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Shigella spp. and Salmonella spp. in Paediatric Diarrhea: Comparative Epidemiology, Pathogenesis, Risks, Management, and Prevention Strategies for Children Under 10 Years

Yuttasha Nehra, Monojit Majhi

Department of Bioengineering and Biotechnology, Birla institute of Technology, Mesra, Ranchi, India

Abstract- Paediatric diarrhea, which ranks second in terms of epidemiology, pathophysiology, risk factors, management, and prevention in children, continues to be a serious worldwide health concern. extending dangers to children between the ages of five and nine. Ten to twenty percent of infections in low- and middle-income countries (LMICs) are caused by bacterial diseases such as Shigella spp. and Salmonella spp (non-typhoidal). With an emphasis on comparative perspectives, this review summarizes recent research (2020–2025) on the epidemiology, pathophysiology, hazards, management, and prevention of this illness in children under the age of 10. Salmonella spp. causes watery diarrhea with systemic hazards, but Shigella spp. is more commonly associated with dysentery-like presentations. Due to dehydration, malnutrition, and growing antimicrobial resistance (AMR), these pose serious risks. Global incidence trends indicate a reduction, although these regions continue to be hotspots in Africa and Asia. Salmonella spp. causes secretory diarrhea with the possibility of bacteraemia, while Shigella spp. causes dysentery and colitis by producing Shiga toxins. The main risks include mortality (~81,000 under-5 deaths annually from Shigella spp..; ~50,000 from Salmonella spp.), complications such as haemolytic-uremic syndrome (Shigella spp.) or sepsis (Salmonella spp.), and long-term effects like growth stunting and cognitive impairments, which are more severe in children who are malnourished or HIV+. Rehydration and targeted antibiotics are key components of management; however, MDR strains (up to 80%) make treatment more difficult. To reduce mortality in vulnerable groups under ten years old, prevention through WASH, hygiene, food safety, and new vaccinations (such as trials for Shigella spp. and control of Salmonella spp. via animal research) is essential.

Keywords - Antimicrobial resistance, Dysentery, Invasive NTS disease, Paediatric diarrhea,, Non-typhoidal Salmonella spp., Shigella spp.

Introduction

Globally, diarrheal illnesses continue to rank among the top causes of morbidity and mortality in children, especially in low- and middle-income countries (LMICs). An estimated 443,832 children under five died from diarrhea in 2021, accounting for about 9% of all under-five deaths worldwide (GBD 2021 Diarrhoeal Disease Collaborators, 2024; Liu et al., 2024). Due to increased access to oral rehydration therapy, rotavirus vaccination, and improved nutrition, mortality has decreased by more than 60% since 1990; however, the overall burden remains unacceptably high, with approximately 1.7 billion episodes occurring annually in children (World Health Organisation, 2024; UNICEF, 2024). Diarrhea-related mortality and recurrent bouts lead to cognitive decline and stunted growth (Troeger et al., 2024; GBD 2021 Diarrheal Disease Collaborators, 2024).

Malnutrition, poor sanitation, contaminated water, and poverty collectively exacerbate the transmission and severity of diarrhea in sub-Saharan Africa and South Asia, where the highest incidence and case-fatality rates are observed (Kotloff et al., 2019; Platts-Mills et al., 2023). Children who are malnourished are up to 11 times more likely to die from diarrhea than their well-nourished peers, and recurrent infections continue a vicious cycle of weakened immunity and stunting (Black et al., 2023; Walson & Berkley et al., 2024).

Bacterial pathogens become more significant with age and account for a substantial percentage of moderate-to-severe and dysenteric cases, even as viruses, particularly rotavirus and norovirus, dominate the aetiology in children under 24 months (Operario et al., 2021; Ticinesi et al., 2024). In children older than infancy, diarrheagenic Escherichia coli, Shigella spp , and non-typhoidal Salmonella spp. species are the top three bacterial causes (Kotloff et al., 2019; Atlas et al., 2023). Shigella spp and Salmonella spp. species combined are thought to be responsible for 10–20% of all diarrheal episodes and up to 30% of severe cases that require hospitalization in LMICs, according to recent multicentre investigations and systematic reviews (Platts-Mills et al., 2023; Shabana et al., 2025). For several reasons, Shigella spp.and non-typhoidal Salmonella spp. are particularly hazardous in children under the age of ten. First, both have low infectious doses and effective modes of transmission (person-to-person for Shigella spp and food/animal reservoirs for Salmonella spp.), which makes outbreaks frequent in schools and daycare centres (Anderson et al., 2022; Dadi et al., 2025). Second, the risk of fast dehydration, bacteria, and death is significantly increased by immature mucosal immunity, low physiological reserve, and co-existing malnutrition (Walson & Berkley, 2024). Third, there is an alarming increase in antimicrobial resistance: over 70% of Shigella spp.isolates and 50–80% of Salmonella spp. isolates from paediatric cohorts in Asia and Africa are now multidrug resistant, which severely restricts treatment options and prolongs illness and shedding (Parajuli et al., 2023; Shabana et al., 2025; Tack et al., 2024).

This review focuses specifically on Shigella spp.spp. and non-typhoidal Salmonella spp. spp., two of the most dangerous and actionable bacterial causes of paediatric diarrhea in children under 10 years of age. In an era of increasing antimicrobial resistance, this paper compares the epidemiology, pathogenesis, clinical presentation, complications, management challenges, and prevention strategies in children under the age of ten to highlight the unique

yet overlapping threats and offer evidence-based insights for focused clinical and public health interventions.

1. Epidemiology

❖ Global and Regional Prevalence

The epidemiology of Shigella spp. and non-typhoidal Salmonella spp. (NTS) Pediatric diarrhea highlights its disproportionate impact in low- and middle-income countries (LMICs), where endemic transmission is facilitated by inadequate water, sanitation, and hygiene (WASH) infrastructure, dense populations, and limited access to healthcare. Over 267 million people worldwide contract Shigella spp. infections each year, resulting in over 212,000 diarrheal fatalities, of which about 64,000 occur in children under five, mostly in LMICs (GBD 2021 Diarrhoeal Disease Collaborators, 2024; Kotloff et al., 2019). In sub-Saharan Africa, NTS is one of the leading five causes of bacterial illness in children under five, accounting for up to 20% of invasive infections. It is expected to result in 155,000 deaths and 93 million cases globally per year (Tack et al., 2024; Ao et al., 2022). Recent Global Burden of Disease (GBD) estimates from 1990 to 2021 show that LMICs account for more than 90% of the attributable disability-adjusted life years (DALYs) for these diseases. Despite overall decreases in viral etiologies, the incidence of bacterial diarrhea in high-burden areas stabilizes at 1.5–2.5 episodes per child-year (Troeger et al., 2024; Liu et al., 2024).

❖ Due to common risk factors such as overcrowding, unclean water supplies, and malnutrition, sub-Saharan Africa and South Asia emerge as regional epicenters, accounting for 80–90% of pediatric cases worldwide. The Global Enteric Multicenter Study (GEMS) found that Shigella spp. is the second most common bacterial cause of moderate-to-severe diarrhea (MSD) in seven countries in sub-Saharan Africa, with a prevalence of 10–15% among children under five (Platts-Mills et al., 2023; Kotloff et al., 2019). A pooled prevalence of 8.2% for Shigella spp. in diarrheal stools was found in a 2024 meta-analysis of African research, with hotspots in East Africa (such as Ethiopia and Kenya), where rates surpass 12% in urban slums (Alemu et al., 2024). For example, a 2025 Burkina Faso cohort study in peri-urban areas found NTS incidence at 15.3 cases per 1,000 child-years under 5, with 25% of these cases progressing to bacteria (Ouédraogo et al.,2025). The NTS prevalence in the same region is 5–8%, but its invasive potential drives higher mortality rates. 15–20% of dysentery cases in South Asia are caused by Shigella spp. especially in the Ganges–Brahmaputra Delta, where spatiotemporal modelling predicts year-round transmission that is exacerbated by monsoon flooding (Khanam et al., 2023; Anderson et al., 2022). Although NTS rates are marginally lower at 4–7%, outbreaks associated with poultry intake increase burdens in Bangladesh and rural India, accounting for 10–15% of hospitalizations for MSD (Das et al., 2025; Platts-Mills et al., 2023).

❖ When compared to high-income settings, where Shigella spp. and NTS occurrences drop to less than 1 per 100,000 due to greater WASH and food safety, these regional inequalities are striking (Tack et al., 2024). However, climate-sensitive variables, including humidity and temperature, which are ideal for Shigella spp. Survival at 20–30°C exacerbates seasonality in LMICs, peaking during both regions' rainy seasons (Khanam et al., 2023). Inequalities are

further highlighted by urban-rural gradients; NTS flourishes at rural livestock interfaces, while urban slums in sub-Saharan Africa have 1.5 times higher Shigella spp. rates than rural areas, due to person-to-person transmission (Alemu et al., 2024; Ao et al., 2022)

❖ **Epidemiology: Burden Statistics**

The burden of Shigella spp. and non-typhoidal Salmonella spp. (NTS) In pediatric diarrhea, the key metrics such as incidence, mortality, and disability-adjusted life years (DALYs) are used. The Global Burden of Disease (GBD) Study 2021 is the primary source of these measures, with updates reflecting changes through evaluations conducted in 2024 and 2025. These measures demonstrate how the pathogens contribute to the total burden of diarrheal illness, which disproportionately affects children under ten years old in low- and middle-income countries (LMICs). A comprehensive measure of health loss is provided by DALYs, which combine years of life lost (YLLs) owing to premature death with years lived with disability (YLDs) from morbidity, whereas incidence monitors new cases and mortality records fatal outcomes (GBD 2021 Diarrhoeal Diseases Collaborators, 2024). An estimated 1.17 million deaths worldwide were attributed to diarrheal illnesses in 2021, a 60.3% decrease from 2.93 million in 1990. However, bacterial etiologies, such as Shigella spp. and NTS, continue to be major causes, especially in children under five, where they account for 10-15% of moderate-to-severe cases (Liu et al., 2024; Platts-Mills et al., 2023).

➢ The age-standardized incidence rate (ASIR) for diarrheal illnesses in children under five was roughly 4,500 cases per 100,000 people worldwide in 2021. Shigella spp. accounted for 5–10% of cases (peaking at 200–300 per 100,000 in high-burden regions) and NTS for 3–7% (150–250 per 100,000), indicating changes toward bacterial predominance after infancy (GBD 2021 Diarrheal Diseases Collaborators, 2024; Tian et al., 2025). Shigella spp. rates remain high (100–200 per 100,000) due to school-based transmission, but NTS decreases to 50–100 per 100,000 as immunity develops in children aged 5–9 (Wang et al., 2024; Deng et al., 2025). The incidence stabilizes at 2,000–3,000 per 100,000.

➢ Shigella spp. and NTS are linked to 24.0% and 8–10% of fatal diarrheal population-attributable fractions (PAFs) in children under 5, respectively, which translates to roughly 280,000 and 117,000 deaths per year for these pathogens combined (GBD 2021 Diarrhoeal Diseases Collaborators, 2024; Tack et al., 2024). Between 1990 and 2021, the overall under-5 diarrheal mortality decreased by 79.2% (from approximately 1 million to approximately 340,000 deaths). Shigella spp. attributable deaths decreased by 50–60%, while NTS decreased by 30–40% because of the invasive potential in malnourished children (Liu et al., 2024; Ao et al., 2022). The mortality rate in the 5–9 age range is lower (~50,000–60,000 overall diarrheal deaths); however, Shigella spp. accounts for 15–20% of cases, resulting in around 10,000 additional deaths annually, while NTS adds approximately 5,000, often due to bacterial infections (Wang et al., 2024; GBD 2021 Diarrheal Diseases Collaborators, 2024). Regional hotspots continue to exist: South Asia accounts for 30–40% (NTS up to 40 per 100,000) and sub-Saharan Africa for 40–50% of under-5 bacterial deaths (e.g., Shigella spp. mortality rate 50–

100 per 100,000), with only slight decreases (0–10% EAPC) according to 2025 assessments (Alemu et al., 2024; Khanam et al., 2023).

❖ **Epidemiology: Risk Factors**

Non-typhoidal Salmonella spp. (NTS) and Shigella spp. both flourish in environments where fundamental health determinants are weakened; however, their principal modes of transmission and risk profiles are significantly different. While distinct biological and behavioural reasons drive each pathogen's epidemiology in children under ten, shared environmental and socioeconomic risk factors provide the favourable conditions for both infections.

❖ **Shared Risk Factors**

➢ Over 80% of the attributable diarrheal disease burden in LMICs can be attributed to poor sanitation, contaminated food, and unsafe drinking water (GBD 2021 Diarrhoeal Diseases Collaborators, 2024; Troeger et al., 2024). Unsafe water increases risk by 1.4–2.0 times for both Shigella spp. infection and NTS, while inadequate access to improved sanitation facilities increases risk by 1.5–2.3 times and 1.3–1.8 times, respectively (Wolf et al., 2023). During the 6–36-month interval, when children are transitioning from breastfeeding, contaminated weaning foods and foods sold on the street are especially dangerous. Consuming meals prepared outside the home raised the risk of bacterial diarrhea by 2.1 (95% CI 1.6–2.8), according to a 2024 meta-analysis (Dadi et al., 2025). Malnutrition, particularly stunting and wasting, increases both pathogen susceptibility and severity: children under five who are stunted have 1.9–2.7 times higher odds of NTS infection and 2.3–3.1 times higher odds of Shigella spp.infection, with case-fatality rates increasing up to 11 times (Walson & Berkley, 2024; Black et al., 2023). Low maternal education and crowded living conditions (with more than five people per family) increase the risk by 1.6–2.5 times across studies (Alemu et al., 2024).

❖ **Unique Risk Factors for Shigella spp. spp.**

➢ According to Kotloff et al. (2019), Shigella spp. is primarily an anthroponotic pathogen with a very low infectious dose (10–100 organisms), which enables effective person-to-person transmission through the fecal–oral pathway. Attendance at preschools or childcare centers increases the risk by three to five times, and during outbreaks, attack rates can reach 30 to 50 percent (Anderson et al., 2022). A 2023 Bangladeshi cohort found that children whose caregivers did not wash their hands with soap after using the restroom had a 4.1 times higher incidence of Shigella spp. (Khanam et al., 2023). This indicates that poor hand hygiene following defecation or changing diapers is a crucial behavioral relationship. Shigella spp.is mechanically transferred by fly infestation, which is frequent in unhygienic settings and increases risk by 1.8–2.4 times on its own (Platts-Mills et al., 2023). The age range of 2–5 years represents the peak vulnerability period due to increased mobility, exploratory behavior, and immature hygiene practices, combined with the waning of maternal antibodies (Tilahun et al., 2025).

❖ **Risk Factors for Salmonella spp. (NTS)**

➢ " On the other hand, NTS is mainly zoonotic, and in the majority of LMICs, animal reservoirs such as pigs, cattle, poultry, and reptiles are the primary source (Tack et al., 2024). Consuming undercooked poultry, eggs, or unpasteurized milk increases the risk by three to six times, whereas direct or indirect contact with livestock increases the risk by two to four times (Ao et al., 2022). Keeping hens indoors, a prevalent practice in many rural sub-Saharan African households, increases the prevalence of NTS by 2.7 times (Ouédraogo et al., 2025). Due of extensive exposure during complementary eating and crawling, when children regularly place contaminated objects in their mouths, the peak incidence occurs earlier (6–24 months) (Walson & Berkley, 2024). HIV infection and malaria co-infection are particularly high NTS-specific risks: HIV-exposed children have 5–10 times higher rates of invasive NTS disease, and recent malaria episodes increase risk 3-fold through impaired macrophage function (Troeger et al.,2024, Gilchrist & MacLennan, 2023).

❖ **Comparative Prevalence and Mortality Rates by Region/Age Group**

➢ The following table summarizes important information from current Global Burden of Disease (GBD) 2021 analyses, systematic reviews, and multicenter investigations (2019–2025) to contextualize the comparative epidemiology of Shigella spp.spp. and non-typhoidal Salmonella spp. (NTS) in pediatric diarrhea. While mortality rates are presented as deaths per 100,000 children (age-standardized where available), prevalence shows the percentage of diarrheal cases related to each pathogen (mostly via stool isolation or PCR in moderate-to-severe cases). Under-5s (0–59 months) and 5–9-year-olds are the primary focus of the statistics, with a particular emphasis on high-burden regions such as South Asia (SA) and sub-Saharan Africa (SSA). Global statistics are shown for reference. Shigella spp.peaks later (2–5 years) and NTS earlier (6–24 months) in hotspots in SSA (Ethiopia, Kenya) and SA (Bangladesh, India) because of WASH deficiencies and malnutrition. Although there have been clear declines since 1990 (such as a 50–70% decrease in mortality), ongoing discrepancies draw attention to intervention gaps (GBD 2021 Diarrhoeal Diseases Collaborators, 2024; Tian et al., 2025; Alemu et al., 2024).

2. Pathogenesis and Clinical Features:

❖ **Non-typhoidal Salmonella spp. (NTS)**

- In contrast to Shigella spp. spp.'s exclusively invasive approach, non-typhoidal Salmonella spp. Serovars (mostly S. Typhimurium, S. Enteritidis, S. Dublin, and increasingly S. Stanley and S. Heidelberg) cause gastroenteritis through a unique secretory-inflammatory mechanism. In immunocompetent hosts, NTS remains primarily non-invasive, causing illness through the production of strong enterotoxins and temporary mucosal inflammation. However, in young children, particularly those who are malnourished, HIV-positive, or have malaria, it frequently develops into potentially fatal bacteria (Gilchrist & MacLennan, 2023; Tack et al., 2024).
- Two chromosomally encoded type III secretion systems (T3SS-1 and T3SS-2) on Salmonella spp. Pathogenicity islands SPI-1 and SPI-2 are essential to pathogenesis. Rapid

enterocyte ruffling and bacterial absorption are triggered by SPI-1 effectors (SipA, SopB, SopE). This is followed by a significant release of pro-inflammatory cytokines (IL-8, TNF-α), which attract neutrophils and lead to acute mucosal inflammation. The typical high-volume, watery diarrhea is caused by SopB and other effectors simultaneously activating chloride secretion via the adenylate cyclase/cGMP pathway (Tack et al., 2024; Mattock & Blocker, 2022). The majority of NTS strains do not generate traditional Shiga toxin, in contrast to Shigella spp. Spp.; nonetheless, some African S. Typhimurium ST313 variants express a distinct cytolethal distending toxin (CDT) and exhibit improved intracellular survival, which facilitates systemic spread (Gilchrist et al., 2023).

- After a 12–72-hour incubation period, children under 10 years old, particularly those aged 6–36 months, experience abdominal pain, vomiting, a rapid fever (38.5–40 °C in >80% of cases), and copious non-bloody watery diarrhea (typically >10 stools/day). Stool rarely contains blood unless there is significant secondary mucosal damage (Platts-Mills et al., 2023). NTS is a major cause of hypovolemic shock in African pediatric wards because the secretory component causes fast dehydration; children can lose 10–15% of their body weight in 24–48 hours (Ao et al., 2022).
- Invasive NTS illness (INTS), which has a bacterial rate of 20–40% in sub-Saharan Africa (compared to less than 1% in high-income settings), is the most feared complication in young infants. Malnutrition, HIV, recent or concurrent malaria, sickle-cell illness, and age <3 years are risk factors (Gilchrist & MacLennan, 2023). Through SPI-2-mediated intracellular survival within macrophages, NTS avoids phagocytosis once it enters the circulation, resulting in localized infections (such as pneumonia, meningitis, and osteomyelitis) and 15–25% case-fatality rates despite antibiotic treatment (Tack et al., 2024). NTS is one of the top three causes of bloodstream infection and sepsis-related mortality in undernourished or HIV-positive children under five (Ao et al., 2022).

❖ **Comparative Mechanisms and Pediatric Vulnerability**

Shigella spp. and non-typhoidal Salmonella spp. (NTS) represent two contrasting paradigms of bacterial gastroenteritis: Shigella spp. is a classic enteroinvasive pathogen, whereas NTS is primarily enterotoxin-driven with secondary inflammatory and invasive potential. These mechanistic differences have a profound impact on clinical severity and complications in children under the age of 10.

3. Clinical Presentation and Complications in Children Under 10

Both pathogens cause acute-onset illness (incubation 12–72 h), high fever (>39 °C in 60–90%), vomiting, and severe abdominal pain, but stool characteristics and complications diverge dramatically:

The Shigella spp.Classic dysentery: tenesmus and frequent small-volume, bloody, mucoid stools (50–80% of cases >2 years). However, watery diarrhea frequently predominates at first in newborns, making diagnosis difficult. Hemolytic-uremic syndrome (HUS) is one of the complications (5–15% with S. dysenteriae type 1). Seizures that are febrile (10–45%), particularly in children under five. Intestinal perforation, encephalopathy, and toxic megacolon

Absent typhoid Salmonella spp. Bacteria. High output (>10 stools per day) and copious watery diarrhea (typically green, "pea-soup") cause dehydration more quickly than Shigella spp. spp. Stool containing blood is uncommon unless it persists for a prolonged period. Complications include invasive NTS illness, which causes bacteria in 20–40% of SSA children under five. Recurrent bacteria in HIV/malaria co-infection, meningitis, osteomyelitis, and septic shock. 15–25% of cases of INTS result in death, compared to less than 5% of cases of simple gastroenteritis (Tack et al., 2024; Ao et al., 2022).

In conclusion, NTS causes secretory small-bowel diarrhea with a high susceptibility for bloodstream invasion in immunologically immature or malnourished children under ten, whereas Shigella spp. damages the colonic mucosa through direct invasion and toxins, resulting in dysentery and HUS. These distinctions account for the fact that whereas Shigella spp. is the most common cause of bloody diarrhea worldwide, NTS either matches or surpasses it as a cause of paediatric sepsis-related mortality in Africa.

4. Clinical Management and Challenges

Efficient clinical treatment of non-typhoidal Salmonella spp. (NTS) and Shigella spp. A multimodal strategy is needed to treat infections in pediatric populations under the age of ten. This strategy must incorporate prompt etiological diagnosis, supportive care, and prudent antimicrobial therapy while addressing the growing challenge of antimicrobial resistance (AMR). Delays in intervention can result in hypovolemic shock, sepsis, or hemolytic-uremic syndrome (HUS), with case-fatality rates in malnourished children exceeding 10% in resource-constrained settings where these pathogens predominate in moderate-to-severe diarrheal episodes.

The World Health Organization's (WHO) integrated management of childhood illness (IMCI) framework and the Infectious Diseases Society of America's (IDSA) 2017 guidelines for infectious diarrhea, which are supplemented by the 2024 IDSA AMR guidance, emphasize syndrome-based assessment of fever, bloody/mucoid stools, or sepsis signs to prioritize bacterial etiologies over viral ones (Shane et al.,2017; Tamma et al.,2024; WHO, 2024). The need for context-specific adaptations in low- and middle-income countries (LMICs) is underscored by recent revisions to China's 2024 pediatric recommendations, which emphasize regionally tailored empirical strategies (Fang et al., 2025).

- **Diagnosis**

In order to distinguish Shigella dysentery from NTS secretory diarrhea, prompt and precise diagnosis is essential for directing antibiotic choices and public health reporting. Conventional stool culture on selective media such as MacConkey agar, Salmonella-Shigella (SS) agar, or xylose-lysine-deoxycholate (XLD) agar remains the gold standard for isolation and serotyping, within 48 hours of the start of symptoms, with a sensitivity of 70–90% (Zenebe et al., 2025). Shigella (non-motile, oxidase-negative) and NTS (H_2S -positive on TSI) are distinguished biochemically using triple sugar iron (TSI) slants and API 20E strips. In endemic locations, quantitative PCR thresholds (>10^5 CFU/g) reduce overdiagnosis by differentiating infection from colonization. With 92% concordance to culture, newly developed loop-mediated

isothermal amplification (LAMP) tests that may be used in peripheral labs simultaneously identify AMR markers such as qnrS (fluoroquinolone resistance) (Tilahun et al., 2025).
For children with fever (>38.5°C), bloody stools, severe cramps, or signs of sepsis, IDSA advises stool testing for Shigella spp, NTS, Campylobacter spp, Yersinia spp, Clostridium difficile, and Shiga toxin-producing Escherichia coli (STEC) (strong recommendation, moderate evidence) (Shane et al., 2017). Rotavirus/norovirus syndromic panels can reduce the need for needless antibiotics in children under five, where viral co-infections confound diagnosis. According to local health regulations, post-treatment clearance cultures are required for Shigella and NTS to permit return to daycare or school (Tamma et al., 2024).

- **Treatment**

Oral rehydration solution (ORS) prevents 93% of dehydration-related mortality, according to WHO IMCI procedures (WHO, 2024). Supportive care is the cornerstone. In NTS instances, reduced-osmolarity ORS (245 mOsm/L) at 75–100 mL/kg over 4 hours, titrated to continuing losses, restores electrolyte balance without aggravating secretory fluxes (Fang et al.,2025).
Antimicrobial therapy is graded by severity and pathogen. Given their low infectious dose, empiric medicines for Shigella reduce sickness by one to two days and stop transmission (Shane et al., 2017). Ceftriaxone (50–100 mg/kg IV/IM daily for 3–5 days) is an alternative for hospitalized dysentery or HUS suspicions. Azithromycin (10–20 mg/kg/day orally for 3 days) is the first-line treatment in LMICs, with 90–95% efficacy against macrolide-susceptible organisms (Tamma et al., 2024; Zenebe et al., 2025). According to IDSA AMR guidelines, ciprofloxacin (15–30 mg/kg/day for 3 days) should only be used for verified susceptibility.
Routine antibiotics are not recommended for NTS in cases of uncomplicated gastroenteritis because they cause biofilm formation, which prolongs fecal shedding by two to three weeks (Ouédraogo et al., 2025). Azithromycin or ceftriaxone, which mimic Shigella regimens, are recommended for severe infections (defined as ≥9 stools/day, hospitalization, or bacteremia); however, fluoroquinolones should be empirically avoided due to 20–40% resistance in African pediatric cohorts (Tack et al., 2024). Duration: 7–10 days for invasive NTS and 3–5 days for gastroenteritis. Although the evidence is inconsistent, adjunctive probiotics (such as Lactobacillus reuteri) indicate minor advantages in reducing NTS recurrence by 15% (Fang et al., 2025).

- **Challenges**

Multidrug resistance (MDR; resistance to ≥3 classes) affects 50–80% of pediatric Shigella and NTS isolates in LMICs, eroding empirical efficacy and increasing mortality by 2–4-fold (Tilahun et al.,2025; Nyarkoh et al.,2024). Plasmid-mediated mechanisms, blaCTX-M (extended-spectrum β-lactamases, ESBLs), qnr genes (quinolone efflux), and mphA (macrolide phosphotransferases) drive this, with horizontal transfer via IncFII plasmids exacerbating outbreaks (Viana et al.,2025). In Ethiopia's 2024–2025 surveillance, 73% of Shigella flexneri were MDR, including 65% ciprofloxacin-resistant, while 58% of NTS exhibited ESBLs, rendering third-generation cephalosporins obsolete (Tilahun et al.,2025). Salmonella spp/Shigella spp that are resistant to cephalosporins and fluoroquinolones are listed as serious concerns in the WHO's 2024 Bacterial Priority Pathogens List, which calls for the use of genomic

surveillance (WHO, 2024). For CRE co-infections, IDSA 2024 AMR guidelines promote stewardship—de-escalation post-susceptibility, avoidance of broad-spectrum drugs, and new agents such as plazomicin (Tamma et al., 2024). While vaccine hesitation delays Shigella candidates (phase III trials continuing), diagnostic deficiencies in rural settings (e.g., <20% PCR availability) encourage empiric misuse. To stop this trend, integrated One Health strategies that monitor wastewater and animal reservoirs are essential (Viana et al., 2025).In conclusion, while ORS and targeted antibiotics mitigate Shigella/NTS morbidity, AMR's inexorable advance demands enhanced diagnostics, stewardship, and vaccine pipelines to safeguard pediatric outcomes (Fang et al.,2025).

5. Prevention and Future Directions

In low- and middle-income countries (LMICs), where these pathogens account for 10–20% of pediatric diarrheal morbidity, preventing Shigella spp. and non-typhoidal Salmonella spp. (NTS) Infections in children under the age of ten require a multilayered approach that incorporates individual behaviours, environmental controls, and cutting-edge biomedical tools. Promoting good hygiene, guaranteeing access to clean water, and expanding immunization programs are the main tactics. In the meantime, scalable infrastructure is provided by public health initiatives, including surveillance and water, sanitation, and hygiene (WASH) programs.

Although there are currently no approved products for any pathogen, vaccination has the potential to be transformational. Leading candidates for Shigella spp, such as the SF2a-TT15 conjugate vaccine, which has shown 70–80% immunogenicity in adults, will begin phase 3 studies in LMIC children under five in 2025. The goals of these trials will be moderate-to-severe dysentery prevention (Roozen et al., 2025; MacLennan et al., 2023). In order to close efficacy gaps against S. flexneri 2a and S. sonnei, the Enterics for Global Health (EFGH) surveillance research, which was initiated in 20f24 throughout Bangladesh, Kenya, and Malawi, will map strain diversity in under-10s to inform trial designs (Vannice et al., 2024). The trivalent Salmonella spp conjugate vaccine (TSCV) for NTS, which combines core-O antigens from S. Typhimurium and S. Enteritidis with Vi polysaccharide from S. Typhi, finished phase 1 in 2025 with 85–95% seroconversion in adults and showed encouraging safety in paediatric simulations (MacLennan et al., 2025). Public health programs reinforce these efforts through WASH scaling, community education, and extensive monitoring. Sentinel systems such as WHO's Global Antimicrobial Resistance and Use Surveillance System (GLASS) found 15–20% rises in MDR Shigella in African under-10s in 2024 when paired with PCR-based pathogen tracking, enabling targeted responses (WHO, 2024). School-based programs in South Asia decreased Shigella epidemics by 25% by teaching hygiene norms to children ages 5 to 9 (Khanam et al., 2023). WASH initiatives, like those supported by USAID in Ethiopia and Burkina Faso between 2023 and 2025, reduced diarrhea in children under five by 27–40% by providing piped water and latrines to 500,000 families. When NTS transmission peaks during wet seasons, the effects were enhanced (up to 50%) (Dimitrova et al., 2023; Ouédraogo et al., 2025).

According to 2025 Ethiopian meta-analyses (Tilahun et al., 2025; Nyarkoh et al., 2024), gaps in real-time genomic platforms for under-10 cohorts exacerbated by diagnostic voids fuel MDR rates of 50–80%.

In conclusion, synergistic prevention hygiene, WASH, and vaccines could reduce Shigella/NTS burdens in children under ten by half. However, in order to combat AMR and climate-amplified hazards, it is critical to fill research gaps through financed consortia (Tian et al., 2025).

6. Conclusion

Children under the age of ten are still at serious risk from Shigella spp. and non-typhoidal Salmonella spp., according to GBD 2021 (Diarrhoeal Diseases Collaborators, 2024; Tack et al., 2024; Tian et al., 2025). Together, they cause millions of lost years of disability-adjusted life, thousands of cases of haemolytic-uremic syndrome and invasive sepsis, and an estimated 130,000–150,000 fatalities annually. Their distinct but complementary pathogenic strategies, invasive, toxin-mediated dysentery for Shigella and secretory-to-systemic progression for NTS, take advantage of young children's physiological immaturity, limited fluid reserve, and developing immunity to transform preventable infections into potentially fatal situations in a matter of hours.

The fast rise of multidrug-resistant bacteria, which currently approaches 70% in many pediatric cohorts, has rendered traditional empirical therapies worthless. This has raised the risk of community transmission as well as individual death (Tilahun et al., 2025). To reduce this load, immediate, all-encompassing approaches that transcend single-intervention paradigms are needed. Programs for safe food handling, scalable handwashing, and continuous investment in water, sanitation, and hygiene (WASH) infrastructure must remain priorities. (Roozen et al., 2025; MacLennan et al., 2025) claim that the quick development and fair distribution of safe, affordable vaccines offer a potential for long-lasting population-level protection, such as Shigella conjugates that will begin pivotal trials in 2025–2026 and multivalent NTS candidates that target African ST313 lineages. Effective, pediatric-focused monitoring networks that include genomic AMR surveillance and molecular diagnostics are essential for stewardship, early epidemic detection, and vaccine strain selection. The cycle of recurrent infection, malnutrition, and developmental loss can only be broken through coordinated action across clinical care, public health systems, research consortia, and international financing mechanisms. This will guarantee that children under the age of ten in the most vulnerable regions finally realize their right to survive and thrive beyond the shadow of avoidable bacterial diarrhea.

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Contact with Authors: itsyuttasha@gmail.com, majhimonojit0@gmail.com

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