VOLUME-8, ISSUE-5, MAY-2019 • PRINT ISSN No. 2277 - 8160

Original Research Paper

Epidemiology

LEPTOSPIROSIS IN KERALA: IMPORTANCE OF SUSPECTED CASES IN SURVEILLANCE

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ABSTRACT

Leptospirosis is considered as the most widespread zoonotic disease reported in the world. The disease is endemic in many sub-tropical and tropical developing countries. In India, states of Kerala, Tamil Nadu, Andaman and Nicobar, Karnataka, Gujarat, and Maharashtra are endemic to leptospirosis. Most of the Indian states have reported leptospirosis over the period of time in multiple epidemiological forms of sporadic to mini-epidemic to endemic with epidemic potential. The state of Kerala has reported human leptospirosis since the late 1980s and is endemic to the disease for three decades. Surveillance system for reporting and monitoring the disease exists in the state from the late 1990s, even though multiple gaps were acknowledged. After 2006, among IDSP reported diseases, leptospirosis has caused the maximum mortality over the years. The current monitoring system in Kerala, do reporting of suspected and confirmed cases (laboratory-confirmed) separately from the year 2011onwards, to bring in more inclusive data to understand the actual burden of the disease. But the study conducted in Kerala has observed that all the current strategies and interventions are based on the prevalence of monitored confirmed cases; though suspected cases are causing high morbidity and mortality over the years. The paper tries to elaborate the reasons of why suspected cases are critical in analyzing the actual disease burden in the state of Kerala, and need for interventions based on the suspected leptospirosis cases in the health service system.

KEYWORDS : Leptospirosis, Surveillance, Public Health, Suspected Cases, Epidemiology

BACKGROUND

Leptospirosis is an acute bacterial infection caused by spirochetes. There are different pathogenic species of genus *Leptospira* that causes the infection. More than 250 serovars (basic unit for classification based serology) belonging to 20 serogroups are identified to cause leptospirosis (Tilahun, Reta, & Simenew, 2013). The particular disease is a zoonosis and is maintained in nature by a variety of animal hosts which includes both domestic as well as wild animals. The disease of leptospirosis is manifested in humans who are at risk of direct or indirect contact with the urine or tissues of the infected animal. The leptospires which are present or lodged in the renal tubules of the carrier animals are excreted through urine into the environment and people who are in situations which augment contact with the infected urine get the disease. Areas with heavy precipitation and low lying area with high levels of subsurface water, that is basically tropical regions, show high endemicity The disease is endemic in humid, tropical and sub-tropical areas of developing countries. The extensive spread of the disease in tropical regions, when compared to temperate regions, can be mainly attributed to the longer survival of leptospires in a warm and humid environment (Dutta & Christopher, 2005; Zavitsanou & Babatsikou, 2008; Tilahun, Reta & Simenew, 2013). The risk factors commonly considered for the disease are those human activities that expose them to animal reservoirs and contaminated environment (Vijayachari, Sugunan, & Shriram, 2008).

Leptospirosis is the largest zoonotic disease in the world. All continents have reported human leptospirosis except Antarctica. It is a disease that affects the most vulnerable population with a global annual incidence of 5 per 100000 which is considered as a very much underestimated value. Other than epidemiological factors, infrastructural gaps and lack of monitoring systems are two important reasons for under-diagnosis. The protean behavior, difficulty in diagnosis, epidemiological shifts, outbreak potential, and high case fatality rates add to the complexity of the disease. The very high mortality shown by the disease in its severe forms is more alarming (Vijayachari, Sugunan, & Shriram, 2008; WHO, 2013).

Hence the disease is endemic in tropical countries of South Asia, Southeast Asia, China, Africa, South and Central America (Dutta & Christopher, 2005; Zavitsanou & Babatsikou, 2008; Tilahun, Reta & Simenew, 2013). Outbreaks of leptospirosis in the past few years have resulted from natural calamities like cyclones and floods (Trivedi & Kamath, 2010). Cyclone of Orissa (now Odisha) in 1999 and hurricane of Puerto Rico in 1996 was followed with severe epidemics (Dutta & Christopher, 2005). The disease shows high seasonal variability (Zavitsanou & Babatsikou, 2008). Only sporadic cases occur in arid zones and desert areas (Dutta & Christopher, 2005). Sporadic is peak in summers whereas large epidemics happen usually after monsoons with heavy rainfall (Tilahun, Reta & Simenew, 2013).

Leptospirosis in India

The disease of leptospirosis was considered to be a rare zoonotic disease in India for a long time. After the 1980s the disease was reported in mini-epidemic proportions in various states in India. Currently, it is endemic in the states of Kerala, Tamil Nadu, Gujarat, Andaman and Nicobar, Maharashtra, and Karnataka. There has been a large increase in the number of cases in Chennai during 2005-2006. Contaminated water and heavy rainfall were two important epidemiological risk factors that were made out in different studies in Chennai (Shivakumar, 2008). Cases have also reported from Andhra Pradesh, Odisha, West Bengal, Delhi, and Pondicherry. In India, the cases of leptospirosis have been underreported or under-diagnosed due to lack of awareness and lack of appropriate diagnostic facilities in most parts of the country (Shivakumar, 2008).

In the Indian context, much of North Indian states are subject to a humid subtropical climate where flooding and unseasonal precipitation which is suitable for the transmission of leptospirosis is not that uncommon, even though possibilities of the disease compared to typical tropical regions are less (Trivedi & Kamath, 2010). Heavy rainfall during 2003 in Delhi has reported a large number of leptospirosis cases among the slum dwellers (Kamath & Joshi, 2003). Cases are seen more in monsoons in the state of Gujarat. Clay soil and high water table are the two other factors that favor the endemicity in Gujarat (Shivakumar, 2008). Increasing prevalence of the disease in North Indian states are notable where it receives much lesser rainfall than the coastal regions and southern states which receives rainfall of more than about 100 centimeters in the monsoon months from July to October. Incidence of cases in Chandigarh, Ludhiana, New Delhi, and Uttar Pradesh points to the fact that leptospirosis is there all over India (Sethi et al, 2010). Unplanned urbanization is a very important factor and points towards the increased prevalence of the disease in many parts of the country (Sethi et al, 2010). Leptospirosis is common in northern India and should be considered as a possible differential diagnosis in patients with an acute febrile illness of more than 7 days duration (Deodhar & John, 2011).

The State of Kerala in southern India is endemic to leptospirosis for the last three decades. The cases of leptospirosis have been reported from all districts of the state from the late 1990s after the disease was made notifiable in 1997. From the early 2000s onwards the disease was considered a major public health problem as

evident from the multiple government documents and reports published (GoK, 2011; Jagadeeshan, 2011; Sukumaran & Pradeepkumar, 2015). After the advent of the National Rural Health Mission (currently integrated to National Health Mission), the Integrated Disease Surveillance Programme (IDSP) came into existence in Kerala from the year 2006. Leptospirosis was reported through the IDSP since its inception in all districts in varying proportions. Among IDSP notifiable communicable diseases, leptospirosis has caused maximum mortality in Kerala. With this background, this paper analyses the time trend of leptospirosis in the state of Kerala and emphasizes the criticality of analyzing 'suspected cases' while planning intervention programmes.

OBJECTIVE

The objective of the paper is to understand how and why it is important to analyze suspected cases of leptospirosis trends in understanding the disease burden in the state of Kerala.

MATERIALS AND METHODS

The observations made in the paper are a part of the research conducted by the author during his ongoing doctoral research. The research is exploratory in nature and uses mixed methods. The study was conducted in two phases. In the first phase, the time trend and epidemiological history of leptospirosis in Kerala were analyzed. Materials required for the data was collected from IDSP monthly reports, government records and Statistical Unit, Directorate of Health Services, Government of Kerala. The incidence of leptospirosis per one lakh population and Case Fatality Rates (CFR) were calculated quantitatively and separately for suspected cases and confirmed cases reported in the state. Time trend of leptospirosis was analyzed based on three periods. As mentioned above, the disease was made notifiable communicable disease in 1997. In the first phase, the researcher was able to collect data for 5 years reported data from the statistical unit from 1998 to 2002. The second period of analysis was based on the first phase of IDSP in the state starting from 2006 to 2010 and the third period of analysis was the continuing phase of IDSP starting from 2011. For this paper updated data until 2018 is used for analyzing the time trend. The confirmed cases data was available in the government website and the suspected cases data was collected from other government documents, reports and manually from the statistical unit of Directorate of Health Services and State surveillance Unit of IDSP.

The second phase of the research analyses the determinants of the disease in the study area of Ernakulam district by empirical research using qualitative methods of ethnography, case studies, in-depth interviews, Focus Group Discussions (FGDs) and observations. The district of Ernakulam was selected for the study considering multiple factors. The district is endemic to leptospirosis since the last three decades, as well as the first laboratory, confirmed human leptospirosis was identified from this district. The district also has all three physiographic features of lowland, midland, and highland and the rural-urban continuity that is typical of Kerala is explicit in the district. Other important factors were the coastal plains, water bodies and estuaries flowing through the district which also helped in bringing out the nuances of living conditions and ecological factors that make humans susceptible to contract the disease. The study has tried to explore the determinants of leptospirosis in Kerala using an eco-social epidemiological perspective, the perceptions about the disease leptospirosis among general population through case studies and also has tried to understand how the existing health service system is handling the endemicity of leptospirosis in the study area from a systems perspective. The observations made in the second phase of the study are used in the discussion part of this paper to bring out the objective of the paper and elaborate why suspected cases are important in analyzing leptospirosis situation in Kerala. The details of the participants who were part of the second phase of the study are summarized in Table No. 1. The ethnographic field observations were done in 12 field areas comprising one Corporation, four Municipalities, seven Grama-Panchayats of which three were Census towns.

Ethical approval for the study was taken from the Institutional Ethical Review Board (IERB) of the University where the researcher is affiliated to. All interviews were conducted with the signed informed consent of the participants in forms generated from the IERB. Government Office orders permitting interviews and study in the government institutions was taken from District Medical Officer, Ernakulam with ratification from Directorate of Health Services, Kerala. The field study was conducted from January 2016 to November 2017.

Table: 1- List of Participants/ Respondents in the Study

Respondents	Number of participants	Methods used
Case studies (Confirmed cases of leptospirosis in Ernakulam District in the year 2015)	27	Case study method
Case studies (Prospective study of suspected cases of leptospirosis notified in the study area)	12	Case study method
Director of Health Service (DHS), Kerala (Health)	1	In-depth interview
Additional DHS, Public Health	1	In-depth interview
Additional DHS, IDSP/Communicable diseases+ State Surveillance Officer	2	In-depth interview
District Medical Officer (Ernakulam)	1	In-depth interview
District Surveillance Medical Officer (Ernakulam)	1	In-depth interview
Epidemiologist (Ernakulam)	1	In-depth interview
Additional DMO s (Ernakulam)	2	In-depth interview
Faculty (Department of Medicine, Government Medical Colleges- Ernakulam, Kozhikode, and Thrissur)	6	In-depth interview
Medical Officers (General Hospital Cochin Corporation), District Hospital (Ernakulam), Primary Health Centres and Community Health Centres of study areas	3+2+5+5= 15	In-depth interview
Field staffs: Health inspectors, Junior Health Inspectors, Junior Public Health Nurses and other field staff (public health) in the study areas	25	In-depth interview and Focus group discussions
Total Respondents	94	

RESULTS AND DISCUSSION

The time trend of leptospirosis along with the incidence per one lakh population and Case Fatality Rates are detailed in the following tables.

Table 2: Time Trend of Leptospirosis in Kerala-1998-2002

Year	Cases reported	Deaths	Incidence/one lakh population	CFR
1998	342	67	1.1	19.6
1999	910	65	2.9	7.1
2000	1174	87	3.7	7.4
2001	2582	121	8.1	4.7
2002	2128	181	6.7	8.5

Source: Statistical Unit, Directorate of Health Services, Kerala.

The time trend of leptospirosis should be read in two phases in the IDSP era starting from 2006 onwards because there was a change in the surveillance strategy after 2010. From 2011 onwards the cases of leptospirosis were reported separately as confirmed and suspected cases. From 2006 to 2010 all cases were considered as confirmed cases, and the confirmation was based on clinical criteria. Acknowledging the fact that leptospirosis is endemic in all districts of the state, DHS decided to do surveillance based on laboratory

confirmation from 2011. Only those cases confirmed from public health lab or authorized government labs at district head-quarters were considered as confirmed cases and those which are suspected to be leptospirosis clinically without laboratory confirmation were considered as suspected cases. The method was practiced to bring in more cases under surveillance and also to bring in early interventions.

Table 3: Trend of Leptospirosis in Kerala: 2006-2018

Year	Confirmed cases (CC)	Suspected Cases (SC)	Total (CC+SC=TC)	Mortality due to CC	Mortality due to SC	Total number of Deaths
2006	1821	n/a	1821	104	n/a	104
2007	1359	n/a	1359	229	n/a	229
2008	1305	n/a	135	136	n/a	135
2009	1237	n/a	1237	107	n/a	107
2010	1016	n/a	1016	85	n/a	85
2011	944	3023	3967	70	238	308
2012	736	2709	3445	18	130	148
2013	814	2670	3484	34	134	168
2014	1078	2661	3736	28	142	170
2015	1098	2398	3496	43	71	114
2016	1710	2362	4072	35	60	95
2017	1381	2514	3895	80	46	126
2018	2078	3625	5703	94	120	214

Source: State Surveillance Unit of IDSP, Directorate of Health Services, Kerala.

The incidence per one lakh population and CFRs of Leptospirosis of 13 years were calculated separately for suspected cases and confirmed cases of leptospirosis (See Table:4).

Table-4: Mortality and morbidity of Leptospirosis in Kerala from 2006-2018

Year	Incidence/one lakh population	CFR (CC)	CFR (SS)	CFR
2006	5.6	5.7	-	5.7
2007	4.1	16.9	-	16.9
2008	4.0	10.4	-	10.4
2009	3.7	8.7	-	8.7
2010	3.1	8.4	-	8.4
2011	2.8-11.9*	7.4	7.9	7.8
2012	2.2-10.3*	2.4	4.8	4.3
2013	2.4-10.5*	4.2	5	4.8
2014	3.2-11.2*	2.6	5.3	4.6
2015	3.3-10.5*	3.9	3	3.2
2016	5.1-12.2*	2	2.5	2.3
2017	4.2-11.7*	5.8	1.8	3.2
2018	6.2-17.1*	4.5	3.3	3.8

*The maximum values are based on the total cases of leptospirosis reported adding suspected cases and confirmed cases together.

First laboratory-confirmed case of leptospirosis was reported in year 1987 (George, 2007). Since then, cases have existed in Kerala depending on multiple determinants like topography, occupational exposure, and climate, environmental and different ecological factors.

The surveillance data from the year 1998 to 2002 is shown in the Table 2. Cases were reported in all districts of Kerala by the late 1990s, devoid of the fact that there were no definitive protocols used in the health service system for diagnosis of leptospirosis and only a few tertiary centres were having laboratory facilities for diagnosing leptospirosis serologically (Sukumaran & Pradeepkumar, 2015). Hence almost all the cases were based on clinical suspicion and most commonly monitored symptoms were fever with jaundice and body ache, signs as conjunctival suffusion and calf tenderness though most physicians have claimed the signs were very atypical and more than a week of fever with bleeding tendencies were considered as an important implication towards leptospirosis (Personal communication made by retired Additional DHS, Public Health). The awareness among doctors was mostly for those working in areas where endemicity was suspected and many physicians were unaware of the morbidity potential of the disease in the state during the late nineties and early 2000s. Urban leptospirosis started getting attention after the outbreak of urban leptospirosis in the northern districts, which behaved more like 'a' water-borne disease with increased contaminated environmental exposure without occupational associations (Pappachan et al, 2004). Before 2000 the disease was considered as a rural disease with occupational associations. Hence most of the cases reported during the period were probable or suspected cases based on clinical suspicion. The high CFRs during these years are to be noted and the number of mortality reported has been increasing constantly, which clearly indicates the mortality potential of the disease.

In the year 1999, a new surveillance model was tried in the district of Kottayam, Kerala for monitoring the occurrence and outbreaks of communicable diseases as well as to monitor the success of already existing interventions. The model was adopted from a surveillance method which was developed in the North Arcot district of Tamil Nadu which was successful, easily replicable, less expensive and practical in public health action. The diseases monitored in the pilot attempt in Kottayam district included 14 diseases, including vaccine-preventable diseases. The list was exclusive of leptospirosis, though there was a provision in the surveillance model to report anything critical and of public health relevance in the extra criteria provided in the reporting as 'Other'. The monitoring system was called District Level Disease Surveillance (DLDS). The pilot was conducted for two years starting from July 1999 to June 2001. The most number of cases reported in the surveillance was acute dysentery with 322 cases in the initial year, whereas the next commonly reported cases were of leptospirosis with 233. During the second year of surveillance, acute dysentery and leptospirosis were reported equal in numbers with 221 cases each. On the other, another category for reporting was fever with bleeding tendencies. The physicians who were part of the monitoring programme claimed that most of the cases if not all, manifested as fever with bleeding tendency, were also leptospirosis. If the two categories were added together, the most commonly reported case in the district of Kottayam was leptospirosis during these years. Considering the pilot as successful and effective, with modifications the programme was expanded to nearby districts of Ernakulam and Alappuzha in the year 2000. This monitoring system brought out the definitive prevalence of leptospirosis in all the three districts and was included in the list of surveillance from then on. In the forthcoming years the programme was expanded to all the districts in the state (John, Rajappan & Arjunan, 2004) and ultimately got merged with the IDSP surveillance after the advent of NRHM.

Analyzing the time trend of leptospirosis after inception of Integrated Disease Surveillance Programme (IDSP) in Kerala by the advent of National Rural Health Mission (now integrated to National Health Mission) in 2006, data shows that during initial five years of IDSP (first phase of IDSP) from 2006 to 2010, more than 1000 cases were reported every year with a decreasing trend of incidence rate (See Table- 3&4). During this phase of IDSP, only cases reported in the public institutions were included in the surveillance system. The first phase report of IDSP on the situation of communicable diseases in the state of Kerala has acknowledged leptospirosis as a critical public health problem in Kerala (GoK, 2011). Among IDSP reported diseases, leptospirosis has caused the maximum number of mortality counting through these years. The CFR was as high as 16.9 and 10.4 in the years 2007 and 2008 respectively. The criticality of the disease was considered seriously by the authorities and importance of bringing in maximum number cases in the surveillance systems with segregation of suspected and confirmed cases (based on laboratory confirmation from authorized Government Public Health labs or institutions) were given importance. Cases reported in the Private hospitals and institutions

were included in the surveillance thereafter since 2011 onwards. The time trend of disease from 2011 onwards show a tremendous increase in the number of cases reported. When incidence rate of leptospirosis per one lakh population was calculated during these years, incidence due to confirmed cases showed a minimum of 2.2 cases per one lakh population in 2012 and a maximum of 6.2 in 2018. But when the total incidence was calculated, considering suspected and confirmed cases together, every year from 2011 to 2018 showed an incidence rate of more than 10 per one lakh population with a minimum of 10.3 in 2012 and a maximum of 17.1 cases per one lakh population in 2018. These figures are clearly pointing towards endemicity and the variations show the epidemic potential of the disease with the acute rise of incidence to 17.1 in the year 2018, with the previous years averaging around 10-12 cases per lakh population. An incidence rate of more than 10 per one lakh population is indicative of endemicity with epidemic potential (WHO, 2013). Two probable reasons for the rise in incidence in 2018 was outbreak situation occurred due to the massive flood affecting all districts of Kerala; and the more vigilant and stressed surveillance on leptospirosis during the post-flood period by the authorities expecting outbreak. On the other hand, when CFR was calculated, both confirmed and suspected cases have been showing similar occurrences and CFR due to suspected cases were more than confirmed cases during most years (see Table 4). Actual numbers of mortality were three to five times more due to suspected cases than confirmed cases from 2011 to 2014. The following years also reported more number of deaths due to suspected cases of leptospirosis than confirmed cases, except in 2017. Hence suspected cases of leptospirosis are critical cause of morbidity and mortality in Kerala.

The study analyzed how the health service system is currently handling the disease and an important factor understood from a systems perspective is that, even though suspected cases are reported in the surveillance system, the programmes and interventions are based and prioritized on the basis of confirmed cases. The preventive activities, IECs and follow up monitoring are all based on confirmed cases reporting. Only those cases leptospirosis confirmed by laboratory confirmation from authorized public health labs are considered to 'confirmed' cases of leptospirosis. An ample number of cases of leptospirosis occur in milder forms, which may not show any pathognomic signs during the initial week of occurrence and out of which a very few would have clinical indications towards leptospirosis, with findings like mild conjunctival suffusion or calf tenderness. Hence it is difficult to differentiate leptospirosis clinically, as many of the symptoms are very similar to multiple other febrile illnesses. In the health care system antibiotics like Amoxycillin, Azithromycin or Doxycycline are started in all suspected cases of leptospirosis in the first week itself as a 'routine'. Hence many of the mild cases of leptospirosis did get cured within a week's time, and are not monitored continuously for the second week for laboratory confirmation. The ELISA test for detecting IgM antibody is the test routinely used in the state in public health labs for confirmation, which gets positive after the initial stage of the disease. So most of the suspected cases, being cured in the earlier stage of the disease are not 'confirmed' with laboratory tests; and are not included in the list of confirmed cases. During the case studies conducted in the study, it was observed that, out of the cases reaching confirmation by laboratory tests which are included in the list, a small majority are those which has missed early suspicion/ early diagnosis or even haven't contacted the doctor, and attaining severity is the point where they come into contact with the system and are diagnosed to have leptospirosis.

After recognizing leptospirosis as a critical public health problem and having multiple occupational associations; from 2011 onwards, as a preventive strategy tab doxycycline as prophylaxis was elaborately given among suspected at-risk populations. The intervention has brought down severe form of leptospirosis and morbidity in general as informed by the District Epidemiologist. The political pressures existing within the system also have certain influences on reporting system, as the public health staff, as well as local administrative bodies, do have the tendency to keep confirmed cases to the minimum to avoid the accusation of lack of preventive measures, also are reasons for under-reporting.

Acute development of complications is a factor which cautions the caregivers in the health care system about leptospirosis. The protean behavior of leptospirosis clinically confuses the physicians many a time while they treat cases of febrile illness. This increases the tendency to start giving antibiotics in the earlier stages of the disease. If the person getting treated is coming from endemic focal areas, the physicians in the system are particular in the initiation of antibiotics. Hence many cases of leptospirosis are treated early as suspected cases, but only those laboratory-confirmed cases are considered as 'confirmed cases' and clinically diagnosed cases if not confirmed serologically are considered as 'suspected'.

CONCLUSION

The high morbidity and mortality exhibited among suspected cases as well as the epidemiological and systemic dilemma existing in the study area as discussed points towards the criticality of assessing suspected cases of leptospirosis in the surveillance system to understand the actual burden of the disease and need for strategizing interventions accordingly. Before 2011, the majority of cases in the surveillance data were those which were only clinically confirmed and the prevalence of the disease was acknowledged by the system to bring in more preventive strategies. But after the cases were being differentiated as confirmed and suspected on the basis of laboratory confirmation, the emphasis on strategizing based on confirmed cases causes blurring of the actual burden of disease. To conclude preventive measures and monitoring based on suspected cases of leptospirosis has to be given more importance; spotting, identifying focal clustering, executing more IEC activities based on suspected cases, taking preventive measures and involving local self-government in areas of prevalence of suspected cases will help in bringing down morbidity and mortality due to leptospirosis with better epidemiological understanding.

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