The Prevalence of Community Acquired Salmonellosis, Associated Factors and Antibiotic Susceptibility Among Out Patients Attending Kagando Hospital, Kasese District, Mid-western, Uganda.

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Research Article

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Abstract

Background: Uganda has experienced a number of typhoid fever out breaks, the most recent being in Kampala city in which 1,038 (29%) patients were positive out of 3464 suspected cases. In 2011, typhoid cases (1042) were reported in Kasese and neighboring Bundibugyo District with many more intestinal perforations (566) and with emergence of multidrug resistant strains.

Objective: The study was conducted at Kagando hospital in Kasese district to determine the prevalence of community acquired Salmonellosis, evaluate antimicrobial susceptibility and document factors associated with salmonellosis.

Methods: A cross sectional study was used to enroll 165 participants at Kagando hospital suspected of having salmonellosis. Data on demographics and risk factors were explored by the questionnaire. Venous blood and stool samples were taken from each participant to run a rapid test for *Salmonella* Typh*i*/ Paratyphi immunoglobulin M and G (IgM/IgG) and culture respectively.

Results: Prevalence of Salmonellosis by *Salmonella* Typhi*/*Paratyphi IgM/IgG serological testing was 22% and 15.8% by culture of blood and stool. NTS accounted for a prevalence of 10.3% followed by *S.* Typhi 4.9% and then *S.* Paratyphi 0.61%. Most isolates were susceptible to levofloxacin, Gentamycin, Imipenem, Tetracycline and Cotrimoxazole. Most isolates were resistant to ampicillin, ceftriaxone and amoxicillin-clavulanic acid. Salmonellosis was associated with consumption of locally packed water, primary level of education, non-hand washing, history of gastric surgery and *Helicobacter pylori* treatment.

Conclusion: Confirmed Community acquired salmonellosis exists among out patients attending Kagando hospital in Kasese district at a prevalence of 15.8% and a sero prevalence of 22%. Salmonellosis is associated with consumption of locally packed water, history of gastric surgery, primary level of education, *Helicobacter pylori* treatment and the practice of non-hand washing. Routine Culture and sensitivity is recommended for proper diagnosis and appropriate treatment of patients with clinical diagnosis of salmonellosis. Also sensitization on community acquired salmonellosis through health education programs should be considered.

Background

Salmonellosis is one of the most common food borne infections on the globe [8;3] and 12 to 33 million cases of 2 Salmonellosis are reported globally [1;7]. World-wide, NTS is estimated to cause 3.4 million cases of salmonellosis, resulting in 681,000 deaths annually; 57% of these infections and deaths occur in Africa [7].

Salmonellosis is caused mainly by the common serovars of *Salmonella enterica* subspecies *enterica* that includes serotype Typhi (*S.* Typhi), serotype Paratyphi (*S.* Paratyphi) and several non-Typhi serotypes of *S. enterica* (NTS) that are important causes of childhood and adult hood bacteremia in Africa [15;8].

Uganda has experienced a number of typhoid fever out breaks, the most recent being in Kampala city in which 1,038 (29%) patients were serologically positive out of 3464 suspected cases [11]. In addition, an outbreak of typhoid fever in Kasese District affected 577 persons from 27 December 2007 to 30 July 2009, resulting in at least 249 patients being diagnosed with intestinal perforations and 47 deaths [17;11]. In 2011, numerous typhoid cases (1042) were again reported in Kasese and neighboring Bundibugyo District where many more persons suffered intestinal perforations (566) which could have been as a result of multidrug resistant strains of *Salmonella* [19;11]. The emergence of antimicrobial resistant *Salmonella* strains is a serious health problem globally.

A study conducted in Kasese district in 2008–2009 reported that 76% of *Salmonella* Typhi isolates were resistant to ampicillin, streptomycin, sulfamethoxazole, tetracycline, and cotrimoxazole, but were susceptible to chloramphenicol; however no resistance to nalidixic acid or ciprofloxacin was detected [17]. About two years later another study reported that 83% of *Salmonella* Typhi isolates were resistant to ampicillin, chloramphenicol, and cotrimoxazole (MDR), and were also resistant to sulfamethoxazole, streptomycin, and tetracycline. Only one isolate showed intermediate susceptibility to ciprofloxacin [19]. The current antibiotic susceptibility is unknown yet literature shows that changes in susceptibility to different drugs occur often. The study is therefore aimed at determing the current prevalence of salmonellosis, establish associated factors and evuluate antibiotic susceptibility to commonly prescribed antibiotics.

Materials And Methods

Study design.

This was a cross sectional study and data was obtained from the questionnaires and laboratory analysis of blood and stool samples.

Inclusion criteria.

1. Patients aged 2 years and above attending Kagando hospital outpatient's department.
2. Patients suspected of having salmonellosis by the clinician at the outpatients department basing on the following signs and symptoms; body temperature above 37.5℃, loose stools, vomiting, nausea, headache, abdominal cramps, relative bradycardia, and myalgias. Signed informed consent form for participants aged 18 years and above or signed assent form for participants who are less than 18 years.

Exclusion criteria.

1. Patient unable to provide study sample, that is; stool and blood.

Sample collection and Laboratory Test.

Blood sample.

Venous blood samples were taken from patients by venipuncture. This was followed by inoculation of 7 mls or 3 mls of blood into 20 mls of sterile brain-heart infusion broth (BHI) (CM1135; Oxoid Ltd., England, UK) The culture bottles were incubated at 37°C for 7 days and examined daily for evidence of bacterial growth, including turbidity and hemolysis. If bacterial growth was observed, a subculture was made on Xylene Lysine Deoxycholate agar (XLD) (CM0271, Oxoid Ltd., England UK) and *Salmonella Shigella* agar (SSA) (CM0099, Oxoid Ltd., England, UK).

Three(3) mls of blood sample used to run the *Salmonella* Typhi and Paratyphi IgG/IgM serological test.

Stool sample.

Stool samples were collected in accordance with the World Health Organisation (WHO) standard guidelines [20], thereafter about 1 gram of stool was cultured in Selenite F broth overnight followed by sub culture on *Salmonella Shigella* (SS) agar and Xylene Lysine Deoxycholate agar (XLD) and incubated for 18–24 hours at 35–37°C [4].

Transparent colonies with or without black centers on SSA and pink-red colonies with metallic sheen with or without a black center on XLD were presumptively identified as *Salmonella* species [14;4].

Biochemical identification.

All presumptive positive Salmonella isolates were sub-cultured on Urea agar, Triple sugar iron (TSI), Motility indole ornithine (MIO), Simon's Citrate ager (SCA) and Lysine iron agar (LIA) followed by incubation for 24 hours. Interpretation of the reactions on these Biochemical tests helped in broad classifying *Salmonella* isolates as either *Salmonella* Typhi, *Salmonella* Paratyphi or Non-Typhi *Salmonella* (NTS) [14;4].

Antimicrobial susceptibility testing.

Antimicrobial susceptibility of *Salmonella* isolates was determined by the agar disc diffusion method on Mueller-Hinton agar (CM0337; Oxoid Ltd., England, UK) according to the protocol and guidelines of the European Committee on Antibiotic Susceptibility Testing –EUCAST and Clinical Laboratory Standards Institute - CLSI [9;5]. The *Salmonella* strains were screened for their susceptibility to the following antimicrobials: Ampicillin (AMP, 10µg), Cefuroxime (CFX, 30µg), Ceftriaxone (COX, 30µg), Gentamicin (CEN, 120µg), Imipenem (IMP, 10µg), Amoxicillin-clavulanic acid (AMC, 30 + 10µg), Tetracycline (TET, 30µg), Chloramphenicol (COL, 30µg), Trimethoprim (TRI, 1.25µg)/Sulfamethazole (SUL, 23.75µg), Nalidixic acid (NAL, 30µg), Ciprofloxacin (CIP, 30µg) and Levofloxacin (LEV, 5µg). Six drug discs were used on each plate at an interval of 20 mm.

Escherichia coli - American type culture collection (ATCC) 25922 and *Pseudomonas aeruginosa* ATCC 27853 were used for quality control. The EUCAST (2018) guidelines [9] and CLSI (2018) breakpoints [6] were used to interpret zone diameters.

Results

Study flow:

One hundred and eighty (180) outpatients at Kagando hospital suspected by the clinician of having salmonellosis were screened for eligibility to participate in the study. After excluding 15 (8.3%) outpatients who did not fulfill the inclusion criteria (failed to provide the study samples) or declined to participate in the study, 165 (91.7%) outpatients were enrolled as study participants in a cross sectional study as shown in figure 1 below.

Demographic description of study participants.

Males were 88 out of 165 (53%) while females were 77 out of 165 (47%). Majority of study participants were aged between 4 to 24 years and these were 72 (44%), those aged 25 to 40 years were 46 (28%) and those aged 41 and above were 47 (28%). Mean age for males was 30 years while females had a mean age of 32 years with overall mean age of 31 years. Majority of study participants came from nuclear families 119 (72%) while the rest 46 (28%) came from extended families. Most of the study participants were married and these accounted for 83 (50.3%) followed by single participants 80 (48.5%) and then finally separated participants 2 (1.2%). Most study participants had achieved tertiary level of education 59 (36%), then followed by those with primary level 50 (30%), then secondary level 45 (27%), and then finally non-educated 11 (7 %.) as shown in table 1 below.

Table 1: Demographic description of study participants.

Variable	Frequency (percentage)
Age categories (years)	
4-24	72 (44%)
25-40	46 (28%)
41 and above	47 (28%)
Gender	
Females	77 (47%)
Males	88 (53%)
Marital status	
Separated	2 (1.2%)
Single	80 (48.5%)
Married	83 (50.3%)
Education level	
No education	11 (7%)
Primary	50 (30%)
Secondary	45 (27%)
Tertiary	59 (36%)
Family setting	
Nuclear	119 (72%)
Extended	46 (28%)

Overall prevalence of Salmonella infection (typhoid, paratyphoid and non-typhi salmonellosis).

The sero prevalence of salmonellosis by *Salmonella* Typhi/Paratyphi IgM/IgG serological testing was 22% (36 positive out of 165 study participants) as shown in table 2 below

Table 2: Prevalence of salmonellosis by *Salmonella* Typhi/Paratyphi IgM/IgG by serological testing.

Salmonella typhi/paratyphi IgM/IgG result	Frequency	Prevalence (%)
Positive	36	22
Negative	129	78
Total	165	100

Blood and stool culture was positive for 26 study participants out 165, giving a general prevalence of 15.8%. Of the 26 isolates 65.4% (17 out of 26) were Non-typhi salmonella, 30.8% (8 out of 26) were *Salmonella* Typhi and 3.8 % (1 out of 26) was *Salmonella* Paratyphi. Non-Typhi *Salmonella* accounted for a prevalence of 10.3% (17 out of 165) followed by *Salmonella* Typhi with a prevalence of 4.9% (8 out of 165) and then finally *Salmonella* Paratyphi with prevalence of 0.61% (1 out of 165) as shown in figure 2 below

Of the 165 study participants, 6 (3%) had a positive culture of blood or stool for *Salmonella* (either Typhi or Paratyphi or NTS) and a positive *Salmonella* Typhi/Paratyphi IgM/IgG test, 20 (12.1%) had a positive culture of blood or stool for *Salmonella* (either Typhi or Paratyphi or NTS) and a negative *Salmonella* Typhi/Paratyphi IgM/IgG test, 30 (18.2%) had a positive *Salmonella* Typhi/Paratyphi IgM/IgG test and a negative culture of blood or stool for *Salmonella* (either Typhi or Paratyphi or NTS, and finally 109 (66.1%) had both culture of stool or blood and *Salmonella* Typhi/Paratyphi IgM/IgG test negative as shown in table 3 below.

Table 3: Comparison of *Salmonella* Typhi/Paratyphi IgM/IgG test with Culture of stool and blood.

	Blood and stool culture			
Salmonella Typhi/Paratyphi IgM/IgG test		Positive Salmonellosis (%)	Negative Salmonellosis (%)	Total
	Test positive	06 (3.6%)	30 (18.2%)	36
	Test negative	20 (12.1%)	109 (66.1%)	129
	Total	26	139	**165**

Description of the susceptibility of salmonella isolates to selected antibiotics.

a.) Levofloxacin (LEV): Of the 26 salmonella isolates; one (3.8 %) isolate was resistant while 25 (96.2) isolates were susceptible. No isolate had intermediate susceptibility.

b.) Ampicillin (AMP): Of the 26 salmonella isolates; 24 (92.3%) isolates were resistant while 2 (7.7%) isolates were susceptible. No isolate had intermediate susceptibility.

c.) Cefuroxime (CFX): Of the 26 salmonella isolates; 4 (15.4%) isolates were resistant while 22 (84.6%) isolates shown intermediate susceptibility. No isolate was susceptible.

d.) Ceftriaxone (COX): Of the 26 salmonella isolates; 13 (50.0%) isolates we susceptible, 9 (34.6%) were resistant while 4 (15.4%) isolates shown intermediate susceptibility.

e.) Gentamycin (CEN): Of the 26 salmonella isolates; 25 (96.2%) isolates were susceptible while 1 (3.8%) isolate was resistant. No isolate had intermediate susceptibility.

f.) Imipenem (IMP): Of the 26 salmonella isolates; 25 (96.2%) isolates were susceptible while one (3.8%) isolate had intermediate susceptibility. No isolate was resistant.

g.) Amoxicillin-clavulanic acid (AMC): Of the 26 salmonella isolates; 21 (80.8%) isolates were resistant, four (15.4%) isolates were susceptible while one (3.8%) isolate had intermediate susceptibility.

h.) Tetracycline (TET): Of the 26 salmonella isolates, 23 (88.5%) isolates were susceptible while three (11.5%) isolates were resistant. No isolate had intermediate susceptibility.

i.) Chloramphenicol (COL): Of the 26 salmonella isolates; 19 (73.1%) isolates were susceptible, two (7.7%) isolates were resistant while five (19.2%) isolates had intermediate susceptibility.

j.) Cotrimoxazole (SXT): Of the 26 salmonella isolates; 24 (92.3%) isolates were susceptible while two (7.7%) were resistant. No isolate had intermediate susceptibility.

k.) Nalidixic acid (NAL): Of the 26 salmonella isolates; 11 (42.3%) isolates were susceptible, 11 (42.3%) isolates had intermediate susceptibility while four (15.4%) isolates were resistant.

l.) Ciprofloxacin (CIP): Of the 26 salmonella isolates; 20 (76.9%) isolates were susceptible, one (3.8%) isolate was resistant while five (19.2%) isolates had intermediate susceptibility as shown in figure 3 below.

Factors associated with confirmed *Salmonella* infection (salmonellosis).

Bi-variate data analysis showed observed association between salmonellosis and;

1. Being of female gender, odds ratio (OR) 1.17, confidence interval (95% CI) 0.51 – 2.71, p-value 0.71.
2. Having a primary level of education OR 1.57, 95% CI 0.59 – 4.15, p-value 0.37.
3. The practice of non-hand washing practice OR 1.45, 95% CI 0.31 – 6.76, p-value 0.64.
4. Having a history of gastric surgery OR 1.36, 95% CI 0.27 – 6.82, p-value 0.71.
5. Consumption of locally packed water in “kavera” OR 1.28, 95% CI 0.55 – 2.96, p-value 0.57.
6. Being on helicobacter pylori treatment OR 1.05, 95% CI 0.41 – 2.71, p-value 0.91 as shown in table 4 below.

Table 4: Factors associated with confirmed *Salmonella* infection (bi-variate analysis).

Factor	Odds ratio	p-value	95% Confidence interval
Gender			
Female	1.17	0.71	0.51 - 2.71
Education			
Primary level	1.57	0.38	0.59 - 4.16
Hand wash			
No	1.45	0.64	0.31 - 6.76
Gastric surgery			
Yes	1.36	0.71	0.27 - 6.82
Drink Locally packed water (kavera)			
Yes	1.28	0.57	0.55 - 2.96
Helicobacter pylori treatment			
Yes	1.05	0.91	0.41- 2.71

Multi-variate data analysis and controlling for confounders using Mantel-Haenszel (MH) method showed a little stronger association between salmonellosis and;

1. Consumption of locally packed water in “kavera” MH OR 2.15, 95% CI 0.87 – 5.30, p-value 0.09.
2. The practice of non-hand washing practice MH OR 1.76, 95% CI 0.33 – 9.56, p-value 0.50.
3. Having a primary level of education MH OR 1.95, 95% CI 0.71 – 5.19, p-value 0.20.
4. Having a history of gastric surgery MH OR 1.68, 95% CI 0.29 – 9.67, p-value 0.55.
5. Being on helicobacter pylori treatment MH OR 1.28, 95% CI 0.32 – 5.15, p-value 0.73 as shown in table 5 below.

Table 5: Factors associated with confirmed *Salmonella* infection (multi-variate analysis and mantel-Haenszel analysis).

Factor	MH- odds ratio	p-value	95% confidence interval
Locally packed water			
Yes	2.15	0.09	0.87 - 5.30
Hand washing			
No	1.76	0.50	0.33 - 9.56
Gastric surgery			
Yes	1.68	0.56	0.29 - 9.67
Helicobacter pylori treatment			
Yes	1.28	0.73	0.32 - 5.15
Education			
Primary level	1.95	0.20	0.71 - 5.19

Discussion

The results obtained show that there is moderately high prevalence of confirmed community acquired salmonellosis of 15.8 % among out patients attending Kagando hospital in Kasese district, that is higher than the prevalence of 11% of *Salmonella* Typhi that was documented among patients Kasese district in a study conducted in Kasese and Bundibugyo districts. This can be attributed to the fact that this study looked at the serotypes; typhi, paratyphi and non-typhi salmonella instead of one serotype that was examined in the study in 2009-2011 [19]. However the results are not so different from the prevalence of confirmed salmonella typhi of 16% reported in Bundibugyo district in the same study. Also it is not so different from 15% that was reported in Kampala in 2017 [11;19]. The noticed composition of isolates where by majority being NTS (65.4%) followed by *S.* Typhi (30.8%) and then Paratyphi (3.8%) is in accordance with what was reported in studies; one in rural Tanzanian hospital in 2010 and the other in Ghana in 2017 [15;2]. The higher composition of NTS among the isolates can be attributed to the fact that the current serological kit being used the laboratory diagnosis of salmonellosis is specific for *Salmonella* Typhi and Paratyphi only leading to false negative for NTS and hence no timely treatment leaving un checked NTS organisms circulating with in the population [12].

Serologically the prevalence of 22% obtained in this study is lower than that documented in a study conducted in 2009-2011 of 35% in Kasese district. It is also lower than the 29% reported in Kampala in 2017 [11]. This may be attributed to the different techniques used; that is the *Salmonella* Typhi/Paratyphi IgM/IgG used versus TUBEX TF used in the previous studies [11; 19]. This can be attributed to key interventions by both Government and Non- Government organizations including provision of safe clean piped water in Kasese district and establishing functional health facilities up to parish level [13;12].

In contrast to at least 11% pan-susceptible isolates reported in 2009 - 2011 study, no isolate was found to be pan-susceptible. This can be attributed to the increasing antibiotic resistance among different pathogens [19]. Over 80% of the isolates were resistant to Ampicillin and Amoxicillin-clavulanic acid in accordance with what was observed in 2009 - 2011 study that reported over 83% of isolates being resistant to Ampicillin and Amoxicillin-clavulanic acid [19].

This study noted trend in in which there was an increase in resistance to quinolones. Previously a study conducted in Kasese in 2008-2009 reported no isolate resistant to nalidixic acid and ciprofloxacin, then another study in 2009-2011 reported one isolate resistant to nalidixic acid with intermediate sensitivity to ciprofloxacin [17;19]. However in this study 4 isolates were resistant to nalidixic acid and 1 isolate was resistant to ciprofloxacin. This is in accordance with what was reported in a study in Kampala in 2017 in which 12 isolates resisted nalidixic acid and also showed intermediate sensitivity to ciprofloxacin [19]. Levofloxacin with susceptibility of more than 95% susceptible salmonella isolates is attributed to the fact that it is not routinely used as first line treatment for infections including salmonellosis [18].

Over 70% of isolates were susceptible to Chloramphenical, Cotrimoxazole and Tetracycline in contrast to what was reported in 2008-2009 and 2009-2011 studies in which over 70% of isolates were reported as resistant [17;19]. However this is fairly in agreement with what was reported in a study in Kampala in 2017 [11]. This is because these antibiotics are no longer routinely used on a large scale with some like Cotrimoxazole reserved as a prophylaxis to opportunistic infections among people living with Human Immune deficiency virus (HIV) [18].

The susceptibility of isolates to ceftriaxone (only 50% of Salmonella isolates susceptible) and cefuroxime (no isolate found susceptible though over 80% with intermediate susceptibility) is in accordance with the fact that majority of the isolates were Non-Typhoidal *Salmonella* with known resistance to extended spectrum cephalosporins since 1990s [7;8]. Also most cephalosporins like ceftriaxone are routinely used as either first line or alternative treatment for many bacterial infections [18]. Gentamycin and Imipenem antibiotics each with susceptibility of more than 95% is in accordance with the fact that these antibiotics are not very routinely prescribed by health professionals and also being generally expensive.

The association of community acquired salmonellosis with consumption of locally packed water in “kavera” with MH-OR of 2.15, 95% CI 0.87 – 5.30, is in accordance with association reported in a study in Kampala in 2017 [11]. The associations between community acquired salmonellosis and; history of gastric surgery with MH OR 1.68, 95% CI 0.29 – 9.67 and helicobacter pylori treatment with MH OR 1.28, 95% CI 0.32 – 5.15 are not very new findings since they had been documented in 2015 [7] and 2001 [10].

The associations between community acquired salmonellosis and; primary level of education and non-washing of hands can regarded as manifestation of illiteracy with MH OR 1.95, 95% CI 0.71 – 5.19 and MH OR 1.76, 95% CI 0.33 – 9.56 respectively. This is in agreement with what was documented in 2015 [7]

The non-statistical significance of observed association between salmonellosis and the factors can be attributed to a relatively small sample size.

Conclusion

- Salmonellosis was high among out patients attending Kagando hospital in Kasese district. This is to recommend the following; Intense sensitization on community acquired salmonellosis through health education programs.
- Culture and sensitivity should be encouraged for proper diagnosis and appropriate treatment of patients with salmonella infections.
- Periodic monitoring of water sources in the community through Testing of water samples including immediate products like cold millet porridge and fruit juices should be considered.
- More research on salmonellosis should be carried out across Uganda with consequent review of the Uganda clinical guidelines of 2016.

Abbreviations

ATCC - American type culture collection, CLSI - Clinical and Laboratory Standards institute, CPHL - Central Public Health Laboratories, ELISAs - Enzyme linked immunosorbent assays, EUCAST - European Committee on Antimicrobial Susceptibility Testing, HIV - Human immune deficiency virus, IgG - Immunoglobulin class G, IgM - Immunoglobulin class M, LPS - Lipo-poly saccharide, MAR - Multiple antimicrobial resistance, MDR - Multi Drug resistence, MOH - Ministry of Health, MUST - Mbarara University of Science and Technology, NTS - Non Typhi *Salmonellae*, ROU - Republic of Uganda, SSA - Salmonella Shigella agar, TSI - Triple sugar iron, UK - United Kingdom, USA - United States of America, WHO - World Health Organization, XLD - Xylose lysine deoxycholate agar.

Declarations

Ethical consideration

Ethical approval to conduct the study was obtained from Mbarara University of Science and Technology Research and Ethics Committee (REC) (Ref. MUREC 1/7). Upon ethical clearance, Administrative clearance was sought from Kagando Hospital to conduct the study from the hospital and written informed consent was sought from each participant. All participants who were found with typhoid were referred to clinicians for further management.

Availability of data and materials

Data and materials are readily available from the corresponding author upon request.

Authors' contributions

BK and TK contributed in study conception and design, HZ Collected data and participated in laboratory analysis, IK carried out data analysis, MB and HI wrote the first draft of the manuscript while JB reviewed and approved the manuscript.

Conflicts of Interest

The authors declare that they have no conflicts of interest

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Figures

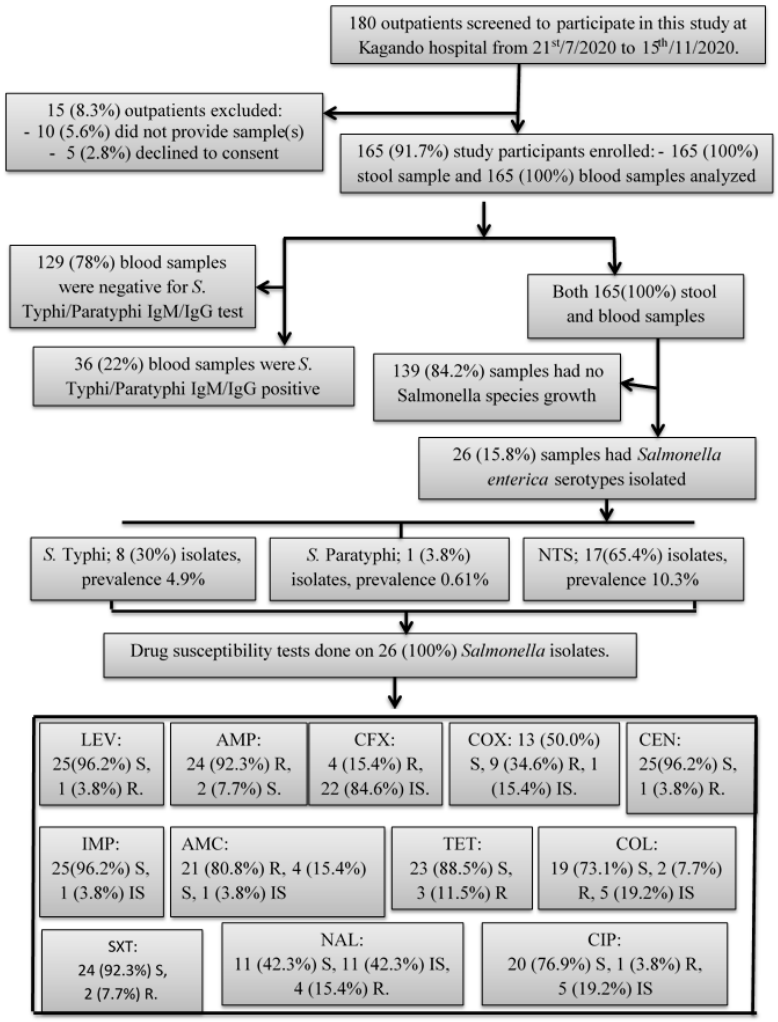

Figure 1

Study flow diagram. Key: LEV – Levofloxacin (5 µg), AMP – Ampicillin (10µg), CFX – Cefuroxime (30µg), COX – Ceftriaxone (30µg), CEN – Gentamycin (120µg), IMP – Imipenem (10µg), AMC – Amoxicillin-clavulanic acid (20µg + 10µg), TET – Tetracycline (30µg), COL – Chloramphenicol (30 µg), SXT – Cotrimoxazole (Trimethoprim 1.25 µg + Sulfamethoxazole 23.75µg) , NAL – nalidixic acid (30 µg), CIP – Ciprofloxacin (30µg), R – Resistant, IS – Intermediate susceptibility, S – Susceptible, Ig M and G – Immunoglobulin M and G respectively.

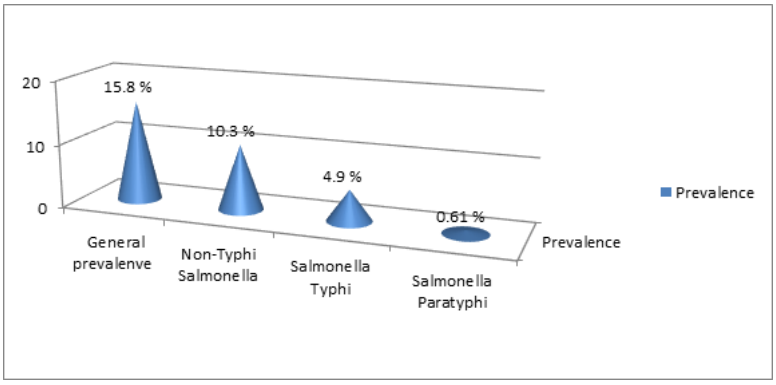

Figure 2

General and specific prevalence of salmonellosis by blood and stool culture.

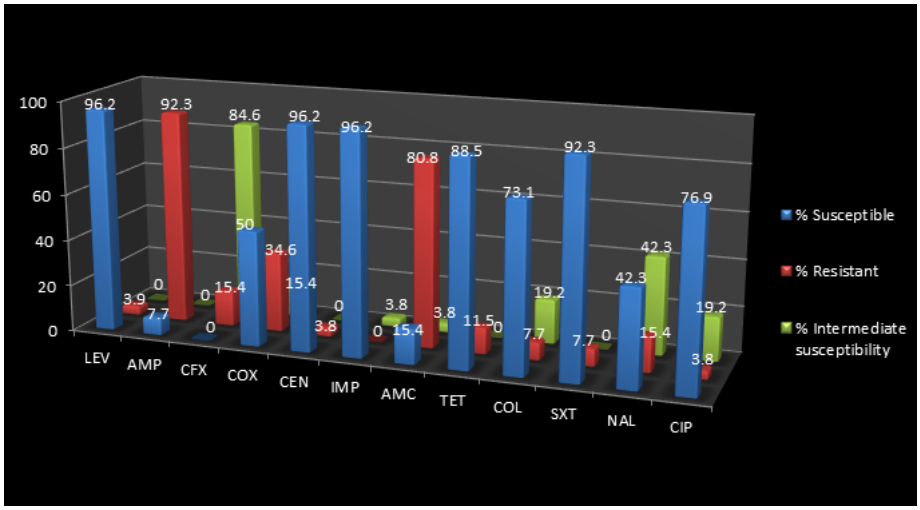

Figure 3

Description of the susceptibility of Salmonella isolates to selected antibiotics.