PREVALENCE OF AVIAN ZOONOTIC DISEASES IN NAIROBI COUNTY AND ITS ENVIRONS

A research project submitted to the University of Nairobi in partial fulfilment of the requirements for the degree of Bachelor of Veterinary Medicine

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DECLARATION

I, Wahome M. Wambui, hereby declare that this project is my original work and has not been submitted by anyone else for a diploma or a degree in any other institution of higher learning.

Signature ...é é é é é é é é é é . Date é é é é é é é é ..

This project has been submitted for examination with my approval as University supervisor.

Signature é é é é é é é é é é é é é . Date é é é é é é é é é é

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DEDICATION

This report is dedicated to my beloved parents

Mr. and Mrs.Wahome, sister Susan, Lucy and Mercy

and dear brother Samuel

Thanks for your support and May God bless you all.

ACKNOWLEDGEMENT

Without Dr. Njagi (Supervisor), the project would not have been successful. Words cannot express my gratitude for her tremendous support and continuous and timely guidance. She was a great source of inspiration.

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I would like to extend my heartfelt gratitude to the Department of Veterinary Pathology, Microbiology and Parasitology for giving me the opportunity to carry out my project at the Poultry clinic. I am highly indebted to them for providing the necessary information that enabled me to successfully attain my objectives.

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I am grateful to my loving parents for their endless and consistent support that facilitated successful completion and compilation of the project.

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ABOVE ALL I THANK THE ALMIGHTY GOD WHO MADE ALL THIS POSSIBLE.

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LIST OF ABREVIATIONS

H	Hemagglutinin
HPAI	Highly Pathogenic Avian Influenza
LPAI	Low Pathogenic Avian Influenza
MTHS	Months
N	Neuraminidase
NDV	Newcastle Disease Virus
VPMP	Veterinary Pathology, Microbiology and Pathology
WHO	World Health Organization
WNV	West Nile Virus

ABSTRACT

Avian zoonotic diseases are infectious diseases of birds that can be naturally transmitted to humans. Retrospective study was carried out to document avian zoonotic diseases and their trend in Nairobi County over a period of fourteen years (2001-2014) in the department of Pathology, Microbiology and Parasitology, Faculty of Veterinary Medicine, University of Nairobi. Diagnosis of different disease conditions were made on the basis of the history, age of birds, clinical signs, post-mortem examination and microbiological results.

A total of 176 (19.49%) birds, dead and/or alive, were diagnosed with avian zoonotic diseases at the poultry clinic in the Department of Veterinary Pathology, Microbiology and Parasitology, University of Nairobi (2001-2014). Three avian zoonotic diseases were documented; colibacillosis, salmonellosis and Newcastle disease. Colibacillosis had the highest prevalence (69.32%) followed by Newcastle disease (15.91%) and lowest was salmonellosis (14.77%). In the course of the fourteen years, avian zoonotic diseases were significantly higher in birds below 2 months of age (57.31%) compared to older birds. Layers had a significantly high rate of infection (50%) compared to broilers (34.30%) and local (15.70%). No seasonality pattern of the diseases was elucidated. Chickens had highest infection rate (97.73%) than other birds. The trend in occurrence of the diseases fluctuated from year to year without following a certain pattern.

It was concluded that although infections in humans are relatively rare, there is a substantial zoonotic risk from birds and their products that veterinarians and physicians alike should be aware of mostly this era where emerging and re-emerging diseases are a big challenge to one health.

The study therefore recommends further research to come up with the preventive, control and eradication measures.

CHAPTER ONE: INTRODUCTION

Poultry keeping is one of the most popular livestock enterprises in Kenya due to its low capital investment and space requirements. The poultry industry comprises of both smallholder and large scale poultry producers under commercial hybrid or indigenous poultry production system (Omiti and Okuthe, 2009).

The commercial hybrid poultry production system is mainly market oriented, relying on exotic layer or broiler parent and grandparent stock which are imported into the country by breeding companies. The birds are reared under intensive production (Okello *et al*., 2010).

Indigenous poultry production system is the dominant production system in Kenya, which is concentrated in rural and peri - urban areas such as Nairobi and other major towns in the country. This production system is characterized by unconfined birds that roam and scavenge around homesteads and they often interact with wild birds, besides other domestic and wild animals (Nyaga, 2007). About 65% of Kenyan households keep chickens; whereby on average, about 12 chickens are kept by each household (Omiti and Okuthe, 2009).

Poultry diseases have been reported in the country, and they vary both spatially and temporally; with very few structured epidemiological studies carried out. However, few studies have been conducted, but cannot be extrapolated to represent the disease picture of the whole country (DVS, 2001 and 2002). Other sources of information are usually obtained from government annual reports which are mainly based on tentative diagnosis from field reports (DVS, 2001 and 2002). However, there is scanty information in Kenya on the status of avian zoonotic diseases.

Zoonoses are infectious diseases of animals (usually vertebrates) that can be naturally transmitted to humans (WHO, 2014). Zoonoses can be caused by a range of pathogens such as viruses, bacteria, fungi and parasites; of 1,415 pathogens known to infect humans, 61% were zoonotic (Taylor *et al*., 2001). Most birds are asymptomatic carriers of the zoonotic diseases though in young birds, diseases like Newcastle disease and avian influenza manifests with high morbidity and mortalities which approaches 100% (Alexander, 2000).

Human transmission occurs through exposure to contaminated avian faecal material, oral and nasal discharges or consuming improper cooked avian meat or eggs. Humans also get infected with wild avian zoonotic diseases like West Nile Virus, avian influenza due to the interaction between carrier host and domestic birds which get infected and act as a source of zoonoses. Other major factor contributing to the transmission of new zoonotic pathogens in human population is the increased contact between humans and wildlife (Daszak *et al*., 2001).

Despite all these negative impacts of the avian zoonoses and global spread, there is paucity of information on the disease status in the country. The aim of this study was therefore to investigate the prevalence of avian zoonotic diseases among poultry in Nairobi County and its environs.

1.1Objectives

1.1.1. General objective

To establish the prevalence of avian zoonotic diseases in Nairobi county and its environ

1.1.2. Specific objectives

1. To determine the prevalence of avian zoonotic diseases in Nairobi county and its environ.

2. To determine the trends in occurrence of avian zoonotic diseases between the years (2001-2014).

1.2 Justification

Majority of infectious diseases of human are shared within animals. The challenges have been exacerbated by increasing interaction between animal and humans both on farm, wildlife and animal trade hence owning to the continued neglect of animal diseases impacting people.

This study is aimed at promoting awareness of the common avian zoonotic diseases through documenting and determining their trends in occurrence in Nairobi County and its environs which will help in coming up with preventive, control and eradication measures.

CHAPTER TWO: LITERATURE REVIEW

2.1 General overview

Most commonly documented avian zoonotic diseases include avian influenza, west Nile virus, Newcastle disease, colibacillosis, salmonellosis, listeriosis, avian tuberculosis, campylobacteriosis and aspergillosis (Elizabeth, 2013).

2.2 Viral avian zoonotic diseases

2.2.1. Avian influenza

Avian influenza A is a zoonotic pathogen with natural reservoir entirely in birds. Influenza virus is a single stranded RNA virus of the family orthomyxoviridae of which three types A, B and C are recognized and only influenza A and B occur in highly pathogenic form (Daszak *et al*., 2000). Influenza A virus is classified into subtypes determined by the prominent proteins ï hemagglutinin (H) and neuraminidase (N) which are used for host cell entry by the virus during replication (Alexander, 2000). Influenza H5N1 virus affects birdsôspecies but has been found infrequently in a range of other species of animals and humans.

Influenza virus can be divided into two groups according to their pathogenicity (Alexander, 2000; Heeney, 2006) as follows: highly pathogenic avian influenza (HPAI) virus which causes severe illness and a mortality rate approaching 100% and low pathogenic avian influenza (LPAI) virus that do not produce clinical signs in birds (Alexander, 2000; Swayne, 2000).The ability of LPAI virus to mutate into a HPAI virus particularly in poultry and diversity of virus circulating in wild bird population emphasize the importance of wild birds as a primary source of zoonotic introduction of influenza into human population (Baigent and MacCauley, 2003; Heeney, 2006).

Disease is transmitted through ingestion of contaminated food or water with faeces from infected birds. Other avian influenza virus subtypes in addition to H5N1 have been known to infect humans (Peiris, 2009; Kalthoff *et al.,* 2010). In 2002, H7N7 influenza virus caused massive poultry morbidity, mortality and culling and resulted in 80 humansô infection and one (1) fatality (Fouchler *et al*., 2004). Of concern now is the recently diagnosed LPAI H7N9 which was discovered in China that caused 129 human illnesses with an 18% mortality rate (Jernigan *et al*., 2013).

2.2.2 WEST NILE VIRUS

West Nile Virus (WNV) is a Mosquito borne virus that can result to fatal encephalitis in humans, horses and in domestic and wild birds. West Nile Virus is a positive stranded RNA virus belonging to the family flaviviridae. The WNV was first isolated from a woman in West Nile district in Uganda hence the name (Smithburn *et al*.,1940).Wild birds are central to the transmission cycle of WNV because they serve as amplifying host for the virus in nature (Peterson *et al*., 2000). Virus spread from one bird to another and to humans and horses through bite of infected mosquitoes generally *culex* species (Greene and Reid, 2013). Majority of individual birds infected with WNV do not get sick or show symptoms. Infected birds may manifest the following clinical signs; inability to fly, anorexia followed by rapid weight loss, blindness, abnormal body posture and may die 24-48 hours of showing symptoms.

In New York, WNV outbreak resulted to 62 cases of severe encephalitis in humans including seven deaths in 1999 (Asris *et al*., 2000), in addition, significant mortality was noted among horses and numerous species of resident and exotic birds. Also WNV outbreak has been documented in Algeria, Romania, Czech and Democratic republic of Congo (Tiber, 1996). Most

people who get WNV experience have no symptoms at all while others may experience a sudden high fever with flu like symptoms or signs of encephalitis (Tiber 1996).

2.2.3. Newcastle disease

Newcastle disease (ND) is a highly contagious, fatal viral disease of poultry occurring worldwide. It is usually identified by its three virulence types as follows; mildly pathogenic (lentogenic), moderately pathogenic (mesogenic), and very pathogenic (velogenic) (Barman, 2002). It may also be classified according to the predilection site of the virus: pneumotropic (respiratory system), viscerotropic (gastrointestinal tract), or neurotropic (nervous system) (Cardona and Msoffe, 2009). It is caused by Newcastle disease virus (NDV) of the order *Mononegavirales*, family *Paramyxoviridae*, subfamily *Paramyxovirinae* and genus *Avulavirus* (Mayo, 2002). Newcastle disease is a disease that affects birds of all ages while at the same time infects mammals and humans (Shankar, 2008; Njagi *et al.,* 2010). Newcastle disease usually presents with sudden onset of clinical signs: hoarse chirps in chicks, watery discharge from nostrils, and dyspnea as bird gasps for air, swelling of areas around the face, paralysis, trembling and twisting of the neck that may indicate central nervous system involvement (Cardona and Msoffe, 2009). Besides these manifestations, mortality rate ranges from 10% to 80% depending on pathogenicity of the infecting strain of the Newcastle Disease virus (Shankar, 2008). Zoonoses of the disease is mostly limited to primary laboratory workers and vaccinators team who are exposed to large quantities of virus manifested as transitory conjunctivitis (Kaleta *et al.,* 1988; Kahn, 2005).

2.3. Bacterial avian zoonotic diseases

2.3.1. Colibacillosis

Avian colibacillois is an infectious disease of birds caused by *Escherichia coli* which is considered as one of the principal cause of morbidity and mortality associated with heavy economic loses to the poultry industry by its association with various disease condition as primary pathogen or as secondary pathogen (Calneck *et al*., 1997).Some strains of avian *E.coli* are also associated with diarrhoea disease in humans (Heuvelink *et al*., 1999). *E. coli* is a gram negative, non -acid fast uniform staining, non- spore forming, bacillus that grow aerobically or an aerobically and is considered as a normal flora in avian and mammals including humans (Barness *et al*., 1997). Avian strains of *E.coli* associated with avian colibacillosis include 078.K80, 01.K1 and 02.K1 (Rahman *et al*., 2004) and strain 0157.H7 (Bebora *et al.*, 1993) also 078 strains isolated from humans, poultry, cattle, sheep and pig (Cherifi *et al*., 1994).Transmission of the pathogen in avian is mostly through faecal oral route that result from contamination of feed and water with faeces of infected birds (Dho-mourin*et al*., 1999). Also faecal contamination of egg during passage through cloacae or after laying (Barness *et al*.,1997) can result to penetration of *E.coli* through the shell and may spread to the chick during hatching and is associated with high mortality rates (Wigley *et al.,* 2001). Humans are infected by consumption of food and water contaminated with infected poultry faeces or by consumption of infected eggs and meat. Avian *E. coli* occur as acute form characterized by septicaemia resulting to death or as sub-acute form (Haider *et al.,* 2004). It causes variety of diseases manifested as Omphalitis, respiratory tract infection, swollen head syndrome, septicaemia, polyserositis, enteritis, cellulitis and salpingitis (Calneck *et al.,* 1997).In humans, E.coli 0157:H7 outbreaks causes diarrhoea (Heuvelink *et al*., 1999).

In 1994, seven cases of *E.co*li 0157:H7 infection was traced to a farm in Leicestershire United Kingdom. An epidemiological investigation into the outbreak revealed that the strains of *E. coli* 0157:H7 isolated from nine animals on the same farm was indistinguishable from the strain isolated from human samples (Shukla *et al*., 1994).

Some strains also colonize human intestinal track and may contribute to resistant gene to human endogenous flora (Van den Bogoard *et al*., 2001).

2.3.2. Salmonellosis

Avian salmonellosis is an important cause of clinical disease in avian and a source of food borne disease in human. The etiological agent of fowl typhoid and pullorum disease is *Salmonella enterica* subspecies enteric, serova Gallinarum which is divided into two distinct biova under the serogroup D; *Salmonella gallinarum* and *Salmonella pullorum* respectively (Shivaprashad, 1997).Under the family enterobacteriaceae the genus salmonella is a facultative intracellular pathogen causing localized or systemic infection as well as chronic asymptomatic carrier state (Shivaprasad, 1997). Transmission mostly is through faecal - oral route. Chick maybe infected early by vertical transmission either from infected ovary, oviduct or from infected egg during the passage through the cloacae of infected or carrier birds (Berchieri, 2007). Humans get infected by eating raw chicken or egg products which are already infected by salmonella or food and water contaminated with faecal material of infected birds (Foley *et al*., 2008) .Fowl typhoid occur as peracute, acute or chronic form of disease affecting mostly adult avian whereas pullorum disease affects the very young chicken mostly two-three weeks of age and in adult, the disease tends to be chronic (Shivaprasad, 1997). Clinical signs in chicken include anorexia, drop in egg production, increased mortality, reduced fertility and egg hatchability (Shivaprasad,

1997). In humans, salmonella infection causes diarrhoea and destroys epithelium leading to gastro-intestinal ulceration.

2.3.3 Listeriosis

Listeriosis is a disease that causes septicaemia or encephalitis in humans, animals and birds. The causative agent is *Listeria monocytogenes*. *Listeria monocytogenes* is a medium sized gram positive rod, non- spore forming and non- acid fast bacteria (Quinn *et al*., 1994). Most indigenous chicken are carriers of *Listeria monocytogenes* (Njagi *et al.,* 2004). Cattle also are carriers of the bacteria where they shed it in milk asymptomatically as well as symptomatically as a result of listeria-related mastitis (Farber *et al*.,1990) abortion or encephalitis (Ryser and Marth, 1991).Humans are infected by the bacteria through contact with affected birds, and consumption of their product and unpasteurized milk (Marsden, 1994). About 2500 cases of food borne listeriosis in humans has been reported in United States each year (Stapleton, 2002). Most cases and deaths occur in pregnant women, newborns, the elderly and immunosuppressed adults (Stapleton, 2002). In avian, all age group are susceptible but the disease is primarily of the young birds where it causes a septicaemia with focal necrosis in the liver, myocardium, pericarditis and occasionally encephalitis manifested as torticollis in broiler chicken (Cooper, 1989). In human, meningitis is the most common of the three forms of listeriosis (Walker, 1999).

2.3.4 Avian tuberculosis

Avian tuberculosis is a highly contagious and chronic disease characterized by granulomatous lesions and a variety of clinical presentation (Hermoso, 2002).The etiologic agent is *Mycobacterium avium*, a highly resistant, acid-fast bacillus (Charlton, 2006). *Mycobacterium avium* may infect different animal species like swine, cattle, deer, sheep, goat, horses, cat, dogs

and humans (Thorel *et al*., 1997; Aranaz*et al*., 2003)**.** Transmission to all animals is through ingestion and inhalation of aerosolized infectious organisms which are mostly found in soil and water contaminated by faecal material from infected birds (Fulton *et al*., 2003). In birds, avian tuberculosis manifests as a primary intestinal and hepatic disease with dissemination to other organs including lungs, air sac, spleen, bone marrow and skin (Vander heyden, 1997; Thoen, 1998; Fulton *et al*., 2003). It is clinically manifested as progressive weight loss, depression, white diarrhoea with soiled feathers, increased thirst, respiratory distress, fatigue and decreased egg production (Thoen, 1998; Dhama *et al*., 2007)**.** In humans, high risk is seen in immuno compromised people such as those on chemotherapy, infected with human immunodeficiency virus (HIV), the elderly and children (Linda Pesek., 1998)**.** Human infections occur through contact with infected bird or ingestion of food or water contaminated with faecal material from infected birds (Linda Pesek., 1998).

2.3.5 Campylobacteriosis

Campylobacteriosis is a food borne gastroenteritis disease caused by zoonotic pathogen namely *Campylobacter jejuni*. *Campylobacter jejuni* is a micro-aerobic, non- spore forming gram negative bacteria that are motile, spiral shaped and moves by corkscrew motion (Borriello *et al.*, 2005). It causes disease in humans, avian, cattle, pigs, sheep, dog, cats and rabbits (Fitzgerald, 2007). In humans, most often campylobacteriosis is caused by *Campylobacter jejuni*, which is also the leading cause of bacterial diarrhoea in developed countries and a leading cause of diarrhoea in children under the age of 5 years in developing countries (Scallan *et al.*, 2011). The organisms are common inhabitants of avian digestive tracts and poultry may support extensive colonization without any adverse effects (Berrang *et al.*, 2000). Once present in a flock, the bacteria spread quickly; infecting more than 90% of birds within 2 weeks (Boulianne, 2013).The

ubiquity of the bacteria in the environment makes eradication and prevention of infection at the farm level nearly impossible. During processing, one infected carcass can easily contaminate the entire production line and thus, much of the control measures in place focus on this stage of production (Friedman *et al.,* 2000).Over 70% of cases are linked to consumption of chicken meat (Allos, 2001).

2.3.6. Ornithosis

Avian chlamydiosis occur in more than 400 species of birds, often in an unapparent manner (Beeckman, 2009). In poultry, a well-defined clinical disease syndrome is recognized only in turkeys, where it manifests as a mild respiratory infection. In other poultry species, the disease may be unapparent because there are several genotypes of *C. psittaci*, which tend to infect only certain species and these species-specific genotypes vary in their virulence for birds as well as humans. There are numerous reports of humans obtaining the infections from turkeys.

Infection, of either turkeys or humans, is through inhalation of contaminated aerosols. Infected birds, whether clinically ill or asymptomatic, will shed the organism in respiratory and ocular secretions, and faeces. The organism survives drying and will become aerosolized when environmental conditions allow. Data from slaughter plants indicate a very high rate of human infection, with up to 70% of turkey plant employees being seropositive (Dickx *et al.,* 2010). Areas of greatest infection/exposure are in the receiving rooms of live birds and also in the evisceration stations. This is probably due to secretions from live birds and exposure to air sacs and respiratory tree at the evisceration stations. Studies from Belgium have indicated a high rate of positivity in chicken broilers as well; although, there seems to be less transmission to humans from broilers, probably because of difference in genotypes (Dickx *et al*., 2010). In France, there have been documented cases of severe clinical disease in workers at duck farms with no

evidence of disease in any of the ducks. Additionally, seropositivity of ducks was very low and yet they were intense shedders of *C. psittaci* (Laroucau *et al*., 2009).

2.4. Fungal avian zoonotic diseases

2.4.1. Aspergillosis

Aspergillosis is a fungal infection caused by *Aspergillus fumigatus* but also *Aspergillus flavus* and *Aspergillus niger* (Barton *et al*.,1992; Pereiman and Kuttin, 1992; Joseph, 2000).The reason why *Aspergillus fumigutus* is the predominant species of air borne fungal infection might be that the spores are much smaller than the spores of other *Aspergillus species* (Richard and Thurston, 1983) .Predisposing factor to infection is due to an increase in concentration of spores in the environment as a result of warm environment, humidity and poor ventilation (Phalen, 2000), poor sanitation (Oglesbee, 1997), long term storage of feed (Khosravi *et al*., 2008) and factor impairing immunity e.g. long term administration of tetracycline (Oglesbee, 1997), long term steroids (Verstappen and Dorrestein, 2005), inadequate diet (Bauk *et al*., 1992).Transmission is through inhalation of the fungi spores (Fedde, 1998). In avian, aspergillosis can manifest as acute or chronic; acute is due to inhalation of overwhelming number of spore while chronic aspergillosis is generally associated with immune suppression (Vanderheyden, 1993). Nasal aspergillosis cause exudative rhinitis, accompanied by malformation of nostril and beak (Bauck *et al*., 1992; Tsai *et al.,* 1992).

While itôs not possible for humans to contract aspergillosis from eating the meat of infected bird, it is possible for humans to contract this disease from inhaling the spores that are present in the air sacs and lungs (Denning *et al*., 2013). Majority of the cases occur in people with underlying

illness such as tuberculosis (Denning *et al*., 2013) or chronic obstructive pulmonary disease (Smith and Denning, 2011).

CHAPTER THREE: METHODS AND METHODOLOGY

3.0 . Study design

This was a retrospective study that relied on diagnostic records of poultry cases presented to the poultry clinic in the Department of Veterinary Pathology, Microbiology and Parasitology (VPMP). All cases which originated from Nairobi County and its environs were examined. The records for a period of fourteen years (2001-2014) were utilized for this study. These records were bacteriology and post mortem records.

The archival post mortem records were stored in hard copy files. Post mortems done in each of the years had been recorded in a separate file and record sheets for each year. Diagnoses in the post mortem and /or bacteriology records were taken as the final diagnosis on the respective cases.

January 2001 to December 2014 post mortem records were manually retrieved to access the relevant data on avian zoonotic diseases.

3.1 . Source of the poultry cases

The study was carried out at the University of Nairobi, College of Agriculture and Veterinary Sciences, Upper Kabete, Department of Veterinary Pathology, Microbiology and Parasitology, which is situated in Nairobi County off Kapenguria road 14 kilometers Northwest of Nairobi city, Kenya. The geographical coordinates in decimal degrees are: Latitude -1.267 and Longitude: 36.717. The department offers consultancy and diagnostic services to poultry farmers. The carcasses of chicken brought for post mortem examinations at VPMP as well as the sacrificed chicken (s) were obtained from smallholder individual farmers and large commercial

poultry producing farms in Nairobi and its peri - urban areas of Kiambu, Machakos and Kajiado Counties.

3.2. Data collection and statistical analysis

Data collection involved scrutinizing post mortem records and listing down zoonotic diseases and where samples were submitted to bacteriology laboratory, bacteriological records were also scrutinized and zoonotic disease listed down. Data regarding the date of case submission, case number, category of the bird affected, age of the bird, organism isolated and pathological diagnosis was collected, and recorded into data collection sheets. All the cases that had details of post mortem findings and poultry biodata were included in the study. Descriptive analysis was used to analyze the data. The data was entered in Microsoft excel where percentages calculations were done. The data was then entered, stored and analyzed using Microsoft Excel (Microsoft Corporation) and statistical package, Stata 2011 ®.

CHAPTER 4: RESULTS

4.1.1Overall prevalence of avian zoonotic disease recorded in 2001-2014

The total number of birds presented for necropsy from 2001 ï 2014 was 903. The overall prevalence of avian zoonotic diseases was 19.49 % (**Appendices 1and 2)**. The most prevalent avian zoonotic disease was colibacillosis (69.32%) followed by Newcastle disease (15.91%) and then salmonellosis (14.77%) as shown in **Figure 1**.

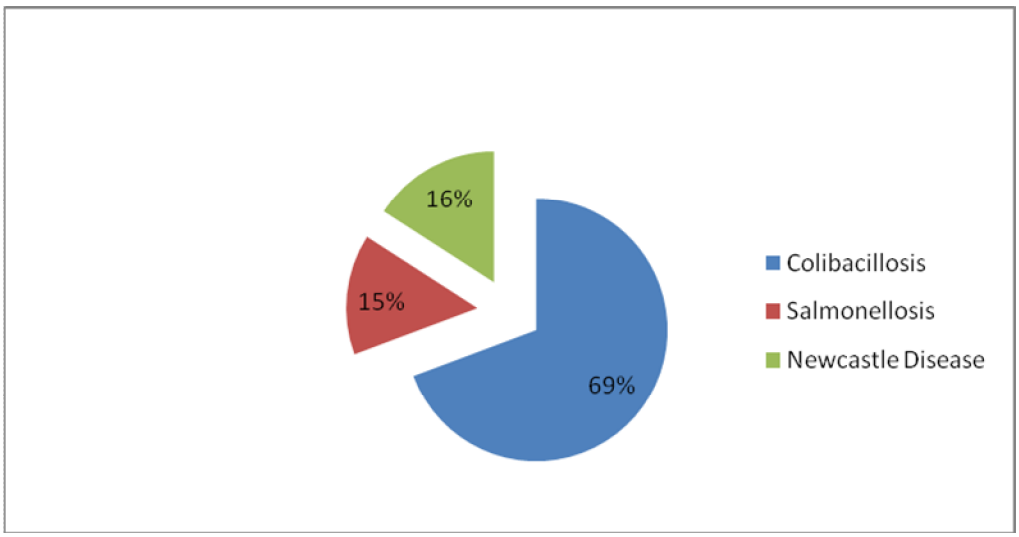
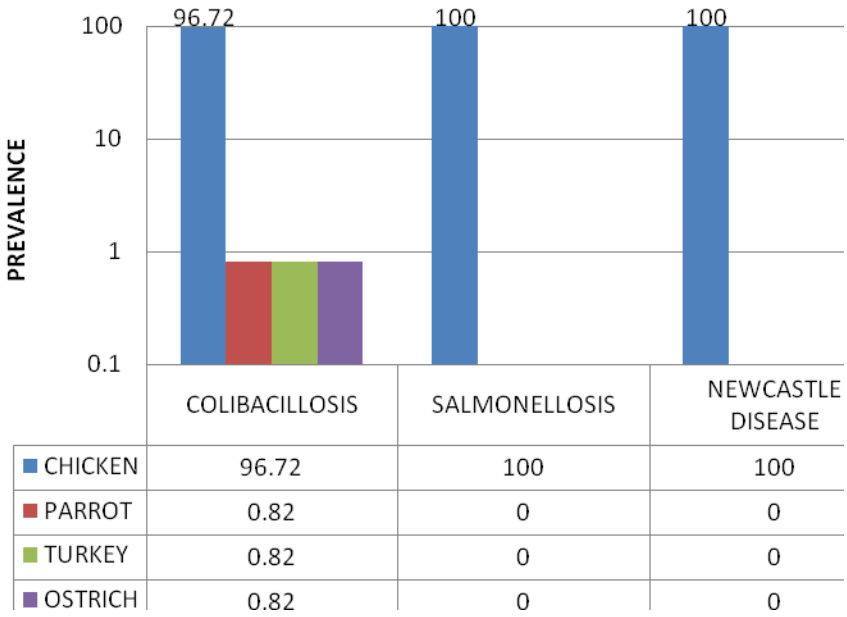


Figure 1: Prevalence of avian zoonotic disease recorded in 2001-2014

4.1.2. Prevalence of avian zoonotic diseases in different types of birds (2001-2014)

Among the different types of birds, chicken had the highest prevalence of avian zoonotic diseases. Parrot, turkey, peacock and ostrich were only infected with colibacillosis with a prevalence rate of 0.82% each (**Figure 2**; **Appendix 3**).



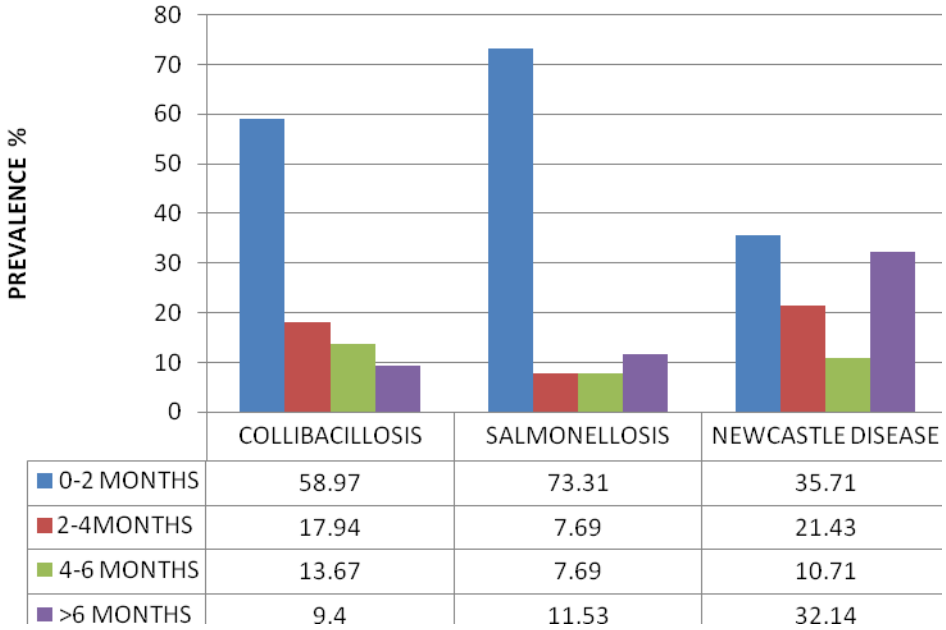
	COLIBACILLOSIS	SALMONELLOSIS	NEWCASTLE DISEASE
CHICKEN	96.72	100	100
PARROT	0.82	0	0
TURKEY	0.82	0	0
OSTRICH	0.82	0	0

Figure 2: ***Prevalence of avian zoonotic diseases in different types of birds (2001-2014)***

4.1.3. Prevalence of zoonotic diseases in different age groups of chicken (2001-2014)

From the records, 0-2 months old chicks had the highest prevalence rate of the avian zoonotic **(Appendix 4).**

Colibacillosis most recorded in 0-2 months chickens (58.97) and least recorded in >6 (9.4%) Salmonellosis was most prevalent in 0-2 months chick (73.31%) and less prevalent in 2-4 and 4-6 months chicken (7.69%). Newcastle disease most frequent in 0-2 months chick (35.71%) followed by >6 months (32.14%) and lastly 2-4 months (21.43%) **(Figure 3).**



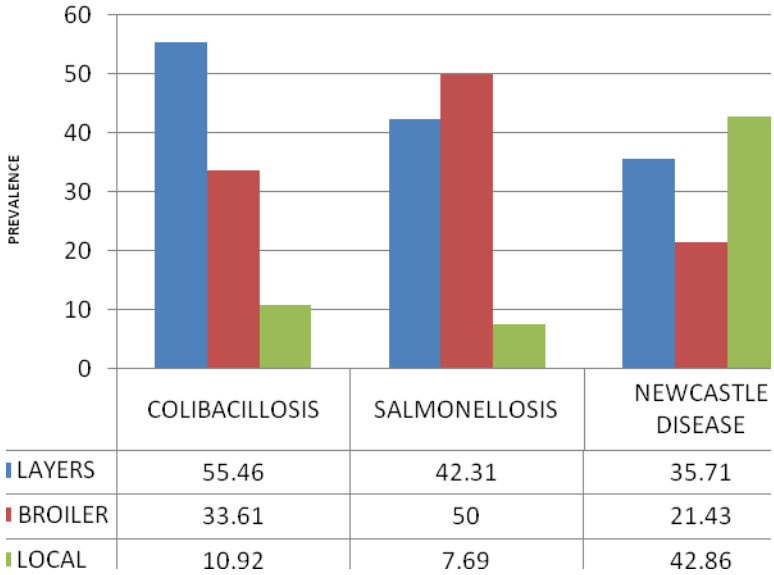
	COLLIBACILLOSIS	SALMONELLOSIS	NEWCASTLE DISEASE
0-2 MONTHS	58.97	73.31	35.71
2-4MONTHS	17.94	7.69	21.43
4-6 MONTHS	13.67	7.69	10.71
>6 MONTHS	9.4	11.53	32.14

Figure 3: Prevalence of zoonotic diseases in different categories of chicken age groups (2001-2004)

4.1.4. Prevalence of avian zoonotic diseases in different categories of chicken (2001-2014)

Layers had the highest prevalence of avian zoonotic diseases (50%) followed by broilers (34.30%) and then local chicken (15.70%). (**Appendix 5**)

Colibacillosis most frequent in layers (55.46%) followed by broilers (33.61%) and lastly by local (10.92%) chickens. Salmonellosis most recorded in broiler (50%) then in layers (42.31%) and finally in local chickens (7.69%). Newcastle disease occurred most in local chickens (42.86%) followed by layers (35.71%) and finally in broilers (21.43%). **(Figure 4)**

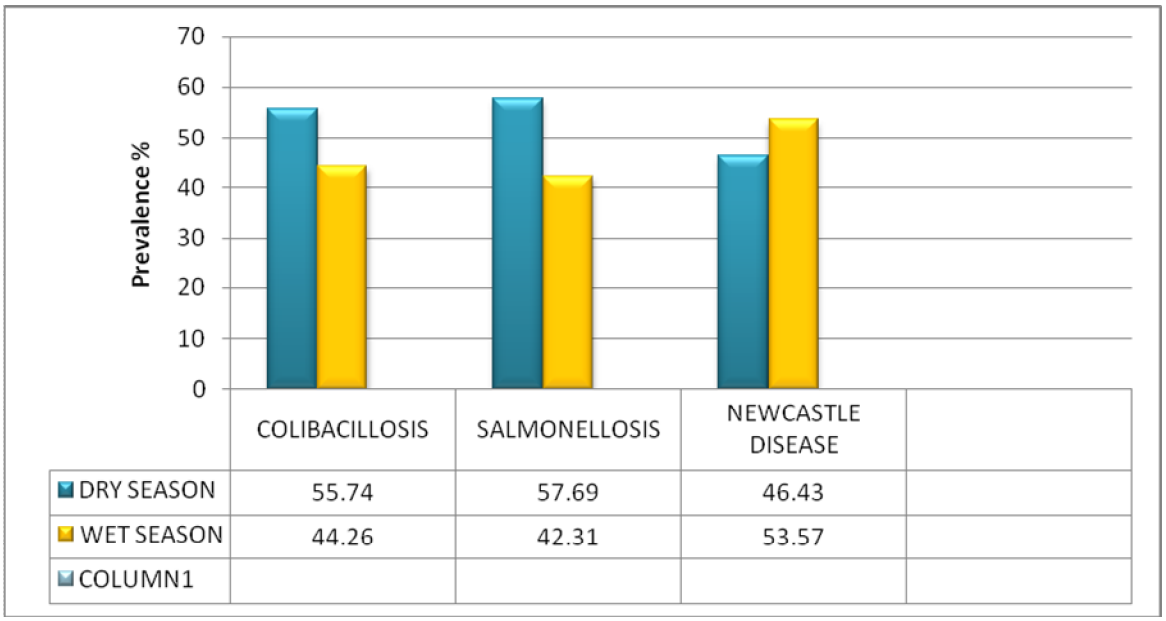


	COLIBACILLOSIS	SALMONELLOSIS	NEWCASTLE DISEASE
LAYERS	55.46	42.31	35.71
BROILER	33.61	50	21.43
LOCAL	10.92	7.69	42.86

Figure 4: Prevalence of avian zoonotic diseases in different categories of chicken (2001-2014)

4.1.5. Seasonal prevalence of avian zoonotic disease

Prevalence of Avian zoonotic diseases was higher during dry than wet season with exception of Newcastle disease (**Figure 5; Appendix 6**).



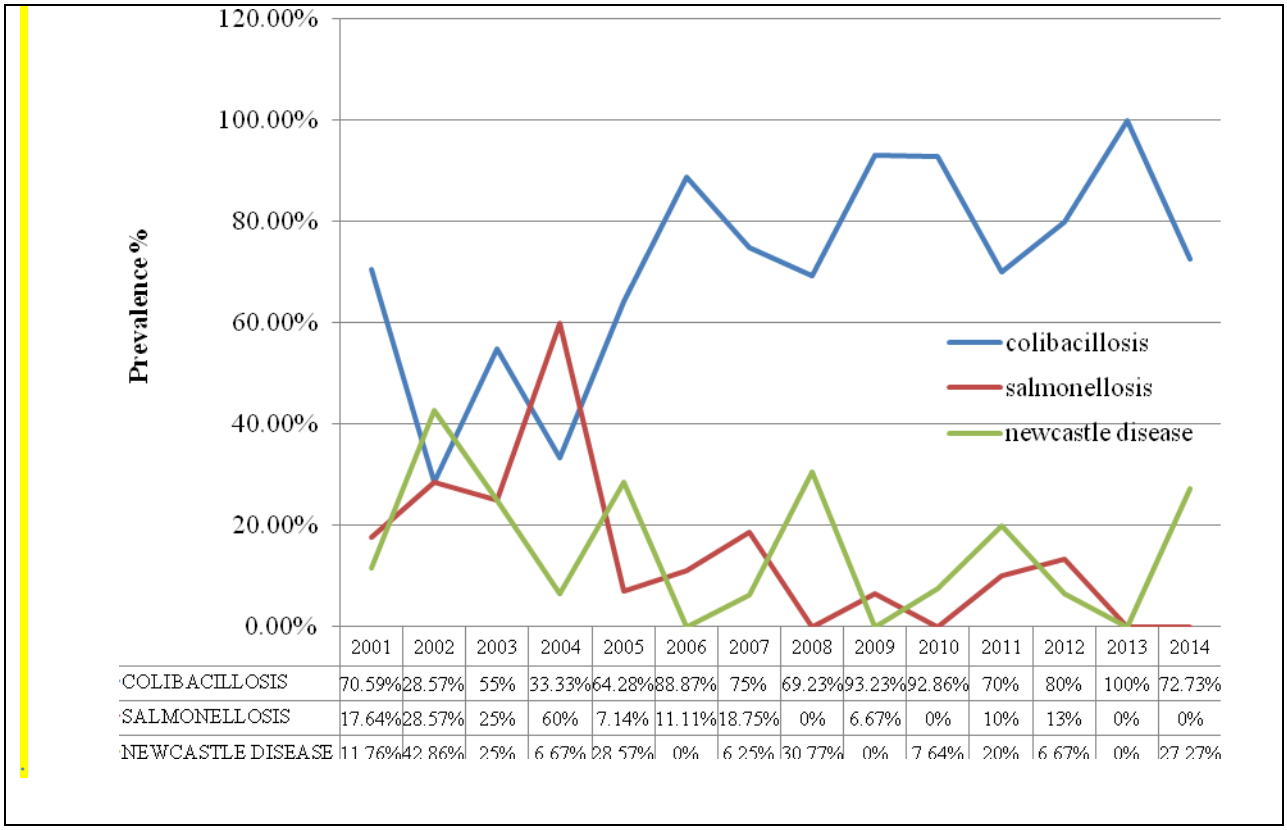
	COLIBACILLOSIS	SALMONELLOSIS	NEWCASTLE DISEASE	
DRY SEASON	55.74	57.69	46.43	
WET SEASON	44.26	42.31	53.57	
COLUMN1				

Figure 5: Seasonal prevalence *of avian zoonotic disease in the dry season and wet season*

4.2 Trends in occurrence of chicken zoonotic diseases in the last 14 years (2001 – 2014)

4.2.1Overall trend of avian zoonotic diseases

Colibacillosis infection rate, fluctuate from year to year with highest infection rate being 100% in 2013 and least prevalence of 33.33% in 2004. Prevalence rate of salmonellosis also fluctuated from one year to other with highest in 2004 (60%) with no infection in 2013 and 2014. In 2002, the prevalence of Newcastle disease in poultry was 42.86% while no infections were recorded in the years 2006, 2009 and 2013 (**Figure 6; Appendix 6**).



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
COLIBACILLOSIS	70.59%	28.57%	55%	33.33%	64.28%	88.87%	75%	69.23%	93.23%	92.86%	70%	80%	100%	72.73%
SALMONELLOSIS	17.64%	28.57%	25%	60%	7.14%	11.11%	18.75%	0%	6.67%	0%	10%	13%	0%	0%
NEWCASTLE DISEASE	11.76%	42.86%	25%	6.67%	28.57%	0%	6.25%	30.77%	0%	7.64%	20%	6.67%	0%	27.27%

2001-2014

Figure 6*:* Trends in the occurrence of avian zoonotic diseases in the last 14 years (2001-2014)

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 DISCUSSION

Colibacillosis was the most common avian zoonotic disease over the fourteen years of the study. This was consistent with a study done on the causes of high rates of carcass rejection at a poultry processing plant (Yogaratam, 1995). Forty three (43%) of broiler carcasses condemned at processing had lesions consistent with colisepticemia (Yogaratnam, 1995). Similarly, colibacillosis was the major cause of infections causing condemnation of processed chickens in Switzerland (Jacob *et.al*., 1998).

Colibacillosis mainly affected birds below 2 months of age. This result was similar to a study carried out by Petridis *et al*.(2006) on egg transmission of Colibacillosis in chicks that showed that fluoroquinolone resistant *E.coli* was vertically transmitted from clinically normal breeders and caused high mortality in chicks (Petridis *et al*., 2006).

Layers had a higher rate of infection with avian zoonootic disease compared to broilers. This was similar to data collected at the East Flanders regional laboratory in Belgium between 1997 to 2000.The data was on groups of healthy and sick broilers, layers and breeders in which the incidence rate of zoonotic bacterial infection was 17.7%, 38.6% and 26.9% respectively.

Most *E. coli* serotypes isolated from poultry have been taken to be pathogenic only for birds and are not important causes of diseases in other animals including man (Barness and Gross, 1997). However, Bebora *et al.* (1993) have differing view to this theorem. Considering the fact that Bebora *et al.* (1993) demonstrated easy plasmid transfer between bacteria in close proximity, and that bacteria present in the gut are normally in close proximity, they argue that there is always a possibility of the poultry/human strains acquiring the respective plasmids and thus be able to

produce the relevant fimbriae for attachment. This is supported by the fact that Bebora *et al.* (1993) isolated serotypes 0127, 0158, 078,063, 0126, 01 and one isolate of 0157:H7 which is documented as human pathogen, from cases of septicaemia and omphalitis in chicks (Honda, 1992) .

Some of the avian *Salmonella* infections are important both as a cause of clinical disease in poultry and as a source of food-borne zoonoses to humans (Kabir, 2010).

Salmonella infections are mainly asymptomatic in poultry (least recorded avian zoonotic disease in the study 14.77%) but are associated with widespread human illness from this source; this is supported by a study done by (McGarr *et al*., 1980) that broilers are considerable reservoirs of infection for man. In this study, young birds of 0-2 months are more susceptible to salmonellosis compared to older birds though according to Bailey (1980) several other factors affect the susceptibility of chickens to salmonellosis such as health and disease status of the bird.

Newcastle disease occurrence is not influenced by wet or dry season as variation between the two seasons was small. Nyaga *et al*. (1985) proves this as they documented outbreaks of Newcastle disease during the dry and wet season, also Njagi *et al.* (2010a) in their study indicated high levels of antibody titers against Newcastle disease in both dry and wet season.

Newcastle disease had high prevalence rate in local chicken (42.86%) as compared to layers and broilers. This can be as a result of the free range management systems of local chicken that allow the uninterrupted cycle of infection as the virus passes from one chicken to another (Zeleke *et al.,* 2005). The local chickens may also acquire infections from wild birds and in some instances from the ducks which are shown to harbour and shed the NDV without showing any clinical signs of the disease (Njagi, 2008; Njagi *et al*., 2010b).

A study carried out by Kutto *et al*.(2011) showed that kale (Brassica oleracea acephala) were contaminated with salmonellosis and coli forms especially *E. coli* which could have originated from poultry manure of sick/ carrier birds acting as source of infection to humans (Kutto *et al*., 2011)

5.2 CONCLUSSIONS

Although infections in humans are relatively rare, there is a substantial zoonotic risk from birds and their products that veterinarians and physicians alike should be aware of mostly this era where emerging and re-emerging diseases is a big issue to one health.

Colibacillosis is the most prevalent avian zoonotic disease followed by Newcastle disease and lastly salmonellosis in Nairobi County and environs.

Mortalities due to avian zoonotic diseases are highest in <2 months birds and lowest in mature chicken. This is due to the increased immunity as the birds mature. Local chickens are resistant to most diseases as compared to commercial (broiler and layers) chickens.

5.2 RECOMMENDATION

1. The study recommends further research to come up with the appropriate preventive, control and eradication measures.

2. Farmers need to be educated on the threat that these disease conditions pose to their health and poultry production and the available methods for their control.

3. Veterinarians need to include the specific control measures for the important conditions identified in their routine flock herd health, which would include; proper vaccinations, improve hygiene by regularly changing beddings, employing all-in-all-out principle and putting in place adequate biosecurity measure; control of human traffic to poultry houses and isolation of sick birds.

CHAPTER 6: REFERENCES

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CHAPTER 7: APPENDICES

Appendix 1: Individual post mortem records for poultry for the year 2001-2014

year	Date when The case Was received	Case No.	Age	Category/ Breed of bird	sex	Organism isolated	Diagnosis
2014	04-03	Pu/1/2014	2wks	Broiler	male	E.coli	Septecimia
	27-3	Pu/2/2014	57wks	Isa brown	female	-	Generalised

							Bacterial
	14-5	DV/8/2014	2wks	-	-	E.coli	Omphalities
	25-5	DV/20/2014	1mth	layer	female	-	Newcastle Disease
	12-6	DV/23/2014	Adult	layer	female	-	Newcastle Disease
	10-7	DV/28/2014	1year	local	male	E.coli	Bacterial infection
	22-7	DV/31/2014	1wk	local	-	E.coli	Yolk sac infection
	21-8	DV/40/2014	7mths	Isa brown	female	E.coli	Bacterial infection
	26-8	DV/41/2014	5days	local	male	-	Newcastle disease
	22-9	PU/IO/2014	5days	Isa brown	female	E.coli	Bacterial infection
	3-10	DV/56/2014	7wks	cross	-	E.coli	Bacterial infection
	18-11	DV/58/2014	2 days	layers	female	E.coli	Yolk sac infection
2013	18-1	DV/1/2013	Adult	layers	female	E.coli	Omphalities
	19-1	DV/2/2013	1.5mths	local	-	E.coli	Egg peritonities
	11-2	DV/4/2013	Adult	layer	female	E.coli	Suspected bacteria Infection
	23-2	DV/6/2013	Adult	-	-	E.coli	Omphalities
	10-4	DV/14/2013	3days	Broiler	male	-	Localized bacteria Infection
	17-5	DV/22/2013	2mths	layer	female	E.coli	coliseptecemia
	1-7	DV/26/2013	3mths	local	-	E.coli	Yolk sac infection
	8-7	DV/29/2013	4mths	local	-	E.coli	Bacterial infection
	15-7	DV/34/2013	6mths	layer	female	E.coli	Bacterial infection
	13-9	DV/43/2013	4wks	layer	female	E.coli	Avian leucosis And septicemia
	29-09	DV/46/2013	4mths	-	female	E.coli	Bacterial infection
	9-10	DV/53/2013	-	local	female	-	Typhilities
	3-10	DV/56/2013	5mths	-	female	E.coli	Bacterial infection And crop impaction
	4-11	DV/59/2013	2.5mths	local	-	E.coli	Yolk sac infection
	14-11	DV/62/2013	42 days	-	male	E.coli	Suspected marecks With secondary Bacterial infection

year	Date when The case was Isolated	Case No.	Age	Category/ Breed of The bird	Sex	Organism isolated	Diagnosis
2012	23-10	DV/66/2012	4mths	layer	female	E.coli	Colliseptsemia
	22-10	DV/63/2012	4wks	broiler	male	E.coli	Suspect Bacterial infection
	22-10	DV/64/2012	6wks	broiler	male	E.coli	Bacterial septicemia
	1-02	DV/I/2012	3wks	Avian Aboracre	female	Salmonella gallinurum	Salmonellosis
	22-02	DV/4/2012	3mths	local	male	E.coli	Suspect bacterial infection
	16-03	DV/8/2012	7mths	layer	female	E.coli	Bacterial infection
	25-03	DV/20/2012	4mths	layer	female	Salmonella gallinurum	Inconclusive
	8-05	DV/24/2012	4wks	Local	female	E.coli	Colliseptsemia
	24-07	DV/32/2012	5days	broiler	male	E.coli	Omhalities
	16-08	DV/47/2012	6days	Broiler	male	E.coli	Colliseptcemia
	16-08	DV/48/2012	1day	broiler	male	E.coli	Yolk sac infection
	27-09	DV/52/2012	8mths	Layer	female	E.coli	Septicemia and crop Impaction
	27-09	DV/51/2012	8mths	Layer	female	E.coli	-
	12-10	DV/56/2012	4wks	broiler	male	E.coli	Suspect bacterial infection
	18-12	DV/83/2012	adult	Local	-	-	Newcastle virus disease
2011	21-2	DV/13/2012	9mth	Layer	Female	-	New castle disease
	28-2	DV/15/2012	1wk	Local	-	E.coli	Bacterial infection
	29-3	DV/25/2012	1yr	Local	Female	-	New castle disease
	7-04	DV/31/2012	3.5mths	Layer	Female	-	New castle disease
	28-04	DV/35/2012	3mths	Layer	Female	-	New castle disease
	03-05	DV/39/2012	adult	parrot	-	E.coli	Septicemia
	04-05	DV/40/2012	adult	Layer	Female	E.coli	Egg peritonitis
	03-06	DV/48/2012	4mths	layers	Female	E.coli	Bacterial infection
	07-06	DV/50/2012	2mths	Layer	Female	E.coli	Bacterial infection
	13-6	DV/53/2012	10mths	Layer	Female	Salmonella gallinurum	Bacterial infection
	29-6	DV/54/2012	3yrs	Turkey	Female	E.coli	Bacterial infection
	14-07	DV/64/2012	5.5mths	Layer	Female	E.coli	Avian leucosis and septicemia
	05-08	DV/73/2012	63wks	Layer	Female	E.coli	Egg peritonitis
	15-08	DV/74/2012	Adult	Local	Male	E.coli	Septicemia and malnutrition

	22-08	DV/76/2012	4.5mths	Layer	Female	E.coli	Septicemia
	29-08	DV/80/2012	4mths	Layer	Female	E.coli	Bacterial infection and coccidiosis
	30-08	DV/95/2012	2mths	Layer	Female	E.coli	Coccidiosis and septicemia
	06-10	PU/7/2012	37wks	Isa brown	Female	E.coli	Bacterial infection
	28-10	DV/112/2012	19wks	Layer	Female	Salmonella gallinurum	Suspected Salmonellosis
	03-11	DV/114/2012	1wk	Layer	Female	E.coli	Bacterial infection
2010	07-01	DV/2/2010	14mths	Layer	female	E.coli	Traumatic hepato-perito-ventriculis
	25-01	DV/6/2010	3yrs	peacok	female	E.coli	Bacterial infection
	28-01	DV/7/2010	6mths	layer	female	E.coli	Egg peritonitis
	02-02	PU/1/2010	42wks	layer	female	E.coli	Coliseptecemia
	02-03	DV/16/2010	2.5mths	layer	female	E.coli	Gumboro disease
	10-05	PU/8/2010	6days	Abor Acre	female	E.coli	Omphalities
	19-05	DV/27/2010	5wks	broiler	male	E.coli	Bacterial infection
	09-06	PU/13/2010	5wks	Abor acre	female	E.coli	Coliseptcemia
	10-06	PU/16/2010	3 days	Layer	female	E.coli	Omphalities
	21-06	DV/33/2010	6mths	layer	female	E.coli	Visceral gout
	27-06	DV/40/2010	-	layer	female	E.coli	Egg peritonitis
	16-08	DV/45/2010	3mths	layer	female	E.coli	Septicemia and coccidioses
	01-11	DV/49/2010	64wks	layer	female	E.coli	Egg peritonitis
	29-11	DV/51/2010	6wks	layer	female	-	Newcastle disease
2009	20-01	DV/3/2009	3mths	ostrich	-	E.coli	Inconclusive
	22-02	DV/4/2009	1wks	Broiler	male	E.coli	Waterbelly syndrome
	04-02	DV/6/2009	10wks	Broiler	male	E.coli	Bacterial infection
	10-02	PU/EX6/2009	18wks	Isa brown	female	-	Bacterial infection
	04-03	DV/10/2010	3days	Broiler	male	E.coli	Yolk sac infection
	16-03	DV/11/2009	4wks	Broiler	male	E.coli	Polyseriosities
	20-04	PU/11/2009	37wks	Isa brown	female	E.coli	Colliseptecemia
	07-05	DV/21/2009	4mths	Layer	female	E.coli	IBD with secondary bacterial infection
	01-05	DV/22/2009	2days	Layer	female	E.coli	Yolk sac infection
	27-05	DV/25/2009	33wks	Layer	female	Salmonella gallinurum	Egg peritonitis
	14-06	DV/26/2009	2mths	Layer	female	E.coli	Septicemia
	20-7	PU/8/2009	36wks	Layer	female	E.coli	Septicemia
	06-08	DV/34/2009	4.5mths	Layer	female	E.coli	Septicemia
	24-08	PU/20/2009	3days	Layer	female	E.coli	Omphalitis
	30-11	PU/32/2009	55wks	Isa brown	female	E.coli	Bacterial infection
	18-12	DV/53/2009	1yr	Layer	female	E.coli	Septicemia

year	Date when the case was received	Case No.	age	Category/ Breed of the bird	sex	Organism isolated	Diagnosis
2008	18-02	DV/7/2008	chick	Broiler	male	E.coli	Suspect bacterial Infection
	07-03	DV/12/2008	3wks	Broiler	male	E.coli	Polyserosities
	31-03	PU/11/2008	9wks	Shavers	female	E.coli	Respiratory infection
	16-04	DV/19/2008	Adult	Local	-	-	Newcastle disease
	17-04	DV/20/2008	Adult	local	-	E.coli	Inconclusive
	25-04	PU/15/2008	56wks	Isa-brown	female	E.coli	Egg peritonitis
	06-05	DV/22/2008	5wks	Broiler	male	-	Newcastle disease
	09-05	DV/23/2008	Adults	Layer	female	E.coli	Bacterial infection
	27-05	DV/26/2008	-	Local	female	-	Newcastle disease
	02-07	DV/37/2008	5wks	Broiler	male	E.coli	IBD and septicemia
	15-07	DV/40/2008	7mths	Layer	female	-	Newcastle disease
	22-07	DV/42/2008	3wks	Broiler	male	E.coli	IBD
	02-10	DV/59/2008	5.5mths	Layer	female	E.coli	Egg peritonitis
	16-12	DV/66/2008	1day	Broiler	male	-	Omphalitis
2007	17-01	DV/4/2007	5days	Layer	Female	E.coli	-
	09-02	DV/6/2007	5days	Layer	Female	E.coli	Omphalities
	19-02	DV/9/2007	5days	Layer	Female	E.coli	Omphalities
	28-03	DV/16/2007	3days	Layer	Female	Salmonella gallinurum	Yolk sac infection
	03-04	DV/20/2007	13wks	Breeders	-	E.coli	Bacterial infection
	08-05	PU/15/2007	46wks	Layer	Female	E.coli	Malnutrition
	10-05	DV/27/2007	6days	Layer	Female	E.coli	Omphalities
	30-05	PU/19/2007	9wks	Isa brown	Female	E.coli	Pendulous crop
	25-06	DV/39/2007	4wks	Broiler	male	E.coli	Bacterial infection
	25-06	PU/24/2007	5wks	layer	Female	-	Suspect Salmonellosis
	04-07	DV/40/2007	1yr	layer	Female	Salmonella gallinurum	Septicemia and helminithiasis
	16-07	DV/45/2007	5wk	Broiler	Male	E.coli	Newcastle disease
	09-08	DV/48/2007	2mth	local	-	E.coli	Gumboro and hemorrhagic enteritis
	07-09	PU/30/2007	6wk	Layer	Female	E.coli	Leg and thigh myositis
	12-09	DV/54/2007	5wks	Broiler	male	Salmonella gallinurum	Bacterial infection
	29-10	DV/55/2007	pullet	Local	female	-	Newcastle disease
	08-12	DV/62/2007	4days	Layers	Female	E.coli	Yolk sac infection

2006	19-01	DV/06/2006	4days	layer	female	E.coli	Inconclusive
	16-02	PU/3/2006	49days	layer	female	-	Suspect bacteria Infection
	24-04	DV/8/2006	3wks	broiler	male	E.coli	Bacterial infection
	24-06	DV/19/2006	1wk	broiler	male	E.coli	Ompalities
	29-07	DV/28/2007	19wks	layer	female	E.coli	Avian leucosis
	06-08	DV/32/2006	5mths	layer	female	E.coli	Bacterial infection
	11-08	DV/39/2006	5days	broiler	male	E.coli	-
	24-09	DV/43/2006	5wks	broiler	male	E. coli	Water belly and septicemia
	08-09	DV/45/206	1wk	broiler	male	-	Septicemia and ompalities
	25-11	DV/47/2006	-	local	-	Ecoli	Probable bacterial infection
	11-11	DV/53/2006	5.5wks	broiler	male	Salmonella Gallinurum	Bacterial infection
2005	24-02	DV/11/2005	1wk	broiler	male	E.coli	Yolk sac infection
	15-03	DV/15/2005	22days	broiler	male	E.coli	Colliseptesemia
	21-03	DV/16/2005	4.5wks	broiler	male	-	Newcastle disease
	04-04	DV/19/2005	11mths	layer	female	E.coli	Bacterial infection
	15-04	DV/25/2005	5wks	broiler	male	E.coli	Fibrinous peritonitis
	25-05	DV/33/2005	1wk	broiler	male	E.coli	Septicemia
	17-08	DV/42/2005	7days	layer	female	E.coli	Omphalities
	31-09	DV/53/2005	1.5mths	local	-	-	Newcastle disease
	21-10	DV/59/2005	adult	layer	female	-	Newcastle disease
	03-11	DV/60/2005	5wk	broiler	male	E.coli	Bacterial septicemia
	02-11	DV/61/2005	1wk	layer	female	-	Newcastle disease
	07-11	DV/63/2005	6wks	broiler	male	E.coli	Coliseptecemia
	08-11	PU/19/2005	34wks	Isa-brown	female	E.coli	Colliseptsemia
	05-12	DV/72/2005	10days	broiler	male	Salmonella	Salmonellsis
2004	16-02	DV/1/2004	11days	local	-	Salmonella	Septicemia and hepatitis
	18-02	DV/2/2004	12days	broiler	male	Salmonella	Septicemia
	22-03	DV/4/2004	4days	-	-	E.coli	Omphalities
	08-04	DV/8/2004	5days	layer	female	Salmonella	Omphalities
	29-04	DV/12/2004	6wks	broiler	male	-	Newcastle disease
	21-05	DV/15/2004	4wks	broiler	male	Salmonella	Salmonellosis
	08-07	DV/30/2004	7days	broiler	male	E.coli	Septicemia
	06-07	DV/28/2004	1wk	broiler	male	Salmonella	Bacterial infection
	19-07	DV/31/2004	chick	broiler	male	Salmonella	Bacterial infection
	24-07	DV/34/2004	6wks	broiler	male	Salmonella	Bacteria septicemia
	09-08	DV/35/2004	6days	broiler	male	Salmonella	Salmonellosis
	20-08	DV/39/2004	13days	broiler	male	E.coli	Septicemia
	06-09	DV/42/2004	8wks	layer	female	E.coli	Septicemia
	23-09	DV/47/2004	4days	broiler	male	E.coli	Septicemia
	29-09	DV/48/2004	14days	broiler	male	Salmonella	Bacterial infection

year	Date when The case was received	Case No.	Age	Category/ breed	sex	organism	Diagnosis
2003	16-04	DV/13/2003	1wk	broiler	male	E.coli	Colliseptecemia
	20-06	DV/24/2003	10days	layer	female	E.coli	Bacterial infection
	24-06	DV/27/2003	3wks	broiler	male	-	Newcastle disease
	12-07	DV/32/2003	Adult	local	female	-	Newcastle disease
	19-08	DV/33/2003	7wks	broiler	male	Salmonella gallinurum	Salmonellosis
	05-09	PU/11/2003	5days	broiler	male	E.coli	Collibacillosis
	23-09	DV/39/2003	5days	layer	female	Salmonella gallinurum	Salmonellosis
	24-10	DV/45/2003	3.5wks	broiler	male	E.coli	-
2002	23-04	DV/9/2002	Adult	Local	female	-	Newcastle
	11-06	PU/6/2002	2days	Isabrown	female	E.coli	Omphalities
	01-07	DV/19/2002	6days	Broiler	male	E.coli	Bacterial infection
	15-07	DV/24/2002	3wks	broiler	male	-	Newcastle
	15-10	DV/35/2002	6wks	broiler	male	salmonella	Bacterial infection
	20-10	DV/37/2002	Adult	local	female	-	Newcastle
	14-11	DV/40/2002	8mths	layer	female	salmonella	Bacterial infection
2001	18-01	DV/7/2001	6days	layer	female	E.coli	Omphalities
	23-01	DV/9/2001	2wks	layer	female	E.coli	Omphalities
	31-01	DV/12/2001	Adult	local	female	E.coli	Bacteria infection
	31-01	DV/14/2001	1mth	layer	female	E.coli	Bacteria infection
	15-03	PU/9/2001	26wks	isabrown	female	E.coli	Bacteria septicemia
	30-03	DV/22/2001	4mths	layer	female	-	Newcastle disease
	04-04	DV/24/2001	5mths	breeders	-	E.coli	Bacteria infection
	24-04	DV/25/2001	Adult	local	male	-	Newcastle disease
	20-04	DV/26/2001	6wks	broiler	male	E.coli	Bacterial infection
	05-05	DV/27/2001	6days	broiler	male	E.coli	Bacterial infection
	21-05	PU/4/2001	4days	layer	female	Salmonella	Bacterial infection
	11-07	PU/5/2001	43wks	isabrown	female	E.coli	Yolk sac infection
	13-07	DV/49/2001	Adult	broiler	male	Salmonella	Bacterial infection
	27-07	DV/58/2001	3days	broiler	male	E.coli	Omphalities
	18-08	DV/65/2001	9days	broiler	male	E.coli	Omphalities and starvation
	20-09	DV/76/2001	8wks	layer	female	salmonella	Bacterial infection
	19-12	DV/87/2001	7wks	broiler	male	E.coli	Bacterial infection

Appendix 2: Summarized records of Avian zoonotic diseases

Diseases	Year															
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	total	%
Colibacillosis	11	2	4	6	9	8	11	9	10	9	10	13	12	8	122	69.32
salmonellosis	3	2	2	9	1	1	3	0	1	0	2	2	0	0	26	14.77
Newcastle Disease	2	3	2	2	4	0	2	5	0	0	4	1	0	3	28	15.91
Total	16	7	8	17	14	9	16	14	11	9	16	16	12	11	176	

Appendix 3: Prevalence of avian zoonotic diseases in different types of birds

Diseases	Birds category										
	chickens		parrot		turkey		peacock		ostrich		Total
	n	%	n	%	N	%	n	%	n	%	
collibacillosis	*118*	96.72	*1*	0.82	*1*	0.82	*1*	0.82	*1*	0.82	122
salmonellosis	*26*	100	*0*	0	*0*	0	*0*	0	*0*	0	26
Newcastle disease	*28*	100	*0*	0	*0*	0	*0*	0	*0*	0	28
Total diseases	*172*		*1*		*1*		*1*		*1*		176
% prevalence	*97.73*		*0.56*		*0.56*		*0.56*		*0.56*		

Appendix 4: Prevalence of zoonotic diseases in different categories of chicken age groups

Diseases	Age(months)								
	0-2mth		2-4mth		4-6mth		>6mth		Total
	n	%	n	%	n	%	n	%	
Collibacillosis	*69*	58.97	*21*	17.94	*16*	13.67	*11*	9.40	117
Salmonellosis	*19*	73.31	*2*	7.69	*2*	7.69	3	11.53	26
Newcastle disease	*10*	35.71	*6*	21.43	*3*	10.171	*9*	32.14	28
Total diseases	*98*	100	*29*	100	*21*	100	*23*	100	171
%	*57.31*	100	*16.96*	100	*12.28*	100	*13.45*	100	

Appendix 5: ***Prevalence of avian zoonotic diseases in different categories of chicken***

Diseases	Category of birds						
	layers		Broilers		local		Total
	n	%	n	%	n	%	
Colibacillosis	*65*	55.46	*40*	33.61	*13*	10.92	118
Salmonellosis	*11*	42.31	*13*	50	*2*	7.69	26
Newcastle disease	*10*	35.71	*6*	21.43	*12*	42.86	28
Total diseases	*86*		*59*		*27*		172
%	*50.00*		*34.30*		*15.70*		

Appendix 6: Seasonal prevalence of avian zoonotic disease in the dry season and rainy season

Disease	Season				
	Dry season		Wet season		Total
	n	%	n	%	
Collibacillosis	*68*	55.74	*54*	44.26	122
Salmonellosis	*15*	57.69	*11*	42.31	26
Newcastle disease	*13*	46.43	*15*	53.57	28
Total	*96*	100	*80*	100	176
% prevalence	*54.54*	100	*45.46*	100	