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Occurrence of Zoonotic and Other Infectious Bacterial Organisms in Dessie Regional Health Laboratory, South Wollo, Ethiopia: A Retrospective Study on Medical Records

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Abstract: A retrospective study was conducted on zoonotic and other infectious bacterial organisms from October 2010 to June 2011 from laboratory records of culture confirmed cases in human admitted to Dessie Hospital during the period of 2006/7 to 2011 in Dessie Regional Health Research Laboratory. The main objective of the study was to illustrate the epidemiology of the most frequent zoonotic and other infectious bacterial organisms and assess the potential risk factors in the area. Out of 2395 individual cases, 1186 were found to be infected with one or more infectious bacterial organisms, indicated by a prevalence rate of 49.52% (95% CI: 47.52-51.52%). There was significant association between prevalence of bacterial infection ($\chi^2 = 8.8953$; $p = 0.031$) within age groups and those individuals below 12 years old were found to be affected 1.37 fold (OR = 1.37; 95% CI: 1.08-1.75) than those individuals above 35 years old. But there was no significant association between prevalence of bacterial infection ($p = 0.0538$) and sex groups. The highest proportion of bacterial infection was recorded during the year 2009/10 and least record was documented in the year 2010/11 with a prevalence of 13.57 and 8.1%, respectively. A relative increase in disease was observed during the study period. Future studies of zoonotic disease should standardize diagnostic ascertainment and incorporate therapeutic response and outcome, particularly the selection and effects of antibacterial therapy. Ongoing advances in bacteriology to improve clinical decision making for complex microbial infections is urgently required.

Key words: Bacteria, dessie, infectious organism, retrospective, zoonosis

INTRODUCTION

Zoonotic infectious agents are among the most prevalent on earth and are thought to be responsible for >60% of all human infections and 75% of emerging human infectious diseases (Cunningham, 2005). The success and widespread epidemiology of these infections can be attributed to a range of human factors including social and dietary changes as well as an increased mobility of the human population continues to grow; there is an ever increasing need to develop and maintain food products with a high protein content (particularly livestock and fish) under intensive farming situations which is inevitably leading to a greater spread of animal diseases and their transmission to humans (Keiser and Utzinger, 2005). Improved diagnosis and/or recognition of neglected human infections can account for some diseases apparently emerging or re-emerging in recent times (e.g., Salmonellosis). Climate change has also been suggested as a cause for disease spread and is a concern for the future (McCarthy and Moore, 2000).

Emerging infectious diseases are a threat to developing countries as well as industrialized countries as numerous risk factors for human disease emergence exist in both populations (Taylor *et al*., 2001). Several hundred infectious diseases are classified as zoonotic diseases as they are caused by bacteria, virus, fungi or parasites that can be transmitted form animals to humans. These zoonotic diseases include many of the classic infectious diseases such a rabies and ricketssia (e.g., Rocky Mountain spotted fever) as well as most of the new emerging infectious diseases such as HIV, SARS. Zoonotic infections can be significant pathogens with a more severe outcome, in patients with various forms of immune suppression due to infection, i.e., HIV or immune suppressive drugs, i.e., monoclonal antibodies to TNF-α. A number of parasitic zoonoses such as cryptosporidiosis, toxoplasmosis and leishmaniasis have gained an importance as human pathogens due to their ability to cause disease in patients with immune suppression due to HIV. The majority of the classic parasitic diseases due to helminthes, trematodes, cestodes, pentastomids and protozoa are zoonotic (Krauss *et al*., 2003).

Many factors have been mentioned as contributing to under diagnosis and under reporting of zoonotic

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disease particularly in the Sub-Sahara African region. These include poor disease surveillance coverage, poor diagnostic capacity, the geographical distribution of those most affected and lack of clear strategies to address the problem of zoonotic diseases (Taylor *et al*., 2001). Besides the fact that many emerging human diseases are zoonotic, it's only now that they have been demonstrated by quantitative analysis as risk factors for disease emergence. Both domestic and wild animals have been shown to be important reservoirs of zoonoses (Haydon, 2002).

In Africa, Bovine tuberculosis, Brucellosis, Anthrax, Sleeping Sickness and Rabies are still widespread (Meslin, 1992). Poor referral systems, limited surveillance coverage, difficulty and delay in diagnosis by the health facilities have been contributing to the under reporting of zoonoses. Patients on the other hand have been seeking alternative services such as those offered by traditional healers and hence delay to present to health facilities or failing to present at all making data on their diseases not available for epidemiological records (Cattand *et al*., 2001).

Most cases of zoonotic infection are preventable through good farm management, personal hygiene and food preparation practices (Perry *et al*., 2002). This study was designed to determine the prevalence of the most frequent zoonotic and other infectious bacterial organisms since study has not been conducted yet in the study area.

MATERIALS AND METHODS

Study area: The study was conducted from October 2010 to June 2011 in Dessie Regional Health Research Laboratory, South Wollo zone, Amhara Regional State Northeast Ethiopia which is located at 400 km North of the capital city, Addis Ababa. Based on the 2007 census conducted by the Central Statistical Agency of Ethiopia (CSA), South Wollo zone has a total population of 2,518,862, an increase of 18.60% over the 1994 census, of whom 1,248,698 are men and 1,270,164 women with an area of 17,067.45 km^2, this zone has a population density of 147.58. While 301,638 or 11.98% are urban inhabitants, out of which Dessie woreda has a total population of 151,174 of whom 72,932 are men and 78,242 women; 120,095 or 79.44% are urban inhabitants living in the town of Dessie, the rest of the population is living at rural kebeles around Dessie.

The study area has a bimodal rainfall, the short rainfall duration (half of March to May) with 39.63 mm and long rainfall time (September to November) with 1000 mm with the minimum and maximum mean annual rainfall of 750-900 mm. The recorded temperature in the area range from 23.9°C during short rainfall and 11.7°C during long rainfall and the relative humidity of the region vary from 23.9-79% (ANRS, 2007). The vegetation in the area changes with altitude ranging from scattered free bushes to dense shrubs. The farming system in the area is mixed type crop-livestock production. The major crops grown in the area include sorghum, wheat, teff, barely, maize and others.

Study subjects and population: Annual record of individual cases from different local hospitals of South Wollo Zone in Dessie research regional laboratory that were admitted from September 2006 to June 2011 was documented. The total number of cases admitted every year, their sex, age, type of sample taken and the pathogen identified were carefully documented to assess the extent and importance of infectious bacterial organisms in the study area.

Study design: The study design was retrospective type. All secondary data sources were used as a source of information. The study was conducted using the laboratory reports of the diagnostic results documented in the consecutive 5 years period in Dessie regional health research laboratory, Amhara Regional Health Bureau.

Statistical analysis: The secondary data sources were collected. The data was entered and managed in MS Excel data sheet. Then, the data was analyzed using intercooled STATA Version 7.0 Statistical Software (STATA Corporation, College Station, Texas, USA). The prevalence of each zoonotic and infectious bacterial organism was calculated by dividing the number of positive findings/records by the total cases diagnosed at that particular year. The χ^2-test was used to assess difference in the frequency of zoonotic disease between years, sexes and age groups. Odds Ratio (OR) was calculated to assess the strength of association of different factors. A statistically significant association between variables was said to exist if the calculated $p<0.05$ and the 95% Confidence Interval (CI) for OR doesn't include 1.

RESULTS AND DISCUSSION

Overall prevalence of zoonotic and infectious bacterial organisms: Out of 2395 individual cases, 1186 were found to be infected with one or more infectious bacterial organisms which gave a prevalence rate of 49.52% (95% CI: 47.52-51.52%) (Table 1).

Prevalence of zoonotic and infectious bacterial organisms by sex: Out of the 1186 infected individual

cases, 655 (49.73%) and 531(49.26%) were females and males, respectively (Table 1). However, between the risk groups, the prevalence of infectious organisms was found statistically insignificant.

Prevalence of zoonotic and infectious bacterial organisms by age: Table 2 indicated that the prevalence of bacterial infection was statistically significant (χ^2 = 8.8953; p = 0.031) among different age groups. Those individuals <12 years old were 1.37 fold (OR = 1.37; 95% CI: 1.08-1.75) found affected than those individuals below 35 years old. The prevalence of infectious bacterial organisms was decreased as age of individual cases increased (Table 2).

Prevalence of zoonotic and infectious bacterial organisms by year: Higher (13.57%) proportion of bacterial infection was recorded during the year 2009/10 and least (8.1%) record was documented in the year 2010/11 (Fig. 1).

Out of the 1186 identified zoonotic and infectious bacterial organisms, 337 (14.07%), 267 (11.15%) and 155 (6.47%) were found to be *E. coli*, *Pseudomonas* species and *Staphylococcus aureus*, respectively which were predominant bacteria in the years 2006/7-2010/11 (Table 3). Additionally, mixed infection was recorded in 90 (3.76%) individual cases. *S. aureus*, *E. coli*, *Pseudomonas*, *Proteus* and *Citrobacter* species were found in most of the mixed infections.

Prevalence of zoonotic and bacterial infectious organisms by sample type: *Pseudomonas* species were found predominant in almost five types of samples; from 673 ear samples 107 (15.90%), 100 eye samples 23 (23.00%), 297 pus samples 48 (16.16%), 740 urine samples 43 (5.81%) and from 144 Vaginal discharge samples 25 (17.36%). *E. coli* was found to be predominant which was 66 (21.22%) out of 83 stool samples taken, *S. aureus* was also identified; 9 (10.84) and 5 (10.64) from 311 wound samples and 47 other samples, respectively (Table 4). Only 4 (1.29%) *Salmonella* species were found in samples taken from stool and *Shigella* species were found to be common in samples taken from stool, 3 (0.96%) and ear, 1(0.15%) (Table 4).

In this retrospective study, 2395 individual cases were recorded in Dessie regional laboratory, health research center in the years, September 2006 to June 2011. Out of these recorded cases, 1186 were found to be infected with one or more infectious bacterial organisms which gave a prevalence rate of 49.52% (95% CI: 47.52-51.52%). From the infected individual cases, 655 (49.73%) and 531 (49.26%) were females and males, respectively. However, between the risk groups, the prevalence of infectious organism was found statistically insignificant.

In the present study the prevalence of infectious bacterial organisms was statistically significant among different age groups. Those individuals below 12 years old were 1.37 fold (OR = 1.37; 95% CI: 1.08-1.75) found affected than those individuals above 35 years old. The prevalence of infectious bacterial organism was decreased as age of individual cases increased. Although, every human being is exposed to innumerable bacteria, some of

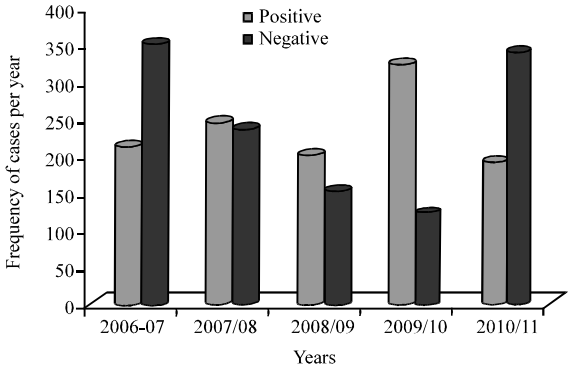

Fig. 1: Frequency of cases per 5 consecutive years (2006/2007 to 2010/2011). Positive (214, 249, 204, 325 and 194) and Negative (353, 240, 151, 125 and 340)

Table 1: Overall prevalence of zoonotic and infectious bacterial organisms by sex

	Number			
Risk factor	Positive (%)	Negative (%)	Total (%)	χ^2 (p-value)
Sex				0.0538
Male	531 (49.26)	547 (50.74)	1078 (45.01)	
Female	655 (49.73)	662 (50.27)	1317 (54.99)	
Total	1186 (49.52)	1209 (50.48)	2395 (100.00)	

Table 2: Level of association prevalence of bacterial infection in different age groups

	Number				
Risk factor	Positive (%)	Negative (%)	Total (%)	χ^2 (p-value)	OR (95% CI)
Age				8.8953 (0.031)	
<12	255 (54.49)	213 (45.51)	468 (19.54)		1.37 (1.08-1.75)
12-18	188 (52.37)	171 (47.63)	359 (14.99)		1.26 (0.97-1.64)
19-35	464 (47.88)	505 (52.12)	969 (40.46)		1.05 (0.86-1.29)
>35	279 (46.58)	320 (53.42)	599 (25.01)		1
Total	1186 (49.52)	1209 (50.48)	2395 (100.00)		

Table 3: Prevalence of zoonotic and infectious bacterial organisms by 5 consecutive years

	Years					
Infectious organism	2006/7	2007/8	2008/9	2009/10	2010/11	Total (%)
Staphylococcus epidermidis	9	2	4	4	4	23 (0.96)
Staphylococcus aureus	59	27	12	55	2	155 (6.47)
E. coli	81	102	51	56	47	337 (14.07)
Pseudomonas species	18	35	61	78	75	267 (11.15)
Proteus vulgaris	0	3	7	30	20	60 (2.51)
Protues mirabilis	2	5	0	20	13	40 (1.67)
Proteus species	27	19	5	7	4	62 (2.59)
Enterobacter species	2	15	16	34	13	80 (3.34)
Citrobacter species	1	4	5	20	10	40 (1.67)
Klebsiella species	7	2	0	8	4	21 (0.88)
Salmonella species	1	1	1	0	1	4 (0.17)
Shigella species	0	3	0	0	1	4 (0.17)
Edwardsiella species	2	2	2	0	0	6 (0.25)
Mixed infection	5	29	40	16	0	90 (3.76)
No pathogen identified	353	240	151	122	340	1206 (50.35)
Total	567	489	355	450	534	2395 (100.00)

Table 4: Prevalence of zoonotic and infectious bacterial organisms per sample taken during

	Sample taken								
Infectious organism	Ear	Eye	Pus	Urine	Vaginal discharge	Wound	Stool	Others	Total (%)
S. epidermidis	6 (0.89)	1 (1.00)	5 (1.68)	10 (1.35)	1 (0.69)	0 (0.00)	0 (0.00)	0 (0.00)	23 (0.96)
S. aureus	76 (11.29)	1 (1.00)	31 (10.44)	25 (3.38)	4 (2.78)	9 (10.84)	4 (1.29)	5 (10.64)	155 (6.47)
E.coli	71 (10.55)	14 (14.00)	32 (10.77)	121 (16.35)	25 (17.36)	5 (6.02)	66 (21.22)	3 (6.38)	337 (14.07)
Pseudomonas species	107 (15.90)	23 (23.00)	48 (16.16)	43 (5.81)	25 (17.36)	7 (8.43)	11 (3.54)	3 (6.38)	267 (11.15)
P. vulgaris	37 (5.50)	0 (0.00)	11 (3.70)	3 (0.41)	2 (1.39)	5 (6.02)	2 (0.64)	0 (0.00)	60 (2.51)
P. mirabilis	30 (4.46)	1 (1.00)	4 (1.35)	3 (0.41)	1 (0.69)	0 (0.00)	1 (0.32)	0 (0.00)	40 (1.67)
Proteus species	42 (6.24)	1 (1.00)	5 (1.68)	6 (0.81)	0 (0.00)	4 (4.82)	4 (1.29)	0 (0.00)	62 (2.59)
Enterobacter species	36 (5.35)	9 (9.00)	12 (4.04)	11 (1.49)	6 (4.17)	5 (6.02)	1 (0.32)	0 (0.00)	80 (3.34)
Citrobacter species	26 (3.86)	2 (2.00)	5 (1.68)	0 (0.00)	3 (2.08)	3 (3.61)	1 (0.32)	0 (0.00)	40 (1.67)
Klebsiella species	10 (1.49)	0 (0.00)	2 (0.67)	7 (0.95)	0 (0.00)	1 (1.20)	0 (0.00)	1 (2.13)	21 (0.88)
Salmonella species	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	4 (1.29)	0 (0.00)	4 (0.17)
Shigella species	1 (0.15)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	3 (0.96)	0 (0.00)	4 (0.17)
Edwardsiella speices	2 (0.30)	0 (0.00)	1 (0.34)	3 (0.41)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	6 (0.25)
Mixed infection	40 (5.94)	3 (3.00)	19 (6.40)	8 (1.08)	1 (0.69)	10 (12.05)	4 (1.29)	5 (10.64)	90 (3.76)
No pathogen identified	189 (28.08)	45 (45.00)	122 (41.08)	500 (67.57)	76 (52.78)s	34 (40.96)	210 (67.52)	30 (63.83)	1206 (50.35)
Total	673.00	100.00	297.00	740.00	144.00	83.00	311.00	47.00	2395(100.00)

us are at risk of infection than others. Individuals at either end of the age spectrum (neonates and the elderly) are at increased risk of bacterial infections. According to Chandra (2002, 2004) neonates are most susceptible to infections by pathogens such as *E. coli* and people older than 60 years are susceptible to lower respiratory tract infections caused by *Staphylococcus* species.

Higher proportion of bacterial infection was recorded during the year 2009/10 and least record was documented in the year 2010/11. This may be due to the reason that the number of individual cases presented, weather condition of the year that might have contributed a lot for the survival of the pathogen in the environment. Out of the 1186 identified infectious bacterial organisms, 337 (14.07%), 267 (11.15%) and 155 (6.47%) were found to be *E. coli*, *Pseudomonas* species and *Staphylococcus aureus*, respectively which were predominant bacteria of the years, September 2006 to June 2011 (Table 3). Additionally, mixed infection was recorded in 90 (3.76%) individual cases. *S. aureus*, *E. coli*, *Pseudomonas*, *Proteus* and *Citrobacter* species were found in most of the mixed infections.

Pseudomonas species were found predominant in almost five types of samples; 107/673 (15.90%), 23/100 (23.00%), 48/297 (16.16%), 43/740 (5.81%) and 25/144 (17.36%) were isolated from ear, eye, pus, urine and vaginal discharge samples, respectively. *E. coli* was found to be predominant, 66 (21.22%) out of 83 stool samples taken. *S. aureus*; 9 (10.84) and 5 (10.64) from 311 wound samples and 47 other samples was also identified, respectively (Table 4). Only 4 (1.29%) *Salmonella* species were found in samples taken from stool but none in the other samples. The present study agreed with earlier study of Ashenafi and Lindtijorn (1999) in Yirga Alem Hospital, Sidama Zone of the Southern National, Nationalities and Peoples Region of Ethiopia which was stated as *Staphylococcus aureus*, *Escherichia coli*, *Proteus* and *Streptococcus pyogenes* were the most common bacteria isolated from abscesses whereas *Staphylococcus aureus* and *Proteus* species dominated among isolates from infected wounds. The most common isolates from urine were *E. coli*, *Proteus* species, Klebsiella pneumonia and coagulase negative staphylococci.

In a retrospective cross sectional study examined laboratory records of 4485 stool specimens analyzed by Botswana National Health laboratory in Gaborone from 2003 through 2008, 367 (8.2%) bacterial pathogens were isolated. The most common bacterial pathogens were *Shigella* species and *Salmonella* species, isolated from 4.0% (180) and 3.9% (175) of specimens, respectively. *E. coli* accounted for 0.5% (22) pathogens. The present study revealed that only 4 (1.29%) *Salmonella* species and 3 (0.96%) *Shigella* species were found in samples taken from stool.

Zoonotic and other infectious bacterial diseases are an important cause of morbidity and mortality in developing countries like Ethiopia. The intervention was found to be effective but not as much as expected. Individuals as well as societies have been slow to act on zoonoses. This could be due to insufficient systematic continuing education and opportunities to acquire new knowledge on zoonoses for those working in health institutions (Asano *et al*., 2003). A physician attending to an ill veterinarian or a zookeeper will immediately suspect a wide array of diseases other than zoonoses; likewise a pediatrician attending to a sick child who recently received a puppy will not suspect an animal transmitted disease. All these underscores the fact that medical professionals have not been giving due consideration of animals as carriers of diseases that can be transmitted to humans. This has resulted in poor quality of epidemiological data on zoonoses and their control measures on animal and human population; particularly in sub-Saharan Africa. Zoonotic diseases remain common health problems in the community of the study area.

CONCLUSION

The present study indicated that zoonotic and other infectious bacterial organisms are more prevalent and this also shows the organisms are circulating among the population of the South Wollo. From this study, it can be concluded that it is necessary to study and investigate the different potential sources of infectious organisms for their safety along with the environmental and socioeconomic factors of the community.

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