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Diagnostic, Therapeutic, and Evolutionary Profile of Salmonellosis at the CHNEAR in Dakar

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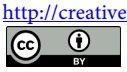

Abstract

Typhoid fever is a fecal–oral transmitted disease and a common, highly contagious, non-immunizing foodborne infection originating in the gastrointestinal tract and caused by major *Salmonella* species. It represents a medical and sometimes surgical emergency due to the risk of severe and unpredictable complications. The aim of this study was to evaluate the epidemiological, clinical, evolutionary, and therapeutic characteristics of salmonellosis. This was a retrospective, descriptive, and analytical study conducted among children at CHNEAR over a five-month period, from January 1 to May 31, 2025. All confirmed cases of salmonellosis requiring hospitalization during the study period were included. A total of 52 cases of salmonellosis were identified, of which 31 met the inclusion criteria. The male-to-female sex ratio was 2.1. The mean age was 7.3 years, with a range from 1.5 to 14 years. More than two-thirds of patients (67.74%) originated from suburban areas. The most frequent reasons for consultation were fever, diarrhea, and vomiting, reported in 90.32%, 70.97%, and 58.06% of cases, respectively. Nearly half of the patients (46.43%) had received undocumented treatment prior to hospitalization. None of the patients had received typhoid vaccination, while all children were up to date with their Expanded Programme on Immunization (EPI) vaccines. On physical examination, fever was present in 90.32% of cases. The majority of patients (95.6%) presented with tachypnea. Dehydration (41.94%), abdominal pain (32.26%), and clinical anemia (19.35%) were the most frequently observed physical signs. Laboratory investigations showed that the majority of patients (82.76%) had normal leukocyte counts, with normal lymphocyte levels in more than half of cases (51.72%), while 41.38% presented with lymphopenia

(These are the results we found). C-reactive protein (CRP) was elevated in all patients. Blood cultures were positive for *Salmonella* in 87% of cases. Ceftriaxone was the most commonly administered antibiotic, used in 68.97% of patients. Hyponatremia (80.65%) and hypokalemia (29.03%) were the most frequent metabolic complications observed. A disease duration of ≥3 weeks was significantly associated with an unfavorable outcome, with a p-value of 0.02. Two deaths were recorded. Salmonellosis remains a common condition in our region. Preventive measures, particularly typhoid vaccination and strict hand hygiene, remain essential and effective strategies for reducing disease burden.

Keywords

Salmonellosis, Diarrhea, Children

1. Introduction

The term "salmonellosis" generally refers to all infections caused by Gram-negative bacilli of the genus *Salmonella*, belonging to the family *Enterobacteriaceae* [1].

Typhoid and paratyphoid fevers are systemic infections caused by *Salmonella enterica* serotype Typhi and serotypes Paratyphi A, B, or C, respectively [2]. These pathogens represent major causes of febrile illness, particularly among socioeconomically disadvantaged and overcrowded populations living in poor sanitary conditions and exposed to unsafe water and food sources [3]. In addition to fever and other common clinical manifestations, such as headache, abdominal pain, and diarrhea, these infections may also lead to hematological complications, including anemia, leukopenia, thrombocytopenia, and disseminated intravascular coagulation [4].

Typhoid fever remains a major public health concern and a significant cause of morbidity and mortality in low- and middle-income countries, particularly in South Asia, Southeast Asia, and sub-Saharan Africa. It is estimated to cause between 12.5 and 16.3 million cases and approximately 140,000 deaths worldwide each year. India alone accounts for more than half of the estimated global burden of typhoid fever [5].

In high-income regions, salmonellosis continues to represent a substantial health burden. According to the European Union's 2020 zoonoses report under the "One Health" initiative, a total of 52,702 confirmed cases of human salmonellosis were reported across the European Union [6].

Despite its considerable burden, systematic surveillance of salmonellosis in Africa remains limited, and the reported incidence varies widely between countries. Substantial heterogeneity exists, with very low rates observed in northern and southern African countries, while several countries in East and West Africa report much higher incidence rates [7] [8]. In 2017, an estimated 535,000 cases of invasive non-typhoidal *Salmonella* disease occurred globally, with the highest incidence observed in sub-Saharan Africa (approximately 34.5 cases per 100,000 per-

son-years), predominantly affecting children under five years of age [9].

In Senegal, data on *Salmonella* infections are scarce. Since 2017, the World Health Organization (WHO) has recommended typhoid vaccination; however, its implementation in our country, particularly among children, remains limited and irregular due to financial constraints. After a period of relative stability in recent decades, a resurgence of salmonellosis cases was observed in early 2025. In this context, the present study aimed to assess the epidemiological, clinical, therapeutic characteristics and clinical outcomes of salmonellosis in a pediatric population.

2. Methods

This retrospective, descriptive, and analytical study was conducted among children aged 0 to 15 years over a five-month period, from January 1 to May 31, 2025, at the Albert Royer National Children's Hospital (CHNEAR). Inclusion criteria comprised all hospitalized cases of salmonellosis confirmed by blood or stool culture and with complete medical records.

The variables studied included epidemiological, clinical, diagnostic, therapeutic, and outcome parameters (An unfavorable outcome was defined as any death occurring during hospitalization). Data were collected from hospital records and patient files.

Data entry and statistical analysis were performed using SPSS version 21 and Microsoft Excel 2021.

3. Results

During the study period, 52 cases of salmonellosis were bacteriologically confirmed. Of these, 13 patients were managed on an outpatient basis. Thirty-nine children were hospitalized, of whom eight had incomplete or missing medical records. A total of 31 patients were ultimately included in the study (**Figure 1**).

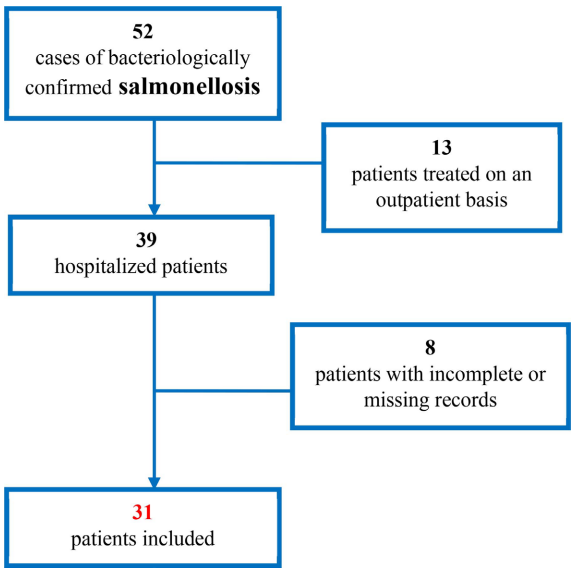

Figure 1. Flow diagram.

The mean age of the patients was 7.26 ± 3.76 years, with a median age of 8 years and an age range of 1.5 to 14 years. Children under five years of age accounted for 29.03% of cases (Table 1). More than two-thirds of the patients (67.74%) originated from suburban areas.

Table 1. Distribution of cases by age group.

Age (year)	Frequency	Percentage (%)
<5	9	29.03
5 - 9	10	32.26
10 - 14	12	38.71
Total	**31**	**100.00**

The most frequent reasons for consultation were fever (90.32%), diarrhea (70.97%), and vomiting (58.06%) (Table 2). Nearly half of the patients (46.43%) had received undocumented treatment at the onset of symptoms prior to hospital admission.

Table 2. Distribution of patients according to reason for consultation.

Reason for consultation	Frequency	Percentage (%)
vomiting	22	70.97
Diarrhea	18	58.06
Headaches	8	25.81
Abdominal pain	9	29.03
Fever	28	90.32
cough	3	9.68
Abdominal bloating	1	3.23
seizures	1	3.23
Pain in left elbow	1	3.23
Dizziness	1	3.23
Weight loss	1	3.23
Rectal bleeding	1	3.23
Breathing difficulty	1	3.23

None of the children had received typhoid vaccination, although all were up to date with their Expanded Programme on Immunization (EPI) vaccines. Three patients (9.68%) had SS-type sickle cell disease, and two patients (6.45%) presented with severe acute malnutrition.

On general examination, fever was observed in 90.32% of cases, and the majority of patients (95.6%) exhibited tachypnea. The most frequently observed physical signs were dehydration of any severity (41.94%), abdominal pain (32.26%),

and clinical anemia (19.35%) (Table 3). In terms of respiratory function, respiratory distress was observed in three patients and pulmonary condensation syndrome in two patients.

Table 3. Distribution of patients according to physical signs.

Physical sign	Frequency	Percentage (%)
Dehydration	13	41.94
Abdominal pain	10	32.26
Clinical anemia	6	19.35
Hypovolemic shock	3	9.68
Respiratory distress	3	9.68
Occlusive syndrome	3	9.68
Pulmonary condensation syndrome	2	6.45
Hepatomegaly	2	6.45
Meningeal syndrome	1	3.23
Swelling of the left elbow	1	3.23

Laboratory investigations showed that the majority of patients (82.76%) had normal leukocyte counts. Lymphocyte counts were normal in more than half of the cases (51.72%) and decreased in 41.38% of patients. Thrombocytopenia was observed in 19.3% of cases, and anemia in 64.5%. C-reactive protein (CRP) was elevated in all patients, with a mean value of 185.10 ± 99.10 mg/L (range: 17.72 - 378.90 mg/L).

Bacteriological confirmation was obtained via blood culture in 90.3% of cases, while the remainder were confirmed by stool culture. Non-typhoidal *Salmonella* species were isolated in 64.5% of cases, and *Salmonella* Typhi in 35.5%. Antibiotic susceptibility testing revealed ciprofloxacin resistance in six cases (19.3%).

Salmonella were sensitive to third-generation cephalosporins (cefotaxime and ceftriaxone) in all antibiograms. Ceftriaxone was the most commonly administered antibiotic, used in 68.97% of cases either as monotherapy or in combination with aminoglycosides. One patient developed acute appendicitis requiring surgical intervention. Other digestive complications included inflammatory colitis in two patients, terminal ileitis in two patients, colo-colic intussusception in one patient, and reactive ascites in three patients.

Metabolic complications were frequent, with hyponatremia observed in 80.65% of patients and hypokalemia in 29.03%. Five patients experienced a disease duration of more than three weeks prior to diagnosis, and two of these patients died. A disease duration of ≥3 weeks was significantly associated with an unfavorable outcome ($p = 0.02$) (Table 4).

The mean length of hospital stay was 10 days, with a range of 1 to 25 days.

Table 4. Correlation between duration of progression and unfavorable progression.

Duration of progression	Unfavorable progression		Total	Fisher's test (p-value)
	Yes (%)	No (%)		
≥3 weeks	2 (40)	3 (60)	5	0.02
<3 weeks	0 (0)	26 (100)	26	
Total	**2**	**29**	**31**	

4. Discussion

Outpatients n = 13 were children who presented with mild or non-specific clinical symptoms and no indications for hospitalization. They were not included in the study because their medical records did not provide complete documentation of clinical findings and disease progression.

In our study, children under five years of age represented a smaller proportion of cases (29.03%). This is consistent with a 2017 meta-analysis conducted in Asia and Africa, which reported an even lower proportion of 24% among children under five, suggesting that younger children account for a smaller fraction of pediatric enteric fever cases in Africa [10].

More than two-thirds of the patients (67.74%) came from suburban areas. These regions are characterized by high population density, limited access to safe drinking water, inadequate sanitation, poverty, and poor hygiene, in contrast to city centers, which generally benefit from better infrastructure [11] [12].

Fever was observed in 90.32% of patients and was one of the most frequent reasons for consultation. A 2015 review reported that fever is a constant feature of pediatric typhoid fever, occurring in 97% - 100% of cases [13].

Laboratory investigations in our study showed that the majority of patients (82.76%) had normal leukocyte counts, with normal lymphocyte counts in more than half of cases (51.72%) and lymphopenia in 41.38%. Thrombocytopenia was observed in 19.3% of patients, while anemia was present in 64.5%. Leukopenia is a common hematological finding in typhoid fever. *Salmonella* species are facultative intracellular Gram-negative bacteria that induce apoptosis in the macrophages they infect, contributing to leukopenia [4] [14]. Anemia observed in our patients was likely related to toxemia, hemolysis, or, less frequently, intestinal hemorrhage. In typhoid fever, anemia generally does not require aggressive treatment, as it is primarily associated with endotoxemia and typically resolves during convalescence [15]. The prevalence of thrombocytopenia in typhoid fever has been reported to range from 2% to 15% [16] [17]. In contrast to previously published studies, our results revealed different biological findings.

The *Salmonella* Typhi serotype was identified in 35.5% of cases. Despite the introduction of the typhoid conjugate vaccine (Typbar-TCV) in 2017, its use remains limited in many countries due to accessibility and cost constraints. Although most studies classify cases as typhoid or paratyphoid fever, few distinguish between Paratyphi A, B, and C serotypes. It is generally assumed, though not con-

firmed, that Paratyphi A is the predominant paratyphoid serotype [9].

Antibiotic susceptibility testing revealed ciprofloxacin resistance in six cases (19.3%). High rates of fluoroquinolone resistance have been reported in South Asia and are increasingly observed in Africa [18].

A disease duration of ≥3 weeks was significantly associated with an unfavorable outcome in our cohort ($p = 0.02$). Patients presenting with an average disease duration of ≥10 days exhibited a higher prevalence of complications and a threefold increased risk of severe disease (OR 3.00; 95% CI, 2.14 - 4.17; $p < 0.0001$) compared with patients who presented earlier (16%; 95% CI, 13% - 18%) [14].

5. Conclusion

Despite ongoing efforts to control fecal-borne diseases, there has been a resurgence of salmonellosis cases. The emergence of antibiotic-resistant strains remains a significant public health concern. Prevention is crucial and can be effectively achieved through proper hand hygiene and the use of the available typhoid vaccine.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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