# Antibiotic Susceptibility Pattern and Its Potential Correlates among Admitted Typhoid Patients in a Tertiary Care Hospital of Kolkata, India: A One Year Retrospective Evaluation

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## Abstract

*Introduction:* Typhoid fever is a very common disease of the developing world, being a major public health concern in countries like India. The antibiotic susceptibility scenario varies significantly across regions. In India the pictures are conflicting. *Objective:* The objective of the study was to identify the antibiotic susceptibility pattern of S. typhi among registered patients in a tertiary care hospital in India. *Materials and Methods:* The study was done at Peerless Hospital and B. K. Roy Research Center which is a tertiary care Hospital in Kolkata. This was a record-based retrospective cross-sectional and descriptive analysis using SAS software version 9.3.2 during 2012 to 2013. The patients included in the study were admitted in the hospital with accessible medical records. *Results:* Among 86 recruited patients, the average age was 43.14 years and 59.30%, subjects were male. Overall, fever (91.86%) was the most common symptom followed by nausea (84.88%), diarrhea (83.72%), vomiting (63.95%) and body ache (51.16%). Of total 86 blood samples, 23 (26.74%) samples were blood culture positive. Of these 23 blood culture positive samples, 20 (23.26%) samples were positive for Salmonella Ser.typhi and 3 (3.49%) samples were positive for Salmonella Ser. paratyphi. Overall, among the 23 blood culture positive subjects, isolated bacterial strains were 100% sensitive to ampicillin, amoxicillin/clavulanic acid, piperacillin/tazobactum, cefoperazone/sulbactam, ceftriaxone, cefepime, ertapenem, imipenem, meropenem, tigecycline and colistin and 100% resistant to cefuroxime axetil, cefuroxime, amikacin and gentamycin. *Conclusion:* blood culture positivity and resistant pattern to commonly used antibiotics for S. typhi was substantially high among the patients admitted in a tertiary care hospital in eastern part of India and a standardized protocol for proper antibiotic treatment and management of the patients infected with S. typhi is warranted.

**Keywords:** Typhoid; Antibiotic; Salmonella Ser. typhi.

## Introduction

Typhoid fever is an infectious disease caused by the bacteria Salmonella typhi. The spread of the disease occurs mainly via faecal-oral route, through contaminated food and water supplies and also via direct spread from infected patients. Typhoid fever is a common disease & major public health concern in countries like India [1]. The etiologic agent of typhoid fever (S.typhi) is a gram negative, non-sporing facultative anaerobic bacilli that measure 2-3 by 0.4 to 0.6 µm. Humans are the only known hosts [1].

Antibiotic use is the mainstay of treatment and the success depends on the susceptibility pattern. The antibiotic susceptibility scenario varies significantly across regions. Antibiotic susceptibility pattern of any bacteria depends heavily on the local antibiotic use practice of the physicians and their rationality, socio-demographic and behavioral factors of the patients. The dearth of information and existing conflicting evidences regarding these factors in India and more so in eastern part of the country called for a detailed evaluation of these factors in relation to the susceptibility of S. typhi to regular antibiotics [1,2,3].

*Objective*

The objective of the study was to identify the antibiotic susceptibility pattern of S. typhi among registered patients in a tertiary care hospital in India

## Materials and Methods

The study was done at Peerless Hospital and B. K. Roy Research Center which is a tertiary care Hospital in Kolkata. This was a record-based retrospective cross-sectional analysis in a tertiary care hospital in Kolkata, India during 2012 to 2013. Expected benefit of the study was that, the identified antibiotic susceptibility patterns and their correlates would help to identify and strategize policies to bridge gaps in the antibiotic management protocols in typhoid cases. The research proposal was conducted only after submission of the same to the ethical committee and subsequent approval of the same by the before said committee.

The patients who were included in the study were those whose who were only admitted in the hospital and medical records were accessible having complete records on demographic factors, presenting symptoms at the time of admission and had blood culture and antibiotic susceptibility pattern results. The patients who were not admitted were excluded from the study. Patients whose complete medical records were not accessible were also excluded. The patients' records of this hospital were used anonymously for the purpose of this study without mentioning any personal identifiers so that the data could not be linked with the participants. Information was collected on socio-demographic characteristics, symptoms presented at the time of admission and blood culture reports for S. typhi and S. paratyphi A as well as antibiotic susceptibility pattern of the participating patients. Total 86 patients met the inclusion criteria.

Data were analyzed using SAS software version 9.3.2 and descriptive analysis were performed to understand the distribution of demographic factors, symptoms presented at the time of admission and to estimate the percentage of blood culture results for S. typhi and S. paratyphi A as well as antibiotic susceptibility patterns among the participating patients. Analysis was also done to compare the distribution of these demographic factors, blood culture positivity and antibiotic susceptibility pattern across gender. Based on the number of symptoms present at the time admission, patients were categorized into three categories:

1. Less severe disease(symptoms $\leq 3$)

2. Severe disease (symptoms $\leq 4$)

3. Very severe disease(symptoms $\leq 5$).

Overall antibiotic susceptibility was also additionally categorized into subjects infected by bacterial strain sensitive to less no. of antibiotics (if sensitive to <7 antibiotics) and those infected by bacterial strain sensitive to more no. of antibiotics (if sensitive to $\geq 7$ antibiotics). Bi-variate logistic regression analyses were conducted to measure the associations of demographic factors, symptoms presented at the time of admission with blood culture positivity, overall severity of the disease, bacterial strains identified and lastly to determine the relationships between demographics, overall severity of the disease and higher antibiotic sensitivity pattern.

## Results

**Table 1:** Age and gender distribution of the recruited patients     (N=86)

| Continuous Variable | | N | Mean | SE of the mean | 95% Confidence Limits Lower | Upper |
|---|---|---|---|---|---|---|
| **Age** | | 86 | 43.14 | 1.89 | 39.37 | 46.91 |
| Categorical Variable | Categories | N | Proportion (%) | SE of the Proportion | 95% Confidence Limits Lower | Upper |
| Gender | Male | 51 | 59.30 | 5.33 | 48.71 | 69.90 |
| | Female | 35 | 40.70 | 5.33 | 30.10 | 51.29 |

**Table 2:** Distribution of the symptoms among the participating patients     (N=86)

| Symptoms | Categories | N | Proportion (%) | SE of the Proportion | 95% Confidence Limits Lower | Upper |
|---|---|---|---|---|---|---|
| Body Ache | Absent | 42 | 48.84 | 5.42 | 38.06 | 59.62 |
| | Present | 44 | 51.16 | 5.42 | 40.38 | 61.94 |
| Fever | Absent | 7 | 8.14 | 2.97 | 2.24 | 14.04 |
| | Present | 79 | 91.86 | 2.97 | 85.96 | 97.76 |
| Vomiting | Absent | 31 | 36.05 | 5.21 | 25.69 | 46.40 |
| | Present | 55 | 63.95 | 5.21 | 53.60 | 74.31 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Nausea | Absent | 13 | 15.12 | 3.89 | 7.39 | 22.84 |
| | Present | 73 | 84.88 | 3.89 | 77.16 | 92.61 |
| Diarrhea | Absent | 14 | 16.28 | 4.00 | 8.32 | 24.24 |
| | Present | 72 | 83.72 | 4.00 | 75.76 | 91.68 |
| Overall severity of the disease | Less severe disease (≤3 symptoms) | 33 | 38.37 | 5.27 | 27.88 | 48.86 |
| | Severe disease (4 symptoms) | 37 | 43.02 | 5.37 | 32.35 | 53.70 |
| | Very severe disease (All 5 symptoms) | 16 | 18.60 | 4.22 | 10.21 | 27.00 |

**Table 3:** Distribution of the symptoms among the participating male patients (N=51)

| Symptoms | Categories | N | Proportion (%) | SE of the Proportion | 95% Confidence Limits | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Body Ache | Present | 23 | 45.10 | 7.04 | 30.96 | 59.23 |
| | Absent | 28 | 54.90 | 7.04 | 40.77 | 69.04 |
| Fever | Present | 47 | 92.16 | 3.80 | 84.52 | 99.79 |
| | Absent | 4 | 7.84 | 3.80 | 0.21 | 15.48 |
| Vomiting | Present | 35 | 68.63 | 6.56 | 55.45 | 81.81 |
| | Absent | 16 | 31.37 | 6.56 | 18.19 | 44.55 |
| Nausea | Present | 47 | 92.16 | 3.80 | 84.52 | 99.79 |
| | Absent | 4 | 7.84 | 3.80 | 0.21 | 15.48 |
| Diarrhea | Present | 42 | 82.35 | 5.39 | 71.52 | 93.18 |
| | Absent | 9 | 17.65 | 5.39 | 6.82 | 28.48 |
| Overall severity of the disease | Less severe disease (≤3 symptoms) | 20 | 39.22 | 6.90 | 25.35 | 53.08 |
| | Severe disease (4 symptoms) | 19 | 37.25 | 6.84 | 23.52 | 50.99 |
| | Very Severe disease (All 5 symptoms) | 12 | 23.53 | 6.00 | 11.48 | 35.58 |

**Table 4:** Distribution of the symptoms among the participating female patients (N=35)

| Symptoms | Categories | N | Proportion (%) | SE of the Proportion | 95% Confidence Limits | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Body Ache | Present | 21 | 60.00 | 8.40 | 42.93 | 77.07 |
| | Absent | 14 | 40.00 | 8.40 | 22.93 | 57.07 |
| Fever | Present | 32 | 91.43 | 4.80 | 81.67 | 100.00 |
| | Absent | 3 | 8.57 | 4.80 | 0.00 | 18.33 |
| Vomiting | Present | 20 | 57.14 | 8.49 | 39.90 | 74.39 |
| | Absent | 15 | 42.86 | 8.49 | 25.61 | 60.10 |
| Nausea | Present | 26 | 74.29 | 7.50 | 59.05 | 89.52 |
| | Absent | 9 | 25.71 | 7.50 | 10.48 | 40.95 |
| Diarrhea | Present | 30 | 85.71 | 6.00 | 73.52 | 97.91 |
| | Absent | 5 | 14.29 | 6.00 | 2.09 | 26.48 |
| Overall severity of the disease | Less severe disease (≤3 symptoms) | 13 | 37.14 | 8.29 | 20.30 | 53.98 |
| | Severe disease (4 symptoms) | 18 | 51.43 | 8.57 | 34.01 | 68.85 |
| | Very severe disease (All 5 symptoms) | 4 | 11.43 | 5.46 | 0.34 | 22.52 |

**Table 5:** Distribution of the laboratory results among the participating patients (N=86)

| Laboratory results | Categories | N | Proportion (%) | SE of the Proportion | 95% Confidence Limits | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Blood culture results | Negative | 63 | 73.26 | 4.80 | 63.71 | 82.80 |
| | Positive | 23 | 26.74 | 4.80 | 17.20 | 36.29 |
| Bacterial strain identified | None | 63 | 73.26 | 4.80 | 63.71 | 82.80 |
| | *Salmonella Ser.typhi* | 20 | 23.26 | 4.58 | 14.15 | 32.37 |
| | *Salmonella Ser. paratyphi A* | 3 | 3.49 | 1.99 | 0.00 | 7.45 |

**Table 6:** Distribution of the laboratory results among the participating male patients (N=51)

| Laboratory results | Categories | N | Proportion (%) | SE of the Proportion | 95% Confidence Limits | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Blood culture results | Positive | 14 | 27.45 | 6.31 | 14.77 | 40.13 |
| | Negative | 37 | 72.55 | 6.31 | 59.87 | 85.23 |
| Bacterial strain identified | None | 37 | 72.55 | 6.31 | 59.87 | 85.23 |
| | *Salmonella Ser. typhi* | 13 | 25.49 | 6.16 | 13.11 | 37.87 |
| | *Salmonella Ser. paratyphi A* | 1 | 1.96 | 1.96 | 0.00 | 5.90 |

**Table 7:** Distribution of the laboratory results among the participating female patients                (N=35)

| Laboratory results | Categories | N | Proportion (%) | SE of the Proportion | 95% Confidence Limits Lower | Upper |
|---|---|---|---|---|---|---|
| Blood culture results | Positive | 9 | 25.71 | 7.50 | 10.48 | 40.95 |
| | Negative | 26 | 74.29 | 7.50 | 59.05 | 89.52 |
| Bacterial strain identified | None | 26 | 74.29 | 7.50 | 59.05 | 89.52 |
| | *Salmonella Ser. typhi* | 7 | 20.00 | 6.86 | 6.06 | 33.94 |
| | *Salmonella Ser. paratyphi A* | 2 | 5.71 | 3.98 | 0.00 | 13.80 |

**Table 8:** Antibiotic susceptibility pattern among the participating patients                (N=86)

| Antibiotic | Categories | N | Proportion (%) | Male (N=51) N | Proportion (%) | Female (N=35) N | Proportion (%) |
|---|---|---|---|---|---|---|---|
| Ampicillin | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Amoxicillin/Clavulanic acid | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Piperacillin/Tazobactum | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Cefoperazone/Sulbactam | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Cefuroxime Axetil | Sensitive | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| | Resistant | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| Cefuroxime | Sensitive | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| | Resistant | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| Ceftriaxone | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Cefepime | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Ertapenem | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Imipenem | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Meropenem | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Amikacin | Sensitive | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| | Resistant | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| Gentamicin | Sensitive | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| | Resistant | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| Nalidixic Acid | Sensitive | 3 | 13.04 | 2 | 14.29 | 1 | 11.11 |
| | Resistant | 20 | 86.96 | 12 | 85.71 | 8 | 88.89 |
| Ciprofloxacin | Sensitive | 3 | 13.04 | 2 | 14.29 | 1 | 11.11 |
| | Resistant | 20 | 86.96 | 12 | 85.71 | 8 | 88.89 |
| Nitrofurantoin | Sensitive | 2 | 8.70 | 1 | 7.14 | 1 | 11.11 |
| | Resistant | 21 | 91.30 | 13 | 92.86 | 8 | 88.89 |
| Trimethoprim/Sulfamethoxazole | Sensitive | 20 | 86.96 | 12 | 85.71 | 8 | 88.89 |
| | Resistant | 3 | 13.04 | 2 | 14.29 | 1 | 11.11 |
| Tigecycline | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Colistin | Sensitive | 23 | 100.00 | 14 | 100.00 | 9 | 100.00 |
| | Resistant | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Overall antibiotic susceptibility pattern | Sensitive to less no. of antibiotics (<7) | 5 | 21.74 | 3 | 21.43 | 2 | 22.22 |
| | Sensitive to more no. of antibiotics (≥7) | 18 | 78.26 | 11 | 78.57 | 7 | 77.78 |

**Table 9:** Association of age, gender and symptoms with blood culture positivity (N=86)

| Variables | Categories | OR | 95%Confidence limits Lower | Upper | p value |
|---|---|---|---|---|---|
| Age | | 0.99 | 0.96 | 1.02 | 0.3800 |
| Gender | Male | 1.09 | 0.41 | 2.90 | 0.8582 |
| | Female | | Reference | | |
| Body ache | Yes | 1.34 | 0.51 | 3.51 | 0.5486 |
| | No | | Reference | | |
| Fever | Yes | 0.91 | 0.16 | 5.03 | 0.9093 |
| | No | | Reference | | |
| Vomiting | Yes | **3.56** | **1.09** | **11.69** | **0.0361** |
| | No | | Reference | | |
| Nausea | Yes | 5.18 | 0.63 | 42.29 | 0.1250 |
| | No | | Reference | | |
| Diarrhea | Yes | 1.41 | 0.36 | 5.59 | 0.6247 |
| | No | | Reference | | |
| Overall severity of the disease | Less severe disease (≤3 symptoms) | | Reference | | |
| | Severe disease (4 symptoms) | 2.07 | 0.63 | 6.86 | 0.2321 |
| | Very severe disease (All 5 symptoms) | **5.60** | **1.43** | **21.95** | **0.0134** |

**Table 10:** Association of age and gender with overall severity of the disease                        (N=86)

| Over all severity of the disease (reference= Less Severe (≤3 symptoms) | Age and gender | Categories | OR | 95%Confidence limits Lower | Upper | p value |
|---|---|---|---|---|---|---|
| Severe disease (4 symptoms) | Age | | 1.01 | 0.98 | 1.04 | 0.4184 |
| | Gender | Male | 0.69 | 0.27 | 1.78 | 0.4372 |
| | | Female | | Reference | | |
| Very severe disease (All 5 symptoms) | Age | | 0.99 | 0.96 | 1.03 | 0.5969 |
| | Gender | Male | 1.95 | 0.52 | 7.37 | 0.3249 |
| | | Female | | Reference | | |

**Table 11:** Association of age, gender and overall severity of the disease with bacterial strain identified                (N=86)

| Bacterial strain identified [reference=none] | Age, gender, symptoms and severity | Categories | OR | 95%Confidence limits Lower | Upper | p value |
|---|---|---|---|---|---|---|
| *Salmonella Ser. Typhi* | Age | | 0.98 | 0.96 | 1.02 | 0.3078 |
| | Gender | Male | 1.31 | 0.46 | 3.72 | 0.2484 |
| | | Female | | Reference | | |
| | Body ache | Present | 0.97 | 0.35 | 2.65 | 0.9507 |
| | | Absent | | Reference | | |
| | Fever | Present | 1.29 | 0.23 | 7.22 | 0.7728 |
| | | Absent | | Reference | | |
| | Vomiting | Present | 0.33 | 0.10 | 1.11 | 0.0737 |
| | | Absent | | Reference | | |
| | Nausea | Present | 0.22 | 0.03 | 1.84 | 0.1636 |
| | | Absent | | Reference | | |
| | Diarrhea | Present | 0.83 | 0.21 | 3.35 | 0.7981 |
| | | Absent | | Reference | | |
| | Overall severity of the disease | Less severe disease (≤3 symptoms) | | Reference | | |
| | | Severe disease (4 symptoms) | 2.07 | 0.63 | 6.86 | 0.2321 |
| | | Very severe disease (All 5 symptoms) | 3.50 | 0.81 | 15.19 | 0.0943 |
| *Salmonella Ser. Paratyphi A* | Age | | 1.01 | 0.94 | 1.07 | 0.8582 |
| | Gender | Male | 0.35 | 0.03 | 4.08 | 0.6989 |
| | | Female | | Reference | | |

**Table 12:** Association of age, gender and overall severity of the disease with higher antibiotic sensitivity                    (N=23)

| Age, gender and severity | Categories | OR | 95%Confidence limits | | p value |
| --- | --- | --- | --- | --- | --- |
| | | | Lower | Upper | |
| Age | | 1.03 | 0.96 | 1.11 | 0.3827 |
| Gender | Male | 1.05 | 0.14 | 7.93 | 0.9640 |
| | Female | | | Reference | |
| Overall severity of the disease | Less severe disease (≤3 symptoms) | | | Reference | |
| | Severe disease (4 symptoms) | 1.56 | 0.17 | 14.65 | 0.6994 |

Among 86 recruited patients, the average age was 43.14 years and 59.30%, subjects were male. Overall, fever (91.86%) was the most common symptom followed by nausea (84.88%), diarrhea (83.72%), vomiting (63.95%) and body ache (51.16%). Among all the symptoms, fever (92.16%) and nausea (92.16%) were the most complains among male patients followed by diarrhea (82.35%), vomiting (68.63%) and body ache (45.10%). Alike male patients, fever (91.43%) was most frequent symptom among female patients followed by diarrhea (85.71%), nausea (74.29%), body ache (60%) and vomiting (57.14%). Of total 86 blood samples, 23 (26.74%) samples were blood culture positive. Of these 23 blood culture positive samples, 20 (23.26%) samples were positive for Salmonella Ser.typhi and 3 (3.49%) samples were positive for Salmonella Ser. paratyphi. Of total 51 blood samples among male subjects, 14 (27.45%) samples were blood culture positive. Of these 14 blood culture positive samples, 13 (25.49%) samples were positive for Salmonella Ser.typhi and 1 (1.96%) sample was positive for Salmonella Ser. paratyphi. Of total 35 blood samples among female patients, 9 (25.71%) samples were blood culture positive. Of these 9 blood culture positive samples, 7 (20%) samples were positive for Salmonella Ser.typhi and 2 (5.71%) samples were positive for Salmonella Ser. paratyphi.

Overall, among the 23 blood culture positive subjects, isolated bacterial strains were 100% sensitive to ampicillin, amoxicillin/clavulanic acid, piperacillin/tazobactum, cefoperazone/sulbactam, ceftriaxone, cefepime, ertapenem, imipenem, meropenem, tigecycline and colistin and 100% resistant to cefuroxime axetil, cefuroxime, amikacin and gentamycin.

Although in bi-variate regression analyses, there were some associations between socio-demographic factors, symptoms presented with at the time of admission with odds of having blood culture positivity and overall severity of disease as well as associations of age, gender and overall severity of the disease with bacterial strain identified and higher antibiotic sensitivity though the results were not

statistically significant except vomiting was positively associated with blood culture positivity (OR=3.56, 95% CI: 1.09, 11.69) and the result was statistically significant and compared to those having less severe disease, subjects suffering from very severe disease were more likely to have blood culture positivity (OR=5.60, 95% CI: 1.43, 21.95) and result was statistically significant.

**Discussions**

A hospital based cross-sectional analyses was conducted among 86 patients who were admitted in a tertiary care hospital in the past year (2012-2013) and were tested for S. typhi and S. paratyphi A as well as antibiotic susceptibility pattern. Overall, more than 90% participating patients had fever followed by nausea, diarrhea, vomiting and body ache. When we categorized patients based on the presenting symptoms at the time of hospital admission, it was observed that majority had four symptoms or had severe disease, slightly above one-third had three or less symptoms or less severe disease and less than one-fifth had all five symptoms or very severe disease. Thus, it seemed that patients who were admitted at this tertiary care hospital were more likely to be symptomatic.

Of total 86 blood samples, 23 (26.74%) samples were blood culture positive. Of these 23 blood culture positive samples, 20 (23.26%) samples were positive for Salmonella Ser. typhi and 3 (3.49%) samples were positive for Salmonella Ser. paratyphi . Thus, more Salmonella typhi cases were detected among participating patients during our study period.

Overall, among the 23 blood culture positive subjects, isolated bacterial strains were 100% sensitive to ampicillin, amoxicillin/clavulanic acid, piperacillin/tazobactum, cefoperazone/sulbactam, ceftriaxone, cefepime, ertapenem, imipenem, meropenem, tigecycline and colistin and 100% resistant to cefuroxime axetil, cefuroxime, amikacin and gentamycin. Among other drugs, isolated

bacterial strains were 13.04% susceptible to nalidixic acid, 13.04% susceptible to ciprofloxacin, 8.70% susceptible to nitrofurantoin, and 86.96% susceptible to trimethoprim/sulfamethoxazole. Overall, 21.74% isolated bacterial strains were susceptible to less than seven antibiotics and 78.26% were susceptible to seven or more antibiotics. These findings were consistent with previous studies like in Kathmandu, Medical College, Nepal, during 2010-11[6], In the Buea health district, Cameroon, researchers isolated 21 (21%) culture positive Salmonella species out of 100 cases. 12 (57.1%) were S paratyphi A, 8 (38.1%) were S typhiand 1 (4.8%) was S paratyphi C among these samples.

## Conclusion

Thus, findings from the current study revealed that the blood culture positivity and resistant pattern to commonly used antibiotics for S. typhi was substantially high among the patients admitted in a tertiary care hospital in eastern part of India and thus it seemed a standardized protocol for proper antibiotic treatment and management of the patients infected with S. typhi is a critical public health issue in endemic areas like India.

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