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Original Article

Analysis of Hospital-Based Sentinel Surveillance Data on Leptospirosis in Sri Lanka, 2005–2008

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SUMMARY: In Sri Lanka, leptospirosis is a notifiable disease. In addition to having a routine disease reporting system, Sri Lanka has implemented a hospital-based sentinel surveillance system since 2004. This report discusses the findings of a descriptive analysis of the sentinel surveillance data collected from 2005 to 2008. Of the 4,000 suspected leptospirosis cases, 46.9% and 26.8% were recorded from the Western and Sabaragamuwa provinces, respectively. Most of the individuals were male (83.5%), and approximately 45.6% were aged 30–49 years. Farmers accounted for 16.5%, and laborers for 16.1%; however, the occupation of nearly half (44.8%) of the study population was unknown. More than half (53.9%) of the individuals worked in paddy fields. Almost all had acute fever (98.8%), myalgia (92.9%), and headache (92.7%), but fewer had other related symptoms. Out of the 4,000 individuals, 2,496 (62.4%) underwent a laboratory test; however, the laboratory test results of only 1,445 (57.9%) and the microscopic agglutination results of only 41 (2.8%) were available at the sentinel sites. Less than 2% of the reported individuals underwent prophylactic treatment. These findings will help enhance the ongoing efforts for controlling and preventing leptospirosis in Sri Lanka. Sentinel surveillance is a useful tool, but the data quality needs to be improved by supplementing the findings with adequate laboratory diagnosis data.

INTRODUCTION

Leptospirosis is a global public health burden occurring primarily in tropical zones. It is caused by spirochetes belonging to the genus *Leptospira*. The annual incidence rates of leptospirosis range from approximately 0.1–1 per 100,000 persons in temperate climates; and from 10–100 per 100,000 persons in humid tropical climates (1). The occurrence of the disease is usually related to socioeconomic and climatic conditions, which influence the growth of animal vectors and the chances of human exposure. While leptospirosis is generally endemic in tropical countries, it has been sporadically reported in temperature countries, where it is commonly associated with recreational exposure to contaminated water sources (2). The clinical diagnosis of leptospirosis is complicated because of the varied and non-specific manifestations of its symptoms (1). Further, the findings of general laboratory tests are often non-specific. Therefore, certain specific laboratory tests need to be performed for a definitive diagnosis, which include micorbial culture, microscopic agglutination test (MAT) using paired sera, and DNA detection by polymerase chain reaction (PCR). However, accurate diagnosis is difficult because of poor and inadequate laboratory facilities. Thus, the disease remains largely underdiagnosed and therefore underestimated (1). The incidence of this disease has been commonly reported to increase in areas under leptospirosis surveillance.

Disease surveillance is a critical component of healthcare systems in the generation of essential epidemiological information for cost-effective healthcare delivery (1). Surveillance helps determine the incidence and distribution of diseases and their implications for effective public health strategies. Although the surveillance of leptospirosis has been in place in many countries for decades, it is yet to be adopted and implemented as a monitoring tool to address issues related to the control and prevention of the disease (3). Surveillance consists of three main integrated activities: (i) systematic collection of pertinent data, (ii) analyses of the data, and (iii) timely dissemination of results; all of which are intended to guide decision on interventions. A successful surveillance program should optimize the integration of these three activities in order to obtain precise information for disease control and prevention. In many countries, healthcare providers (e.g., physicians and public health inspectors) are legally mandated to collect disease-related data and report them to relevant authorities.

Sri Lanka's national disease reporting system, which is empowered by the Quarantine and Prevention of Diseases Ordinance enacted in 1897, with subsequent amendments, identifies 28 notifiable diseases and pro-

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vides reporting guidelines to physicians and other healthcare providers (4). Leptospirosis is one such disease regularly reported to the Ministry of Health, which has jurisdiction over the reporting system.

It is unclear as to when the official reporting of leptospirosis cases to the Ministry of Health began in Sri Lanka, and until 1991, the number of notifications was unknown. However, some studies had documented the local presence and described the epidemiology of leptospirosis. For instance, a study in 1953 confirmed the earliest diagnostic evidence of the disease in Sri Lanka (5). Other local studies had also isolated and identified more than 19 *Leptospira* serovars (belonging to over seven serogroups) as the causative agent for leptospirosis in humans and/or animals (6). In early 1991, disease notifications and data analyses at the Ministry of Health improved as a result of its enhanced computer-based data management system. The data collected in the period 1991–2010 showed between 167 and 7,423 reported cases, with the highest increase noted during 2008 (5).

Although the government's reporting system has captured an upward trend in the notifications of leptospirosis cases, further clinical and epidemiological information was required to understand and control the disease dynamics. Thus, in 2004, the government implemented a hospital-based sentinel site surveillance for leptospirosis, which ran parallel to the notifiable disease-reporting system. The sentinel surveillance seeks to obtain the following information about those suspected to have an infection: clinical data (e.g., signs and symptoms), epidemiological data (e.g., exposures), laboratory data (e.g., serovar causing infection) and data on prophylactic treatment (e.g., intake of antibiotics) (6).

From 2005 to 2008, the sentinel surveillance system collected a tremendous amount of data each year from 52 sentinel hospitals, involving a total of 5,173 suspected cases of leptospirosis according to the surveillance case definition. This report discusses the findings from a multiyear analysis of the available electronic data for 4,000 patients and analyses the patterns of disease dynamics with a view to enhancing control and prevention measures.

METHODS

Surveillance case definition and laboratory confirmation of leptospirosis: The surveillance case definition of leptospirosis is described in Volume 1 of the International Statistical Classification of Diseases and Related Health Problems published by the World Health Organization (WHO) in 1992 (7). This classification was adopted by the Epidemiology Unit of the Ministry of Health, Sri Lanka, and was included in the handbook titled ''Surveillance Case Definitions for Notifiable Diseases in Sri Lanka'' in 2005. On the basis of this definition, an individual is suspected as having leptospirosis if he/she has acute febrile illness with headache, myalgia, and prostration, which could be associated with any of the following conditions: (i) conjunctival suffusion/conjunctival hemorrhage; (ii) meningial irritation; (iii) anuria, oliguria, proteinuria, hematuria, or jaundice; (iv) intestinal bleeding, lung bleeding, or purpuric rash; and (v) cardiac arrhythmia or failure, combined with a history of exposure to infected animals or an environment contaminated with animal urine (8).

Data source: The evidence discussed in this report was derived from the 2005–2008 sentinel site data, which were obtained with permission from the Epidemiology Unit, Sri Lanka. We used the only 4,000 of the 5,173 clinically suspected cases, since these were the only cases electronically stored at the Epidemiology Unit. Among 4,000 cases, 3,962 were clinically diagnosed cases and 28 were cases confirmed in the laboratory using MAT. It should be noted that the number of sentinel centers, from which the 5,173 cases were reported, had increased from 13 in 2005 to 52 in 2008. The Epidemiology Unit was responsible for collecting and storing the surveillance data of the sentinel surveillance sites. The collected data was stored in Microsoft® Excel®-based spreadsheets for further analyses.

In each sentinel site, a nursing officer, delegated by the Head of the Institution, is responsible for carrying out sentinel surveillance activities. Initially, the nursing officer has to complete the surveillance forms with accurate data regarding the patients' demographics, disease history, risk-factor exposure, clinical signs and symptoms, prophylactic treatment, and laboratory test results. Thereafter, the officer must enter the data in a hospital-based register and prepare a Leptospirosis Sentinel Site Hospital Return Form twice a month and submit the form to the Regional Epidemiologist and Epidemiology Unit, which in turn reports the data in its epidemiological bulletin. For the purpose of this report, the data set was analyzed using the frequency distribu-

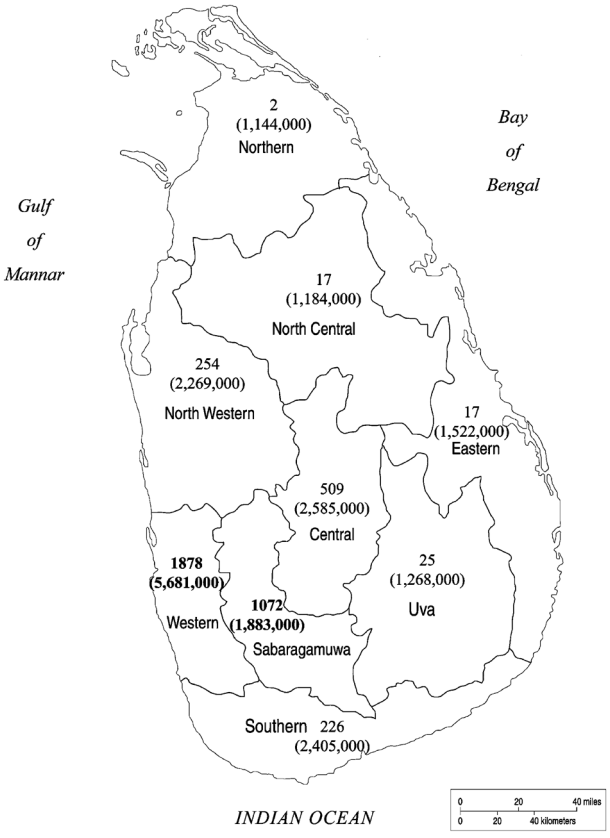

Fig. 1. The provincial boundaries of Sri Lanka with their corresponding cumulative numbers of cases reported to the sentinel centers from 2005 to 2008. The figures in parentheses refer to the average mid-year populations.

tion method.

RESULTS AND DISCUSSION

The 4,000 clinically suspected cases were derived from the annually reported cases (i.e., 664 in 2005; 648 in 2006; 493 in 2007; 2,195 in 2008). Figure 1 shows a map of Sri Lanka with the provinces demarcated, along with the corresponding cumulative number of cases reported to the sentinel centers and their average midyear populations. Of the 4,000 cases, approximately half (46.9%) and one-fourth (26.8%) were recorded from the Western and Sabaragamuwa provinces, respectively (Fig. 1).

Tables 1 and 2 describe the variables included in the multiyear analysis. These include age, gender, occupation, exposure to risk environments, clinical symptoms, prophylactic treatment, and laboratory test results (if they were carried out). Data are presented both at the aggregate level and by year.

The aggregate results indicate that the individuals in most of the suspected cases were men (83.5%). Nearly half (45.6%) of the individuals belonged to 2 aggregated age categories (i.e., 30–39 and 40–49 years). Although the occupations of nearly half (44.8%) of the individuals were unknown, the data showed that 16.5% and 16.1% were farmers and laborers, respectively; the remaining 22.7% belonged to varying occupational groups. More than half (53.9%) and a fourth (25.5%) worked in paddy fields and marshy/muddy areas, respectively (Table 1).

Furthermore, the aggregate analysis shows that almost all of the 4,000 individuals had primary symptoms related to leptospirosis, such as acute fever (98.8%), myalgia (92.9%), and headache (92.7%); however, fewer (44.1%) had prostration. The cases were found to have other concurrent symptoms associated with leptospirosis, such as conjunctival edema (67.1%), anuria/oliguria (37.2%), and jaundice (32.1%). The data indicate that of the 4,000 cases, 2,496 (62.4%) underwent a general urine and blood test and/or laboratory diagnostic examination (MAT). Of those who sub-

Table 1. Sociodemographic characteristics of suspected patients and environmental exposures, 2005–2008

Characteristic	Total (n = 4,000) No. (%)	Year			
		2005 (n = 664) No. (%)	2006 (n = 648) No. (%)	2007 (n = 493) No. (%)	2008 (n = 2,195) No. (%)
Socio-demographics					
Gender					
Male	3,340 (83.5)	601 (90.5)	549 (84.7)	438 (88.8)	1,752 (79.8)
Female	660 (16.5)	63 (9.5)	99 (15.3)	55 (11.2)	443 (20.2)
Age category (y)					
Below 10	34 (0.9)	5 (0.8)	12 (1.9)	4 (0.8)	13 (0.6)
10–19	377 (9.4)	80 (12.0)	75 (11.6)	36 (7.3)	186 (8.5)
20–29	769 (19.2)	154 (23.2)	141 (21.8)	88 (17.8)	386 (17.6)
30–39	893 (22.3)	158 (23.8)	138 (21.3)	113 (22.9)	484 (22.1)
40–49	931 (23.3)	150 (22.6)	142 (21.9)	115 (23.3)	524 (23.9)
50–59	673 (16.8)	85 (12.8)	101 (15.6)	94 (19.1)	393 (17.9)
60 or above	323 (8.1)	32 (4.8)	39 (6.0)	43 (8.7)	209 (9.5)
Occupation[1)]					
Unknown	1,793 (44.8)	320 (48.2)	262 (40.4)	221 (44.8)	990 (45.1)
Farmer	660 (16.5)	96 (14.5)	79 (12.2)	56 (11.4)	429 (19.5)
Laborer	642 (16.1)	110 (16.6)	80 (12.3)	105 (21.3)	347 (15.8)
Service worker	311 (7.8)	46 (6.9)	97 (15.0)	54 (11.0)	114 (5.2)
Student	200 (5.0)	37 (5.6)	56 (8.6)	16 (3.2)	91 (4.1)
Housewife	186 (4.7)	15 (2.3)	46 (7.1)	20 (4.1)	105 (4.8)
Driver	126 (3.2)	22 (3.3)	20 (3.1)	12 (2.4)	72 (3.3)
Forces	29 (0.7)	8 (1.2)	2 (0.3)	0 (0.0)	19 (0.9)
Other	53 (1.3)	10 (1.5)	6 (0.9)	9 (1.8)	28 (1.3)
Environmental exposures[2)]					
Paddy land	2,157 (53.9)	370 (55.7)	238 (36.7)	214 (43.4)	1,335 (60.8)
Marshy/muddy areas	1,018 (25.5)	139 (20.9)	220 (34.0)	167 (33.9)	492 (22.4)
River/stream/lake	513 (12.8)	72 (10.8)	108 (16.7)	66 (13.4)	267 (12.2)
Other agricultural land	134 (3.4)	31 (4.7)	19 (2.9)	7 (1.4)	77 (3.5)
Farming animals	19 (0.5)	5 (0.8)	3 (0.5)	3 (0.6)	8 (0.4)
Missing data	159 (4.0)	47 (7.1)	60 (9.3)	36 (7.3)	16 (0.7)

[1)]: Farmer: a person who owns or manages a farm. Laborer: a person doing unskilled manual work for wages. Service worker: a person who works in service sector. Student: a person who is studying at an academic institution. Housewife: a married woman whose main occupation is caring for her family, managing household affairs, and doing housework. Driver: a person who drives a vehicle. Forces: a person who engages in the armed services of a nation.

[2)]: Paddy land: a flooded land used for growing rice and other semiaquatic crops. Marshy/muddy land: a waterlogged land. River/stream/lake: a running water source. Other agricultual land: a land use for cultivation other than paddy. Farming animals: livestock animals such as cattle, pig, and goat.

Table 2. Clinical symptoms, prophylactic treatment, and laboratory test among suspected cases, 2005–2008

Characteristic	Total (n = 4,000) No. (%)	Year			
		2005 (n = 664) No. (%)	2006 (n = 648) No. (%)	2007 (n = 493) No. (%)	2008 (n = 2,195) No. (%)
Clinical symptoms					
Primary symptoms					
Acute fever	3,951 (98.8)	653 (98.3)	642 (99.1)	491 (99.6)	2,165 (98.6)
Myalgia	3,715 (92.9)	633 (95.3)	619 (95.5)	460 (93.3)	2,003 (91.3)
Headache	3,707 (92.7)	615 (92.6)	632 (97.5)	462 (93.7)	1,998 (91.0)
Prostration	1,763 (44.1)	248 (37.3)	406 (62.7)	286 (58.0)	823 (37.5)
Other related symptoms					
Conjunctival	2,685 (67.1)	368 (55.4)	480 (74.1)	295 (59.8)	1,542 (70.3)
Anuria/oliguria	1,486 (37.2)	257 (38.7)	277 (42.7)	245 (49.7)	707 (32.2)
Jaundice	1,285 (32.1)	268 (40.4)	329 (50.8)	149 (30.2)	539 (24.6)
Hemorrhage	344 (8.6)	85 (12.8)	125 (19.3)	32 (6.5)	102 (4.6)
Meningeal irritation	238 (6.0)	51 (7.7)	80 (12.3)	30 (6.1)	77 (3.5)
Cardiac failure/arrhythmia	205 (5.1)	23 (3.5)	51 (7.9)	24 (4.9)	107 (4.9)
Skin rash	156 (3.9)	37 (5.6)	45 (6.9)	8 (1.6)	66 (3.0)
Laboratory tests					
Has performed	2,496 (62.4)	527 (79.4)	546 (84.3)	382 (77.5)	1,041 (47.4)
Laboratory test data	1,445 (57.9)	412 (78.2)	444 (81.3)	311 (81.4)	278 (26.7)
Microscopic agglutination test results (among laboratory test data)					
Positive	28 (1.9)	2 (0.5)	10 (2.3)	9 (2.9)	7 (2.5)
Negative	13 (0.9)	0 (0.0)	6 (1.4)	0 (0.0)	7 (2.5)
Unknown	1,404 (97.2)	410 (99.5)	428 (96.4)	302 (97.1)	264 (95.0)

mitted to such a test, only 1,445 (57.9%) had any laboratory test results. The laboratory test data were available for only 41 (2.8%) persons for whom the MAT results were available. Only 1.9% of the cases experienced chemoprophylaxis as recommended by the Ministry of Health (one 200-mg tablet of doxycycline per week) (Table 2). Additional data revealed that in the period 2005–2008, leptospirosis was the cause of 196 deaths, with the highest numbers been recorded in both Colombo and Kandy Districts in 2008 (data not shown). Most of the individuals who died were men (161, 82.1%) and were aged between 30 and 59 years (144, 73.4%).

Leptospirosis is considered an important public health problem among the WHO South-East Asian Region member countries (9). However, only Maldives, Myanmar, Sri Lanka, and Thailand have included leptospirosis as one of their notifiable diseases. In 2009, the Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health in Thailand reported 5,439 leptospirosis cases and 64 deaths caused by leptospirosis (incidence rate, 8.57 per 100,000 people; fatality rate, 0.1 per 100,000 people; male-to-female ratio, 4:1). Of the 5,439 individuals, 72.9% were aged between 25–64 years, and 72.4% were in agriculture and labor sectors. Most infections occurred among agricultural workers, primarily rice producers (10). In India, similar outbreaks of leptospirosis have increasingly been reported from the coastline areas of Gujarat (11), Mumbai (12), Kerala (13), and the Andaman Islands (14). A study conducted in India revealed that fever, body aches, and chills were among the most common symptoms observed in patients suspected as having leptospirosis. Furthermore, urinary abnormalities, such as oliguria, yellow discoloration of urine, and hematuria, were found in 20–40% of the patients (15). There is no or very limited published information on human leptospirosis in Maldives and Myanmar. The epidemiological features of leptospirosis in Sri Lanka are similar to those reported in Thailand and India, as this report shows.

In the last two decades, the number of leptospirosis notifications in Sri Lanka has been increasing (6). In 2008, 7,423 cases, of which 207 were leptospirosis-related deaths, were notified to the Epidemiology Unit via the National Notifiable Diseases Reporting System (16). The data on 2,195 (30%) of these 7,423 cases were obtained and analyzed by the sentinel surveillance system. The system has identified, among other factors, the geographic areas, age groups, and occupational categories at risk for leptospirosis in Sri Lanka. On the basis of this information, measures have been taken to enhance the control and prevention of leptospirosis infections, especially among those at risk. Although these data are adequate enough to guide such efforts, these have been generated only on a yearly basis. A multiyear analysis of the data, independent from that of the Epidemiology Unit, will provide empirical clues as to whether the patterns of disease dynamics in Sri Lanka are stable over time.

Our multiyear analysis has yielded three key findings. First, the numbers of leptospirosis case notifications have been increasing. Second, the highest proportion of notifications were observed among men aged 30–49 years, agricultural workers and laborers, and persons who work in paddy fields and marshy/muddy lands. Third, the laboratory examinations were not universal. This information must be interpreted with caution because of a limitation in the data (i.e., sizeable number of individuals with unknown occupations). However, our

findings do highlight a compelling need to reinforce the prevailing interventions against leptospirosis infections in Sri Lanka, particularly among those at risk, and also emphasize the need to provide suspected cases with universal access to laboratory services (e.g., MAT). The quality of data on which the control and prevention of leptospirosis in Sri Lanka is based will hinge upon a periodic and regular assessment of the efficacy with which the sentinel surveillance system captures, analyzes, and disseminates information. Data quality, along with accurate results from laboratory investigations, will help determine the true burden of leptospirosis infection in Sri Lanka.

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Conflict of interest None to declare.

REFERENCES

1. World Health Organization (2003): Human Leptospirosis: Guidance for Diagnosis Surveillance and Control. World Health Organization, 109. ISBN 92–4–154589–5.
2. Bharti, A.R., Nally, J.E., Ricaldi, J.N., et al. (2003): Leptospirosis: a zoonotic disease of global importance. Lancet Infect. Dis., 3, 751–771.
3. World Health Organization (2002): Regional Strategy for Integrated Disease Surveillance, Report of an Inter-country Consultation Yangon. Myanmar. SEA-CD-130.
4. Epidemiology Unit (2005): Surveillance Case Definitions for Notifiable Diseases in Sri Lanka. Ministry of Health, Sri Lanka. p. 1–2.
5. Epidemiology Unit (2009): An Interim Analysis of Leptospirosis Outbreak in Sri Lanka–2008. Ministry of Health, Sri Lanka. Online at 〈http://www.epid.gov.lk/Disease%20Situations.htm〉.
6. Epidemiology Unit (2008): Surveillance report on leptospirosis–2007. Epidemiol. Bull. Sri Lanka, 49, 13–16.
7. World Health Organization (1992): International Classification of Diseases (ICD), World Health Organization. vol. 1. Online at 〈http://www.who.int/classifications/icd/en/〉.
8. Epidemiology Unit (2005): Surveillance case definitions for notifiable diseases in Sri Lanka. Ministry of Health, Sri Lanka. p. 19–20.
9. World Health Organization (2009): Leptospirosis Situation in the WHO South-East Asia Region. World Health Organization Regional Office for South-East Asia. 07.08.2011. Online at 〈http://www.searo.who.int/LinkFiles/Communicable_Diseases_Surveillance_and_response_SEA-CD–216.pdf〉.
10. Bureau of Epidemiology Department of Disease Control (2009): Annual Epidemiology Surveillance Report. Ministry of Public Health, Thailand 09.08.2011. Online at 〈http://epid.moph.go.th/Annual/Annual % 202552/AESR52 _ Part2/Ranking/Ranking _ TABLE%2015_52.pdf〉.
11. Clerke, A.M., Leuva, A.C., Joshi, C., et al. (2002): Clinical profile of leptospirosis in South Gujarat. J. Postgrad. Med., 48, 117–8.
12. Karande, S., Kulkarni, H., Kulkarni, M., et al. (2002): Leptospirosis in children in Mumbai slums. Indian J. Pediatr., 69, 855–8.
13. Kuriakose, M., Paul, R., Joseph, M.R., et al. (2008): Leptospirosis in a midland rural area of Kerala State. Indian J. Med. Res., 128, 307–12.
14. Sehgal, S.C., Murhekar, M.V. and Sugunan, A.P. (1995): Outbreak of leptospirosis with pulmonary involvement in north Andaman. Indian J. Med. Res., 102, 9–12.
15. Sehgal, S.C., Sugunan, A.P. and Vijayachari, P. (2003): Leptospirosis disease burden estimation and surveillance networking in India. Southeast Asian J. Trop. Med. Public Health, 34 Suppl. 2, 170–177.
16. Epidemiology Unit (2009): Surveillance report on leptospirosis–2008. Epidemiol. Bull., Sri Lanka, 50, 14–18.