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Epidemiology of Leptospirosis from Thai National Disease Surveillance System, 2003-2012

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Abstract

Leptospirosis is a major public health problem in Thailand. A description on epidemiology of the disease could increase understanding of leptospirosis and suggest potential prevention and control measures. Data on human leptospirosis cases from all 77 provinces in Thailand were collected based on the national surveillance criteria. Univariate analysis and multiple logistic regression were conducted to describe occurrence of leptospirosis cases and risk factors for mortality. From 2003 to 2012, there were 41,089 cases of leptospirosis reported to Bureau of Epidemiology, Ministry of Public Health, Thailand. Average annual incidence rate was 6.6 per 100,000 population. Northeastern region showed the highest incidence (12.5 per 100,000 population). There were 606 deaths, with case fatality rate 1.5%. Seasonal variation was observed, with the highest incidence during rainy season from August to October. Ratio of male to female cases was 3.5:1. Adults aged 55-64 years had the highest incidence rate (9.9 per 100,000 population). There were 72.3% of the cases that worked in agricultural sector. Delay in seeking treatment, which was beyond three days after onset, significantly increased the risk of death (adjusted odds ratio = 1.8, 95% CI = 1.53-2.19).

Keywords: leptospirosis, epidemiology, mortality determinants, Thailand

Introduction

Leptospirosis is a zoonotic disease, caused by spirochetes of genus *Leptospira* with worldwide distribution. *Leptospira* bacteria are grouped into serovars according to their antigenic relatedness. There are currently over 250 recognized serovars.[1,2] Some pathogenic serovars can infect many species of both wild and domestic animals. The most common serovars infecting humans include Autumnalis, Bratislava and Pyrogenes[3] which were similar serovars found among animals. All mammalian species can harbor *Leptospira* in their kidneys and transmit the disease through urine, acting as a source of infection to humans and other animals. Rodents are the main reservoir because rodents can shed *Leptospira* throughout their lifespan without any clinical manifestations.[4]

Humans are rarely chronic carriers and are, therefore, considered as accidental hosts. Two forms of disease, icteric and anicteric, are found. Anicteric leptospirosis is a mild disease and typically self-limiting while icteric form is more severe. Icteric form occurs in 5-10% of all patients, which is often rapidly progressive, and may be associated with severe jaundice, liver failure, renal failure and even death. [5]

From 1986 to 1996, there were 200-300 reported cases of leptospirosis and less than 10 deaths each year in Thailand. In 2000, epidemics of leptospirosis occurred, following severe flooding in the northeast and the south. There were more than 14,000 cases reported, with incidence rate of 23.1 per 100,000 population, and 362 deaths, with mortality rate of 0.6 per 100,000 population.[6] During the outbreaks in 2000, case fatality rate was 2.5%. Most cases (85.2%) were found in the northeastern region, followed by 7.4% in the north, 4.8% in the south and 2.7% in the central regions. An intensive prevention and control campaign, including integrated pest control, was implemented nationwide since 2000 and cases of leptospirosis decreased to 4,500-5,000 cases annually since 2003, with incidence rate of 5-9 per 100,000 population.[6] Purpose of this study was to describe epidemiology of leptospirosis in Thailand from 2003-2012. Understanding epidemiological patterns could provide better information to guide prevention and control measures.

Methods

We analyzed information of leptospirosis cases from 2003 to 2012, which were reported through the national disease surveillance system to the information center at Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health, Thailand. The surveillance case definition for a suspected leptospirosis case used by Bureau of

Epidemiology was a person with high fever, chills and severe headache, followed by at least one of the following clinical symptoms: myalgia, red eyes, jaundice, neurologic signs, respiratory failure or kidney failure with an epidemiologic link to occupational factors such as being farmers, sewage workers, slaughterhouse workers, or veterinary surgeons.[7]

Exploratory data analysis and management was performed using Epi Info Version 2000[8] and statistical analysis was performed using Stata SE10 (Stata Corporation, College Station, Texas). Two-sided p-value less than 0.05 was considered as statistically significant. Simple tabulation was used to describe proportions of cases in each category of exposure variables. Univariate analysis was performed by calculating odds ratio (OR) and 95% confidence intervals (CI) to evaluate each risk factor for mortality. In order to investigate whether any association was caused by confounding factors, multiple logistic regression analysis was performed. The model was reduced in backward elimination procedure. The 10% change in coefficient was considered as evidence of possible confounding. Any variables that remained significant were kept in the model. Adjusted OR and 95% CI were also calculated.

Results

During 2003-2012, Bureau of Epidemiology received 41,089 reports of suspected leptospirosis cases across all 77 provinces in Thailand while 67% or 27,503 cases were reported from the northeastern region. Average incidence rate was 6.6 per 100,000 population. The northeastern region had the highest incidence rate per 100,000 population (12.5), followed by the south (5.8), the north (5.0) and the central (1.0). There were 606 deaths recorded during 2003-2012, and 56.9% were from the northeastern region (Table 1). Overall case fatality rate was 1.5% and mortality rate was 0.1 per 100,000 population.

Seasonal variation was evident. Number of cases was highest during August to October which coincided with rainy season in Thailand (Figure 1).

Ratio of male to female cases was 3.5:1 (32,055 males and 9,034 females). Persons aged 55-64 years had the highest incidence rate, with 9.9 per 100,000 population. The most common occupation was farmer (60.6%), followed by labor (15.5%) and student (8.7%). More leptospirosis cases came from rural areas (85.8%) compared to urban areas (13.2%). Among the reported cases, 64.9% were reported from community hospitals and 32.8% from central or regional referral hospitals. Proportion of outpatient visits for leptospirosis was 70.5%. Median period between date of onset and date of seeking medical care was three days (range 0-60 days, interquartile range 1-5 days) while median duration between date of onset and date of death was five days (range 0-47 days, interquartile range 4-8 days).

In addition, 540 foreign workers who succumbed to leptospirosis were admitted to hospitals in Thailand and were reported into the surveillance system as well. These foreigners included Myanmar (423 cases), Laotian (45 cases), Cambodian (31 cases), Malaysian (one case) and others (34 cases). There were 29,149 cases that were loss to follow up. Thus, outcome status of only 11,940 cases (29%) among 41,089 cases could be included in the study (Table 1).

Table 1. Characteristics of human leptospirosis cases in national surveillance data of Thailand, 2003-2012 (n=11,940)

Characteristic	Number of dead case (%)	Number of survived case (%)
Region		
Central	88 (14.5)	834 (7.4)
South	79 (13.0)	1,328 (11.7)
Northeast	345 (56.9)	8,193 (72.3)
North	94 (15.5)	979 (8.6)
Age (year)		
≤14	41 (6.8)	824 (7.3)
15-54	436 (71.9)	8,282 (73.1)
≥55	129(21.3)	2,228 (19.7)
Gender		
Female	137 (22.6)	2,511 (22.2)
Male	469 (77.4)	8,823 (77.8)
Marital status		
Married	455 (75.2)	7,984 (70.7)
Single	150 (24.8)	3,301 (29.3)
Occupation		
Government service	6 (1.2)	134 (1.4)
Agricultural farmer	354 (67.9)	7,116 (72.5)
Student	29 (5.6)	957 (9.8)
Labor	132 (25.3)	1,606 (16.4)
Residence		
Urban	68 (11.3)	1,318 (11.7)
Rural	536 (88.7)	9,979 (88.3)
Nationality		
Thai	603 (99.5)	11,224 (99.1)
Foreigner	3 (0.5)	105 (0.9)

There were no significant differences between cases who survived and those who died, with regard to gender, age, area of residence and nationality. The

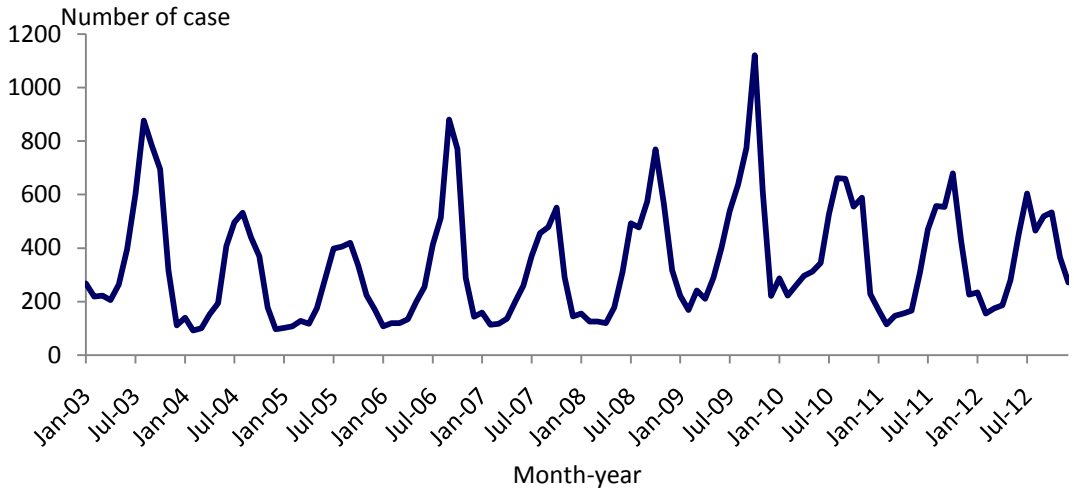

Figure 1. Number of leptospirosis cases by months in Thailand, 2003-2012

only significant risk factor for mortality was delay in seeking medical care of more than three days from onset (Table 2).

Table 2. Univariate and multivariate analyses of factors associated with leptospirosis death in Thailand, 2003-2012

Variable	Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Duration between date of onset and date of seeking medical care (day)		
≤ 3	1	1
> 3	1.93 (1.64-2.28)	1.83 (1.53-2.19)
Age (year)		
≤14	1	1
15-54	1.06 (0.76-1.47)	1.16 (0.81-1.68)
≥55	1.16 (0.81-1.67)	1.24 (0.83-1.85)
Gender		
Female	1	1
Male	0.97 (0.80-1.18)	1.01 (0.81-1.25)
Occupation		
Government service	1	1
Agricultural farmer	1.11 (0.49-2.53)	1.18 (0.52-2.70)
Student	0.68 (0.28-1.66)	0.71 (0.29-1.75)
Laborer	1.84 (0.79-4.24)	1.89 (0.82-4.38)

Discussion

A 10-years retrospective review of leptospirosis cases did not show any change in disease pattern or distribution. However, incidence, mortality and case fatality rate had significantly decreased when compared to the cases occurred during 2000-2002, according to data from the national disease surveillance system.[6]

Cases were most commonly reported from the northeastern region. From a serological study of rodent population in Thailand, antibody against *Leptospira* was identified in 7.1% of rodents in the northeast, 4.9% in the north, 4.3% in the central and 3.0% in the south[9]. The highest proportion of leptospirosis infection among rodents in the northeast might relate to high number of human leptospirosis cases reported.

Another evidence of an association between rodent and human leptospirosis infections was finding of *L. interrogans* serovar Autumnalis as a predominant cause of epidemics among human cases in the northeastern region during 2000-2001 and bandicoot rat was found to be an important reservoir host of *L. interrogans* serovar Autumnalis.[10] Furthermore, environmental conditions in the northeast may offer a suitable habitat for *Leptospira*. Northeastern region was a relatively poor area, with most rubber plantations belonged to small holders[11] and a large source of rodent infestation.

Occurrence of leptospirosis cases showed a distinct seasonality. Most cases occurred during rainy season and several outbreaks could be associated with floods and hurricanes.[12,14] The rainy season in Thailand lasts from July to October. Incidence of leptospirosis in Thailand peak between August and October, which correlate directly with amount of rainfall[15] and frequent exposure of agricultural farmers to rice fields during seeding and planting of rice. Temperature is also a major factor influencing potential reproduction of rodents which tends to increase during rainy seasons. Therefore, humans may have more chance of exposure to water contaminated with urine of infected rodents.[16] Due to the facts mentioned above, rodent control should be strengthened before the rainy season to prevent and control leptospirosis more effectively. As some outbreaks have been associated with flood, prevention

and control measures during flood should be focused against direct contact with contaminated water by wearing protective clothing, especially boots.

Men commonly have frequent contact with *Leptospira* from occupational exposure or recreational activities compared to women.[17-19] From a study in Lao PDR, there were differences in certain daily activities between men and women.[20] For example, proportion of barefoot walkers was significantly higher among men than women. Swimming in streams and collecting woods were also more common among men. These activities have been considered as important risk factors for infection.

Multivariate logistic regression revealed that delay in seeking medical care beyond three days after onset significantly increased the risk of death. There was a clear correlation between leptospirosis death and delay in treatment. This result was consistent with many other studies[21-23]. Risk communication to raise people's and physicians' awareness on symptoms of leptospirosis should be promoted. Preventive health care should be conducted as a program to promote health in the areas. Community-driven campaign on raising public awareness may facilitate early treatment at health care facilities to reduce risk of developing complications.

As the data reported through the national surveillance system were data from passive surveillance on only suspected cases of leptospirosis and did not contain laboratory results, confirmed cases and pattern of serovar changes in each region could not be identified in this study.

In conclusion, epidemiological pattern of leptospirosis cases from the national disease surveillance system in Thailand during past 10 years remained stable. Early diagnosis and treatment of suspected cases could lower case fatality rate of leptospirosis.

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