

Temporal Trends in Antimicrobial Resistance of *Salmonella* Isolates: A Five-Year Surveillance Study in Western India

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To Cite this Article

M. Indira, P. Gangi Reddy, P. Chandra Sekhar, K. Ashok, "Temporal Trends in Antimicrobial Resistance of *Salmonella* Isolates: A Five-Year Surveillance Study in Western India" *Journal of Science and Technology*, Vol. 09, Issue 11-Nov 2024, pp21-26

Article Info

Received: 30-10-2024 Revised: 07-11-2024 Accepted: 18-11-2024 Published: 29-11-2024

ABSTRACT: Background & Objective: India is home to two infectious diseases caused by *Salmonella*: typhoid and paratyphoid fever. The medication of choice for a third-generation cephalosporin. Study was carried out on the Surveillance of Enteric Fever in India to ascertain the prevalence, clinical manifestation, and trajectory of antimicrobial resistance (AMR).

This work aimed to examine the antibiogram profiles of *Salmonella typhi* found in patient blood cultures. Second, to record how often *Salmonella typhi* infections occur located in Vadodara, the Antibiotic Susceptibility Test is third. Material and Methods: study was carried out over a period of 12 months after obtaining. The freshly drawn venous blood was placed in a blood culture vial. Following identification of pathogen isolates, Kirby-Bauer disc diffusion test was employed to determine antibiotic drug susceptibility as per CLSI rules.

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Results:

Total 10,126 blood samples were collected. In 84 samples (0.83%), 83 instances of *Salmonella typhi* and 1 instance of *Para typhi B*. The ratio of males to females was 1:2. Children aged 0–14 years had greater incidence of enteric fever. From July to September, the most instances are solitary. The majority of the *Salmonella typhi* isolates showed resistance to Ceftriaxone but were sensitive to Ciprofloxacin, Azithromycin and Cotrimoxazole.

Conclusion: It has been shown in this review that antibiotic resistance is on the rise among *Salmonella* species. The use of empirical treatment for enteric fevers should be avoided in favor of third generation cephalosporins, Cefepime, Carbapenem, and azithromycin.

INTRODUCTION: Typhoid fever is caused by the gram-negative rod-shaped Enterobacteriaceae family member *Salmonella typhi*, which can enter bloodstream and cause a potentially deadly illness. In developing nations, it has been a significant cause of disease and mortality. The incidence rate of typhoid is much lower in affluent countries than in low- and medium-income South Asian and African countries 1. The Global Burden of Disease Study 2 estimates that there were 9.25 million cases of typhoid fever in 2019, with South Asia and Sub-Saharan Africa accounting for the bulk of the disease's 110,000 deaths. Food or water contamination is the typical vector for the spread of *S. typhi*, a disease that exclusively affects humans in the wild. In 2005, the Malaysian state of Kelantan recorded 88 cases and two fatalities 3. After ingesting *S. typhi*-contaminated food or water, symptoms often start to show 7–14 days after the asymptomatic period. Patients may have diarrhea, vomiting, nausea, and gastrointestinal distress after the first asymptomatic phase. Since antibiotics were a vital tool in the battle against typhoid 4, 5, the number and severity of deaths from a number of infectious diseases have significantly decreased.

Unfortunately, *S. typhi* has become more resistant to antibiotics as a result of their overuse and misuse in human medicine. AMR 6, 7

may arise as a result of *Salmonella typhi* mutations alone. Current antimicrobial resistance (AMR) data for *S. typhi* is essential for effective antibiotic stewardship and better patient outcomes, and this data should be accessible worldwide and in real-time. Consequently, this study used a systematic review and meta-analysis to assess the frequency of AMR in *S. typhi* isolated from people

MATERIALS AND METHODS:

From January to December 2023, researchers from the Microbiology Department of Medical College Baroda in Vadodara, Gujarat, conducted a retrospective study. Regardless of whether they were hospitalized or not, patients with typhoid-like symptoms had their venous blood samples taken (5 mL for adults and 2 mL for children). Blood culture sterile vials, which may be either the classic or Bactec kind (Adult & Pediatric), were used to transfer the venous blood samples that were obtained. After a 24-hour incubation period in a carbon dioxide incubator, the first culture is performed in a conventional blood culture bottle. To help the Bactec machine identify the development, we also precisely label the blood sample. After being incubated at 37°C for 18 to 20 hours, bacteria that showed signs of growth were then moved to a variety of media, such as *Salmonella*-*shigella* (SS), xylose lysine deoxycholate (XLD) agar, and MacConkey agar. Biochemical assays and colony morphology were used to describe the isolates. Instances of *S. typhi* or *Paratyphi* were confirmed with the use of antisera. CLSI criterion 8 was followed while conducting antibiotic susceptibility testing, which comprised the modified Kirby-Bauer disc diffusion technique. The impregnated Mueller-Hinton agar plates were equally spaced. Applying the following antimicrobial discs to the plates with sterile forceps included the following antibiotic dosages: co-trimoxazole (1.25/23.75 micrograms), ciprofloxacin (5 micrograms), imipenem (30 micrograms), doxycycline (30 micrograms), ampicillin (10 micrograms), ceftriaxone (30 micrograms), and azithromycin (15 micrograms). The discs were spaced 10–15 mm apart and 6 mm from the edge. We used ATCC strains (ATCC-25923 for *Staphylococcus aureus*, ATCC-25922 for *Escherichia coli*, and ATCC-27853 for *Pseudomonas aeruginosa*) for quality control.





FIG. 3: SALMONELLA ANTISERA TEST



FIG. 4: INDOLE TEST

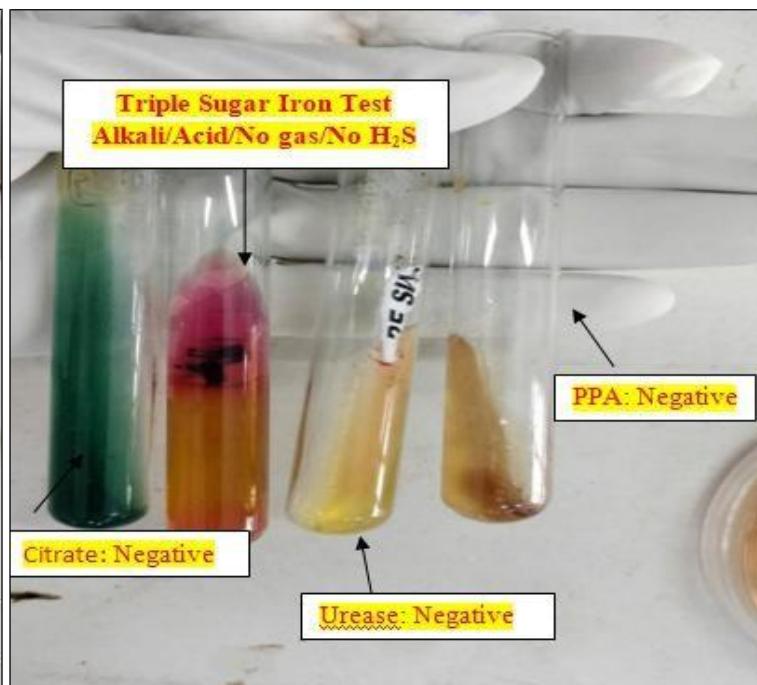


FIG. 5: TRIPLE SUGAR IRON TEST

Inclusion Criteria: If a patient has septicemia symptoms such as a high temperature, shortness of breath, low blood pressure, rapid heart rate, mental disorientation, or decreased urine output, medical attention is needed immediately.

RESULTS: There were 84 patients in the research, 39 of whom were men and 45 of whom were women, representing a male to female ratio of around 1:1.2. The bulk of Salmonella cases (n=54) were in the 0–14 age group. Below, you'll discover the Figure 6 shows the age distribution of the Salmonella cases, whereas Chart 2 shows the gender distribution. According to Fig. 7's age-wise distribution of salmonella, a higher number of isolates were found in the children under the age of 14 (n=54) age group. Thirty youngsters and adults over the age of 14 had a one-third isolation rate of Salmonella. There is no discernible difference between male and female genders, according to chart 2 of the gender-wise distribution of salmonella above.

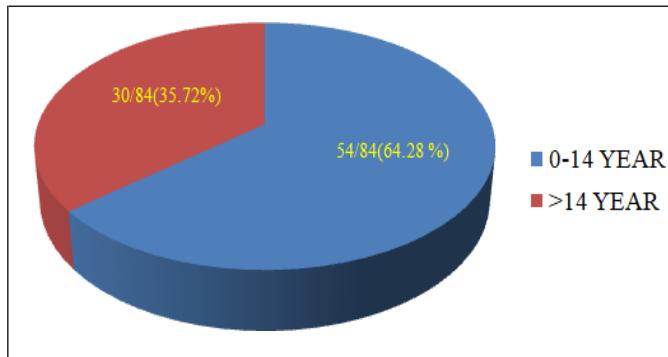


FIG. 6: AGE WISE DISTRIBUTION

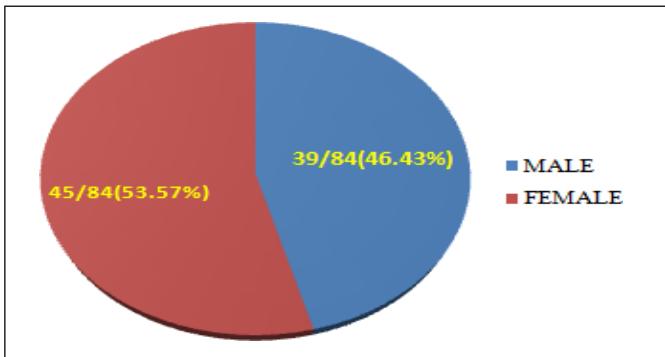


FIG. 7: GENDERWISE DISTRIBUTION

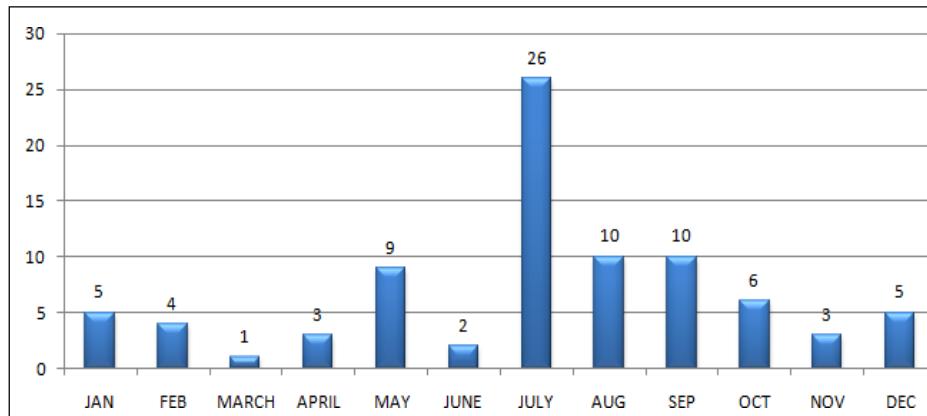


FIG. 8: MONTHWISE DISTRIBUTION

Typhoid fever rates fluctuated throughout the year in this research. According to Table No. 1, the greatest number of cases in this research were isolated in July (26 cases), followed by August and September (10 instances). In October, one solitary case of *Salmonella Paratyphi B* was also reported. In the summer, monsoon, and post-monsoon seasons, 57 instances were isolated.

TABLE 1: ANTIBIOTIC SUSCEPTIBILITY OF *SALMONELLA TYPHI* (N=83)

Antibiotic	Susceptible	Resistant	Intermediate
Ampicillin (10 µg)	67 % (n=54)	32% (n=26)	1% (n=3)
Ceftriaxone (30 µg)	79% (n=66)	17 % (n=14)	4% (n=3)
Azithromycin (15 µg)	71.08% (n=59)	28.92 % (n=24)	-
Doxycycline (30 µg)	65.06% (n=54)	30.12 % (n=25)	4.81 (n=4)
Ciprofloxacin (5 µg)	10 % (n=9)	71 % (n=59)	19% (n=15)
Co-Trimoxazole (1.25/23.75 µg)	70 % (n=59)	25 % (n=21)	5% (n=3)

Azithromycin (71.08%), ampicillin (67%), doxycycline (65.06%), ciprofloxacin (10%), and cotrimoxazole (70%), in order of prevalence, was ceftriaxone (79%). Concerningly, 14 people in the research showed resistance to third-generation cephalosporins (Ceftriaxone 30 µg). Ipenem susceptibility is checked for in isolates that were discovered to be Ceftriaxone resistant using the disc diffusion method. *Salmonella Para typhi B* was completely susceptible to all antibiotic drugs in a single solitary instance.

DISCUSSION: Enteric fever is mostly caused by *Salmonella typhi*. Antimicrobial susceptibility patterns have been shown to be changing in many Indian locales, highlighting the need of ongoing monitoring and evaluation. 9. Of the 84 typhoid and paratyphoid cases reported in this study, about 98% are caused by typhoid fever. According to studies by Patil et al. (2010), Mishra et al. (2011), and Khadaka et al. (12), *S. typhi* is the most prevalent isolate, with *S. Paratyphi A* coming in second. These findings were consistent with their findings. Since patients in rural areas were more likely to have poor feco-oral hygiene and water sanitation, the bulk of *Salmonella* isolates came from these areas. Because patients in rural areas were more likely to have poor feco-oral hygiene and water sanitation, the majority of *Salmonella* isolates came from these areas. 9. In contrast to the Al-Roubaea et al.13 study, which indicates that the largest number of salmonella isolates occur in individuals aged 21 to 30, the majority of typhoid fever cases occur in children under the age of 14. This might be because India has a high rate of enteric fever. There were no appreciable gender differences in the distribution of *Salmonella* spp. This result validated the results of the previous research by Jaafar et al. 14. According to this study, the monsoon months of July, August, and September account for the largest proportion of enteric fever cases (54.76%). This is similar to a research by Al Khafaji et al. (15) that found that the summer and monsoon seasons had the greatest number of typhoid fever patients (65.53%). Consistent with previous research, the current study found that almost all *Salmonella typhi* isolates were cephalosporin-susceptible, with Ceftriaxone making up a relatively significant portion (79%) of these isolates. Similar tests have shown that Patil et al. 10 is completely ceftriaxone sensitive. 71% of patients in the present study were sensitive to azithromycin, which is similar to findings by Chayani et al. (16, 83%). According to Jain et al. (18) and Patel SR et al. (17), 21% and 7% of individuals, respectively, were susceptible to azithromycin (2011-2013).

The present study found a 70% susceptibility to cotrimoxazole, compared to 19.1% in the Jain et al. 18 study. Similar to the 10% susceptibility seen in the present study, Medella et al. (19) showed a 0.6% decrease in susceptibility to the FQs, primarily ciprofloxacin. In this study, 14 individuals are resistant to third-generation cephalosporins (Ceftriaxone 30 µg), according to Farah Naz Qamar et al. (20). This investigation identified two cases of Ceftriaxone resistance to third-generation cephalosporins. All discovered Ceftriaxone-resistant isolates were tested for imipenem sensitivity using the disc diffusion method, and all isolates were confirmed to be susceptible 21.

As a consequence, the ceftriaxone pattern of resistance continues to rise when the susceptibility data of other antibiotic medications are examined. As a result, monitoring the susceptibility pattern's evolution over time is essential.

Limitation: Despite routine quality control, the disc diffusion technique is used to determine the AMR pattern of *S. typhi*; hence, better methods like as broth microdilution or gene sequencing are needed to validate Ceftriaxone resistance. This research did not record the patients' outcomes or the treatment they received.

CONCLUSION: This review has shown that *Salmonella* species are becoming more resistant to antibiotics. Azithromycin, carbapenem, cefepime, and third-generation cephalosporins should be used instead of empirical therapy for enteric fevers.

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