clinical report, as 48 cases were repeated cases considering as follow up cases. Distribution of the study cases was 182 broiler exotic birds, 118 Sonali birds, and 252 layer exotic poultry.

There are 13 Upazillas (sub-districts) in Kishoreganj District (Figure 2.1, with case distribution). There are around 2000 broiler farms, 500 sonali farms and 2000 layer farms in Kishoreganj district (Veterinary Surgeon of the District Veterinary Hospital, Kishoreganj, Personal Communication, 2020). Either sick birds or dead bird cases were presented at the hospital from all parts of Kishoreganj for clinical diagnosis, treatment, and advice. The ratio of bringing dead birds was higher.

A wide range of diseases and disease conditions was investigated but particular focus was given on visceral gout (broiler), IBD, and coccidiosis (Sonali) and salmonellosis (layer) for this study. Cases were tentatively diagnosed based on clinico-epidemiological history, signs, and post-mortem lesions specific to poultry diseases or disease conditions by experienced and registered veterinarians. Salient clinical signs and lesions were considered for the diagnosis of each case.

A structured record keeping sheet was used to record the required data through farmer's interview, physical inspection and post-mortem. Data included farmers' address, education and experience, poultry species, production type (broiler/layer/sonali), farm size, floor type, age of the bird, clinical history, clinical signs, morbidity and mortality, observable post-mortem findings, tentative diagnosis and prescribed drugs. Post-mortem of each bird was done by the assigned veterinary surgeon or by the working intern student with the supervision of the veterinary surgeon as per the standard procedure or protocol maintaining personal protection (Majò and Dolz, 2011). Images of PM lesions of different cases are presented in **appendix 1**.

Before performing post-mortem, the birds were examined systematically and all the gross lesions were listed carefully. Some representative organs were collected for conducting histology, for example, liver from salmonella suspected cases, bursa of fabricius from IBD suspected cases. However, the histology result is only given in the **appendix 2**. Carcasses were then discarded into the convenient dumping pit. The collected samples for histology were preserved in Bouin's solution in the plastic container and brought back to CVASU pathology laboratory for further processing.

All the data were entered into the spreadsheet of Microsoft Excel 2010. Data were then coded and re-coded in MS excel 2010. Data integrity and consistency were checked before exporting to STATA 13 *(Stata Crop, 4905, Lakeway Drive, College Station, Texas 77845, USA)*for statistical analysis.

Proportionate prevalence was calculated by the number of specific cases divided by the total number of cases according to the poultry production types (broiler/sonali/layer) and other recorded factors (age of the sick or dead birds, flock size, floor type, education and experience of farmers and location of the farm). Descriptive statistics were also performed on data of antibiotics prescribed for the poultry cases, for example, frequency of use of access/watch/reserve in the broiler (visceral gout), Sonali (infectious bursal disease and coccidiosis) and layer (salmonellosis).

Fisher's exact test was applied to assess the difference of proportion of each case type (for example, visceral gout, yes/no) between or among categories of each factor under the study. The categories of factors were as follows: location, flock size (600-1050/1051-9000, broiler, 750-2000/2001-9000, sonali, 201-1200/1200-5500, layer), age (3-13/14-25/26-55, broiler, 2-16/17-40/41-56, sonali, 2-180/181-350/351-672, layer), floor type (Earthen/Paved for all type), farmers' education (Primary/Secondary/Higher for all type) and experience (0-2 year/2.5-12, broiler, 1-2/2.5-5, sonali, 0-2.5/2.6-5.5/5.6-14, layer) and location of the farm. The results were expressed as frequency number, percentage, and p-value (0.05 or less as significant).

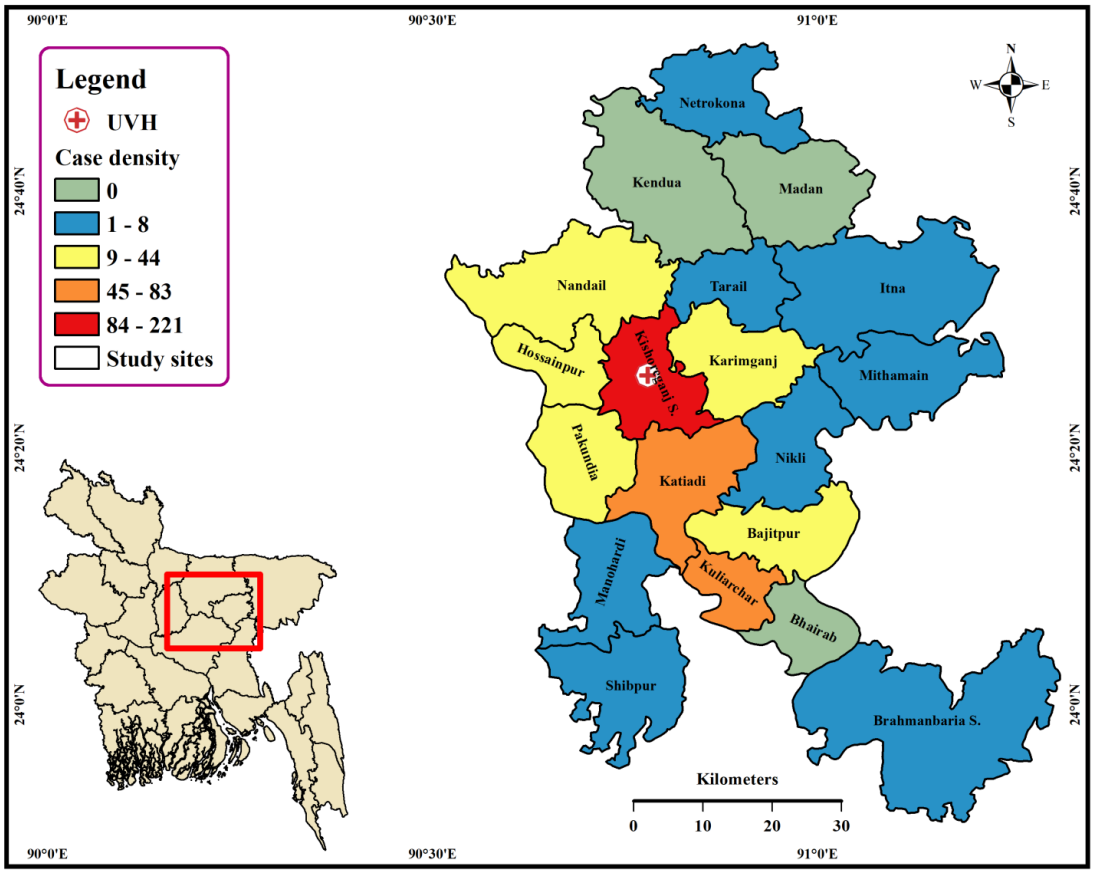

Figure 2.1: Map showing the case distribution presented in Kishoreganj District Veterinary Hospital

Chapter 3: Results

3.1. Distribution of poultry cases by group of diseases or disease conditions

Commonly occurring poultry cases were visceral gout (42.4%) in broiler, coccidiosis (49.2%) and infectious bursal disease (39%) in Sonali and salmonellosis (18.3%) in layer (Table 3.1)

Table 3.1: Distribution of different diseases and disease conditions in commercial poultry (N=182 broiler, 118 Sonali and 252 layer cases) in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Group	**Disease or disease conditions**	**Broiler, n(%)**	**Sonali, n(%)**	**Layer, n (%)**
Viral	Infectious bursal disease	46 (25.3)	**46 (39.0)**	9 (3.6)
	Newcastle disease	3 (1.7)	6 (5.1)	49 (19.4)
	Avian influenza	2 (1.1)	1 (0.9)	5 (1.98)
	Chicken infectious anemia	2 (1.1)		3 (1.2)
	Avian leucosis			2 (0.8)
	Infectious bronchitis			2 (0.8)
	Marek's disease			1 (0.4)
Bacterial	Complex respiratory disease	41 (22.5)	7 (6.0)	23 (9.1)
	Colibacillosis	28 (15.4)	16 (13.6)	61(24.2)
	Salmonellosis	12 (6.6)	9 (7.6)	**46(18.3)**
	Fowl cholera	1 (0.6)	1 (0.9)	11(4.4)
	Infectious coryza		1 (0.9)	4(1.6)
	Necrotic enteritis			3(1.2)
	Tuberculosis			1(0.4)
Others	Visceral gout	**77 (42.4)**	9 (7.6)	4(1.6)
	Coccidiosis	18 (10.0)	**58 (49.2)**	15(6.0)
	Management problem*	2 (1.1)	2 (1.7)	1(0.4)
	Heat stress	2 (1.1)		24(9.5)
	Aspergillosis	1 (0.6)		
	Giardiasis	1(0.6)		
	Ascites	1(0.6)		

	Common cold		2 (1.7)	
	Nutritional disease**			3 (1.1)
	Aflatoxicosis			2 (0.8)
	Low egg production			20 (8.0)

***Lighting problem, Brooder pneumonia; **Vit B1 & B2 deficiency, Ca deficiency, Fatty liver syndrome*

3.2. Spatial distribution of poultry cases of visceral gout, infectious bursal disease, coccidiosis and salmonellosis

Visceral gout in broiler, infectious bursal disease and coccidiosis in Sonali and salmonellosis in layer were frequently recorded cases that were originated from KishoreganjSadar followed by Katiadi and Nandail (Figures 3.1-3.4).

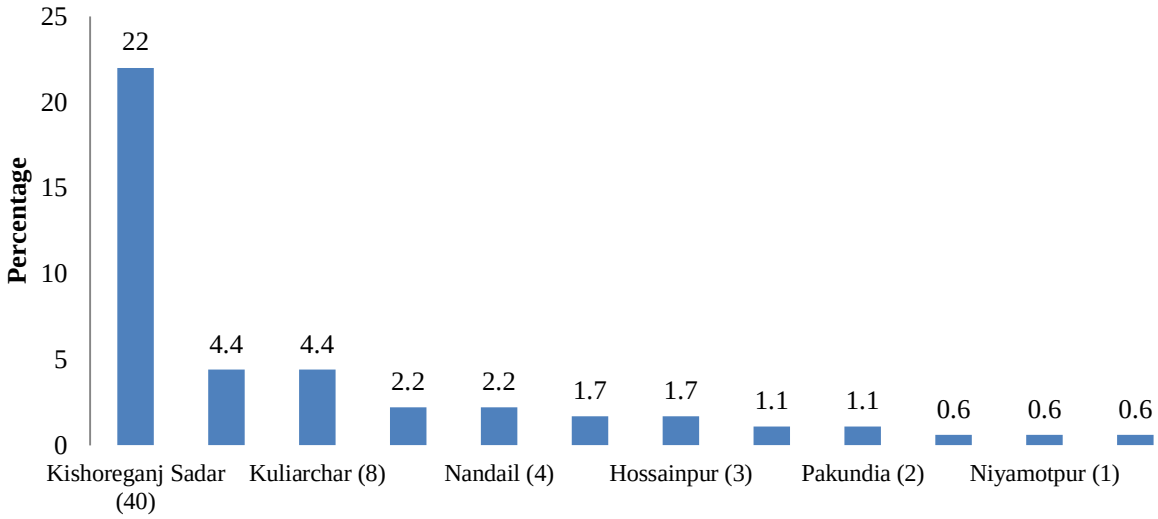

Figure 3.1: Spatial distribution of visceral gout (N=77 broiler cases) in commercial broiler poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

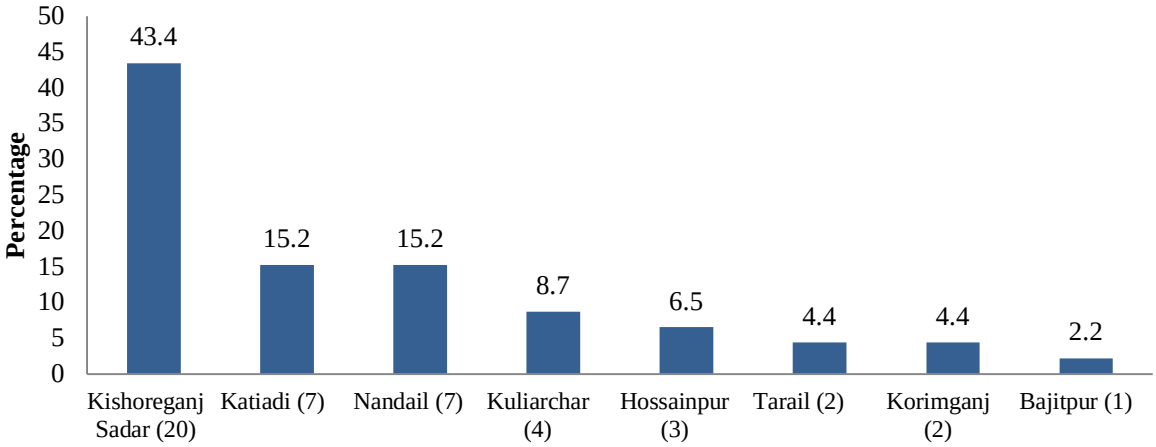

Figure 3.2: Spatial distribution of infectious bursal disease (N=46 Sonali cases) in commercial Sonali poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

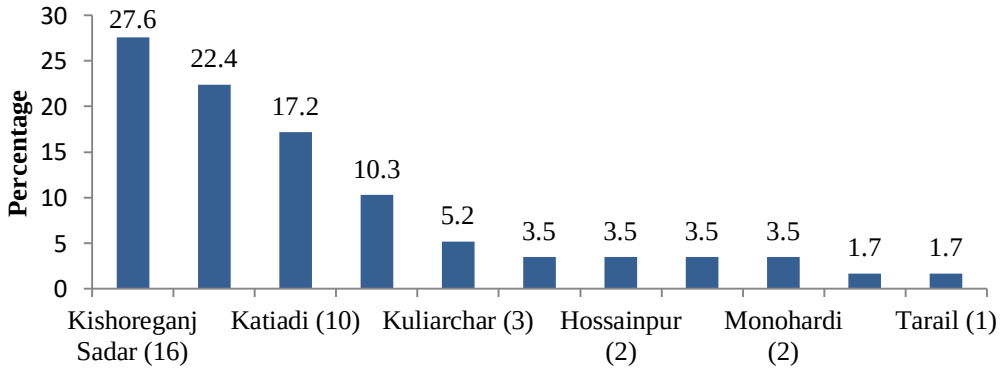

Figure 3.3: Spatial distribution of coccidiosis (N= 58 Sonali cases) in commercial Sonali poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

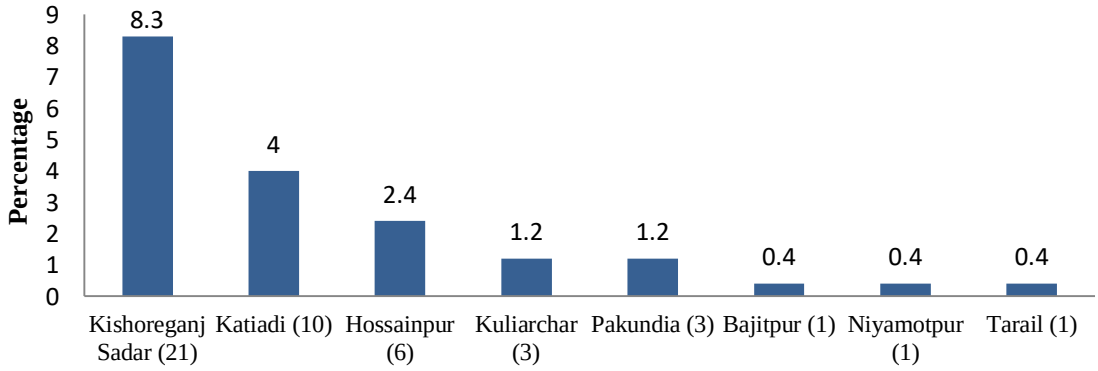

Figure 3.4: Spatial distribution of salmonellosis (N= 46 layer cases) in commercial layer poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

3.3. Distribution of the selected types of poultry cases by factors

The proportionate prevalence of visceral gout (broiler) was higher at the age of 3-13days (55.6%), being in 600-1050 flock size (46.5%) and rearing in paved floor (46.4%) while the proportionate prevalence of infectious bursal disease (Sonali) was higher at the age of 17-40 days of age, being in 2001-9000 flock size (39.5%) and rearing in paved floor (40%) (Table 3.2). In addition, the proportionate prevalence of coccidiosis (Sonali) was higher at the age of 17-40 days of age, being in 2001-9000 flock size (53.5%) and rearing in paved floor (57.6%) while the proportionate prevalence of salmonellosis (layer) was higher at the age of 351-672 days (24.5%), being in 1201-5500 flock size (17.2%) and rearing in paved floor (20%) (Table 3.3).

Table3.2: Distribution of visceral gout (N=77 broiler cases) and infectious bursal disease (N= 46 Sonali cases) by different factors in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Factors	**Broiler: Visceral gout**			**Sonali: Infectious bursal disease**		
	Categories	**+ (%)**	***p***	**Categories**	**+ (%)**	***p***
Age (days)	3-13	40 (55.6)	0.001	2-16	7 (22.0)	0.02
	14-25	37 (41.6)		17-40	36 (52.2)	
	26-55	0 (0)		41-56	3 (17.7)	
Flock size	600-1050	40 (46.5)	0.2	750-2000	29 (38.7)	1.0
	1051-9000	37 (38.5)		2001-9000	17(39.5)	
Floor type	Earthen floor	52 (41.4)	0.5	Earthen floor	33 (38.8)	1.0
	Paved floor	26 (46.4)		Paved floor	13 (40.0)	
Education	Primary	37 (41.6)	1.0	Primary	22 (43.1)	0.4
	Secondary	25 (44.0)		Secondary	15 (41.7)	
	Higher	15 (41.7)		Higher	9 (29.0)	
Experience (years)	0-2.0	52 (43.3)	0.7	1-2	36 (38.7)	1.0
	2.5-12	25 (40.3)		2.5-5	10 (40.0)	

Table3.3: Distribution of coccidiosis (N=58 Sonali cases) and salmonellosis (N=46 layer cases) by different factors in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Factors	**Sonali: Coccidiosis**			**Layer: Salmonellosis**		
	Categories	**+ (%)**	***p***	**Categories**	**+ (%)**	***p***
Age (days)	2-16	12 (37.5)	0.2	2-180	14 (16.3)	0.4
	17-40	38 (55.1)		181-350	19 (16.8)	
	41-56	8 (47.1)		351-672	13 (24.5)	
Flock size	750-2000	35 (46.7)	0.5	201-1200	29 (19.0)	0.7
	2001-9000	23 (53.5)		1201-5500	17 (17.2)	
Floor type	Earthen floor	39 (46.0)	0.3	Earthen floor	25 (17.0)	0.6
	Paved floor	19 (57.6)		Paved floor	21(20.0)	
Education	Primary	28 (55.0)		Primary	11 (15.1)	0.7
	Secondary	18 (50)	0.3	Secondary	14 (9.4)	
	Higher	12 (38.7)		Higher	21 (19.6)	
Experience (years)	1-2	44 (47.3)	0.5	0-2.5	14 (17.1)	0.9
	2.5-5	14 (56.0)		2.6-5.5	20 (20)	
				5.6-14	12 (19.7)	

3.4. Frequency distribution of reported or observable clinical signs of the selected types of poultry cases

Huge mortality (88.3% and 67.4%) and dull and depressed (11.7% and 80.4%) were commonly reported signs for the cases of visceral gout in broiler poultry and infectious bursal disease in Sonali, respectively (Tables 3.4 and 3.5). Huge mortality (24.1%) and bloody diarrhoea (74.1%) were more frequent signs for the cases of coccidiosis in Sonali (Table 3.5), whereas huge mortality (34.8%) and decreased egg production (43.5%) were commonly reported signs for the cases of salmonellosis in layer poultry (Table 3.6).

Table 3.4: Distribution of different clinical signs observed in Visceral Gout (N=77 broiler cases) in commercial broiler poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Broiler: Visceral gout		
Signs	**Frequency**	**%**
Huge mortality report	68	88.3
Dull and depressed	9	11.7
Decreased growth	3	4.0
Coughing	2	2.6
Bloody diarrhoea	2	2.6
Decreased feed intake	1	1.3
Dyspnoea	1	1.3
Water coming out from mouth	1	1.3
Curled toe	1	1.3

Table 3.5: Distribution of different clinical signs observed in infectious bursal disease (N=46 Sonali cases) and coccidiosis (N=58 Sonali cases) in commercial Sonali poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Sonali: Infectious bursal disease			**Sonali: Coccidiosis**		
Signs	**Frequency**	**%**	**Signs**	**Frequency**	**%**
Dull and depressed	37	80.4	Bloody diarrhoea	43	74.1
Huge mortality report	31	67.4	Huge mortality	14	24.1
Bloody diarrhoea	10	21.7	Dull and depressed	10	17.2
Decreased feed and water intake	4	8.7	Decreased feed intake and growth	3	5.2
Chalky watery diarrhoea	2	4.4	Coughing	2	3.5
Greenish diarrhea	1	2.2	Chalky watery diarrhea	1	1.7
Coughing	1	2.2	Watery discharge from mouth	1	1.7

Table 3.6: Distribution of different clinical signs observed in salmonellosis (N= 46 cases layer) in commercial layer poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Layer: Salmonellosis		
Signs	**Frequency**	**%**
Decreased egg production	20	43.5
Huge mortality report	16	34.8
Decreased feed intake	12	26.1
Decreased body weight	3	6.5
Chalky watery diarrhoea	3	6.5
Dull and depressed	2	4.4
Dyspnoea and coughing	2	4.4
Cannibalism	1	2.2

3.5. Frequency distribution of lesions of the selected typepoultry cases

Uric acid deposition was most commonly observed in the visceral organs (98.7%) in the cases of visceral gout in broiler poultry (Table 3.7).

Swollen bursa (93.5%) followed by pus in bursa (71.7%) and haemorrhagic bursa (58.7%), junction of proventriculus and gizzard (50%) were commonly registered lesions in the caes of infectious bursal disease cases in Sonali (Table 3.8), whereas clotted blood in ceca (86.2%) was frequently observed in the case of coccidiosis in Sonali poultry (Table 3.8).

Fragile liver (71.7%), perihepatitis (26.1%), pericarditis (24%) and cystic ova (17.6%) were regular lesions in the cases of salmonellosis in layer poultry (Table 3.9).

Table 3.7: Distribution of different post mortem lesions observed in visceral gout (N=77 broiler cases) in commercial broiler poultry in Kishoreganj, Bangladesh ((13 October to 27 November, 2019)

Broiler: Visceral gout		
Lesions	**Frequency**	**%**
Uric acid deposition in visceral organs	77	98.7
Congested and fibrosed lungs	11	14.1
Swollen kidney	11	14.1
Swollen bursa	8	10.3
Pericarditis and perihepatitis	7	9.0
Liver damage and enteritis	5	6.5

Pus and haemorrhage in bursa	4	5.2
Clotted blood in ceca	2	2.6
Haemorrhage in the junction of proventriculus and gizzard, abdominal fat, abdominal mucosa and shank	2	2.6

Table 3.8: Distribution of different post mortem lesions observed in infectious bursal disease (N=46 Sonali cases) and Coccidiosis (N=58 Sonali cases) in commercial Sonali poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Sonali: Infectious bursal disease			**Sonali: Coccidiosis**		
Lesions	**Frequency**	**%**	**Lesions**	**Frequency**	**%**
Swollen bursa	43	93.5	Clotted blood in ceca	50	86.2
Pus in bursa	33	71.7	Pus in swollen bursa	21	36.2
Pinpoint haemorrhage in bursa	27	58.7	Pinpoint haemorrhage in bursa and haemorrhage in the junction of proventriculus and gizzard	8	13.8
Haemorrhage at the junction of proventriculus and gizzard	23	50.0	Pericarditis and perihepatitis	4	7.0
Clotted blood in ceca	11	24.0	Damaged bronze colored liver	4	7.0
Swollen kidney	8	17.4	Congested lungs	2	3.5
Ecchymotichae morrhage in thigh muscle and pectoral muscle	5	11.0	Omphalitis	2	3.5
Colienteritis, Congested lungs and damaged liver	4	8.8	Pericarditis	2	3.5

Haemorrhage in the fat of the visceral organs and in the tip of the proventricular glands	1	2.2	Caseous mass in ceca and Uric acid deposition in viscera	2	3.5
Pericarditis and Perihepatitis	1	2.2	Swollen kidney	1	1.7
Caseous mass in viscera	1	2.2	Swollen periorbital sinus	1	1.7
Uric acid deposition in viscera	1	2.2	Colienteritis	1	1.7

Table 3.9: Distribution of post mortem lesions observed in salmonellosis (N= 46 layer cases) in commercial layer poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Layer: Salmonellosis		
Lesions	**Frequency**	**%**
Fragile liver	33	71.7
Perihepatitis	12	26.1
Pericarditis	11	24.0
Cystic ova	8	17.6
Bronze colored liver	7	15.2
Egg peritonitis	4	8.7
Enlarged liver	3	6.5
Omphalitis	3	6.5
Unabsorbed yolk sac	3	6.5
Misshapen ova	2	4.4
Congested lungs	2	4.4
Typhilitis	2	4.4
Cloudy peritoneum	2	4.4
Presence of caseous mass	2	4.4
Fibrosed lungs	1	2.2
Greenish feces	1	2.2
Haemorrhage in coronary fat	1	2.2

3.6. Antibiotic prescription pattern against the selected types of poultry cases

Antibiotics belonging to the watch group (according to WHO) were mostly prescribed against the cases of visceral gout (88.3%) in broiler, in the cases of infectious bursal disease (67.4%) and coccidiosis (67.2%) in Sonali and salmonellosis (56.5%) in layer (Tables 3.10-3.11).

Table 3.10: Distribution of antibiotics used against visceral Gout (N= 77 broiler cases) and infectious bursal disease (N=46 Sonali cases) by frequency in commercial poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

	Broiler: Visceral gout			**Sonali: Infectious bursal disease**		
Antibiotics prescribed	**Access, n(%)**	**Watch, n(%)**	**Reserve, n(%)**	**Access, n(%)**	**Watch, n(%)**	**Reserve, n(%)**
Single	9(11.7)	68(88.3)	4(5.2)	5(11.0)	31(67.4)	3(6.5)
Double	3(4.0)	4(5.2)	0	7(15.2)	9(19.6)	0
Multiple	50(65.0)	0	0	6(13.0)	0	0
None	15(99.5)	5(6.5)	73(94.8)	28(61.0)	6(13.0)	43(93.5)

Table 3.11: Distribution of antibiotics used against coccidiosis (N=58 Sonali cases) and salmonellosis (N= 46 layer cases) by frequency in commercial poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Antibiotics prescribed	**Sonali: Coccidiosis**			**Layer: Salmonellosis**		
	Access, n(%)	**Watch, n(%)**	**Reserve, n(%)**	**Access, n(%)**	**Watch, n(%)**	**Reserve, n(%)**
Single	6(10.3)	39(67.2)	3(5.2)	14(30.4)	26(56.5)	4(8.7)
Double	8(13.8)	9(15.5)	0	5(11.0)	6(13.0)	0
Multiple	16(27.6)	0	0	14(30.4)	0	0
None	28(48.3)	10(17.2)	55(94.8)	13(28.3)	14(30.4)	42(91.3)

Doxycycline (72.7%), Tylosin (66.2%) and combination of sulphachloropyridazine and trimethoprim (65%) were more frequently prescribed drugs for the cases of visceral gout in broiler poultry, whereas ciprofloxacin (84.8%) and pefloxacin (41.3%) for the cases of infectious bursal disease and ciprofloxacin (58.6%) and erythromycin (20.7%) for the cases of coccidiosis in Sonali poultry. And in layer

tiamulin (6.4%), Sulphachloropyridazine and trimethoprim (5.2%) and enrofloxacin for the cases of salmonellosis (5.2%) (Tables 3.12-3.14).

Table 3.12: Distribution of different types of antibiotics in visceral gout (N=77 broiler cases) in commercial broiler poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Antibiotic types	**Frequency**	**%**
Doxycycline	56	72.7
Tylosin	51	66.2
Sulphachloropyridazine and Trimethoprim	50	65.0
Ciprofloxacin	18	23.4
Sulphadiazine and Trimethoprim	4	5.2
Neomycin	4	5.2
Colistin and Trimethoprim	3	4.0
Oxytetracycline	3	4.0
Tetracycline	3	4.0
Erythromycin	3	4.0
Amikacin	2	2.6
Enrofloxacin	1	1.3
Colistin	1	1.3

Table 3.13: Distribution of different types of antibiotics in infectious bursal disease (N=46 Sonali cases) and coccidiosis (N=58 Sonali cases) in commercial Sonali poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Sonali: Infectious Bursal Disease			**Sonali: Coccidiosis**		
Antibiotic types	**Frequency**	**%**	**Antibiotic types**	**Frequency**	**%**
Ciprofloxacin	39	84.8	Ciprofloxacin	34	58.6
Pefloxacin	19	41.3	Erythromycin	12	20.7
Neomycin	6	13.0	Sulphadiazine and Trimethoprim	12	20.7
Doxycycline	3	6.5	Doxycycline	6	10.3
Colistin	3	6.5	Moxifloxacin	5	8.6
Moxifloxacin	2	4.4	Enrofloxacin	3	5.2

Erythromycin	2	4.4	Neomycin	3	5.2
Tylosin	2	4.4	Colistin	3	5.2
Oxytetracycline	2	4.4	Tylosin	3	5.2
Sulphadiazine and Trimethoprim	2	4.4	Oxytetracycline	3	5.2
Amoxicillin	1	2.2	Pefloxacin	2	3.5
Enrofloxacin	1	2.2	Sulphachloropyridazine and Trimethoprim	1	1.7
Tetracycline	1	2.2			
Sulphachloropyridazine and Trimethoprim	1	2.2			
Metronidazole	1	2.2			

Table 3.14: Distribution of different types of antibiotics in salmonellosis (N= 46 layer cases) in commercial layer poultry in Kishoreganj, Bangladesh (13 October to 27 November, 2019)

Antibiotic types	**Frequency**	**%**
Tiamulin	16	6.4
Sulphadiazine and Trimethoprim	13	5.2
Enrofloxacin	13	5.2
Chlortetracycline	12	4.8
Florfenicol	9	3.6
Erythromycin	8	3.2
Doxycycline	6	2.4
Amoxycillin	5	2.0
Moxifloxacin	5	2.0
Colistin	3	1.2
Colistin and Trimethoprim	2	0.8
Tetracycline	2	0.8
Oxytetracycline	1	0.4
Tylosin	1	0.4

Chapter 4: Discussion

Primarily the analysis dealt with almost all of the widespread diseases and disease conditions of poultry (25 different types among ~552 cases) recorded during 2-month internship period at Kishoreganj District Veterinary Hospital, Bangladesh. For the detailed investigation, cases were grouped by production type namely broiler, Sonali and layer. 7 viral diseases, 6 bacterial diseases, 2 parasitic diseases, and many cases due to lack of management practices were recorded. This study prioritized 4 diseases from the aforementioned three classified groups for further research: Visceral gout, Infectious bursal disease, Coccidiosis and Salmonellosis.

A huge number of poultry cases were studied during a short period which is due to the established reputation of the veterinary hospital, experienced poultry veterinarian and post-mortem, and other handy diagnostic facilities. This finding corroborates with the results of previous conducted at the same placement (Rahman et al., 2019) and other parts of the country (Uddin et al., 2010; Hasan et al., 2011; Karim et al., 2017; Sayeed et al., 2020). So, this study and the study conducted by Rahman et al. (2019) have suggested this is an excellent internship placement for future intern students.

Cases were clustered more in KishoreganjSadar which is quite natural because of short distance and higher number of poultry farms with dense poultry population in KishoreganjSadar (N~520 commercial poultry farms of different production types) then surrounded upazillas (N~350 commercial poultry farms of different production types) (Veterinary Surgeon of KishoreganjSadar, Personal Communication, 2020). However, cases were presented at the hospital from ~50-100 KM way of the hospital which indicated that the hospital offers good services with the experienced veterinarian and associated staff.

Common poultry diseases/disease conditions with variable numbers recorded in the study are supported by many earlier studies (Hassan, 2018; Rahman et al., 2019;

Sabuj et al., 2019) suggesting that farm hygiene and bio-security, vaccine coverage against endemic poultry diseases and vaccine efficacy might have been poorly practiced which are agreed by the many earlier studies in Bangladesh (Høg et al., 2019; Rimi et al., 2017; Parvin et al., 2020)

Visceral gout in broiler poultry was recorded high in the present study which is supported by an earlier study in India (Anon, 2011). No significant risk factor was identified for the occurrence of visceral gout in the current study, but many earlier reports suggest the following driving factors: getting supplied excessive calcium and protein without optimum phosphorus supplement, lack of water, and vitamin A deficiency, which can be marked as nutritional or metabolic fact (Julian, 1982; Guo et al., 2005; Patel et al., 2007;). Besides, infectious bronchitis, avian nephritis, chicken astrovirus disease, toxic substances mostly sulpha drugs, aminoglycosides, diclofenac, mycotoxins (such as citrinin, ochratoxin, oosporein) have also been reported to be associated with the occurrence of visceral gout (Pegram and Wyatt, 1981; Bulbuleet al., 2014; Zhang et al., 2018). Management problems e.g., the high density of poultry flock, low temperature may be considered as potential risk factors for the occurrence of visceral gout (Singh et al., 2013; Vishwakarma, 2014). Low temperature decreases the dissolution of uric acid (Vishwakarma, 2014).

Visceral gout was common in broiler at age of 3-13days (55.6%), being in 600-1050 flock size (46.5%) and rearing in the paved floor (46.4%) agreeing with the study of Singh et al. (2013) where they stated the prevalence of visceral gout is higher in broiler aged below 2 weeks of age (62.3%). Thicker flock size and floor type using wet litter also have been reported to have influenced the visceral gout formation because that circumstances create volatile ammonia imputing nitrogenous compounds decomposition mainly uric acid and pH>7 (alkaline) is the most suitable for uric acid decomposition (Vishwakarma, 2014).

Ascribing lacking uricase enzyme, poultry can't metabolize large amounts of uric acid, for what insoluble uratetophies are shown over visceral parts of the bird (Anon, 2011).

Aricibasi (2010) published that, the broiler birds of 3-6 weeks are clinically more susceptible to IBD. With acquiescence, the current study said that IBD was more frequent in Sonali poultry of 17-40 days. The study also explored that the prevalence of the IBD was higher in 2001-9000 flock size (39.5%) than that of 750-9000 flock size which is however controversial with the finding of Farooq et al. (2000) saying that the incidence of the disease was higher in smaller flock size. But in this study, the scenario is different which might be due to lacking of experience and proper knowledge about the poultry farm rearing systems. The present study also found that the IBD was higher in sonali poultry reared in the paved floor (40%) which can be explained with the consent of the findings of Farooq et al. (2003) that, over-crowding may act as a crucial factor of the occurrence of IBD and the farmers' of Kishoreganj, Bangladesh used to use wood shavings (litter material) over the paved floor which lead to have unhygienic environment of the farm along with wet litter which is very much suitable for the occurrence of IBD in Sonali.

According to Talukdar et al. (2017) coccidiosis was also high in Sonali which is rightly matched up with the current study. The present study showed Sonali birds of 17-40 days were more susceptible to have the disease than that of other age groups which is affirmed with the report of Belal (2017) saying that the prevalence of coccidiosis is higher in sonali birds aging 1-4 weeks followed by 5-16 weeks and so on. The current study also revealed that the prevalence of coccidiosis was higher in bigger flock size (2001-9000) (53.5%) and Sonali reared on the paved floor (57.6%). These results are corroborated with the earlier findings (Yunus et al., 2008).

Lee et al. (2003) published that the incidence of salmonellosis was greater in the commercial layer due to stress of heat and laying period which trigger the occurrence of salmonellosis in poultry most. Mbuko et al. (2009) observed salmonellosis was more common at the age of 15 weeks following by 1-6 weeks and 6 to 15 weeks. These findings are closely aligned with the findings of the present study.

Regardless of diseases or disease conditions and production type antibiotics belonging to the watch group were mostly prescribed, followed by reserve group antibiotics which could lead to developing antibiotic resistance and also pose potential public health threats (Wongsuvan et al. 2017). Antibiotics work on particular site of an bacterium morphological or functional structure and due to modify of these structure through acquired resistance genes, genetically alteration, detouring metabolic pathways, antimicrobial resistance bacteria are developed (Tenover, 2006). Irrational and unwise prescription by veterinarians, lack of sufficient equipment in hospital or clinics for disease diagnosis, overuse of antibiotics, defying the withdrawal period of antibiotics and paucity of knowledge of the farmers are the basis of antimicrobial resistance development in Nepal (Acharya and Wilson, 2019). Different antimicrobial resistant organisms can transfer into human body through food chain by handling raw meat, raw organs, by eating inadequately cooked meat, by cross contamination with other food, from slaughter house of poultry or from direct animals of farm etc (Procura et al. 2019; Saud et., 2019; Bennani et al. 2020;).The residue of applied antibiotics store in body tissue of poultry and excrete out as manure ultimately causing hamper in human body and environment (Muhammad et al. 2020; Yèvenes et al., 2019).

The present study showed that doxycycline (72.7%), tylosin (66.2%), and sulphachloropyridazine and trimethoprim together (65%) were prescribed drugs against visceral gout in broiler poultry. No authentic document was found that consent with the application of antibiotics as a treatment for visceral gout rather de Nobrega et al. (2020) studied seabirds in Brazil where there was a citation of using sulfonamide and enrofloxacin without any success.

The study found that, ciprofloxacin (84.8%) and pefloxacin (41.3%) were administered against IBD while ciprofloxacin (58.6%) and erythromycin (20.7%) were prescribed against coccidiosis in Sonali poultry. These findings are agreed with the findings of Islam et al. (2014) in Bangladesh. There is no specific therapeutic or supportive treatment for IBD (Saif et al. 1997) and so the symptomatic treatment can

be considered to manage the secondary bacterial infections e.g. colibacillosis, salmonellosis (Kabir, 2010).

The present study also explored that, tiamulin (6.4%),sulphachloropyridazine and trimethoprim (5.2%), and enrofloxacin (5.2%) were prescribed against salmonellosis. Avian intestinal spirochaetosis causes reduction of egg production, body growth, consumption of feed intake which as like as in salmonellosis (Roberts et al. 2011). Hampson et al. (2002) stated in his study that, spirochaetosiscould be prevented by tiamulin and zinc combined applicaton which may be a reason of using tiamulin in layer obtaining result of this study. About 70% studied strains of salmonella showed sensitive to the drugs of fluoroquinolone groups (nalidixic acid, ciprofloxacin, norfloxacin, enrofloxacin) while 46.67% to sulpha drugs that may be another cause of higher application of sulpha drugs and enrofloxacin against salmonellosis (Lenchenko et al., 2020).

Conclusion and Recommendations

The study obtained gives an overall knowledge about common poultry diseases and disease conditions and their distribution, management practices, antibiotic prescription pattern. Throughout the present study, it is very much clear that, there is a shortage in knowledge of proper management of poultry farming as well as indiscriminate usage of antibiotics. More training programmes on poultry farm management and use of antibiotics and its risk of developing antimicrobial resistance should be offered to poultry farmers in the study areas.

Limitations

1. As all infected poultry cases were not presented to the hospital and total number of birds was not recorded comprehensively, so we were unable to calculate the true prevalence of diseases or disease conditions.
2. Diagnosis is mostly based on clinical signs and lesions. Therefore, there might have been misclassification of the cases, however experienced poultry veterinarian confirmed the diagnosis of the cases.
3. Farmers might have hided some epidemiological information such as frequency of disease occurrence, proper vaccination schedule, exact time etc. So, there might have happened some level of information bias.

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Appendix 1

(Postmortem findings of selected disease)

Visceral Gout:

Figure 1: Deposition of urate crystals in the serous membrane of the heart

Figure 2: Ulceration in the wall of proventriculus due to excessive urate production

Infectious Bursal Disease:

Figure 1:Haemorrhage at the junction of proventriculus and gizzard

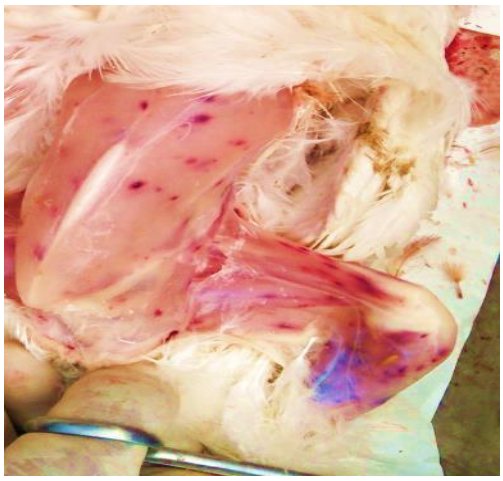

Figure 2: Ecchymotic hemorrhage in leg muscle and pectoral muscle

Figure 3: Renomegaly with hemorrhage, congestion and urate crystals deposition in ureters

Figure 4: Swollen bursa

Figure 5: Hemorrhagic bursa

Coccidiosis:

Figure 1: Dark clotted blood mass in ceca

Salmonellosis:

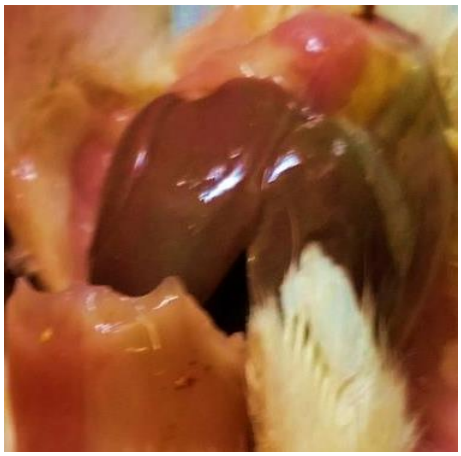

Figure 1: Fragile bronze-colored liver in chick

Figure 2: Omphalitis and typhlitis in chick

Figure 3: Enlarged and fragile liver with congestion and grayish necrotic foci

Appendix 2

(Histopathological findings of selected disease)

Infectious Bursal Disease:

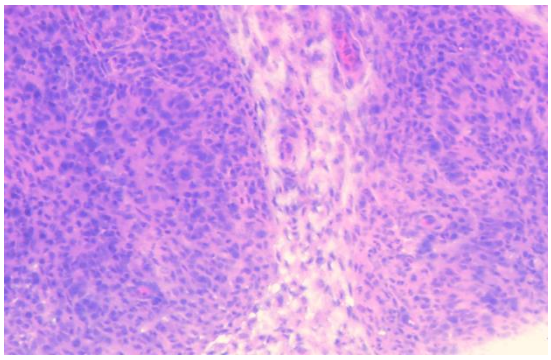

Figure 1: Congestion of the vascular layer with lymphoid cells necrosis, H&E staining, (10X)

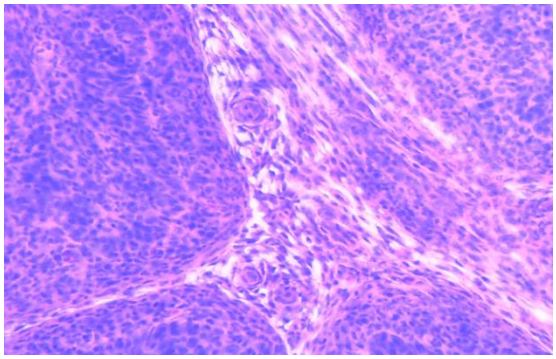

Figure 2: Hyperplasia of reticuloendothelial cells and inter-follicular tissue, H&E staining,(10X)

Salmonellosis:

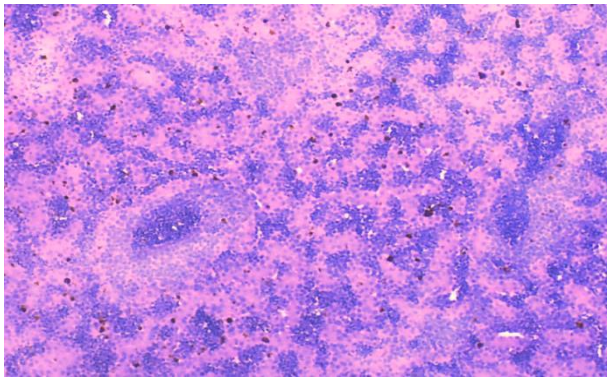

Figure 1: Focal degeneration, focal necrosis with mononuclear cells infiltration, H&E staining, (10X)

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Biography

I am Meherjan Islam, daughter of A.K.M. Mahmudul Islam and Rokeya Islam. I passed my Secondary School Certificate examination in 2011 (G.P.A.-5.00) and Higher Secondary School Certificate examination in 2013 (G.P.A.-5.00). Now I am an intern veterinarian under faculty of veterinary Medicine in Chattagram Veterinary and Animal Sciences University, Chattagram, Bangladesh. In future I would like to work as government service holder.