DECADAL TRENDS IN LEPTOSPIROSOIS DISEASE DENSITY AND IDENTIFICATION OF RISK ZONES IN THIRUVANANTHAPURAM CORPORATION

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Abstract
The present study analyzed decadal trends in Leptospirosis (Lepto) disease density to identify the high-concern wards of Thiruvananthapuram Corporation for immediate interventions. This disease is reported as a threatful disease in urban areas and spreads through contaminated water, especially from infected animal urine. The congested study area faces the issue of water logging and flash floods, which accelerate the epidemicity of the disease. The secondary data were collected on confirmed cases of Lepto from District Medical Office. The hotspot wards, worsened wards, and cold-spot wards were categorized to initiate the epidemiological environment that persists in the study area. The results reveal that 14% of wards worsened in the case Lepto. Composite scores are assessed to identify composite risk wards, and 3 wards are detected as risk zones for Lepto. Among 100 wards, 29% of wards fall in the high-concern level for Lepto. The future trend of Lepto disease will be determined by the effectiveness of interventions in high-concern wards, particularly because they are densely populated urban cores.

Keywords: *Leptospirosis; Epidemicity; Epidemiology.*

Introduction

Leptospirosis (Lepto) is a bacterial infection caused by spirochete of the genus Leptospira [5]. Human infections of leptospirosis are caused by either direct contact with the urine of an infected animal or more usually, indirect exposure from a contaminated environment such as water and soil (that have been contaminated by the urine of an infected host) [2]. Heavy rainfall and flooding have been shown to contribute to an increase in leptospirosis infections [4]. Areas at highest risk are those where multiple risk factors for leptospirosis are likely to coexist, such as the combination of increasing flooding risk, rising temperatures, overcrowding, poor sanitation, poor health, poverty, and an abundance of rats and other animal reservoirs. These conditions are most likely to occur concurrently in urban slums, low lying coastal areas, and small island states [3]. The infection is easily transmitted through contaminated water sources and soil, urban open sewage system and flash floods initiate the outbreak of Leptospirosis. Most mammalian species, cat, rodents, dogs, livestock, pigs, cattle, horses, rare bats, and wild animals are natural carriers of the pathogen leptospires, and living close to humans presents a potentially high-risk reservoir [1]. Improper waste management and unplanned drainage systems increase the exposure to diseases. Congested urban environment with these lacked facilities, become the victim of this disease every year. Therefore, the health concern of the authorities on their population tries to close all loop holes exist for the sporadic spread of diseases.

Thematic mapping of disease density over time allows for the visualization of dynamic trends, and risk-concerned zones can be identified for immediate action. Spatial epidemiological studies attempt to describe how the temporal dynamics of host, vector, and pathogen populations interact spatially within a permissive environment to enable transmission. The transmission rate of diseases in a region is directly proportional to vector proliferation and the population density residing there. Communicable diseases flourish where resistance levels are low, immunization is inadequate, and the environmental barriers against their spread are weak. Poor nutrition makes people, particularly the young and feeble, more vulnerable to infection. This study offers a decadal analysis of the trend of these diseases in order to identify the pattern of disease distribution, specify the intensity of disease burden, and categorize the areas by level of concern for proper intervention.

Study Area

In the present study, Thiruvananthapuram Corporation has been selected for the detailed study of decadal trends in vector-borne diseases. The study area lies over a coastal stretch, and its area covers mid land bounding between the mountainous highland part of the Western Ghats and the Lakshadweep Sea. It has an area of around 214.86 sq km. It covers the geographical extent from 8°20' N to 8°40' N latitude and 76°48' E to 77°03' E longitude. Thiruvananthapuram Corporation is the highest population density region of the district as well as the most populous corporation in the state.

Materials and Methods

This decadal spatial disease analytical study used secondary data on confirmed cases of lepto disease from the District Medical Office (DMO), Thiruvananthapuram. Data included the number of cases per ward per year of lepto. The data was statistically arranged for the two phases of the period, 2015-19 and 2020-24. The data collected were analyzed to map the spatial distribution of the disease and to find the trend of disease density over the periods 2015-19 and 2020-24.

Calculation of Disease Incidence and Disease Density Distribution

Disease density for lepto disease was computed using the standard formula: (confirmed cases / ward population) ^{x} 100000 for each ward, and for standardizing data, z-scores were determined. The disease density distribution range of each disease was categorized as high, medium, and low. This method identifies the mean incidence rate and classifies values based on their distance from the mean. Thematic maps were prepared using ArcGIS software for each period.

Disease Trend Analysis

For trend analysis, ArcGIS software was used for data analysis and preparation of disease distribution maps and trend maps. Wards were classified into five trend categories:

Improved: Disease density ranges changed between 2015-19 and 2020-24, as high to medium, high to low, and medium to low fall in this category.

Stable Low: Disease density ranges changed between 2015-19 and 2020-24 as low to low falls in this category.

Stable Medium: Disease density ranges changed between 2015 -19 and 2020-24, as medium to medium falls in this category.

Stable High: Disease density ranges changed between 2015-19 and 2020-24 as High to High falls in this category.

Worsened: Disease density ranges changed between 2015-19 and 2020-24 as low to medium, low to high, or medium to high fall in this category.

Concern Score and Concern Level

In order to determine the concern levels for each ward, trend scores were assigned, and the wards were ranked. The concern score was developed by assigning a numerical score reflecting its level of concern, as shown in the Table 1. Both disease density ranges were scored, and their concern level was determined for 100 wards.

Table 1. Numerical Scoring of trend categories of diseases from 2015-19 to 2020-24.

Trend in Categories	Score	Trend Status
Stable Low	-2	Consistently Low Persistence
Improved	-1	Decreasing Trend
Stable Medium	0	Moderate Persistence
Stable High	1	High Persistence
Worsened	2	Increasing Trend

The concern level was determined by standardized thresholds and calculated using the mean and standard deviation of the scores. Thus, wards were classified as the following:

Low Concern: Score < Mean – 0.5 SD

Medium Concern: Mean – 0.5 SD ≤ Score ≤ Mean + 0.5 SD

High concern: Score > Mean + 0.5 SD

High-concern wards were those wards necessitating immediate action, enhanced surveillance, and strict control measures. Medium Concern was those that needed proper surveillance and precautionary measures without risk focus, and Low Concern were those with general surveillance and measures for routine prevention.

Composite Score and Determination of Risk Zone

The concern scores of this bacteria-borne disease of each ward were considered for the calculation of composite scores. These composite scores were categorized into discrete risk zones using equal-width intervals. This is employed to ensure comparability across wards and to maintain a consistent interpretation. This method is transparent and does not depend on the distribution of scores in this particular dataset, and therefore, it is easily generalizable. The risk zones of the entire area are thus categorized as high, medium, and low.

Results and Discussion

Distribution of Disease Density (2015-19)

The spatial distribution of lepto disease showed marked heterogeneity across the 100 wards (Figure 1). Leptospirosis with high-density wards was found across central portions and central coastal wards. The high-density wards were 8, which require necessary precautionary measures to control its intensity. The medium-density wards affected by Leptospirosis were 25% and are distributed over central and southern parts. The major part of study area indexed by low-density and it was prominent over northern stretches.

Distribution of Disease Density (2020-24)

The second phase, from 2020 to 2024, showed a distinct shift in disease incidence, and a favorable change was found in disease density conditions. The high-density Lepto cases recorded among 7 wards and were represented almost all portions of the region. The medium-density increased as 28% and the left of the wards be at the low-density as in Figure 2. The safe zone wards at the northern side during 2015-19 exhibited negative transmission rates during 2020-24.

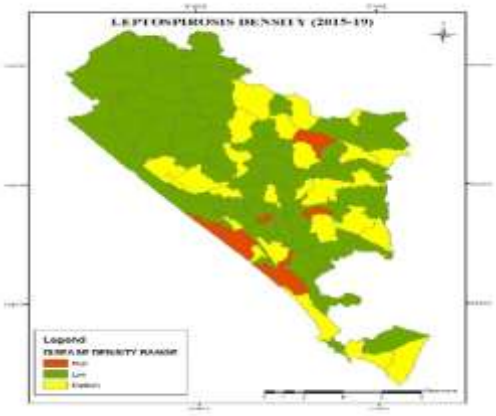

Figure 1

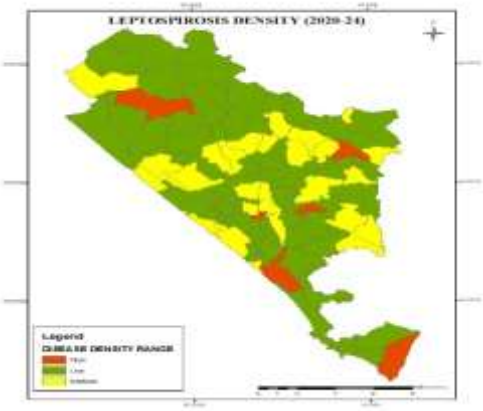

Figure 2

Trends in Disease Burden

Lepto trend map (Figure 3) shows that 14% of wards are under worsened level. This meant the requirement of monitoring of socio-environmental risk factors lead to the local spread of disease and destruction of bacteria for further improvement. Thiruvallam, Manacaud and Karamana were the wards enlisted in Stable High. Though the count rate in Stable High is less, the cautious preparation for the control of epidemics is essential. Some of the coastal wards following improved tendancy and constitute 17% of wards. Most central regions possess Stable Medium trend (12%), which characterize the stability in disease burden. The predominant wards (54%) were included in Stable Low. The serious concern is needed based on these trends because the lepto cases over 10 years were not that much stable.

 ISSN: 2278-4632

Table 2 Worsened Wards of Leptospirosis and their concern level

Sl No.	Ward No.	Ward Name	Score	Concern Level
1	82	VANCHIYUR	2	High
2	1	KAZHAKUTTOM	2	High
3	4	SREEKARIYAM	2	High
4	60	MULLOOR	2	High
5	50	PONNUMANGALAM	2	High
6	90	VETTUCAUD	2	High
7	36	VATTIYOORKAVU	2	High
8	30	KANJIRAMPARA	2	High
9	70	ATTUKAL	2	High
10	16	MEDICAL COLLEGE	2	High
11	15	KESAVADASAPURAM	2	High
12	18	MUTTADA	2	High
13	71	CHALAI	2	High
14	80	FORT	2	High

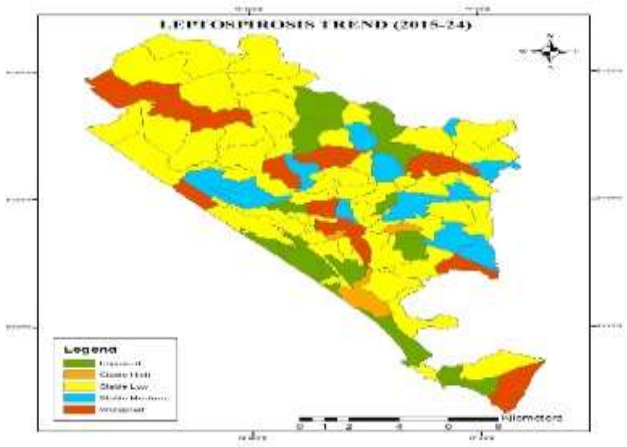

Figure 3 *Concern Level of Disease*

Concern Levels of each disease were determined on the basis of the concern score computed for each ward. With the mean -0.94 and SD 1.43, the threshold was determined for concern level of Lepto. The high-concern wards (score > -0.225) contribute 29%, medium-concern (score between 1.655 to 0.225) consists of 17% wards and remaining falls under low concern (score < -1.655). Leptospirosis positioned as second dominating disease with 29% wards under high-risk.

Conclusion

The trend of Leptospirosis is found to be cautious. Disease burden from leptospirosis is likely to increase as a result of climate change, population growth, and urbanization [3]. The disease progression was slightly controlled during 2020-24, but still the Stable Low cases were comparatively low. This reflects the state of low transmission has lost the stability. Notably, the incidence and mortality of leptospirosis in Kerala for the following years showed a declining trend as compared to the previous years [5].

References

[1] Bharti, A.R. et al. (2003) Leptospirosis: Azoonotic disease of global importance. LancetInfect.Dis.3, 757-771.

[2] Cyrille Goarant. (2016) Leptospirosis: risk factors and management challenges in developing countries. Res Rep Trop Med. Sep 28; 7: 49-62. Doi: 10.2147/RRTM.S102543. https://share.google/7aa2HGDZVkTDvhJJj
[3] Jagadeesan CK. (2011) Leptospirosis: A public health problem which deserves special attention: the state surveillance unit of IDSP at DHS Thiruvananthapuram, Kerala:49-50. https://dhs.kerala.gov.in/wp-content/uploads/2020/06/part3.pdf
[4] S Chadsuthi, K Chalvet-Monfray, S Geawduanglek. (2022) Spatial-Temporal patterns and risk factors for human leptospirosis in Thailand, 2012-2018. Scientific Reports,; 12(1): 1-11. https://share.google/njzg7ORzY00Pv47aV
[5] Sruthi James, Brijesh Sathian, Edwin Van Teijlingen, Mohammad Asim. (2018) Outbreak of Leptospirosis in Kerala. Nepal J Epidemiol. Dec 31; 8(4) : 745-747. Doi: 10.3126/nje.v8i4.23876. https://pmc.ncbi.nlm.nih.gov/articles/PMC6541470/

