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Original Article

Microbiology Section

Evolving Antimicrobial Susceptibility Patterns in *Salmonella* spp. Isolated from Blood Specimens, Over 10 Years: A Retrospective Observational Analysis

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ABSTRACT

Introduction: Species of *Salmonella*, particularly *Salmonella* Typhi and *Salmonella* Paratyphi, remain a significant cause of Bloodstream Infections (BSIs) in developing countries, complicated further by rising antimicrobial resistance. These infections contribute substantially to morbidity, mortality and the public health burden, especially in regions with poor sanitation and limited access to healthcare. The emergence of Multidrug-Resistant (MDR) *Salmonella* strains has rendered many first-line antibiotics less effective, complicating treatment strategies.

Aim: To assess the prevalence of *Salmonella* spp. and the antimicrobial patterns of *Salmonella* isolates over a ten-year period (2014–2024) at a tertiary care hospital in Tamil Nadu, India.

Materials and Methods: This was a retrospective observational study conducted at Chettinad Hospital and Research Institute, Kelambakkam, Tamil Nadu, India. Blood culture records from January 2014 to December 2024 were reviewed. All patients with confirmed *Salmonella*-positive blood cultures were included. Blood samples were processed using standard microbiological protocols, including conventional and automated (BACTEC) methods and antibiotic susceptibility was tested using the Kirby-Bauer disc diffusion method as per Clinical and Laboratory Standards Institute (CLSI) guidelines. Demographic details such as age and gender were documented. Data were compiled using Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 20.0; categorical data were expressed in percentages.

Results: Among the 304 isolates, *S.* Typhi was the most frequently identified species (225, 74%), followed by *Salmonella* Paratyphi A (66 isolates, 21.7%), *Salmonella* Paratyphi B (7 isolates, 2.3%) and *Salmonella* Typhimurium (6 isolates, 2%). A male predominance (213, 70.1%) was observed and the greatest occurrence (162, 53.3%) was recorded in the 21-60 years of age group. Antibiotic sensitivity analysis revealed sustained susceptibility of all serotypes to ceftriaxone, tetracycline, chloramphenicol and cotrimoxazole. However, a predominant level of ciprofloxacin resistance was reported in *S.* Typhi and *S.* Paratyphi A isolates. Year-wise data showed fluctuating resistance patterns, with a notable dip in ceftriaxone sensitivity in 2020 and variable trends in ampicillin and chloramphenicol resistance.

Conclusion: Over the past decade, *S.* Typhi remained the predominant pathogen isolated from BSIs, particularly affecting adults. Although conventional antibiotics continue to be effective, alarming fluoroquinolone resistance trends underscore the need for routine antimicrobial surveillance and judicious antibiotic use. The findings reinforce the importance of empirical therapy guided by local susceptibility patterns and highlight the ongoing challenge of managing drug-resistant *Salmonella* infections in endemic regions.

Keywords: Drug resistance, India, Microbial, Microbial sensitivity tests, Retrospective studies, *Salmonella enterica*

INTRODUCTION

Salmonella infection poses a significant healthcare hazard to the community, causing morbidity, mortality and an increased economic burden, particularly in developing regions [1]. Of growing concern is the increasing antimicrobial resistance exhibited by these pathogens, which complicates clinical management [2,3]. The genus *Salmonella* belongs to the family Enterobacteriaceae and comprises rod-shaped, Gram-negative, facultative anaerobic, motile bacteria, primarily represented by *Salmonella enterica*. This species includes over 2,500 serovars, most of which are implicated in human and animal diseases [4,5]. Clinical classification broadly divides them into serovars of typhoidal and non typhoidal Salmonella (NTS). Typhoidal serovars, such as *S.* Typhi and *S.* Paratyphi, are human-restricted and cause systemic enteric fevers, while NTS serovars, including *S.* Typhimurium, *S.* Enteritidis and *S.* Newport, are zoonotic and often associated with gastroenteritis and invasive BSIs [6-8]. Bacteraemia due to *Salmonella*, especially from invasive NTS serovars like *S.* Dublin and *Salmonella*, presents with high fever and systemic complications, often without gastrointestinal manifestations such as rose spots [9,10]. These BSIs are more prevalent in immunocompromised patients and are of particular concern in endemic areas or among returning travellers from regions such as Africa and South Asia [11].

Salmonella colonises host cells and evades immune responses, a process mediated by virulence factors encoded on pathogenicity islands, virulence plasmids and other genetic elements [12-14]. Once the intestinal barrier is breached, bacteria can disseminate haematogenously to organs such as the liver, spleen and bone marrow, potentially leading to life-threatening complications [15]. Diagnosis of enteric fever relies on blood cultures, which are most sensitive in the early stages of illness. However, prior antibiotic exposure often reduces culture positivity rates. In such cases, bone marrow cultures offer superior sensitivity and remain the diagnostic gold standard [16]. Given the rising concern over MDR *Salmonella* strains, particularly resistance to first-line agents like chloramphenicol, ampicillin and trimethoprim-sulfamethoxazole, there is a critical need for long-term, region-specific surveillance to guide empirical therapy. While several studies have documented resistance patterns, most are limited in duration or scope [17,18]. This study uniquely provides a decade-long retrospective analysis

of *Salmonella* isolates from BSIs in a tertiary care centre in Tamil Nadu, India, using both conventional and automated diagnostics. By evaluating evolving antimicrobial susceptibility trends across serovars, it aims to contribute novel, local epidemiological data to the existing literature and support improved antibiotic stewardship and clinical decision-making in endemic regions.

MATERIALS AND METHODS

This retrospective observational study was conducted at Chettinad Hospital and Research Institute (CHRI), a tertiary care teaching hospital in Kelambakkam, Tamil Nadu, India. The hospital serves a demographically diverse population. The study duration was from January 2014 to December 2024. Institutional Human Ethics Committee approval was obtained prior to the study (IHEC No: IHEC-1/3178/24). As this was a retrospective data-based study, informed consent was waived.

Inclusion criteria: Blood culture-confirmed *Salmonella* spp. from January 2014 to December 2024 were included in the study.

Exclusion criteria: Samples with incomplete records or duplicate isolates within 30 days of initial positivity were excluded from the study.

Sample size: All eligible blood culture-positive *Salmonella* cases from the defined period were included using a time-bound sampling method. No formal sample size calculation was performed as this was a total enumeration study. Similar approaches are used in retrospective studies of this nature. In total, 304 blood specimens from patients diagnosed with BSIs during this timeframe were analysed, providing a broad and representative dataset for the investigation.

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Study Procedure

Blood cultures were processed using conventional methods (BHIB broth) and the BACTEC 9050 system. Positive samples were subcultured and identified by standard microbiological procedures. Antimicrobial susceptibility was assessed using the Kirby-Bauer disc diffusion method, interpreted according to CLSI guidelines [19]. Demographic data (age, gender) were recorded.

Study location: Department of Microbiology, CHRI.

Sample collection and processing: All blood culture samples were processed in the Microbiology Department. Blood specimens were collected in duplicate from patients, as per standard protocol and inoculated either into in-house prepared Brain Heart Infusion Broth (BHIB) bottles or BD blood culture bottles (adult or paediatric types as per clinical requirements).

- Conventional BHIB bottles were incubated and subcultured at the end of 24 hours at 37°C, 76 hours and on the 6th day of incubation onto MacConkey agar, chocolate agar and blood agar plates.
- Plus Aerobic or Peds Plus bottles were inoculated with 8 to 10 mL of the patient sample and placed inside the BACTEC 9050 automated blood culture system (Becton Dickinson), with a total incubation period of five days. When flagged as positive, these samples were also subcultured onto the same types of agar media. Growth-positive cultures were subjected to further identification procedures, including examination of the morphology of the colonies, Gram staining and standard biochemical testing protocols. In selected cases, automated identification and sensitivity testing were carried out using the VITEK® 2 Compact system (bioMérieux, France).

Antibiotic susceptibility test: Pathogens isolated from blood culture positives were detected using standard microbiological techniques. Antibiotic susceptibility testing was performed on Mueller-Hinton agar using the Kirby-Bauer disc diffusion method and interpreted according to the CLSI guidelines updated annually from 2013 to 2023 [19]. In addition, for certain isolates, automated susceptibility testing was performed using the VITEK® 2 Compact system (bioMérieux, France), which utilises advanced colourimetric cards for organism identification and MIC-based antibiotic susceptibility testing. The system provides rapid and standardised results, reducing manual error and aiding in the confirmation of susceptibility profiles. The following antibiotics were tested: ampicillin (10 µg), ciprofloxacin (5 µg), azithromycin (15 µg), ceftriaxone (30 µg), chloramphenicol (30 µg), cotrimoxazole (1.25/23.75 µg) and tetracycline (30 µg).

STATISTICAL ANALYSIS

All data were compiled in Microsoft Excel and analysed using IBM SPSS Statistics version 20.0. Descriptive statistics were used: mean and standard deviation for numerical variables and frequency and percentage for categorical variables.

RESULTS

Over a span of 10 years, 304 blood culture samples yielded *Salmonella* species and were analysed. Among these, *Salmonella* Typhi was the most predominant, with 225 isolates (74%), followed by *Salmonella* Paratyphi A (66 isolates, 21.7%), *Salmonella* Paratyphi B (7 isolates, 2.3%) and *Salmonella* Typhimurium (6 isolates, 2%).

Of the 304 *Salmonella* spp. isolated from patients, 213 isolates (70.1%) were from males and 91 (29.9%) were from females. This indicates a higher prevalence of enteric fever in male patients within the study population over the 10-year period.

The age-wise distribution of the 304 *Salmonella* isolates revealed that 163 (53.6%) belonged to the 21-60 years age group, followed by 80 (26.3%) in the 11-20 years group, 46 (15.1%) in the 2-10 years group and the least 11, (3.6%) in the 0-1 year age group, with 4 (1.3%) in the >60 years age group. Among these, *Salmonella* Typhi was the predominant species across all age groups, accounting for 225 out of the 304 total isolates (74%). Of these 225 isolates, the majority were observed in the 21-60 years age group (119 isolates, 52.9%), followed by 68 isolates (30.2%) in the 11-20 years group and 38 isolates (16.9%) in the 2-10 years group. A total of 66 out of 304 isolates (21.7%) were identified as *Salmonella* Paratyphi A, with the highest occurrence also in the 21-60 years age group (39 cases, 59.3%), followed by 19 cases (28.7%) in the 11-20 years group and eight cases (12%) in the 2-10 years group. *Salmonella* Paratyphi B was less frequently detected, comprising seven out of 304 isolates (2.3%). Of these, four cases (57.1%) were found in individuals aged 21-60 years, two cases (28.6%) in the 0-1 year age group and one case (14.3%) in individuals aged over 61 years. *Salmonella* Typhimurium was rarely isolated, with only six cases (2%) among the 304 total isolates. Of these, four cases (66.7%) were from the 21-60 years age group, while two cases (33.3%) were from the 2-10 years group.

In total, 304 positive blood cultures yielded *Salmonella* species isolated during the period from January 2014 to December 2024. Among these, the majority of the samples (278, 91.4%) were processed using the conventional method, while the remaining 26 samples (8.6%) were identified and processed using the VITEK automated system.

The year-wise distribution of *Salmonella* isolates from 2014 to 2024 revealed that *Salmonella* Typhi (225 cases out of 304) was the most frequently isolated species across all years, with a peak of 35 (15.5%) cases in 2024, followed by 33 (14.6%) cases in 2018 and 28 (12.4%) cases in 2022. *Salmonella* Paratyphi A (66 out of 304) was consistently isolated throughout the years, with the highest number recorded in 2023 with 18 cases (27.2%), followed

by 15 cases (22.7%) in 2015 and 9 cases (13%) in 2016. *Salmonella* Paratyphi B (7 out of 304) was rarely detected, with only one to four cases noted in select years, most notably in 2023 with four cases (57.1%). *Salmonella* Typhimurium (6 out of 304) was the least frequently isolated, appearing in only two years: three cases in 2024 (50%), followed by two cases (33.3%) in 2017 and one case (16.6%) in 2023.

The overall antibiotic susceptibility profile [Table/Fig-1] of the four *Salmonella* serotypes isolated in this study—*S.* Typhi, followed by *S.* Paratyphi A, *S.* Paratyphi B and *S. Typhimurium*—revealed a consistent pattern of high sensitivity to most first-line antibiotics. All four serotypes exhibited the highest sensitivity to ceftriaxone, tetracycline, chloramphenicol, ampicillin and cotrimoxazole, except for *S.* Typhi and *S.* Paratyphi A, which showed slightly reduced sensitivity to ampicillin (217 out of 225, 96.5% in *S.* Typhi and 65 out of 66, 98% in *S.* Paratyphi A respectively) and cotrimoxazole (217, 96.6% in *S.* Typhi and 65, 98% in *S.* Paratyphi A, respectively). Notably, *S.* Paratyphi A showed 7 (11%) resistance to ciprofloxacin, while *S.* Typhi exhibited 51 (23%) resistance. Conversely, *S.* Paratyphi B and *S. Typhimurium* isolates demonstrated higher sensitivity. These findings underscore the continued efficacy of conventional antibiotics like chloramphenicol, tetracycline and cotrimoxazole, while highlighting significant fluoroquinolone resistance, particularly in *S.* Typhi and *S.* Paratyphi A, emphasising the need for cautious use and routine surveillance of antimicrobial resistance trends.

Antibiotic	*S.* Typhi (n-225)	*S.* Paratyphi A (n-66)	*S.* Paratyphi B (n-7)	*S.* Typhimurium (n-6)
Ampicillin	217 (96.50%)	65 (98%)	7 (100%)	6 (100%)
Azithromycin	219 (97.60%)	-	-	-
Ceftriaxone	219 (97.60%)	64 (97%)	7 (100%)	6 (100%)
Ciprofloxacin	51 (23%)	7 (11%)	6 (83%)	5 (80%)
Cotrimoxazole	217 (96.60%)	65(98%)	7(100%)	6 (100%)
Tetracycline	221 (98.50%)	66 (100%)	7 (100%)	6 (100%)
Chloramphenicol	220 (98%)	66 (100%)	7 (100%)	6 (100%)

[Table/Fig-1]: Overall antibiotic sensitivity percentage of *Salmonella* species 10 years.

The resistance pattern changes of S. Typhi are shown in [Table/Fig-2]. Over the past 10 years, ceftriaxone, cotrimoxazole and tetracyclines have demonstrated consistent antibacterial efficacy against *Salmonella* Typhi. The changing resistance pattern of *Salmonella* Paratyphi A (2014-2024) has shown persistent high resistance to ciprofloxacin, fluctuating sensitivity to ampicillin and chloramphenicol and a marked reduction in cotrimoxazole efficacy in 2020. A slight, temporary improvement in ciprofloxacin sensitivity was also observed in 2020, whereas ceftriaxone maintained high sensitivity throughout the decade, with a minor decrease noted in 2023 [Table/Fig-3].

DISCUSSION

During the study period from January 2014 to December 2024, *Salmonella* Typhi was the most frequently isolated serovar, a trend consistent with earlier reports from other parts of India and South Asia. Varghese G et al., in a study conducted in Northern India, reported an even higher prevalence of *S.* Typhi followed by *S.* Paratyphi A, indicating possible regional differences in circulating serovars [20].

Present study observation of a male predominance (213 males, 70.1% vs. 91 females, 29.9%) aligns with findings from a study by Bhumbla U et al., (2022) at a tertiary-care hospital in South-West Rajasthan, which indicated that 33 out of 47 (70.2%) of *Salmonella* bloodstream isolates were in males, compared to 14 out of 47 (29.8%) in females. They attributed this trend to greater occupational exposure among males, including food handling, agricultural labour and increased outdoor activity, all of which may elevate the risk of exposure to contaminated food or water sources [21].

Year	2014 (n=20)*	2015 (n=19)*	2016 (n=26)*	2017 (n=11)*	2018 (n=33)	2019 (n=5)*	2020 (n=19)*	2021 (n=5)*	2022 (n=27)*	2023 (n=24)*	2024 (n=36)
Ampicillin	19 (95%)	19 (100%)	26 (100%)	7 (63%)	32 (97%)	5 (100%)	15 (78%)	5 (100%)	26 (97%)	23 (96%)	36 (100%)
Azithromycin	-	-	-	-	33 (100%)	5 (100%)	19 (100%)	5 (100%)	26 (97%)	23 (96%)	36 (100%)
Ceftriaxone	20 (100%)	19 (100%)	26 (100%)	11 (100%)	33 (100%)	5 (100%)	14 (73%)	5 (100%)	27 (100%)	24 (100%)	34 (97%)
Ciprofloxacin	2 (10%)	4 (20%)	1 (4%)	2 (18%)	3 (9%)	1 (22%)	1 (5%)	1 (20%)	5 (19%)	2 (8%)	7 (19%)
Chloramphenicol	19 (95%)	19 (100%)	20 (77%)	6 (54%)	31 (94%)	5 (100%)	18 (95%)	3 (60%)	27 (100%)	24 (100%)	36 (100%)
Cotrimoxazole	18 (90%)	19 (100%)	26 (100%)	10 (90%)	32 (97%)	5 (100%)	18 (95%)	5 (100%)	25 (92%)	24 (100%)	34 (94%
Tetracyclines	19 (95%)	19 (100%)	26 (100%)	11 (100%)	32 (97%)	5 (100%)	19 (100%)	5 (100%)	26 (97%)	24 (100%)	36 (100%)

[Table/Fig-2]: Changing antibiotic resistance pattern of *Salmonella* typhi.
Years marked with an asterisk (*) indicate sample sizes of fewer than 30 isolates. According to CLSI guidelines, such results are not considered statistically significant for routine reporting. However, they are included here for epidemiological documentation and may be useful for future pooled analyses or meta-analyses

Year	2014 (n=3)*	2015 (n=15)*	2016 (n=9)*	2017 (n=3)*	2018 (n=3)*	2019 (n=2)*	2020 (n=3)*	2021 (n=0)*	2022 (n=6)*	2023 (n=18)*	2024 (n=6)*
Ampicillin	3 (100%)	15 (100%)	9 (100%)	3 (100%	3 (100%)	2 (100%)	2 (66%)	-	6 (100%)	16 (88%)	6 (100%)
Ceftriaxone	3 (100%)	15 (100%)	9 (100%)	3 (100%	3 (100%)	2 (100%)	3 (100%)	-	6 (100%)	16 (91%) 16/18=88%	6 (100%)
Ciprofloxacin	0%	3 (21%)	1 (4%)	1 (33%)	0	0	1 (33%)	-	0	4 (22%)	0
Chloramphenicol	3 (100)%	11 (73%)	7 (77%)	2 (66%)	3 (100%)	2 (100%)	3 (100%	-	1 (16%)	16 (88%)	6 (100%)
Cotrimoxazole	3 (100%)	15 (100%)	8 (89%)	3 (100%)	3 (100%)	2 (100%)	1 (33%)	-	6 (100%)	18 (100%	6 (100%)
Tetracyclines	3 (100%)	13 (86%)	9 (100%)	2 (66%)	3 (100%)	2 (100%)	3 (100%)	-	6 (100%)	18 (100%)	6 (100%)

[Table/Fig-3]: Changing antibiotic sensitivity pattern of *Salmonella* paratyphi A.
Years marked with an asterisk (*) indicate sample sizes of fewer than 30 isolates. According to CLSI guidelines, such results are not considered statistically significant for routine reporting. However, they are included here for epidemiological documentation and may be useful for future pooled analyses or meta-analyses

From a clinical standpoint, the dominance of *S.* Typhi among bloodstream isolates highlights the persistent burden of enteric fever, especially in adults, with significant public health implications. This supports the continued utility of *S.* Typhi-focused vaccination strategies in endemic areas. The low isolation rates of *S.* Paratyphi B and *S. Typhimurium* are consistent with global data, which report these serovars less frequently in systemic infections.

This study revealed that *Salmonella* Typhi was the most prevalent species, with a broad age distribution and peak incidence in young adults and middle-aged individuals. In particular, (119 isolates, 52.9%), followed by 68 isolates (30.2%) in the 11-20 years group and 38 isolates (16.9%). These results are consistent with a 2020 single-centre tertiary care study from Dehradun by Maurya S et al., which found that the age group 21-40 years accounted for the highest proportion of culture-confirmed S. Typhi cases [22].

In the present study, *Salmonella* Paratyphi A demonstrated a moderate presence, with the majority of cases occurring among adults aged 21-60 years (39/66; 59.3%), followed by young adults aged 11-20 years (8/66; 12%). These findings indicate that while the infection spans across different age groups, the adult population appears more affected. A hospital-based surveillance study conducted in Bangalore between 2016 and 2017 similarly reported that *Salmonella* Paratyphi A affected both paediatric and adult populations, with 40 cases in children (≤15 years) and 73 cases in adults (>15 years) among culture-confirmed enteric fever cases [23]. Although their study did not categorise adults into narrower age bands as in present analysis, both findings underscore the broad demographic susceptibility to *S. Paratyphi* A infection. Notably, present study results highlight a comparatively higher burden in the 21-60-years age group, whereas the Bangalore study reported a more general predominance in adults without specifying further stratification.

Salmonella Paratyphi B was infrequently isolated (7 out of 304; 2.3%), with most cases occurring in adults aged 21-60 years (4 out of 7; 57.1%). Similarly, *Salmonella* Typhimurium was rare (6 out of 304; 2.0%), primarily detected in the 21-60 years group (4 out of 6; 66.7%). These findings are consistent with national studies reporting a low prevalence of non-typhi serovars in adults over 20 years conducted by Sur D et al., in India [24].

Over the past decade, our surveillance demonstrated persistently high susceptibility of *Salmonella* Typhi to key antibiotics: ceftriaxone, cotrimoxazole and tetracyclines, all showing ≥95% susceptibility rates. Ceftriaxone, a broad-spectrum third-generation cephalosporin administered parenterally, remains the cornerstone of empirical therapy in severe cases. Meanwhile, cotrimoxazole and tetracyclines—despite their age—continue to be effective oral treatment options, especially where resistance to newer agents is rising. These findings mirror recent data from Northern India: in a prospective observational study conducted by Varghese G et al., (January 2021 to April 2023) involving 32 *Salmonella* bloodstream isolates, all were 100% susceptible to ceftriaxone, chloramphenicol, cotrimoxazole and cefotaxime [20].

Azithromycin susceptibility testing for *Salmonella enterica* serovar Typhi was first introduced by the Clinical Laboratory Standards Institute (CLSI) in 2015 (M100-S25) [25].

During the COVID-19 pandemic period (2020-2022), *Salmonella* Typhi demonstrated high susceptibility to ampicillin, azithromycin, ceftriaxone, cotrimoxazole and tetracycline, while showing a high percentage of resistance to ciprofloxacin—95% in 2020, 80% in 2021 and 81% in 2022. Considering *Salmonella* Paratyphi A, for the year 2020, antibiotic susceptibility to ampicillin was 66%, ceftriaxone 100%, chloramphenicol 100%, cotrimoxazole 66% and tetracycline 100%, with a high resistance rate to ciprofloxacin at 67%. In 2022, all isolates were resistant to ciprofloxacin (100%), while all isolates were highly susceptible (100%) to ampicillin, ceftriaxone, chloramphenicol, cotrimoxazole and tetracyclines. In 2022, *Salmonella* Paratyphi B showed high susceptibility (100%) to ampicillin, ceftriaxone, chloramphenicol, cotrimoxazole, ciprofloxacin and tetracyclines. In contrast, a similar study in Kolkata conducted by Biswas M et al., during 2017-2022 reported no resistance to ampicillin, chloramphenicol, cotrimoxazole, or azithromycin, although a single multidrug-resistant *S.* Paratyphi A isolate showed resistance to ciprofloxacin, cefixime, ceftriaxone, nalidixic acid and meropenem [26].

Salmonella Paratyphi A has shown consistently high sensitivity to ceftriaxone, cotrimoxazole and tetracycline. These antibiotics have remained effective treatment options, even as resistance to fluoroquinolones and other antimicrobials has increased in many regions. Ceftriaxone continues to serve as a reliable empirical therapy for enteric fever caused by *S.* Paratyphi A, while cotrimoxazole and tetracycline have maintained their susceptibility profile, indicating their potential for use as alternative or step-down therapies, especially in resource-limited settings. Present study findings align with those of a previous study from Nepal by Maharjan A et al., which reported high susceptibility of *S.* Paratyphi A isolates to ceftriaxone and cotrimoxazole throughout a multi-year surveillance period [27].

During the ten-year surveillance period (2014-2024), *Salmonella* Paratyphi B was infrequently isolated, appearing only in four specific years: 2018, 2022, 2023 and 2024. Notably, all *S.* Paratyphi B isolates remained 100% susceptible to ceftriaxone, cotrimoxazole and tetracyclines in each of those years. This consistent antibiotic efficacy confirms these agents as reliable treatment options when this rare serovar is encountered. The rarity of *S.* Paratyphi B aligns with national trends, where this serovar is far less common than *S.* Typhi and *S.* Paratyphi A. A recent prospective observational study from India (December 2019–December 2021) conducted by Veeraraghavan B et al., reported a similarly low prevalence of S. Paratyphi B among bloodstream isolates and found no resistance to first-line agents, including ceftriaxone, cotrimoxazole and ampicillin [28].

During the ten-year surveillance period (2014-2024), *Salmonella* Typhimurium was identified infrequently in blood cultures, detected only in 2017, 2023 and 2024. Despite its sporadic appearance, resistance testing revealed 100% susceptibility to five key antibiotics—ampicillin, ceftriaxone, cotrimoxazole, chloramphenicol and tetracycline—in all isolates across these years. This consistent susceptibility underscores the maintained efficacy of these first-line agents, supporting their inclusion in empirical treatment protocols, particularly in regions experiencing dynamic resistance trends. These findings coincide with data from Veeraraghavan B et al., in South India, where a 2018-2021 study at a tertiary care centre in Kerala found that 53 out of 97 (54.6%) of non typhoidal *Salmonella* from diarrhoeal specimens were *S. Typhimurium* and all isolates remained fully susceptible to ceftriaxone and cotrimoxazole [28].

Limitation(s)

This study had certain limitations. Firstly, as a single-centre retrospective analysis, the findings may not be generalisable to other regions with differing epidemiological profiles. Secondly, the study relied on blood culture positivity, which can underestimate the true burden of *Salmonella* infections, especially in patients who have been pretreated with antibiotics or those with low-grade bacteraemia. Thirdly, molecular characterisation of resistance mechanisms and serovar subtyping was not performed, which could have provided deeper insights into resistance evolution and strain dynamics. Additionally, data on clinical outcomes and co-morbidities were not included, limiting the ability to correlate resistance patterns with patient prognosis.

CONCLUSION(S)

This 10-year retrospective study identified *Salmonella* Typhi as the predominant serovar among BSIs at our tertiary care centre, accounting for 225 out of 304 isolates (74.0%). Adults aged

21-60 years were the most affected age group, with a clear male predominance observed, as 213 out of 304 individuals were affected among the overall isolated *Salmonella* species. The antimicrobial susceptibility analysis revealed consistently high sensitivity of *Salmonella* isolates to ceftriaxone, followed by cotrimoxazole and tetracycline, while significant resistance to ciprofloxacin was noted, particularly in *S.* Typhi and *S.* Paratyphi A. These findings emphasise the continued effectiveness of select conventional antibiotics in our setting and underscore the importance of sustained antimicrobial surveillance to guide empirical treatment decisions and update institutional antibiotic policies.

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