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Investigation and response to a large outbreak of leptospirosis in Northern Sri Lanka

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Abstract

Introduction: Leptospirosis, a zoonotic bacterial disease, ranges from mild febrile illness to severe complications. Although Sri Lanka is endemic, Jaffna District was considered low risk. In November 2024, Cyclonic Storm Fengal caused flooding leading to an outbreak. An investigation was conducted to identify the causative agent and implement control measures.

Objectives: To investigate an outbreak of an unidentified febrile illness following Cyclonic Storm Fengal in Jaffna District

Methods: A rapid epidemiological investigation was launched following reports of fatalities and 40 suspected cases. Hospital records were reviewed and case definitions from national guidelines were applied. Laboratory testing, including polymerase chain reaction and microscopic agglutination test was conducted to confirm leptospirosis. Community outreach was implemented to identify additional cases. Veterinary testing of animal serum samples was also conducted to identify potential reservoirs.

Results: A total of 104 suspected cases were identified during 1-17 December 2024, with 20 cases confirmed via laboratory testing. Males (70%) were predominantly affected, with the highest incidence among individuals aged 21-40 years. Seven fatalities occurred, primarily due to severe pulmonary haemorrhagic syndrome. Most cases originated from Point Pedro, Karaveddy and Chavakachcheri, areas with unhygienic livestock farming. Serological testing confirmed leptospirosis in cattle and goats, indicating zoonotic transmission.

Conclusions & Recommendations: The outbreak highlighted the emerging risk of leptospirosis in Jaffna following extreme weather events. Strengthening surveillance, early diagnosis, and rapid treatment protocols are essential to reduce mortality. Public awareness campaigns and environmental sanitation measures, including livestock management, should be prioritized. Further research on the epidemiological shift in leptospirosis transmission in Northern Sri Lanka is warranted.

Key words: *Leptospirosis, Outbreak Investigation, Sri Lanka*

Introduction

Leptospirosis, a zoonotic bacterial infection caused by spirochetes of the genus Leptospira, presents with a clinical spectrum ranging from mild, self-limiting illness to severe, life-threatening complications. The disease's severity is influenced by factors such as the infectious dose, the serovar involved and the host's immune status (1). The incubation period typically ranges from 2 to 30 days, with an average of two weeks (2). Humans acquire the infection through direct contact with the urine of infected animals or via exposure to contaminated water or soil. The bacteria thrive in warm, humid environments, enabling their survival and transmission (2).

The history of leptospirosis extends over a century, yet the first confirmed cases in Sri Lanka were reported in 1959, from Colombo and Batticaloa, diagnosed using serological methods (3). The disease was made notifiable in 1974, and since then, the notification data indicate a steady increase in reported cases over the last two decades (4). These data underscore Sri Lanka's endemic status for leptospirosis, with outbreaks frequently reported across various districts. However, most cases are clinically diagnosed, with only a few confirmed through laboratory investigations (5).

A significant epidemiological shift was observed in 2013 when the first documented recreational water associated outbreak of leptospirosis in Sri Lanka was reported by Agampodi et al. (6). Among the severe manifestations of leptospirosis, severe pulmonary haemorrhagic syndrome (SPHS) is particularly alarming due to its high fatality rate. This condition has been reported in countries such as Brazil, Nicaragua and parts of South America (7-8). A study in Southern Sri Lanka revealed that of 128 cases confirmed by the microscopic agglutination test (MAT), 62.5% developed SPHS. The syndrome typically manifests within the first week of illness, particularly on days 4 and 5, with a case fatality ratio of 41.5%, and most deaths occurring within three days of hospital admission (9).

Although traditionally considered non-endemic for leptospirosis, the Jaffna District recently experienced an unprecedented outbreak of an unidentified fever with severe respiratory symptoms. In response, the Epidemiology Unit, in collaboration with provincial and district health authorities, the Medical Research Institute (MRI), clinical experts and public health teams, launched a comprehensive investigation to identify the cause, source, and mode of transmission in order to implement effective control and preventive measures.

Methods

In November 2024, Cyclonic Storm Fengal triggered severe flooding across Sri Lanka's Northern Province, with Jaffna District being the most affected. Approximately two weeks later, the Epidemiology Unit was alerted to six fatalities and 40 suspected cases of an unidentified febrile illness that rapidly progressed to severe respiratory symptoms at Teaching Hospital (TH) Jaffna and Base Hospital (BH) Point Pedro.

In response, the Epidemiology Unit launched a rapid outbreak investigation in collaboration with key stakeholders. An expert team was promptly deployed to Jaffna District, where they met with the Provincial Director of Health Services (PDHS), the Regional Director of Health Services (RDHS), the Director of TH Jaffna, the Medical Superintendent (MS) of BH Point Pedro and the Medical Officers of Health (MOHs) from most flood affected areas.

Following administrative clearance, the team conducted a comprehensive review of hospital records, including bed head tickets and laboratory reports, and held discussions with visiting physicians, relevant consultants, and members of the affected communities. Based on preliminary findings and field visits, leptospirosis was suspected as the likely cause, given the recent extensive flooding. Samples were sent to the MRI, which confirmed

leptospirosis in three of the six fatalities, officially confirming the outbreak. To identify additional cases, a case definition adapted from the national guidelines (4) was used. Suspected leptospirosis cases were defined as individuals presenting with acute febrile illness and at least one of the following symptoms: headache, myalgia, prostration, jaundice, conjunctival suffusion, oliguria, features of meningeal irritation, haemorrhage, cardiac failure or arrhythmia, cough, breathlessness, skin rash, and/or a history of exposure to floodwater or evidence of organ involvement (4). This definition was applied from 1 December 2024. A line listing was conducted which helped pinpoint the three most affected areas, where targeted control measures were promptly implemented.

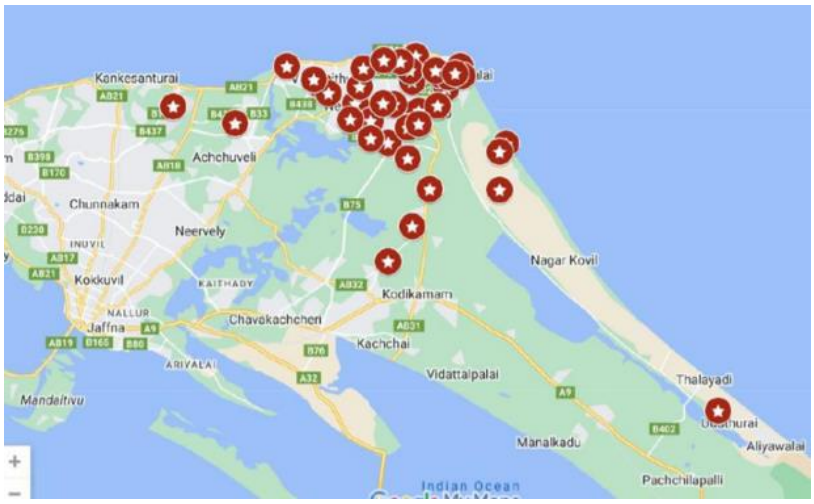

Figure 1: Map depicting clusters of leptospirosis cases

During 1-17 December 2024, 104 patients presenting with symptoms consistent with leptospirosis were reported at hospitals across the flood-affected areas (Figure 1; Table 1). Hospital records were reviewed, and patients not meeting the case definition were excluded. Interviews were conducted with the remaining patients to assess their exposure to floodwater. Blood samples were collected from selected suspected cases for polymerase chain reaction (PCR) testing and MAT to confirm the diagnosis. To rule out potential overlapping infections, a subset of suspected cases underwent additional investigations for dengue, influenza and COVID-19.

Table 1: Clinical and laboratory characteristics of patients with leptospirosis

Characteristic	No. (%)
Clinical presentation (n = 104)	
Fever	104 (100%)
Myalgia	90 (87%)
Respiratory complaints (cough, shortness of breath)	67 (64%)
Laboratory confirmation (n = 20)	
PCR positive	15 (75%)
MAT positive	5 (25%)
Hospital stay (days)	
Mean	5
Median	2
Interquartile range (IQR)	1–6

Under the guidance of PDHS and RDHS, health authorities implemented an active case-finding strategy through house-to-house surveillance in high-risk areas. This community-based intervention served as a practical application of early detection and rapid response principles within the outbreak control framework. By systematically identifying individuals with febrile illnesses suggestive of leptospirosis and ensuring their prompt referral for diagnosis and treatment, the approach provided an opportunity to assess the effectiveness of decentralized surveillance in reducing diagnostic delays and preventing secondary transmission. The findings highlight the value of integrating community-level active surveillance into routine outbreak preparedness plans for leptospirosis and other zoonotic diseases.

Results

The outbreak resulted in seven fatalities, all of which exhibited a rapid progression to respiratory failure, leading to death within 24 hours of hospital admission. Laboratory testing confirmed leptospirosis in three of the deceased, while autopsy findings identified pulmonary pneumonia and leptospirosis-related pulmonary haemorrhage as the primary causes of death. In response, the medical officer of health (MOH) teams conducted household visits, issued public announcements and utilized local media to raise community awareness. As a result, even individuals with a single day of fever in the most severely affected flood zones were promptly hospitalized and initiated treatment.

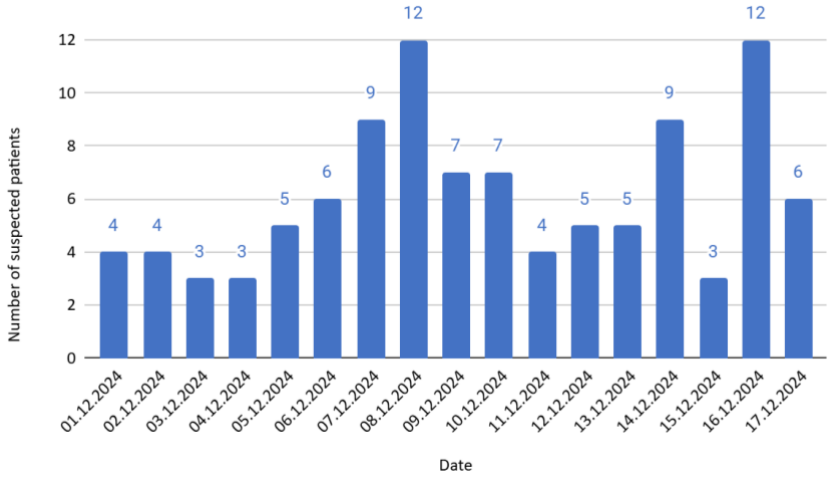

Figure 2: Number of suspected patients admitted to hospitals

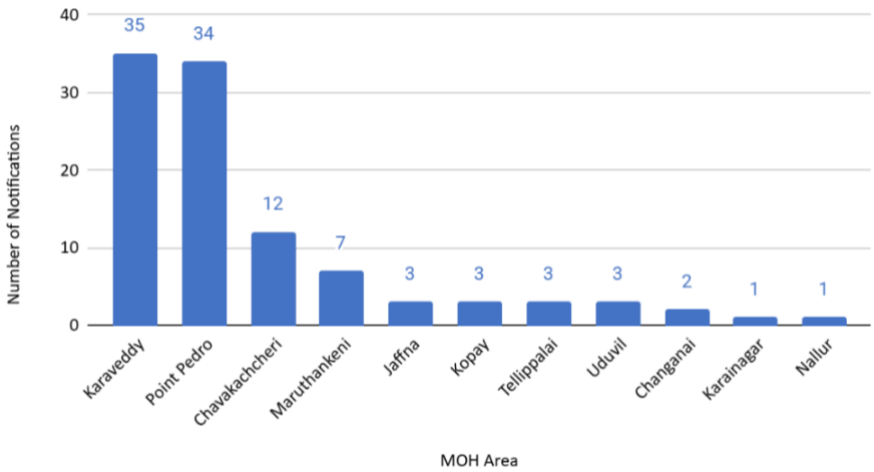

Figure 3: Number of notifications from each MOH area of Jaffna district

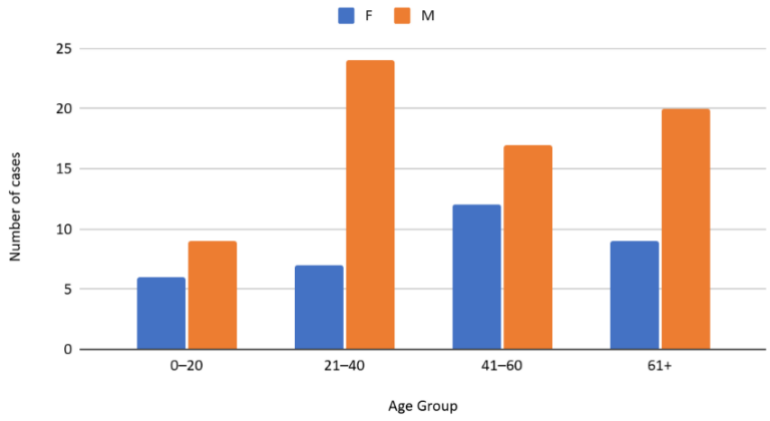

Figure 4: Age and sex distribution of the notified cases of leptospirosis

Morbidity outcomes

As of 17 December 2024, a total of 104 patients were admitted to BH Point Pedro and TH Jaffna (Figure 2). More than 77% of cases originated from the areas of Point Pedro, Karaveddy and Chavakachcheri (Figure 3). Males accounted for the majority of cases, with a total of 70 affected individuals, while 34 were females. Most males fell within the 21–40-year age group, whereas the majority of females were between 41–60 years old (Figure 4).

The adjacent MOH areas of Point Pedro, Karaveddy and Chavakachcheri, characterized by unhygienic grasslands and unauthorized cattle and pig farms, were identified as the potential source of infection following heavy rainfall and flooding. The floodwaters further contaminated community wells and homes, significantly increasing the risk of disease transmission. It was recommended that further investigation of animal samples from the affected grassland be conducted to confirm the source of the leptospirosis outbreak. Veterinary officers analysed 384 animal serum samples, comprising 149 goats, 221 cattle, and 14 sheep, to identify potential serovars associated with human cases. Serological testing identified positive results exclusively among 11 cattle and goats in the four most affected areas (3 from Point Pedro, 2 from Karaveddy, 1 from Chavakachcheri and 5 from Maruthankeni).

Mortality outcomes

The outbreak in Jaffna resulted in seven deaths, six of which occurred among males aged 20-62 years. The fatalities were clustered within three MOH areas: Chavakachcheri (2 cases), Point Pedro (3 cases) and Karaveddy (2 cases), suggesting potential geographic or environmental determinants of transmission. The interval between symptom onset and hospital admission ranged from 2-5 days, while deaths occurred within 0-5 days after admission, reflecting the acute and rapidly progressive nature of the disease. These findings suggest that delayed healthcare-seeking behaviour, combined with the possible circulation of a highly virulent *Leptospira* strain or high-intensity environmental exposure, may have contributed to the increased case fatality rate. This analysis underscores the need for early detection and rapid clinical intervention, particularly in high-risk areas identified during the outbreak.

Discussion

The leptospirosis outbreak in Jaffna, Sri Lanka, highlights the severe public health impact of flooding in areas with poor sanitation and close human-animal interactions. The concentration of cases in the MOH areas of Point Pedro, Karaveddy and Chavakachcheri suggests that environmental factors played a critical role in disease transmission. The presence of unauthorized cattle and pig farms in these regions, coupled with contaminated floodwaters, likely

created ideal conditions for the spread of *Leptospira* bacteria. Previous studies have documented similar outbreaks following heavy rainfall, reinforcing the role of environmental exposure as a key risk factor for leptospirosis in endemic regions (5, 10).

Uncertainty remains regarding the potential underreporting of leptospirosis cases before the outbreak. Historical data from the Epidemiology Unit shows that Jaffna District reported only 21 cases in 2023 and 28 cases in 2022, suggesting that the true burden of the disease may have been underestimated. The emergence of a newly introduced serovar could have contributed to this outbreak, particularly given the occurrence of leptospirosis-associated SPHS, a condition with high fatality rates previously documented in southern Sri Lanka (9). Potential sources of introduction include the transport of wet cow dung by lorries from other regions or the arrival of boats from India, both of which could have facilitated the spread of an unfamiliar leptospiral strain.

The demographic distribution of cases, with a higher proportion of males (67.3%) and a peak incidence among individuals aged 21-40 years, aligns with established epidemiological patterns of leptospirosis. Males, particularly those in physically demanding occupations such as paddy farming, animal husbandry and fishing, are at increased risk due to greater exposure to contaminated water and soil. In contrast, the majority of female cases were observed in the 41–60-year age group, which may reflect differing occupational or household exposure patterns. This gender disparity underscores the need for targeted public health interventions, including occupational safety measures and personal protective equipment for high-risk groups.

The mortality rate in this outbreak is concerning, with seven deaths occurring shortly after hospital admission. The rapid progression of the disease in several cases highlights the urgent need for early detection and prompt intervention, particularly in severe leptospirosis, where complications with pulmonary haemorrhage and multi-organ failure can arise. The rapid progression of respiratory symptoms in this outbreak is particularly notable. Unlike the 2014 outbreak among white-water rafters in Anuradhapura District characterized by a higher prevalence of hypotension and bradycardia, the current outbreak displayed unique and alarming clinical features (6).

Delayed hospital admissions suggest challenges in healthcare access, including limited awareness, logistical barriers, and reluctance to seek medical care. Strengthening community-based surveillance, implementing early warning systems, and ensuring timely prophylaxis administration by grassroots healthcare workers could have significantly improved patient outcomes. Notably, following the initial seven fatalities, no further deaths were reported. The severe respiratory deterioration seen in early cases was largely linked to delayed presentation, but the proactive decision to admit patients with even a single day of fever played a crucial role in preventing additional fatalities. The administration of prophylaxis further contributed to controlling disease transmission and mitigating the outbreak's impact.

Leptospira species are commonly found in rodent and small mammal populations across temperate regions, yet outbreaks of leptospirosis remain rare (10). This indicates that specific environmental and epidemiological factors must align to significantly increase human exposure. The rapid progression of respiratory symptoms in this outbreak is particularly notable. This outbreak reinforces the urgent need for a multisectoral approach to leptospirosis prevention and control. Environmental management strategies, such as improved waste disposal, control of unauthorized livestock farming, and enhanced drainage systems, are critical to reducing transmission risks. Additionally, strengthening public health education on leptospirosis symptoms, transmission routes, and the importance of seeking

early medical care could help mitigate future outbreaks.

In response to the leptospirosis outbreak in Sri Lanka, a national-level response was swiftly initiated, which included the establishment of an Incident Management Support Cell at the regional level. Teams from the central Epidemiology Unit provided on-site technical assistance and organized a symposium on leptospirosis for clinicians and public health staff in the Jaffna District. To control disease transmission, chemoprophylaxis with doxycycline was administered to at-risk communities, while primary care clinicians were equipped with a working case definition to ensure timely referral and diagnosis. Hospitals followed national leptospirosis management guidelines to ensure optimal patient care, and environmental and animal-related factors contributing to the outbreak were addressed through coordinated efforts across multiple sectors. The response underscored the importance of a multisectoral approach in effectively managing such outbreaks. Sri Lanka also plans to review the surveillance case definition in light of the observed atypical clinical presentation, which was marked by predominant respiratory manifestations and rapid clinical progression.

Conclusions & Recommendations

The Jaffna leptospirosis outbreak highlights the complex interplay between environmental factors, occupational exposure, and healthcare access in determining disease outcomes. This highlights the need for One Health approach that integrates human, animal and environmental health strategies. To mitigate the risk of zoonotic disease transmission, it is essential to operationalize the One Health approach through practical, context-specific actions. Strengthening coordination between human and animal health sectors should include regular joint surveillance for animal reservoirs and environmental contamination. Local authorities should improve waste management by preventing the dumping of wet garbage and animal waste in marshy areas, which serve as breeding grounds for rodents. Community-level interventions such as health education on personal protective measures for farmers and waste handlers, and improved drainage and sanitation systems are also critical. Implementing these targeted actions within a One Health framework will help break the transmission cycle and enhance resilience against future outbreaks.

Public Health Implications

- The leptospirosis outbreak in Jaffna highlights the increasing public health risks associated with extreme weather events.
- Enhanced disease surveillance and early detection systems are critical for timely outbreak response.
- Targeted interventions such as community education, better livestock management, and improved environmental sanitation are needed to prevent future outbreaks.
- Strengthening collaboration between human and veterinary health sectors is essential to control zoonotic transmission and protect vulnerable communities.

Author Declarations

Competing interest: There are no competing interests for any author

Ethics approval and consent to participate: Ethical approval was not required for this investigation, as it was conducted as part of a routine public health response to an outbreak under the mandate of the Ministry of Health, Sri Lanka. All data were collected and analysed in accordance with national surveillance guidelines, and individual confidentiality was maintained throughout the process.

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Author contributions: PK, TD, AM and HT comprised the investigation team from the Epidemiology Unit assigned to the Jaffna District. All other contributors were involved in data collection. PK drafted the manuscript, while AM, DN and JK conducted the statistical analysis. TD, AL and HT provided technical guidance and overall supervision throughout the outbreak.

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