WEEKLY EPIDEMIOLOGICAL REPORT
A publication of the Epidemiology Unit
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WEER SRI LANKA 2024

Vol. 51 No. 14 30th – 05th Apr 2024

Epidemiology and Prevention of Typhoid Fever: Disease Dynamics and Vaccination

Epidemiology

Typhoid fever, caused by the bacterium Salmonella Typhi, remains a significant public health concern in low and middle-income countries, particularly in South/Southeast Asia, sub-Saharan Africa, and some island nations of Oceania. Though global estimates suggest a reduction in cases since 2000, the burden remains substantial, with millions of cases and thousands of deaths annually. Undiagnosed cases are common, especially in some regions, highlighting challenges in detection and surveillance. Despite largely being an endemic disease, typhoid fever retains epidemic potential.

Transmission occurs primarily through the fecal -oral route, facilitated by inadequate sanitation and hygiene practices, with both short-cycle (local contamination) and long-cycle (environmental contamination) patterns observed. Factors contributing to transmission include poor access to safe water and sanitation, population density, socioeconomic status, and inadequate hygiene practices.

Children are disproportionately affected, with peak incidence between 5 to <15 years old. Studies show a significant proportion of cases in children under five years old, with notable morbidity and mortality. Limited data exist on the impact of typhoid fever on pregnant women, but some suggest potential maternal complications and adverse pregnancy outcomes.

The distribution of enteric fever in Sri Lanka is concentrated in specific geographic regions within the country, with notably high infection rates reported in districts such as Vavuniya, Jaffna, Nuwara Eliya, Colombo, and Kegalle. This pattern is closely linked to the consumption of contaminated water and food. In districts located in the dry zone, such as Jaffna and Vavuniya, water scarcity exacerbates the problem, while in the hill country, contamination of natural water sources, particularly springs, is a primary concern. Additionally, various dietary practices and inadequate sanitary facilities contribute to outbreaks in both regions. Children and the elderly, particularly those in low-income groups, are particularly vulnerable to these intestinal infections and the highest disease incidence is observed among individuals aged 5-9 years, with two-thirds of all cases occurring in individuals aged 1-34 years.

Pathogen

Salmonella, a genus within the family Enterobacteriaceae, are rod-shaped, Gram-negative, facultative anaerobic bacteria. Most Salmonellae are motile due to peritrichous flagella, which bear the H antigen(s). Salmonella enterica subspecies enterica serovar Typhi, commonly known as S. Typhi, is a specific taxonomic designation within Salmonella. Alongside the H antigen(s), two polysaccharide surface antigens— the somatic O antigen and the capsular Vi (virulence) antigen—aid in further characterizing S. enterica. The Vi antigen is linked to resistance against complement-mediated bacterial lysis and activation of the alternate pathway of complement.

Salmonella enterica serovars Paratyphi A and Paratyphi B (and infrequently Paratyphi C) cause a disease known as paratyphoid fever, which clinically resembles typhoid fever, especially in certain regions of Asia. Together, Typhoid fever and Paratyphoid fever are referred to as enteric fever. While S. Typhi and S. Paratyphi C express the Vi antigen, it is absent in S. Paratyphi A and B.

Pathogenesis and Symptoms

After ingestion, S. Typhi enters a phase of silent primary bacteremia, reaching the reticuloendothelial system where it multiplies within macrophages. Following an average incubation period of 7–14 days (though it can range from 3 to 60 days), patients develop a spectrum of symptoms, with more severe cases marked by persistent high fever, abdominal discomfort, malaise,

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and headache. Older children and adults may experience constipation or diarrhoea, while younger children more commonly suffer from diarrhoea. Individuals with certain forms of immunosuppression, achlorhydria, or those ingesting S. Typhi in food capable of neutralizing gastric acid, are more susceptible to lower infectious doses and are at higher risk of severe illness.

Complications arise in an estimated 10–15% of hospitalized patients, particularly among those whose illness persists for over 2 weeks. The most frequent life-threatening complications include intestinal haemorrhage, intestinal perforation, and encephalopathy leading to hemodynamic shock. Intestinal perforation rates in some outbreaks have exceeded 40%, with associated mortality rates ranging from 18% to 43%.

Chronic gallbladder carriage of S. Typhi can develop in approximately 2%–5% of cases, depending on factors such as the individual's age and the presence of pre-existing gallbladder mucosa disease. This chronic carrier state may also result from subclinical S. Typhi infection. Individuals in this state face an increased risk of developing hepatobiliary cancer. Chronic carriers serve as a source of ongoing infection, perpetuating the long-term prevalence of typhoid fever within communities by continuously shedding S. Typhi into the environment. Additionally, if carriers are involved in food handling, short-cycle transmission can occur through contaminated food.

Diagnosis

The vague symptoms of typhoid fever pose challenges for clinical diagnosis, often leading to confusion with other common febrile illnesses in regions where typhoid fever is prevalent. Relying solely on clinical diagnosis can skew surveillance data, inaccurately reflecting the true incidence of typhoid fever, and may result in inappropriate treatment. Typically, confirmation of the diagnosis relies on isolating S. Typhi through blood culture, but the sensitivity of a single blood culture is around 60% and can be influenced by the volume of blood obtained. This sensitivity is further diminished by the common practice of initiating antibiotic treatment before confirming the diagnosis. Blood culture is often not performed for the majority of cases in low and middle-income countries (LMICs), particularly in non-hospital settings. Additionally, some countries underutilize blood culture in infants and young children, leading to an underestimation of the typhoid fever burden in these age groups. Existing serological tests are limited by variable antibody responses to the pathogen and cross-reactivity of S. Typhi (and S. Paratyphi A) with other enteric bacteria.

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 To be Continued….

Table 1: Selected notifiable diseases reported by Medical Officers of Health 23rd – 29th Mar 2024 (13th Week)

RDHS	Dengue Fever		Dysentery		Encephalitis		En. Fever		F. Poisoning		Leptospirosis		Typhus F.		Viral Hep.		H. Rabiies		Chickenpox		Meningitis		Leishmania-		Tuberculosis		WRCD	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	T*	C**
Colombo	130	4015	0	5	2	3	3	5	0	3	23	132	3	3	0	3	0	0	23	130	1	12	0	0	44	542	100	100
Gampaha	60	1702	0	5	0	4	0	2	0	0	12	190	0	2	0	1	0	0	10	90	0	30	0	6	27	303	93	100
Kalutara	69	1105	1	10	0	0	2	6	0	5	16	206	0	3	0	5	0	0	11	183	1	23	0	0	17	184	80	200
Kandy	51	1517	0	5	0	0	0	0	0	3	5	79	1	8	0	3	0	0	3	175	0	4	2	14	11	175	100	100
Matale	12	304	0	1	0	0	0	1	0	8	0	39	0	0	3	4	0	0	3	28	1	5	7	78	6	37	100	100
Nuwara Eliya	7	169	4	23	0	3	0	1	0	11	3	69	1	15	0	3	0	0	2	60	0	3	0	0	3	76	100	100
Galle	20	961	0	16	1	7	0	1	1	17	11	251	3	38	0	4	0	1	13	185	0	24	0	3	8	120	100	100
Hambantota	29	405	1	6	0	1	0	1	20	28	6	229	1	14	0	2	0	0	11	91	1	12	8	150	3	38	100	100
Matara	14	341	0	2	0	3	0	0	0	4	3	102	0	7	0	1	0	0	15	95	1	38	0	29	9	28	100	100
Jaffna	68	4750	1	22	0	1	1	3	0	15	0	12	6	335	0	3	0	1	1	91	0	6	0	0	2	56	100	93
Kilinochchi	2	258	0	2	0	0	0	1	0	1	1	10	0	7	0	0	0	0	0	1	0	2	0	0	0	7	100	100
Mannar	2	169	0	0	0	0	0	1	0	0	0	16	0	6	0	0	0	0	0	4	0	2	0	1	0	17	100	100
Vavuniya	2	124	0	0	0	0	0	0	4	5	3	50	1	2	0	4	0	0	2	11	0	6	1	5	0	7	100	100
Mullaitivu	1	169	0	3	0	0	0	0	0	2	1	46	1	9	0	0	0	0	0	2	0	0	0	4	0	11	100	100
Batticaloa	26	982	0	46	0	5	0	2	0	12	0	21	0	1	0	6	0	0	5	24	0	19	0	1	0	30	100	100
Ampara	1	129	2	14	0	1	0	0	0	7	3	102	0	1	0	3	0	0	3	48	2	19	1	6	3	64	100	100
Trincomalee	12	389	0	7	0	0	0	1	0	1	0	81	0	9	0	0	0	0	0	19	0	3	0	8	0	18	92	100
Kurunegala	19	1152	1	9	4	11	0	0	0	339	7	223	0	13	0	2	0	2	13	139	1	72	3	147	5	135	93	97
Puttalam	9	574	0	1	0	1	0	0	0	0	4	115	0	5	0	0	0	0	4	45	0	13	2	8	2	53	75	99
Anuradhapura	11	460	0	4	1	1	0	0	0	2	6	180	1	20	0	6	0	0	7	58	1	18	7	244	4	69	91	100
Polonnaruwa	7	171	1	8	0	0	0	0	0	2	6	109	0	1	0	1	0	0	3	50	2	11	16	136	6	26	100	100
Badulla	8	474	0	8	0	2	0	0	1	16	11	200	2	9	1	7	0	0	4	89	1	10	1	8	6	62	88	100
Monaragala	10	342	0	5	0	0	0	1	0	0	10	381	0	13	0	7	0	0	0	34	0	38	5	66	1	26	73	100
Ratnapura	53	808	1	24	1	2	0	0	0	3	45	496	0	10	1	9	1	2	4	93	5	41	5	63	0	63	89	100
Kegalle	30	778	0	3	0	2	0	0	0	2	16	183	2	8	0	5	0	0	14	204	0	19	0	12	5	86	100	100
Kalmunai	11	484	0	8	0	0	0	0	0	0	1	34	0	1	0	1	0	0	1	61	1	5	0	0	3	38	92	100
SRILANKA	**664**	**22732**	**12**	**237**	**9**	**47**	**6**	**26**	**26**	**486**	**193**	**3556**	**22**	**540**	**5**	**80**	**1**	**6**	**152**	**2010**	**18**	**435**	**58**	**989**	**165**	**2271**	**95**	**99**

Source: Weekly Returns of Communicable Diseases (esurvillance.epid.gov.lk). T=Timeliness refers to returns received on or before 29th Mar, 2024 Total number of reporting units 358 Number of reporting units data provided for the current week: 355 **C****-Completeness *

A = Cases reported during the current week. B = Cumulative cases for the year.

Table 2: Vaccine-Preventable Diseases & AFP

23rd – 29th Mar 2024 (13th Week)

Disease	No. of Cases by Province									Number of cases during current week in 2024	Number of cases during same week in 2023	Total number of cases to date in 2024	Total number of cases to date in 2023	Difference between the number of cases to date in 2024 & 2023
	W	C	S	N	E	NW	NC	U	Sab					
AFP*	01	00	00	00	00	00	00	00	00	01	01	19	23	-17.4 %
Diphtheria	00	00	00	00	00	00	00	00	00	00	00	00	00	0 %
Mumps	01	00	00	00	00	00	01	01	00	03	10	72	61	18 %
Measles	03	00	00	00	02	01	00	00	00	06	00	176	00	0 %
Rubella	00	00	00	00	00	00	00	00	00	00	01	01	01	0 %
CRS**	00	00	00	00	00	00	00	00	00	00	00	00	00	0 %
Tetanus	00	00	00	00	00	00	01	00	00	01	00	01	01	0 %
Neonatal Tetanus	00	00	00	00	00	00	00	00	00	00	00	00	00	0 %
Japanese Enceph-alitis	00	00	00	00	00	00	00	00	00	00	00	01	01	0 %
Whooping Cough	00	00	00	00	00	00	00	00	00	00	00	01	00	0 %

Key to Table 1 & 2

Provinces: **W**: Western, **C**: Central, **S**: Southern, **N**: North, **E**: East, **NC**: North Central, **NW**: North Western, **U**: Uva, **Sab**: Sabaragamuwa.

RDHS Divisions: **CB**: Colombo, **GM**: Gampaha, **KL**: Kalutara, **KD**: Kandy, **ML**: Matale, **NE**: Nuwara Eliya, **GL**: Galle, **HB**: Hambantota, **MT**: Matara, **JF**: Jaffna, **KN**: Killinochchi, **MN**: Mannar, **VA**: Vavuniya, **MU**: Mullaitivu, **BT**: Batticaloa, **AM**: Ampara, **TR**: Trincomalee, **KM**: Kalmunai, **KR**: Kurunegala, **PU**: Puttalam, **AP**: Anuradhapura, **PO**: Polonnaruwa, **BD**: Badulla, **MO**: Moneragala, **RP**: Ratnapura, **KG**: Kegalle.

Data Sources:

Weekly Return of Communicable Diseases: Diphtheria, Measles, Tetanus, Neonatal Tetanus, Whooping Cough, Chickenpox, Meningitis, Mumps., Rubella, CRS,

Special Surveillance: AFP* (Acute Flaccid Paralysis), Japanese Encephalitis

CRS =**Congenital Rubella Syndrome

NA = Not Available

Take prophylaxis medications for leptospirosis during the paddy cultivation and harvesting seasons.

It is provided free by the MOH office / Public Health Inspectors.

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ON STATE SERVICE

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