

Sensitivity pattern of salmonella typhi and paratyphi in paediatric patients

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Abstract

Objective: To determine the sensitivity patterns of *Salmonella typhi* and paratyphi in paediatric patients in a public-sector tertiary-care setting.

Method: The retrospective, observational study was conducted at Gajju Khan Medical College, Swabi, Pakistan, from January 11 to March 3, 2024, and comprised samples from patients aged 1-14 years who had been confirmed as cases of *Salmonella typhi* during testing at the Medical Teaching Institution Bacha Khan Medical Complex, Swabi, between January 5 and December 24, 2023. Cultures had been performed manually, while antibiotic susceptibility had been tested using Kirby-Bauer disk diffusion method. Data was analysed using SPSS 25.

Results: Of the 63 patients, 40(63.4%) were boys and 23(36.5%) were girls. The overall mean age was 7.8±4.16 years. Among the samples, 6(10.5%) showed sensitivity to ciprofloxacin, while 57(89.4%) exhibited resistance. None of the samples showed sensitivity to ampicillin, and 1(1.5%) was sensitive to ceftriaxone. Azithromycin showed a high sensitivity rate of 60(95.2%). Meropenem and imipenem demonstrated 63(100%) sensitivity.

Conclusion: The development of extremely high resistance of salmonella typhi to commonly used antibiotics, such as ampicillin, ciprofloxacin and ceftriaxone show a concerning trend in pediatric patients. Measures need to be taken to prevent the misuse and overuse of antibiotics.

Keywords: Enteric fever, *Salmonella*, Antibiotic sensitivity, Blood culture, Disk-diffusion method, Bauer-Kirby, Azithromycin, Meropenem. (JPMA 76: 500; 2026) DOI: <https://doi.org/10.47391/JPMA.21046>

Introduction

Enteric fever is a bacterial infection caused by *Salmonella* (*S.*) typhi and paratyphi that affects people worldwide. It is a significant cause of morbidity and mortality, especially in underdeveloped countries.¹ According to World Health Organisation (WHO) estimates, the annual global cases range from 11 to 21 million, resulting in between 128,000 and 161,000 deaths. Outbreaks often coincide with the monsoon season, and primarily stem from contaminated food and water sources.² Notably, Pakistan has a higher incidence of enteric fever (451.7 per 100,000 people per year) than India (214.2/100,000).¹

The clinical presentation of acute enteric fever is nonspecific and mimics that of other infectious diseases. However, without prompt treatment, it can lead to severe complications, including mortality. Typhoid fever, in particular, has a case fatality rate of 10-30%, which drops to 1-4% with appropriate treatment.³ The emergence of multidrug resistance (MDR) and extended drug resistance (XDR) in *S. typhi*, which affects antibiotics, such as ampicillin, ceftriaxone, cotrimoxazole, and even previously

effective drugs, such as ciprofloxacin, poses significant challenges in the treatment and management of enteric fever.⁴

Studies in Pakistan have highlighted^{5,6} the serious issue of antibiotic resistance in typhoid fever. Azithromycin is the most effective oral antibiotic, with a sensitivity of up to 96.7%. Notably, meropenem has demonstrated 100% sensitivity, and is the only antibiotic with no identified resistance.¹

A study identified strains of *S. typhi* resistant to multiple antibiotics, including amoxicillin, co-trimoxazole, chloramphenicol, ciprofloxacin and ceftriaxone, in Lahore, Pakistan. Phenotypic and genotypic analyses revealed that *S. typhi* XDR isolates were indistinguishable from the outbreak strains identified in southern parts of Pakistan.⁶

A comparative cross-sectional study in Peshawar concluded that out of 97 diagnosed cases of *S. typhi*, 37.2% exhibited MDR.⁷ Another study reported that 80% of *S. typhi* isolates were MDR, 53% were XDR, and all isolates were sensitive to azithromycin and imipenem.⁸ Although antibiotic medication is the primary treatment for this infectious disease, the bacteria's sensitivity is changing, making treatment more challenging. Without regular epidemiological surveys, susceptibility testing, and minimal lethal dose calculations, children in poor countries are often treated empirically, or self-medicated with antibiotics. These factors may contribute to the high morbidity and

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mortality rates in country's with poor health infrastructure.⁹ Sensitivity patterns of *S. typhi* and paratyphi vary globally. In India, such isolates showed high sensitivity to first-line antibiotics, with all the isolates being sensitive to co-trimoxazole and chloramphenicol (100%). Ampicillin and ceftriaxone were sensitive to 98.9% of the isolates.¹⁰

The current study was planned to determine the sensitivity patterns of *S. typhi* and paratyphi in paediatric patients, and to identify the most suitable antibiotics for such cases.

Materials and Methods

The retrospective, observational study was conducted at Gajju Khan Medical College (GKMC), Swabi, Pakistan, from January 11 to March 3, 2024, and comprised samples from patients aged 1-14 years who had been confirmed as cases of *S. typhi* during testing at the Medical Teaching Institution (MTI) Bacha Khan Medical Complex, Swabi, between January 5 and December 24, 2023. After approval from the GKMC ethics review committee, the sample size was calculated using Raosoft online calculator¹¹ with 95% confidence interval (CI), 5% margin of error, 15.6% prevalence¹² and a population size of 701,938 individuals aged <16 years.¹³

The study sample was raised using convenience sampling technique. All the samples were collected from the Microbiology Department where culture testing had been performed manually, while antibiotic susceptibility had been tested using the Kirby-Bauer disk diffusion method.¹⁴ The samples related to patient aged 1-14 years who had been confirmed as cases of *S. typhi* infection. Patients with incomplete data were excluded.

Data was analysed using SPSS 25. Data was presented as mean±standard deviation and frequencies and percentages, as appropriate.

Results

Of the 63 patients, 40(63.4%) were boys and 23(36.5%) were girls. The overall mean age was 7.8±4.16 years. Among the samples, 6(10.5%) showed sensitivity to ciprofloxacin, while 57(89.4%) exhibited resistance. None of the samples showed sensitivity to ampicillin, and 1(1.5%) was sensitive to ceftriaxone. Azithromycin showed a high sensitivity rate

of 60(95.2%). Meropenem and imipenem demonstrated 63(100%) sensitivity (Table).

Discussion

In the current study, all the 63(100%) isolates were resistant to ampicillin, which is a widely used beta-lactam antibiotic, while ciprofloxacin, which is a commonly used fluoroquinolone, also demonstrated poor sensitivity (10.5%). Similarly, ceftriaxone, another beta-lactam antibiotic, displayed limited sensitivity (1.5%). These findings are consistent with previous studies conducted in Pakistan.^{1,15,16}

In an Indian study, all 128 *S. typhi* isolates were sensitive to ampicillin, ceftriaxone and azithromycin, with resistance to ciprofloxacin was noted.¹⁷

In the current study, 95.2%, *S. typhi* isolates were sensitive to azithromycin, while 100% sensitivity was noted for meropenem and imipenem. A study done in Peshawar showed that 43.3% resistance to azithromycin, 17.3% to meropenem and 4.8% to imipenem.¹⁸ A study in Lahore showed that 3.3% isolates were resistant to azithromycin, while none was resistant to meropenem.¹ The current findings are particularly comparable to a study conducted in Karachi in which 97% and 91% of *S. typhi* isolates were resistant to ciprofloxacin and ceftriaxone, respectively, while sensitivity to azithromycin was 95%, and it was 100% for meropenem and imipenem.¹⁹

Resistance to ampicillin, ciprofloxacin and ceftriaxone emphasise the urgent need for alternative treatment options, supporting the urgency highlighted by the Centers for Disease Control and Prevention (CDC)²⁰ to develop and implement strategies to address rising resistance rates in Salmonella infections. Ceftriaxone, a commonly used antibiotic, had previously showed promising sensitivity, but has grown resistant, as was also noted in the current study. The findings are consistent with worries around the world about rising antibiotic resistance.²¹

Since overuse of antibiotics is the leading cause of rising antibiotic resistance, physicians need to be informed on the most recent patterns of antibiotic sensitivity in order to modify their prescribing practices in a way that prevents the emergence of antibiotic resistance, and promote the usage of last-resort antibiotics, like azithromycin and carbapenems.

The current study has limitations as the data related to a single centre. Besides, the actual sample size was 63 compared to the calculated target of 203. This was because of time, resources and data accessibility constraints. Multicentre, large-scale studies are required to validate the

Table: Pattern of Salmonella sensitivity and resistance.

Antibiotic name	Sensitive n (%)	Resistance n (%)
Ciprofloxacin	6 (10.5)	57 (89.4)
Ampicillin	0 (0)	54 (100)
Ceftriaxone	1 (1.5)	62 (98.4)
Azithromycin	60 (95.2)	3 (4.7)
Meropenem	63 (100)	-
Imipenem	63 (100)	-

current findings.

Conclusion

The development of *S. typhi* resistance to commonly used antibiotics showed a concerning trend, underlining the need to prevent the misuse and overuse of antibiotics.

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Author Contribution:

SA: Concept, data analysis and drafting.

MFR: Concept, drafting and revision.

KU & MA: Design, data acquisition and analysis.

MR: Data collection and interpretation.

TH: Supervision.