

Increasing antimicrobial resistance in *Salmonella* isolates across the Indian subcontinent: Is our response to this threat satisfactory?

Dear Editor,

We read the article “Prevalence of *Salmonella typhi* among febrile patients in a tertiary care hospital of South West Rajasthan,” published in the *Journal of Family Medicine and Primary Care* with interest.^[1] The authors reported that the majority of *Salmonella* species isolated were that of *Salmonella typhi* as compared to *Salmonella paratyphi* A and B. This was true even for the rural population. The antimicrobial susceptibility testing revealed a decreased sensitivity for fluoroquinolones (FQs), with the least sensitivity for ciprofloxacin and intermediate susceptibility for levofloxacin.

Typhoid fever is an acute febrile illness caused mainly by gram-negative bacteria *Salmonella typhi* and *Salmonella paratyphi* A and B. These bacteria are transmitted by the fecal–oral route and are more common in areas of overcrowding and poor sanitation. The burden of cases of typhoid fever in southeast Asia, especially the Indian subcontinent, is very high and forms a large proportion of the global burden. The national incidence rate of typhoid in India was approximately 360 cases per 1,00,000 person-years. This corresponds to around 4.5 million cases and 8,900 deaths annually in India.^[2]

Typhoid fever is primarily treated with antibiotics, but due to emerging antimicrobial resistance (AMR), it is becoming more challenging day by day. Those with resistant infections have a twofold increase in mortality risk and cost burden of treatment than patients with sensitive strain infections.^[3,4] India is the largest consumer of antibiotics in low- and middle-income countries. Consequently, there is a development of multidrug resistant (MDR) strains of *S. typhi* (combined resistance to first-line antibiotics, namely chloramphenicol, co-trimoxazole, and ampicillin) and extensively drug-resistant (XDR) *S. typhi* strains (resistant to chloramphenicol, ampicillin, co-trimoxazole, fluoroquinolones (FQs), and third-generation cephalosporins).^[3] MDR *S. typhi* is considered endemic to South and South-East Asia; however, these strains are on the decline due to increased testing for antimicrobial

sensitivity and use of alternative drugs.^[5] FQs, like ciprofloxacin and ofloxacin were the drug of choice for typhoid fever. Widespread use of FQs has led to the emergence of FQ-resistant strains. Since then, the third-generation cephalosporin, especially ceftriaxone as well as azithromycin, have become the treatment of choice.

Due to the increasing number of multi-drug-resistant strains of *S. typhi*, the key to controlling the disease is the prevention of the disease. The primary strategy to prevent the spread of typhoid infection is to improve community hygiene and sanitary infrastructure to interrupt fecal–oral transmission. Improved water supply, sanitation, and hygiene (WASH) practices are more often associated with a lower incidence of typhoid infections.^[6] Vaccination is also an effective prevention strategy, especially for travelers traveling to typhoid endemic areas. In India, presently two typhoid conjugate vaccines are available, and they provide higher immunity than the earlier available vaccines. While one vaccine is conjugated to CRM 197 (a nontoxic variant of diphtheria toxin), another contains Vi polysaccharide conjugated with tetanus toxoid.

Patients infected with resistant strains of bacteria face exorbitant treatment costs, which often force them to resort to self-prescribed, cheaper, and ineffective drugs. This, in turn, leads to the carrier state and increases the likelihood of the emergence of drug-resistant strains. This is a significant problem as drug-resistant infections are difficult to treat and can lead to prolonged hospital admissions, higher healthcare costs, and increased mortality rates.^[7] Rapid awareness programs operating at the local level, such as primary health centers and subcenters, can be utilized to address these issues.

Further prevention of AMR is a huge task considering the high levels of resistant strains and lack of effective antimicrobial stewardship. There is a need for an effective surveillance program to gather reliable information on trends of AMR. Necessary steps should be taken to decrease/curtail the sales of over-the-counter antimicrobials. One such step was Schedule H1 which prohibited the sale of third-generation cephalosporins, carbapenems, and higher-generation FQs without a prescription, but schedule H1 excluded azithromycin and ciprofloxacin.^[8]

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Conflicts of interest

There are no conflicts of interest.

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