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ORIGINAL ARTICLE

ENTERIC PATHOGENS AND ANTIMICROBIAL SUSCEPTIBILITY PROFILE AMONG PEDIATRIC PATIENTS WITH DIARRHEA IN ADDIS ABABA, ETHIOPIA

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ABSTRACT

Background: *Diarrheal disease remain a major public health problem in developing countries including Ethiopia. The current study was designed to isolate medically important bacterial enteric pathogens and assess the antimicrobial susceptibility pattern for prescribed drugs.*

Methods: *A cross-sectional study was performed between November 2016 and May 2017 to determine bacterial enteric pathogens that cause diarrhea and assess their antimicrobial susceptibility profile. Stool specimens from pediatric patients aged 0-14 years were collected from two health centers and one specialized hospital to identify bacterial enteric pathogens. Antimicrobial susceptibility tests were performed on bacterial isolates using the Kirby -Bauer disc diffusion method.*

Results: *Out of 290 study patients with diarrhea examined, the majority of bacterial enteropahogens isolated in the study were Shigella species 22(7.6%) followed by enterohemorrgic E.coli O157:H7 13(4.5%) and Salmonella species 7(2.4%). Among the Salmonella species 42.9% showed resistance to trimethoprim-sulphamethoxazole. Among the Shigella species, 77.3% were resistant to ampicillin and 68.2% to trimethoprim-sulphamethoxazole whereas E.coli O157:H7 strains were resistant mostly to ampicillin (69.2%), and trimethoprim-sulphamethoxazole (46.1%). The overall prevalence of multi-drug resistance (MDR) (to ≥3 classes of antibiotics) among the isolates was 26.2%.*

Conclusion: *Salmonella species, enterohemorrhagic E.coli O157:H7and Shigella species were the most frequently isolated pathogens in children with diarrhea. A high proportion of the Salmonella and Shigella isolates identified in the study showed resistance to the most frequently prescribed drugs ampicillin and trimethoprim-sulphamethoxazole. Ciprofloxacin was found to be the best drug of choice for the treatment of diarrhea caused by Salmonella and Shigella. When antibiotics are indicated to treat diarrhea in children, clinicians should rely on stool culture and antimicrobial susceptibility testing before prescribing drugs.*

Key words*: Enteric pathogens, diarrhea, antimicrobial susceptibility, pediatrics*

INTRODUCTION

Diarrhea is the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual) (1, 2). Bloody diarrhea refers to any diarrheal episode in which the loose or watery stools contain visible blood. Compared with watery diarrhea, bloody diarrhea generally lasts longer, is associated with more complications, is more likely to adversely affect a child's growth, and has a higher case fatality rate (3).

A wide variety of bacterial, viral and protozoan pathogens excreted in the faeces of humans and animals are known to cause diarrhea.

Among the most important of these are *Escherichia coli*, *Salmonella species*, *Shigella species*, *Campylobacter jejuni*, *Vibrio cholerae*, Rotavirus, Norovirus, *Giardia lamblia*, *Cryptosporidium species.*, *and Entamoeba histolytica* (4- 6).

Antimicrobial resistance in enteric pathogens is of great importance in the developing world where the rate of diarrheal diseases is highest. The progressive increase in antimicrobial resistance among enteric pathogens in developing countries is becoming a critical area of concern. The resistance of enteropathogenic bacteria to commonly prescribed antibiotics is increasing both in developing as well as in developed countries. Resistance has emerged even to newer, more potent antimicrobial agents (7).

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Some of the factors leading to increased risk of diarrhea include failure to exclusively breast-feed for the first 4-6 months of life. Diarrhea has been noted to be far greater in non-breastfed than exclusively breast-fed infants. Host susceptibility to infection is determined by the child's age, presence of protective maternal factors (transplacental antibodies), nutritional and immunological status, prior exposure and acquired immunity and genetic susceptibility. Diarrhea as an opportunistic infection may result from immunological impairment due to current illness or immunodeficiency in persons with HIV/AIDS. In rare cases, overuse of antibiotics leads to overgrowth of commensal *Clostridium difficile* which releases a toxin that causes diarrhea in hospital settings. Moreover, some of the antiretroviral medications in HIV patients, particularly protease inhibitors, cause diarrhea as a side-effect. Children with diarrhea are at risk of dehydration and therefore early and appropriate fluid replacement is a main intervention to prevent death (8). The proportion of deaths attributed to diarrhea among children aged under 5 years was 15% worldwide, 25% in Africa and 31% in South East Asia (9).

In Ethiopia there is low culture setup in health facilities; especially of stool culture which is very limited and medical care is dominated by empirical treatment of children with diarrhea. Studies are thus needed to inform choice of the appropriate antibiotics for empirical treatment. Thus, this study was conducted to identify common bacterial and parasitic entropahogens and determine their antimicrobial susceptibility pattern to the most frequent locally prescribed antimicrobial substances for pediatric patients in settings where culture is not routinely available.

MATERIALS AND METHODS

Study design: A cross-sectional study was conducted from November 2016 to May 2017 to identify the enteric pathogens and their antimicrobial susceptibility profile among children with acute diarrheal illness in selected government health facilities in Addis Ababa: Teklehaimanot Health Center, Beletshachew Health Center and Tikur Anbesa Specialized Hospital in Addis Ababa.

Study population: All children with diarrhea visiting the health facilities during the study period. ***Inclusion criteria:*** Children aged 0-14 years (WHO recommended age group) with any type of diarrhea. ***Exclusion criteria:*** Children on antibiotic treatment during data collection time. ***Sampling technique:*** A convenient sampling technique in which all consecutive patients who meet the inclusion criteria were included.

Sample size determination: The sample size was calculated estimating a single population proportion at 95% confidence interval (CI) ($Z\alpha/2 = 1.96$), 5% margin of error, and 10% non-response rates. The prevalence estimate was taken from the study of Balakrishnan 2015 (10). Total sample size was calculated to be 290 including a 10% non-response rate.

Study Variables: Enteric pathogens and antimicrobial susceptibility pattern were dependent variables while socio-demographic variables**,** clinical data, environmental and behavioral variables were the independent variables of the study.

Laboratory methods: At least 5gm of stool samples were collected in a sterile clean and leak-proof plastic container from children who fulfilled the inclusion criteria. The laboratory technologist instructed the baby's mother or care taker to collect the stool specimen in a container with the spoon attached to the lid. Once the specimen was placed in the container, it was sealed and brought to the laboratory. There the specimen was transferred into Cary Blair transport medium and brought to Tikur Anbessa microbiology laboratory at 2-8 ^{O}C.

Culture identification method:
The samples were cultured on differential and selective media for bacterial cultivation in order to isolate bacterial enteropathogens. All stool specimens were inoculated on Salmonella-Shigella (SS) agar, Xylose-Lysine-Deoxycholate (XLD) agar, Hektoen Enteric (HE)agar, Sorbitol-MacConkey medium (10ug) and thiosulfate citrate bile salt sucrose (TCBS) agar. The culture plates were incubated aerobically at 37^{o}C for 18-24 hours. Colonies were examined morphologically for size, shape, and ability to ferment lactose and sorbitol. *E.coli* O157:H7 was identified using Sorbitol-MacConkey media for non sorbitol fermenting colonies, a characteristic of entrohemoregic *E.coli.* Further identification of enteric bacterial pathogens was done using conventional biochemical tests.

The isolates were grouped into lactose fermenting (LF) and non-lactose fermenting (NLF) colonies which were then characterized based on the following standard biochemical tests by Indole Test, Urease test, mannitol broth, hydrogen sulphide production and gas production test (using triple sugar iron agar), citrate utilization test, motility test, carbohydrate fermentation test, malonate test and lysine decarboxylase test (LDC), Oxidase test was used to differentiate *Shigella* (which is oxidase negative) from *Pseudomonas spp* (oxidase positive) which appear as pinkish colonies upon subculture on XLD medium (11).

Antimicrobial susceptibility test:
A pure colony of isolated bacterial organisms was mixed with normal saline to 0.5 McFarland density standard and inoculated on Mueller Hinton agar for susceptibility testing. The following antibiotics were used to screen for the susceptibility of the isolates: ciprofloxacin-CIP (5µg), Augmentin-AUG (30µg), gentamicin-GN (10µg), Chloramphenicol-C (30µg), trimethoprim-sulphamethoxazole-SXT (30µg), Ampicillin -AM (10µg), meropenem-MEM(10µg), Amikacin-AMK (30µg), cefepime FEP (30µg), azithromycin AZT(30µg) and Piperacillin tazobactam –tzp (10µg). After incubation, the diameter of each inhibition zone was measured with a pair of calipers and recorded in mm. The results were interpreted according to 2016 CLSI antimicrobial susceptibility breaking points and recorded as sensitive (s), intermediate (I) or resistant (R) (12).

Quality assurance:
Culture media were tested for sterility and performance. Standard strains of *E. coli* ATCC 25922, *Salmonella* species ATCC13076 and *Shigella* species ATCC 12022 were used for quality control during culture and antimicrobial susceptibility testing.

Data analyses:
Data were entered in SPSS version 20 and analyzed to make inferences on the frequency of occurrence of enteric pathogens associated with diarrhea and on bacterial resistance pattern to locally prescribed antibiotics. Descriptive statistics of frequency, ratio, proportions, and crosstabs were used in analysis.

Ethical consideration:
The study was conducted after it was approved by the Addis Ababa University, Department of Microbiology, Immunology and Parasitology School of Medicine College of Health Sciences Ethical Review Committee. It was also approved by AHRI/ALERT Ethical Review Committee and the Addis Ababa City Administration Health Bureau. The purpose of the study was explained to each participant and informed consent was obtained prior to sample collection. The result was recorded and reported to physicians for patient management.

RESULTS

Socio-demographic variable*:* A total 290 pediatric patients from three health facilities were enrolled in this study. The study participants comprised of 43.1% from Teklehaimanot Health Center, 34.5% from Tikur Anbesa Specialized Hospital, and 22.4% from Beletshachew Health Center with 100% response rate.

The mean age of children in this study was 5.8±3.75 (SD) years and the majority of children with diarrhea, 140(48.3%) were under five followed by 5-9 year olds, 91(31.4%) and those with 10-14 years accounted for 59 (20.3%). Among the study patients, the ratio of males to females was 1.15:1. Most of the study participants were from large family sizes with relatively low income; 55% earned <1500 Ethiopian Birr per month.

Etiologic agents of diarrhea:

The major etiologic agents of diarrhea in children were intestinal parasites, mainly protozoan and bacterial infections which accounted for 93(32%) and 42(14.5%) cases respectively. *E. histolytica* 75 (25.8%) and *G. lamblia 13* (4.5%) were among the most prevalent protozoan infections. The majority of bacterial enteropahogens isolated were *Shigella* species from 22(7.6%) followed by enterohemorrgic *Escherichia coli* O157:H7 from 13(4.5%), and *Salmonella* species from 4 (2.4%) patients. However, no *Vibrio cholerae* was isolated **(Table 1) .**

Table 1: Distribution of etiologic agents of diarrhea among diarrheal pediatric patients attending selected health facilities of Addis Ababa, Ethiopia, 2017.

Enteropahogens	Pediatric Age group			Total 0-14 years
	0-4 years (n=140)	5-9 years (n=91)	10-14 years (n=59)	
Parasite				
E. histolytica	26(18.6%)	32(35.2%)	17(28.8%)	75(25.8%)
G. lamblia	7(5.0%)	2(2.2%)	4(6.7%)	13(4.5%)
H. nana	2(1.4%)	2(2.2%)	-	4(1.4%)
Total	36(25.7%)	36(39.6)	21(35.5%)	93(32.0%)
Bacteria				
Salmonella species	4(2.8%)	3(3.3%)	-	7(2.4%)
Shigella species	11(7.8%)	8(8.8%)	3(5.1%)	22(7.6%)
E. coli O157:H7	8(5.7%)	2(2.2%)	3(5.1%)	13(4.5%)
Total	23(16.3%)	13(14.3%)	6(10.2%)	42(14.5%)

Antimicrobial susceptibility:

All the bacterial isolates from diarrheal patients (table 2) were 100% susceptible to meropenem, cefepime, piperacillin tazobactam and azithromycin. They showed variable antimicrobial resistance to ampicillin, augmentin, trimethoprim-sulphamethoxazole, ciprofloxacin and ceftriaxone.

Table 2: Antimicrobial susceptibility pattern of enteric bacterial pathogens identified from patients attending selected health facilities in Addis Ababa, Ethiopia, 2017.

Antibiotic discs	Salmonella species n=7			Shigella species n=22			E. coli 0157:H7 n=13		
	S	I	R	S	I	R	S	I	R
AMP(10µg)	2(28.5)	1(14.3)	4(57.1)	4(18.2)	1(4.5)	17(77.3)	4(30.8)	0(0.0)	9(69.2)
AUG (30µg)	-	-	-	-	-	-	5(38.5)	3(23.1)	5(38.5)
GN (10µg)	-	-	-	-	-	-	10(76.9)	1(7.7)	2(15.4)
C (30µg)	-	-	-	-	-	-	12(92.3)	0(0.0)	1(7.7)
TMP-SXT (1.25/23.75µg)	4(57.1)	0(0.0)	3(42.9)	6(27.3)	1(4.5)	15(68.2)	6(46.1)	1(7.7)	6(46.1)
MEM(10 µg)	-	-	-	-	-	-	13(100.0)	0(0.0)	0(0.0)
AMK(30 µg)	-	-	-	-	-	-	10(76.9)	1(7.7)	2(15.4)
tzp(10 µg)	-	-	-	-	-	-	13(100.0)	0(0.)	0(0.0)
FEP(30 µg)	-	-	-	-	-	-	13(100.0)	0(0.0)	0(0.0)
AZT(30 µg)	-	-	-	-	-	-	13(100.0)	0(0.0)	0(0.0)
CRO(30 µg)	-	-	-	-	-	-	10(76.9)	1(7.7)	2(15.4)
CIP(5 µg)	7(100.0)	0(0.0)	0(0.0)	21(95.4)	1(4.5)	0(0.0)	10(76.9)	0(0.0)	3(23.1)

Key S-Susceptibility I- Intermediate, R-Resistance, TMP- SXT -trimethoprim-sulphamethoxazole, Ampicillin-AMP, Augmentin-AUG, chloramphenicol- C, Meropenem –MEM, Amikacin-AMK, Piperacillin tazobactam, Cefepime FEP, Azithromycin-AZT, Ceftriaxone-CRO, Ciprofloxacin-CIP

Salmonella isolates were 100% susceptible to ciprofloxacin and ceftriaxone, 57.1% to trimethoprim-sulphamethoxazole and 28.5% to ampicillin, but 57.1% of the isolates were resistant to ampicillin and 42.9% resistant to trimethoprim-sulphamethoxazole
Shigella isolates were susceptible at 95.4% to ciprofloxacin, 27.3% to trimethoprim-sulphamethoxazole, 18.2% to ampicillin and were resistant at 77.3% to ampicillin and at 68.2% to trimethoprim-sulphamethoxazole.

Enterohemorrhagic coli 0157:H7 isolates were 100% susceptible to meropenem, piperacillin tazobactam and azithromycin. However, 92.3% of the isolates were susceptible to chloramphenicol and 76.9% to ciprofloxacin, amikacin, ceftriaxone and gentamicin whereas 46.1% of the isolates were susceptible to trimethoprim-sulphamethoxazole.

Among the *enterohemorrhagic coli 0157:H7* isolates 69.2% showed resistance to ampicillin and 46.1% to trimethoprim-sulphamethoxazole as shown in table 2.

Multi-drug resistant isolates

The overall MDR rate was 26.2%. Three (43%) Salmonella isolates were multidrug resistant, 29% of them showing resistance to three and 14% to four antimicrobials. Among *Shigella,* 16 (72.7 %) of the isolates showed multidrug resistance, of which 12 (54.5%) were resistant to two and the remaining four (18.2%) to three antimicrobials. The other enteric bacteria, *E coli* O157:H7 also showed multidrug resistance for nine (69.2%) isolates in which five (38.5%), one (7.7%), two (15.4%) and one (7.7%) were multidrug resistant to two, three, four and six antimicrobials respectively **(Table 3).**

Table 3: Resistance antibiogram of isolates from pediatric patients in selected health facilities of Addis Ababa, Ethiopia, 2017.

Number of antimicrobial resistance	**Resistance antibiogram**	**Resistance isolates n (%)**		
		Salmonella species(n=7)	**Shigella species (n=22)**	**E coli O157:H7 (n=13)**
RO	None	2(29)	3(13.6)	3(23.1)
R1	Amp	1(14)	1((4.54)	1(7.7)
	AUG	1(14)	-	-
	SXT	-	1(4.54)	-
R2	Amp,AUG	-	4((18.2)	2(15.4)
	Amp,SXT	-	8(36.4)	2(15.4)
	Amp,CIP	-	-	1(7.7)
R3	Amp,AUG,SXT	2(29)	4(18.2)	-
	Amp,SXT,CRO	-	-	1(7.7)
R4	Amp,AUG,SXT,CRO	-	-	1(7.7)
	Amp,AUG,SXT,C	1(14)	-	-
	Amp,AGU,CIP,GEN	-	-	1(7.7)
R6	AUG,CIP,SXT,C,AZT,GEN	-	-	1(7.7)

Key: Amp-Ampicillin, C-Chloramphenicol, SXT-Cotrimethoxazole, AUG-Agumentin, AZT-azithromycin, GEN-Gentamicin, CRO-ceftriaxone, CIP-ciprfloxacin, RO-no resistance, R1-resistance to one antimicrobials, R2-resistance to two antimicrobials, R3-resistance against three antimicrobials, R4-resistance against four antimicrobials, R6- resistance to six antimicrobials

DISCUSSION

In this cross-section study, the overall prevalence of protozoan and bacterial enteropahogens in children aged 0-14 years was 32.0% and 14.5% respectively. Children were thus more affected with parasitic than with bacterial infection. It is possible that other potentially pathogenic bacteria were not isolated due to shortage of supplies and controls. Among the parasitic infections, *E. histolytica/dispar* was the most frequently identified protozoa causing diarrhea in children with an overall rate of 25.8%, which was comparable with another study in Addis Ababa accounting for 19 % (13). However, the present result is higher than a study conducted in western Ethiopia, Jimma which was 0.8% (14). This big difference might be due to sampling technique, metrological differences between the studies, and in Jimma continued community education might have improved control of disease.

The predominant enteric bacterial pathogen isolated was *Shigella* species accounting for 7.6% which was comparable to a study done in Hawassa and Harar which showed 7.0% (15) and 6.9% (16) respectively. On the other hand, in a study done in Northern Ethiopia at Mekele Hospital *Shigella species* was isolated at 6.9 %. Ten (66.7%) of the positive isolates were from children <15 years (17). Other studies conducted in neighboring countries in Sudan *Shigella* species was reported at 8.0% (18) and in Djibouti at 7.7% (19). In high burden countries like Iran, the prevalence of *Shigella* species was 8.5% (20). However, the result was higher compared to the prevalence found in Jimma in several studies: 0.9% (2/218) (21), 2.3% (22) and 4.9% (23). A similar study conducted in Butajira, Ethiopia showed 4.5% prevalence (24). The possible difference could be due to differences in implementation of personal and environmental hygiene in the community from the continuous interventions made by the health extension workers.

Our finding is also higher compared to other studies in Kenya 4.0% (25), China 1.4% (26) and South Africa 5.1% (27). This difference could be due to sample size and study design.

The study showed low prevalence or isolation rate of *Shigella* species compared to the study in St. Paul Millennium Medical College in Addis Ababa where *Shigella* species accounted for 9.1% (28). This difference could be due to seasonal variation and data collection time.

In our study, the prevalence of *Salmonella* species was 2.4%, in line with other studies in Hawassa which showed 2.5% (15) and in Addis Ababa 3.95% (28). The prevalence was comparable with a study done in neighboring countries, Sudan 4.0% (17) and Kenya 3.4% (25). On the other hand, *Salmonella* species were isolated at 4.3 % in Beijing, China (26). However, our study finding is lower compared to the study in Bahir Dar with 7.8% positive for *Salmonella* species (31) whereas in Jimma health center (22) and Addis Ababa (13) the rate was 6.2%. This difference might be due to differences in age group, sample size, geographical variation and endemicity of the disease. Among high burden countries, in a study in India, *Salmonella* was present in 7.8% of cases (32). The present finding is much lower than in a report from Zambia which showed 25.5% positivity in under five children (30). This finding was comparably higher than the study in Gondar which reported that *Salmonella* spp were isolated in 1.6% of cases. (33). The possible difference might be due to variable geographical and climate conditions.

In our study, the rate of isolation of *E. coli* O157:H7 was 4.5%, comparable to study findings in the literature (34-36). This is to our knowledge the first study in Addis Ababa among children even though only few studies have been reported from Ethiopia. The study in Bahir Dar showed an overall isolation rate of 48.3% *E. coli* in children aged under five with acute diarrhea of which 28.9% were *E. coli* O157:H7 (37). In a study done in Jimma, 1.8% were *E. coli* O157:H7 (38), but a similar study in Gondar did not isolate the serotype using a similar method (33). This gap might be due to differences in population density of Addis Ababa and associated higher risk of transmission due to consumption of raw meat and vegetables.

Our finding is in line with a study conducted in Lagos, Nigeria where a prevalence of 5.1% of EHEC associated with watery diarrhea, hemorrhagic colitis and the hemolytic uremic syndrome was described (39). Double infection among parasites and bacteria were observed in 12 of 290 (4.1%) patients. Of these, *E. histolytica* was the predominant protozoan pathogen which occurs in co-infection with *G. lamblia*, *Salmonella* and *Shigella* species. A concurrent infection with *Shigella* species and *E. coli* O157:H7 was observed in one patient with bloody diarrhea. A similar concurrent infections rate of 5.4 % was reported from Jimma. However, in these co-infections, there were no bacterial-bacterial combinations (22).

The majority of the bacterial pathogens were resistant to two or more drugs tested, with ampicillin, cotrimoxazole and augmentin being the most ineffective drugs, similar to the report from a study conducted in Zambia (30). The main reason could be the frequent use of these antibiotics. The antimicrobial resistance pattern of *Shigella* species against ampicillin, trimethoprim-sulphamethoxazole, ciprfloxacin was 77.3%, 68.2% and 0% (intermediate 4.5%), respectively. The high resistance rate to ampicillin (77.3%) and trimethoprim-sulphamethoxazole (68.2%) is comparable to the report from Gondar, 79.9%, 73.4% (40) and Meklele 86.7%, 66.7% (17) respectively. A study in Butajira, Ethiopia also showed 47.1% resistance to ampicillin and 76.5% to trimethoprim-sulphamethoxazole (24). This indicates that the resistance to ampicillin is increasing through time. A study done in Tikur Anbesa, Addis Ababa on *Shigella* species showed resistance level of 78.7% to ampicillin and 45.3% to trimethoprim-sulphamethoxazole. (41) which indicated that trimethoprim-sulphamethoxazole resistance has increased by 12.9% within the last nine years. This study showed a relatively low rate of ampicillin resistance compared to findings in other parts of Ethiopia, Harar 100% (16**)** and Jimma 100% (22).

Another enteric bacterial pathogen, *Salmonella* species also showed antimicrobial resistance to ampicillin (57.1%) and trimethoprim-sulphamethoxazole (42.9%) comparable to others in Jimma 62.5% (22) and in Butajira 60% (24). However, the finding was lower compared to other studies from Addis Ababa (41) showing ampicillin resistance of 81.2% and trimethoprim-sulphamethoxazole of 75.7%. This might be due to variation in number of strains and the different batches of antimicrobial disks used.

E. coli O157:H7 showed resistance of 69.2% to ampicillin, 46.1% to trimethoprim-sulphamethoxazole, 38.5% to augmentin and 23.1% to ciprofloxacin. The isolates had similar resistance pattern (15.4%) to amikacin, ceftriaxone and gentamicin. The study showed difference with the study done in Bahir Dar in which high rates of antimicrobial resistance to ampicillin (86.8%), tetracycline (76%) and cotrimoxazole (76%) was documented and low rates of resistance to ciprofloxacin (6.9%) was documented (37). On the other hand, a study in Jimma showed resistance to ampicillin (50%), augmentin (75%), trimethoprim-sulphamethoxazole (50%) and ceftriaxone (25%). Unlike in our study, no resistance was documented against ciprofloxacin (38).

Limitations of the study

Due to lack of control strains and selective media, primary bacterial enteropahogens such as *Yersinia entricolitica,* microaerophilic *Campylobacter* species and anaerobic *Clostridium difficille* which are common causes of diarrhea were not investigated. Another most important causative agent, rotavirus was not assessed due to logistic challenges. Further confirmation of *E. coli* O157:H7 with serology and molecular (PCR) methods was not done.

Conclusion

Parasitic and bacterial infections are common public health problems among pediatric patients under 15 years of age. *Salmonella* and *Shigella* isolates in the study showed high rates of resistance to the most frequently prescribed drugs ampicillin, amoxicillin+clavulic acid and trimethoprim-sulphamethoxazole. Ciprofloxacin appeared to be an effective drug for the treatment of diarrhea caused by *Salmonella* and *Shigella*. Chloramphenicol was effective against *Shigella.*

RECOMMENDATIONS

Routine stool culture for enteropathogenic bacteria including *E. coli* O157:H7 using Sorbitol MacConkey and appropriate referral linkages between hospitals and health centers is necessary for early identification and targeted treatment. Since gastrointestinal infections are caused by food borne pathogens, environmental sanitation and continuous community education are mandatory. Further studies are necessary to evaluate antimicrobial potency. Cross-checking the in-vitro susceptibility of antimicrobials with their in-vivo efficacy is recommended for evidence based decision making and to better inform clinical practice.

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