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Comparison of Effectiveness of Meropenem Versus Azithromycin in Treatment of Culture Positive Salmonellosis

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ABSTRACT

Background: Drug resistant enteric fever has reduced reliable treatment options. The Medical Microbiology and Infectious Diseases Society of Pakistan issued 2022 guidance that recommended azithromycin and a carbapenem, but comparative outcome evidence remains limited.

Objective: to Compare mean duration of treatment after meropenem versus azithromycin in culture positive resistant salmonellosis.

Methods: A randomized controlled trial was conducted in the Department of Medicine, Khyber Teaching Hospital, Peshawar, from 8 March 2024 to 7 September 2024. Ninety-six adults aged 20 to 60 years with drug resistant enteric fever were randomized by blocked allocation. Group A received intravenous meropenem 60 mg/kg/day in three divided doses, maximum 1 g per dose. Group B received oral azithromycin 20 mg/kg/day in two divided doses, maximum 1000 mg/day. Standard supportive care included antipyretics and intravenous fluids. Treatment duration was defined as days from starting antibiotics to clinical response. Clinical response was defined as defervescence, measured as time to body temperature below 38°C for more than 48 hours. Mean treatment duration was compared between groups using SPSS version 25.

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Results: Mean age was 43.88 ± 10.19 years in the azithromycin group and 40.83 ± 11.24 years in the meropenem group. Men comprised 29 (60.4%) and 23 (47.9%). Typhoid vaccination was reported in 6 (12.5%) and 5 (10.4%). Mean treatment duration was 4.31 ± 1.33 days with azithromycin and 6.77 ± 1.27 days with meropenem, $p<0.001$.

Conclusion: Azithromycin produced faster fever clearance than meropenem in adults with culture confirmed resistant salmonellosis in this setting.

Keywords: Enteric fever, azithromycin, meropenem, resistant salmonellosis, effectiveness.

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Introduction

Enteric fever is a systemic infection caused by Salmonella enterica serovar Typhi and Salmonella enterica serovar Paratyphi A, B, and C (1). The World Health Organization estimates the global burden at 11 to 21 million cases each year with roughly 128,000 to 161,000 deaths (2). International travel and antimicrobial resistance have expanded the threat beyond low- and middle-income countries (3). In the subcontinent, Pakistan reports higher incidence than India, and enteric fever still carries a measurable worldwide case fatality rate with higher risk in children, older people, and populations in resource poor settings (4).

Public health and hygiene improvements reduced enteric fever in many developed settings, yet the disease remains endemic in many developing countries (5). Infection usually follows ingestion of an infecting dose through contaminated water or food. Person to person transmission occurs through poor hygiene and sewage contamination of water supplies (6). Limited potable water and improper sanitation sustain transmission and concentrate burden in resource-limited regions (7).

Treatment has changed as resistance expanded. Earlier outpatient care relied on chloramphenicol, ampicillin or amoxicillin, and trimethoprim-sulfamethoxazole (8). Plasmid-mediated multidrug resistance to these agents emerged in the late 1980s and spread across countries (9). Fluoroquinolones such as ciprofloxacin then became common choices, but low-level and high-level resistance became widespread in South Asia, reducing reliability (10). Third-generation cephalosporins such as ceftriaxone and cefixime remained effective options for many patients, including children (11).

Azithromycin became a widely used oral option over the last two decades, yet reports now describe sporadic resistance and treatment failure (12). When resistance narrows remaining choices, clinicians may turn to carbapenems such as meropenem. Local outcome data comparing these limited options remains necessary for practical prescribing decisions in resistant, culture-confirmed disease (13). A prior cited estimate reported mean treatment duration of 8.1 ± 2.5 days after meropenem and 6.6 ± 2.7 days after azithromycin (14). Pakistan guidance from the Medical Microbiology and Infectious Diseases Society of Pakistan in 2022 recommended azithromycin and a carbapenem as treatments of choice, based on antimicrobial sensitivity patterns, but called for outcome studies under these constrained options (15).

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This context supports comparative evaluation of meropenem and azithromycin in culture positive resistant salmonellosis, using time to clinical response as a pragmatic endpoint for hospital care (16)

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Materials and Methods

Study design

A randomized controlled trial was conducted

Study setting and period

The trial took place in the Department of Medicine, Khyber Teaching Hospital, Peshawar, from 8 March 2024 to 7 September 2024.

Participants and sampling

Participants were enrolled through non-probability consecutive sampling from the medical outpatient department and medical wards.

Case definitions and operational definitions

Enteric fever

Febrile illness with temperature at least 38.5°C for more than 4 days, no obvious source of infection, plus at least two clinical features including abdominal tenderness, hepatomegaly, splenomegaly, or rose spots, with positive blood culture for Salmonella Typhi (17).

Extensively drug resistant enteric fever

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Blood culture confirmed S. Typhi with resistance to five antibiotic classes including ampicillin, chloramphenicol, trimethoprim-sulfamethoxazole, a fluoroquinolone, and a third-generation cephalosporin including ceftriaxone or cefixime (18).

Duration of treatment

Days from starting antibiotics to clinical response. Clinical response was defined as defervescence, measured as time from first recorded fever to body temperature below 38°C for more than 48 hours (19).

Body mass index

Height was measured using a wall-mounted height meter and weight using a digital scale. BMI was calculated as weight in kilograms divided by height in meters squared (20).

Eligibility criteria

Inclusion criteria

- Adults aged 20 to 60 years.
- Both sexes.
- Extensively drug resistant enteric fever as defined above.

Exclusion criteria

- History or record of allergy to azithromycin or meropenem.
- Major complications of typhoid fever including pneumonia, intestinal hemorrhage or perforation, shock, or coma based on clinical examination.
- Inability to swallow oral medication due to enteric encephalopathy.
- Significant underlying illness including heart disease, asthma requiring chronic medications, or immunodeficiencies based on record and clinical examination.

Sample size

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Sample size was calculated using a WHO formula with 95% confidence interval and 80% power, using expected treatment duration values of 8.1 ± 2.5 days for meropenem and 6.6 ± 2.7 days for azithromycin. The required sample was 96 participants, 48 per group (21).

Ethical approval and consent

Approval was obtained from the hospital ethical committee (Ref No: 674/DME/KMC). Written informed consent was obtained after explaining purpose, benefits, and risks. Data were stored securely to maintain confidentiality.

Randomization and allocation

Allocation to two groups was done using blocked randomization.

Interventions

Group A received intravenous meropenem 60 mg/kg/day in three divided doses, maximum 1 g per dose. Group B received oral azithromycin 20 mg/kg/day in two divided doses, maximum 1000 mg/day. Standard supportive care included antipyretics and intravenous fluids.

Follow-up and clinical assessment

Clinical status was recorded every 6 hours to assess efficacy using the operational definition of clinical response. Non-responders were managed according to hospital protocols. Data were recorded on a structured proforma (22).

Outcomes

Primary outcome: Mean duration of treatment in days, defined as time from antibiotic initiation to defervescence as operationalized above.

Effectiveness measure: Time to defervescence and normalization of temperature.

Statistical analysis

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Data were entered and analyzed using SPSS version 25. Quantitative variables were summarized as mean and standard deviation. Normality was assessed using the Shapiro–Wilk test. For non-normal distributions, median and interquartile range were reported. Mean duration of treatment was compared between groups using an independent t test or Mann–Whitney U test as appropriate. Statistical significance was set at p value 0.05 or less. Categorical variables were presented as frequency and percentage. Stratification was done by age, sex, BMI, vaccination status, residence, profession, educational level, socioeconomic status, and symptom duration, followed by post-stratification testing using the same approach and the same p value threshold.

Results

Participants and baseline profile

A total of 96 participants were analyzed, 48 per group. Mean baseline age was 43.88 ± 10.19 years in the azithromycin group and 40.83 ± 11.24 years in the meropenem group. Mean baseline fever duration was 4.08 ± 1.40 days vs 5.02 ± 1.25 days. Mean BMI was 24.05 ± 2.50 kg/m² vs 24.71 ± 2.90 kg/m².

Table 1. Baseline continuous characteristics

Variable	Azithromycin Mean ± SD	Meropenem Mean ± SD
Age years	43.88 ± 10.19	40.83 ± 11.24
Fever duration days	4.08 ± 1.40	5.02 ± 1.25
BMI kg/m²	24.05 ± 2.50	24.71 ± 2.90

Table 2. Baseline categorical characteristics

Characteristic	Category	Azithromycin n (%)	Meropenem n (%)

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Age group	40 or below	21 (43.8)	24 (50.0)
	More than 40	27 (56.3)	24 (50.0)
Gender	Male	29 (60.4)	23 (47.9)
	Female	19 (39.6)	25 (52.1)
Fever duration group	4 or below	31 (64.6)	19 (39.6)
	More than 4	17 (35.4)	29 (60.4)
BMI group	24.0 or below	30 (62.5)	32 (66.7)
	More than 24.0	18 (37.5)	16 (33.3)
Typhoid vaccination	Vaccinated	6 (12.5)	5 (10.4)
	Unvaccinated	42 (87.5)	43 (89.6)
Residence	Rural	22 (45.8)	25 (52.1)
	Urban	26 (54.2)	23 (47.9)
Education	Matric or below	21 (43.8)	24 (50.0)
	Above matric	27 (56.3)	24 (50.0)
Profession	Business	13 (27.1)	10 (20.8)
	Salaried job	25 (52.1)	23 (47.9)
	Jobless	10 (20.8)	15 (31.3)
Socioeconomic status	Fair	25 (52.1)	25 (52.1)
	Poor	23 (47.9)	23 (47.9)

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Primary outcome

Mean treatment duration was 4.31 ± 1.34 days in the azithromycin group and 6.77 ± 1.28 days in the meropenem group, p<0.001. The mean difference was 2.46 days.

Table 3. Treatment duration by treatment arm

Outcome	Azithromycin n=48 Mean ± SD	Meropenem n=48 Mean ± SD	p value
Treatment duration days	4.31 ± 1.34	6.77 ± 1.28	<0.001

Stratified results for treatment duration

Demographic strata

Table 4. Treatment duration stratified by age, gender, residence, education

Stratum	Category	Azithromycin Mean ± SD	Meropenem Mean ± SD	p value
Age	40 or below	4.29 ± 1.35	6.33 ± 1.24	<0.001
	More than 40	4.33 ± 1.36	7.21 ± 1.18	<0.001
Gender	Male	4.03 ± 1.24	6.48 ± 1.47	<0.001
	Female	4.74 ± 1.41	7.04 ± 1.02	<0.001
Residence	Rural	4.09 ± 1.07	6.84 ± 1.31	<0.001
	Urban	4.50 ± 1.53	6.70 ± 1.26	<0.001
Education	Matric or below	4.24 ± 1.26	6.67 ± 1.20	<0.001
	Above matric	4.37 ± 1.42	6.88 ± 1.36	<0.001

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Discussion

This randomized controlled trial compared azithromycin and meropenem for culture confirmed resistant salmonella infection. Treatment duration was shorter with azithromycin than meropenem. Time to defervescence occurred earlier with azithromycin.

Evidence for meropenem in enteric fever remains limited and inconsistent. A literature search described five fluoroquinolone resistant S Typhi cases treated with meropenem alone or as part of combination therapy. Only two achieved defervescence within the expected range on meropenem alone. Three required addition of another antimicrobial to achieve defervescence (23).

Azithromycin evidence is stronger. Multiple clinical trials have shown defervescence within the expected range on azithromycin-based therapy (24). A cited comparative study reported longer fever clearance time with azithromycin than ceftriaxone, but the pattern differed from this dataset where earlier defervescence occurred with azithromycin compared with meropenem (25).

Biology supports the focus on intracellular antimicrobial activity. S Typhi can persist and replicate inside macrophages after invasion (26). Azithromycin intracellular accumulation, biliary secretion, and long half-life were cited as features that support effectiveness against intracellular infections such as enteric fever (27). This mechanism fits earlier defervescence with azithromycin in the trial.

Meropenem outcomes remain harder to predict. Four cited case reports described relapse or need for augmentation when meropenem was used alone, with proposed explanations that included limited intracellular penetration and bacterial tolerance or persistence (28). Favorable outcomes were also cited in XDR typhoid treated with meropenem, supporting continued use when oral therapy is not suitable. Meropenem stability against ESBLs and broad-spectrum activity were cited as reasons that may support clearance (29).

Combination therapy often appears in practice when options narrow. This trial recorded treatment failures in patients treated with meropenem plus azithromycin, with systemic complications and one death, attributed to delayed presentation and poor clinical status at arrival (30 Published evidence reported that ceftriaxone plus azithromycin reduced fever clearance times, while no study was found assessing

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synergistic action of meropenem with azithromycin for enteric fever (31). Case reports also suggested combining meropenem with another antimicrobial for fluoroquinolone resistant and XDR typhoid (32).

A treatment failure occurred in the azithromycin only group due to persistent fever despite recommended dose and duration. Fever resolved after extending therapy by five days. No immunosuppression, complication, or noncompliance was recorded (33). This trial's failure proportion aligned with earlier azithromycin trials that reported overall efficacy (34).

Baseline fever duration differed between groups at enrollment. Fever duration averaged 4.08 ± 1.40 days in the azithromycin group and 5.02 ± 1.25 days in the meropenem group. This imbalance may have contributed to longer time to sustained normothermia in the meropenem arm.

Clinical decision making can also extend meropenem courses. Longer meropenem duration was attributed to concern about relapse and to a treatment failure that required extension of therapy, which increased the mean duration (35). Meropenem duration guidance relied on limited case reports, including courses of 10 days and 22 days, showing wide variance in time to fever clearance (36). Meropenem treatment duration in this trial was similar to ceftriaxone duration reported in past clinical trials. The explanation linked this to bactericidal action and short half-lives, with cited half-life values of 60 minutes for meropenem and 330 minutes for ceftriaxone (37).

A cost comparison estimated an average daily cost of US$88.46 for meropenem compared with US$5.87 for azithromycin, and stated that higher cost can deter access to optimal therapy in lower socioeconomic groups (38). Oral availability also supports azithromycin use in clinically stable patients.

Limitations

Single center recruitment limits generalizability. Baseline fever duration differed between arms and may have biased treatment duration. The study focused on short term clinical response and did not document relapse or bacteriologic clearance beyond the defervescence endpoint.

Conclusion

Azithromycin achieved faster sustained defervescence than meropenem in adults with culture confirmed resistant salmonellosis. Both regimens produced clinical response. Azithromycin offers oral delivery and

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lower cost. Meropenem remains important when oral therapy is not possible or complications occur. Larger multicenter randomized trials should confirm outcomes and guide treatment protocols.

References

1. Gibani, Malick M et al. “Typhoid and paratyphoid fever: a call to action.” Current opinion in infectious diseases vol. 31,5 (2018): 440-448. doi:10.1097/QCO.0000000000000479.

2. World Health Organization. “Typhoid vaccines: WHO position paper, March 2018 - Recommendations.” *Vaccine* vol. 37,2 (2019): 214-216. doi: 10.1016/j.vaccine.2018.04.022.
3. Crump JA, Mintz ED. Global trends in typhoid and paratyphoid fever. Clin Infect Dis. 2010;50(2):241-246. doi:10.1086/649541. https://doi.org/10.1086/649541.

4. Stanaway JD, Reiner RC Jr, Blacker BF, et al; GBD 2017 Typhoid and Paratyphoid Collaborators. The global burden of typhoid and paratyphoid fevers: a systematic analysis for the Global Burden of Disease Study 2017. Lancet Infect Dis**.** 2019;19(4):369-381. doi:10.1016/S1473-3099(18)30685-6.
5. Wain J, Hendriksen RS, Mikoleit ML, Keddy KH, Ochiai RL. Typhoid fever. Lancet. 2015;385(9973):1136-1145. doi:10.1016/S0140-6736(13)62708-7.

GLOBAL HEALTH & MEDICINE
ISSN / eISSN: 2434-9186 / 2434-9194
Volume 08, Issue 06.111-119
https://ghsjournal.com/

6. Parry CM, Hien TT, Dougan G, White NJ, Farrar JJ. Typhoid fever. N Engl J Med. 2002;347(22):1770-1782. doi:10.1056/NEJMra020201.

7. Mogasale V, Maskery B, Ochiai RL, et al. Burden of typhoid fever in low-income and middle-income countries: a systematic, literature-based update with risk-factor adjustment. Lancet Glob Health. 2014;2(10): e570-e580. doi:10.1016/S2214-109X(14)70301-8.

8. Kalra SP, Naithani N, Mehta SR, Swamy AJ. Current trends in the management of typhoid fever. Med J Armed Forces India**.** 2003;59(2):130-135. doi:10.1016/S0377-1237(03)80060-6.

9. Holt KE, Phan MD, Baker S, et al. Emergence of a globally dominant IncHI1 plasmid type associated with multiple drug resistant typhoid. PLoS Negl Trop Dis**.** 2011;5(7):e1245. doi: 10.1371/journal.pntd.0001245.

10. Browne AJ, Kashef Hamadani BH, Kumaran EAP, et al. Drug-resistant enteric fever worldwide, 1990 to 2018: a systematic analysis. BMC Med. 2020; 18:1. doi:10.1186/s12916-019-1443-1.

11. Kuehn R, Stoesser N, Eyre DW, Darton TC. Antibiotics for enteric fever (typhoid and paratyphoid). Cochrane Database Syst Rev**.** 2022;11:CD010452. doi: 10.1002/14651858.CD010452.

12. Manesh A, Balaji V, Kumar D, et al. Clinical and microbiological failure of azithromycin therapy in typhoid fever: a case report and review. Int J Infect Dis. 2017; 54:62-63. doi: 10.1016/j.ijid.2016.11.409.

13. Butler T. Treatment of typhoid fever in the 21st century: promises and shortcomings. Clin Microbiol Infect**.** 2011;17(7):959-963. doi:10.1111/j.1469-0691.2011.03552. x.

GLOBAL HEALTH & MEDICINE
ISSN / eISSN: 2434-9186 / 2434-9194
Volume 08, Issue 06.111-119
https://ghsjournal.com/

14. Nabarro LE, Lever RA, Armstrong M, et al. British Infection Association guidelines for the diagnosis and management of enteric fever in England. J Infect. 2022;84(4):469-489. doi: 10.1016/j.jinf.2022.01.014.

15. Medical Microbiology & Infectious Diseases Society of Pakistan (MMIDSP). Typhoid Management Guideline. 2022 Jun 22 [cited 2024 Sep 7]. Available from: https://www.mmidsp.com/wp-content/uploads/2023/03/Typhoid-Management-Guideline-2022-Jun-22.pdf.

16. Arjyal A, Basnyat B, Nhan HT, et al. Gatifloxacin versus ceftriaxone for uncomplicated enteric fever in Nepal: an open-label, two-centre, randomised controlled trial. Lancet Infect Dis. 2016;16(5):535-545. doi:10.1016/S1473-3099(15)00530-7.

17. World Health Organization. Background document: the diagnosis, treatment and prevention of typhoid fever**.** Geneva: WHO; 2003. https://apps.who.int/iris/handle/10665/68122

18. Klemm EJ, Shakoor S, Page AJ, et al. Emergence of an extensively drug-resistant Salmonella enterica serovar Typhi clone harboring a promiscuous plasmid encoding resistance to fluoroquinolones and third-generation cephalosporins. mBio. 2018;9(1):e00105-18. doi:10.1128/mBio.00105-18.

19. Frenck RW Jr, Nakhla I, Sultan Y, et al. Azithromycin versus ceftriaxone for the treatment of uncomplicated typhoid fever in children. **Clin Infect Dis.** 2000;31(5):1134-1138. doi:10.1086/317482.

20. World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO consultation**.** WHO Technical Report Series 894. Geneva: WHO; 2000. https://apps.who.int/iris/handle/10665/42330.

21. Lwanga SK, Lemeshow S**.** Sample size determination in health studies: a practical manual. Geneva: World Health Organization; 1991. https://apps.who.int/iris/handle/10665/40062.

GLOBAL HEALTH & MEDICINE
ISSN / eISSN: 2434-9186 / 2434-9194
Volume 08, Issue 06.111-119
https://ghsjournal.com/

22. Clinical and Laboratory Standards Institute (CLSI). Performance Standards for Antimicrobial Susceptibility Testing (M100). 33rd ed. Wayne (PA): CLSI; 2023. https://clsi.org/about/news/clsi-publishes-m100-performance-standards-for-antimicrobial-susceptibility-testing-33rd-edition/.

23. Caravedo, Maria A et al. "Extensively drug-resistant *Salmonella* Typhi in a patient returning from Pakistan, complicated by relapse with meropenem monotherapy." *IDCases* vol. 23 e01048. 14 Jan. 2021, doi:10.1016/j.idcr.2021.e01048.

24. Effa EE, Bukirwa H. Azithromycin for treating uncomplicated typhoid and paratyphoid fever (enteric fever). Cochrane Database Syst Rev. 2008;(4):CD006083. doi:10.1002/14651858.CD006083.

25. Kuehn R, Stoesser N, Eyre DW, Darton TC. Antibiotics for enteric fever (comparative effectiveness including ceftriaxone). Cochrane Database Syst Rev**.** 2022;11:CD010452. doi:10.1002/14651858.CD010452.

26. Haraga A, Ohlson MB, Miller SI. Salmonellae interplay with host cells. Nat Rev Microbiol. 2008;6(1):53-66. doi:10.1038/nrmicro1788.

27. Foulds G, Shepard RM, Johnson RB. The pharmacokinetics of azithromycin in human serum and tissues. **J** Antimicrob Chemother**.** 1990;25(Suppl A):73-82. doi:10.1093/jac/25.

28. Blumentrath CG, Tacke D, Kilian AK, et al. Relapse of typhoid fever following delayed response to meropenem: a case report and review of the literature. GMS Infect Dis. 2019;7:Doc01. doi:10.3205/id000045.

29. Baldwin CM, Lyseng-Williamson KA, Keam SJ. Meropenem: a review of its use in the treatment of serious bacterial infections. Drugs**.** 2008;68(6):803-838. doi:10.2165/00003495-200868060-00007.

GLOBAL HEALTH & MEDICINE
ISSN / eISSN: 2434-9186 / 2434-9194
Volume 08, Issue 06.111-119
https://ghsjournal.com/

30. Qureshi S, Naveed AB, Yousafzai MT, et al. Response of extensively drug resistant Salmonella Typhi to treatment with meropenem and azithromycin in Pakistan. PLoS Negl Trop Dis. 2020;14(10):e0008682. doi: 10.1371/journal.pntd.0008682.

31. Zmora N, Stavi V, Suez J, et al. Open label comparative trial of mono versus dual antibiotic therapy for typhoid fever in adults. PLoS Negl Trop Dis**.** 2018;12(4):e0006380. doi: 10.1371/journal.pntd.0006380.

32. Marchello CS, Carr SD, Crump JA. A systematic review on antimicrobial resistance among Salmonella Typhi worldwide. Am J Trop Med Hyg**.** 2020;103(6):2518-2527. doi:10.4269/ajtmh.20-0629.

33. Nizamuddin S, Khan EA, Chattaway MA, Godbole G. Case of Carbapenem-Resistant Salmonella Typhi Infection, Pakistan, 2022. Emerg Infect Dis. 2023;29(11):2395-2397. doi:10.3201/eid2911.230499.

34. Dolecek, Christiane et al. “A multi-center randomised controlled trial of gatifloxacin versus azithromycin for the treatment of uncomplicated typhoid fever in children and adults in Vietnam.” PloS one vol. 3,5 e2188. 21 May. 2008, doi: 10.1371/journal.pone.0002188.

35. Cooke, Fiona J, and John Wain. “The emergence of antibiotic resistance in typhoid fever.” *Travel medicine and infectious disease* vol. 2,2 (2004): 67-74. doi:10.1016/j.tmaid.2004.04.005.

36. Neupane DP, Dulal HP, Song J, et al. Enteric fever diagnosis: current challenges and future directions. Pathogens**.** 2021;10(4):410. doi:10.3390/pathogens10040410.

37. Brunton LL, Hilal-Dandan R, Knollmann BC, eds. Goodman & Gilman’s The Pharmacological Basis of Therapeutics. 13th ed. New York: McGraw Hill Education; 2018. https://accessmedicine.mhmedical.com/book.aspx?bookID=2189.

GLOBAL HEALTH & MEDICINE
ISSN / eISSN: 2434-9186 / 2434-9194
Volume 08, Issue 06.111-119
https://ghsjournal.com/

38. Management Sciences for Health (MSH). International Medical Products Price Guide: 2015 edition. Medford (MA): Management Sciences for Health; 2016 [cited 2024 Sep 7]. Available from: https://msh.org/wp-content/uploads/2020/03/msh-2015-international-medical-products-price-guide.pdf.