

Factors Contributing to the Occurrence of Leptospirosis, and the Impact on Public Health in Saint Lucia 2008-2019

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Abstract

Leptospirosis is a bacterial disease that affects humans and animals. The causative agent is a spirochete of the genus Leptospira. In humans, it causes a wide range of symptoms, however, asymptomatic presentation is not uncommon. Without proper treatment, leptospirosis can lead to kidney damage, meningitis, liver failure, and respiratory distress. Death may occur in some patients. The aim of the study is to identify the factors contributing to the occurrence of leptospirosis, and the impact on public health in Saint Lucia 2008-2019. The study design is a mixed – method, comprising quantitative and qualitative data. A stratified sampling design using probability proportionate to size sampling at the settlement level was used. Secondary data on the incidence of leptospirosis were obtained from the Ministry of Health, and rainfall data were obtained from the Meteorology Office. Analysis of the data reveals several factors contributing to the occurrence of leptospirosis in Saint Lucia: poor garbage disposal; a large rodent population with easy access to garbage; and a lack of knowledge of leptospirosis. The impact on public health is manifested in the mortality and morbidity of individuals primarily men, and the health, social, and economic impact on the country. Reducing the impact of leptospirosis on the individual and country necessitates an island wide multi - sectoral control and prevention educational programme; an evaluation of the collection, storage, and disposal of household garbage; and the enforcement of legislation governing the proper collection, storage and disposal of garbage.

Keywords: Factors, Impact, Leptospirosis, Occurrence, Public Health, Saint Lucia.

Introduction

Leptospirosis is a zoonotic disease with worldwide distribution ^[1]. Leptospirosis is an infectious disease caused by pathogens from the genus *Leptospira*. The infectious agents are transmitted directly or indirectly from animals to human beings. It is classified as a zoonotic disease ^[2], creating a public health problem of global significance ^[3,4]. Common reservoirs of leptospires are cattle, buffaloes, horses, sheep, goat, pigs, dogs, and rodents. Rodents play a significant role in the spread of leptospirosis since they can shed leptospires throughout their life span without clinical manifestations. They are a primary source of infection to human beings. Pigs and cattle are also an important source of human infection ^[5,6].

The leptospira can enter the body through mucous membrane or broken skin in contact with moist soil or vegetation contaminated with the urine of infected animals; contaminated waters; urine, fluids, or tissues of infected animals; and

by consumption of water or food contaminated with urine of infected animals ^[7]. Direct person to person transmission through sexual intercourse is rare ^[8]. Intact skin that has been immersed for a prolong period can be penetrated. In humans, the incubation period ranges from 2 to 21 days. There are two phases of the illness. The acute phase occurs in the first week of the illness and is manifested by the abrupt onset of high fever, myalgias, headache, nausea, vomiting, abdominal pain, diarrhoea, cough, and a truncal or pretibial rash. The second phase is characterised by prolonged fever, jaundice, renal failure, bleeding, respiratory insufficiency, hypotension, myocarditis, meningitis, mental confusion, and depression. Death may occur in some patients ^[9].

Diagnosis of leptospirosis is usually based on serologic analysis, and the microscopic agglutination test (MAT). Serologic screening test available include enzyme-linked immunosorbent assay (ELISA), and multiple

rapid diagnostic tests. Positive screening tests should be confirmed with MAT ^[5]. Antibiotic treatment early in the illness may reduce the duration of fever, and the best antibiotics for treating leptospirosis are penicillin, amoxicillin, ampicillin, doxycycline and erythromycin ^[8].

In recent times, leptospirosis has re-emerged and emerged with a global spread impacting significantly on human and domestic health ^[10]. An emerging infectious disease is an infection that has recently appeared within a population or those whose incidence or geographic range is rapidly increasing or threatens to increase in the near future ^[11]. In Saint Lucia, leptospirosis is an emerging zoonotic disease, with thirty-five confirmed cases reported in 2019, the highest since 2004 ^[12].

The aim of the study is to identify the factors contributing to the occurrence of leptospirosis, and the impact on public health in Saint Lucia 2008-2019.

The findings of the research study are likely to enlighten policy makers, public health personnel, and the public, on the major factors contributing to the proliferation of leptospirosis in Saint Lucia and the measures that should be taken to mitigate the impact on Public Health.

Materials and Methods

Data collection was completed in Region 1, Gros Islet, and the findings are reflected in the article. Secondary data on the incidence of leptospirosis, morbidity and mortality were obtained from the Ministry of Health, and rainfall data were obtained from the Meteorology Office. Data were collected from journals, the Caribbean Public Health Agency ^[13], and the private laboratories.

The study design included a mixed – method approach, comprising quantitative and qualitative data ^[14]. A stratified sampling design using probability proportionate to size sampling at the settlement level was used. Settlements within each Health Region as Secondary Sampling Units (SSU), where three (3) settlements were randomly selected. Maps of the selected settlements were obtained from the Central Statistics Office Mapping Section. This was used to establish starting points for every 3rd household selection process. The researcher used these maps to identify the first household and thereafter, selected every third household in the respective settlements to achieve the required sample

households. Eligible and consenting adults were interviewed within the selected household using a structured interview guide. All data were analysed using SPSS v23.

Two settlement focus groups were conducted. The settlements for the conduct of the focus groups were randomly selected from the list of settlements utilized for the quantitative research. A screening tool was used for the selection of the participants invited to the focus group discussion. Each group comprised 8 – 12 persons with a mix by sex and age distribution to provide for opportunities to obtain both shared and distinctive experiences of group members. The focus group discussions were convened within each selected settlement at a location that was accessible to participants.

The focus group discussion was guided by a prepared Topic Guide based on the study objectives. The focus group discussions were recorded electronically and through note taking. The participants granted consent for the recording of the sessions. An evaluation of each focus group discussion was conducted on completion utilizing a structured evaluation form to identify whether the objectives were met. A report was generated outlining the processes used, challenges and findings of each group discussion. A final report was generated including the varying threads and common themes identified.

The qualitative research component aimed to provide a greater depth of understanding of the variables being assessed by the quantitative component of the research. The quantitative component articulates the views and findings from participants' interaction with the researcher. In addition, it gave the researcher the opportunity to better tie together clusters of behaviours that can help to better describe the situation/problem ^[15]. The methods used were approved and authorized by the local Ethics Board.

Results

Leptospirosis profile of Saint Lucia (2008-2019)

Leptospirosis is prevalent in all the nine Health Regions in Saint Lucia. Between 2008-2019, there were 218 confirmed cases of leptospirosis. During the period 2017 and 2019, there were 91 confirmed cases of leptospirosis (Fig. 1), ^[12]. The highest number of confirmed cases were observed to occur within the highest rainfall season, January to February, and July to

December ^[16]. For the period under study, there were 16 deaths (14 males and 2 females) with the majority of men being between the ages 25 and

50, while the two females ages were 60 and 61 ^[12].

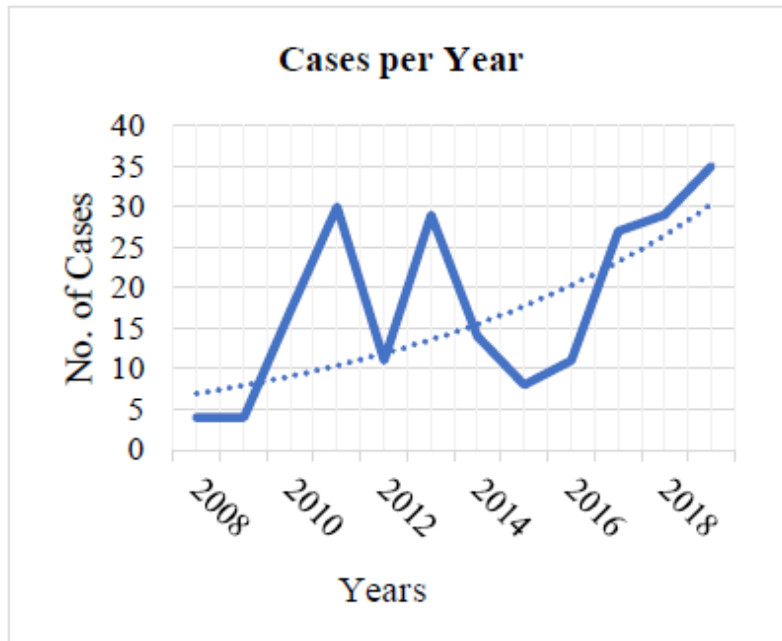


Figure 1. Leptospirosis cases for 2008-2019 in Saint Lucia

Demographics

The study population comprised fifty-three (53) respondents: 20 males (37.7%) and 33 females (62.7%). The mean age of the study sample was 49.9 (SD=14.9); with males 45.9 (SD=15.5) and females 52.3 (SD=14.1). The majority (n=25; 47.2%) of the respondents had a

primary school education (Fig. 2). In terms of employment, (n=35; 67%) of the respondents were employed, primarily in farming, teaching, and management (Fig. 3).

The majority (n=34; 64.2%) of the respondents were affiliated with Roman Catholicism. The majority of respondents were single (n=24; 46.2%); and (n=19;36.5%) were married.

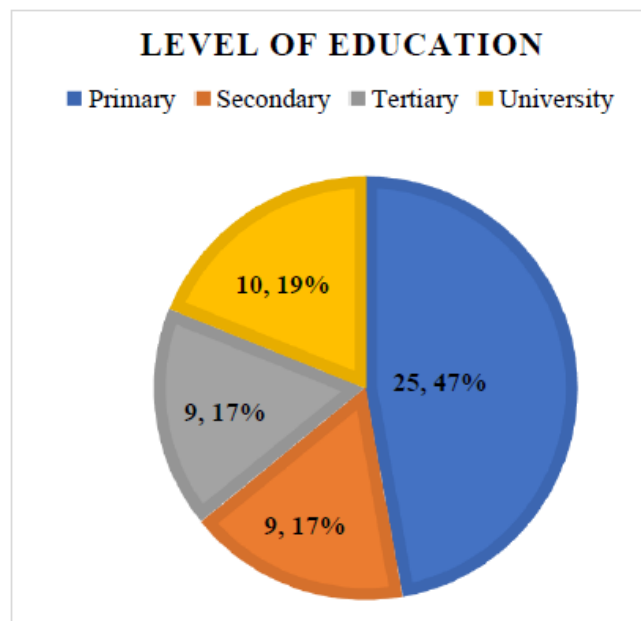


Figure 2. Educational background of respondents

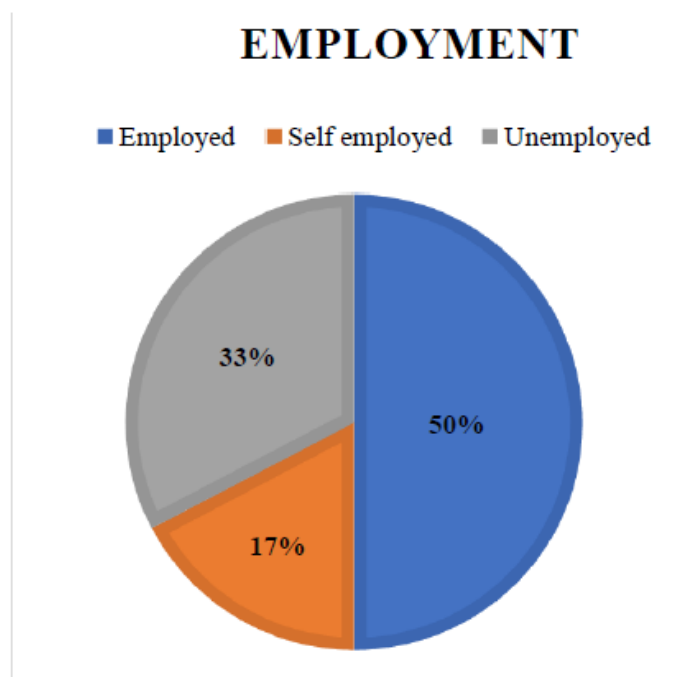


Figure 3. Employment status of respondents

Knowledge, Attitudes and Practices

Knowledge

The majority of respondents (n=52; 98.1%) had heard about leptospirosis, with 63.5% obtaining this information from television. In ascertaining respondents' knowledge about leptospirosis, (n=42; 80.8%) indicated it is a disease; (n=37; 71.2%) it is spread by animals; and (n=25; 48.1%) that it can kill you.

The contributing factors to the spread of leptospirosis were identified as rats (64.2%); improper disposal of garbage (62.3%); and eating food contaminated by rats (41.5%). Knowledge of a leptospirosis case was known by (34.0%) of the respondents. Respondents indicated that an infected person would get sick (88.5%); die (88.5%) or recover (13.5%). They also stated that a person can be cured by taking doctor's medicine (69.8%). However, (30.2%) did not know (Table 1). Respondents indicated that keeping their surroundings clean (94.2%); disposing of garbage properly (67.3%); not walking in flood waters (3.8%), and barefooted (1.9%) were measures that can be taken to prevent leptospirosis (Table 2).

Children (n=25; 48.1%) and adults (n=25; 48.1%) were perceived to be the groups most likely to contract leptospirosis. The urban area

(n=43; 82.7%) and rural area (n=9; 17.3%) were the areas identified in the island where people would be most affected. Leptospirosis was considered a very serious disease by (n=33; 62.3%) and serious by (n=16; 30.2%) of the respondents. In terms of who should be responsible for controlling leptospirosis, the major responses given were: community members (n=23; 44.2%); and the society (n=19; 36.5%). The most common pest identified in the community were rats (n=35; 68.6%); and mosquitoes (n=12; 23.5%). These pests were coming predominantly from garbage (n=17; 32.1%); farms (n=15; 28.3%); homes (n=14; 26.4%); and stagnant water (n=11; 20.8%). In order to get rid of the pests, the majority of participants endeavoured to keep their surroundings clean (n=29; 54.7%).

The majority of respondents (n=33; 63.5%) had a positive attitude to the measures being undertaken to keep their community healthy, particularly to the regular garbage collection (n=23; 69.7%); and household premises are kept clean (n=10; 30.3%). Of the 19 participants who felt that enough was not being done, (n=12; 63.2%) participants suggested: educate community members; (n=4; 21.1%) promote community participation; and community clean - up campaigns (n=3; 15.8%).

Table 1. Respondents' knowledge of leptospirosis

| Knowledge | Frequency (n=53) | | Percentage (%) |
|--|----------------------------------|----|----------------|
| Heard about leptospirosis | Yes | 52 | 98.1 |
| | No | 1 | 1.9 |
| Obtained information | Television | 33 | 63.5 |
| | Radio | 24 | 46.2 |
| What is leptospirosis? | It is a disease | 42 | 80.8 |
| | It is spread by animals | 37 | 71.2 |
| | It can kill you | 25 | 48.1 |
| | Don't know | 5 | 9.6 |
| What contributes to the spread of leptospirosis? | Rats | 34 | 64.2 |
| | Improper disposal of garbage | 33 | 62.3 |
| | Eating food contaminated by rats | 22 | 41.5 |
| Knowledge of a leptospirosis case | Yes | 18 | 34 |
| | No | 35 | 66 |
| What would happen to an infected person | Get sick | 46 | 88.5 |
| | Die | 46 | 88.5 |
| | Recover | 7 | 13.5 |
| How can someone be cured? | Take doctor's medicine | 37 | 69.8 |
| | Don't know | 16 | 30.2 |

Table 1. Measures that can be taken by Respondents to prevent leptospirosis

| Measures | Frequency (n=52) | Percentage (%) |
|-------------------------------------|------------------|----------------|
| Keep my immediate surrounding clean | 49 | 94.2 |
| Dispose of garbage properly | 35 | 67.3 |
| Do not walk in flood waters | 2 | 3.8 |
| Do not walk barefooted | 1 | 1.9 |

Table 3. Attitudes of respondents toward leptospirosis

| Attitudes | Frequency (n=53) | Percentage (%) |
|---------------------------|------------------|----------------|
| I am afraid of it | 31 | 58.5 |
| People die from it | 15 | 28.3 |
| It is a dangerous disease | 14 | 26.4 |

Practices

The major source of drinking water was public supply (n=50; 94.3%). Household garbage was mainly stored in garbage bins (n=32; 60.4%) and was disposed using the municipal services, twice per week (n=49; 92.5%). See Table 4.

The majority of participants (n=35; 66.0%) did not walk barefooted in and around the yard. However, (n=18; 34.0%) walked barefooted in and around the yard. With regards to walking in flood waters when it rains heavily, (n=7; 13.2%)

of the respondents said yes, and (n=46; 86.8%) said no. For those who had walked in flood water, they wore canvas shoes (n=3; 5.7%); rubber boots (n=2; 3.8%); and slippers (n=2; 3.8%).

The majority of respondents (n=52; 96.1%) stated that they washed their hands after being in contact with soil. A considerable number of respondents (n=34; 64.2%) were engaged in farming, particularly cash crop (n=29; 58.0 %); pig farming (n=1; 2.0%); and cattle farming (n=1; 2.0%). The number of respondents who wore

protective gear during farming were (n=18; 34.0 %) compared to those who did not wear (n=17; 32%).

Measures to control leptospirosis

Several measures were identified by respondents to prevent leptospirosis. These included: keeping household surrounding clean (n=48; 92.3%); and controlling rodents on premises (n=15; 26.8%) (Table 5).

In response to what the government can do to control leptospirosis, the majority of respondents indicated that the government should develop and

implement health education programmes, germane to leptospirosis (n=27; 52.9%), and to improve the collection, storage, and disposal of garbage island-wide (n=21; 41.2%).

Main reasons for the spread of leptospirosis in Saint Lucia

The respondents identified several reasons for the spread of leptospirosis in Saint Lucia. These included: poor garbage disposal (n=35; 66.0%); rats have easy access to garbage (n=27; 50.9%); a large rodent population (n=14; 26.4%); and lack of knowledge of leptospirosis (n=11; 20.8%).

Table 4. Hygiene practices of respondents

| Practices | Frequency (n=53) | | Percentage (%) |
|--|------------------|----|----------------|
| Source of drinking water | Public supply | 50 | 94.3 |
| | River | 2 | 3.8 |
| | Bottled water | 1 | 1.9 |
| Storage of Garbage | Garbage bins | 32 | 60.4 |
| | Garbage bags | 24 | 45.3 |
| | Buckets | 3 | 5.7 |
| Disposal of household Garbage | Municipal | 53 | 100 |
| | Other | 0 | 0 |
| Access to household garbage by rodents | Yes | 10 | 18.9 |
| | No | 43 | 81.1 |
| Disposal of garbage | Daily | 1 | 1.9 |
| | Twice weekly | 49 | 92.5 |
| | Once per week | 3 | 5.7 |

Table 5. Measures that can be undertaken by community members to prevent leptospirosis

| Measures to prevent leptospirosis | Frequency (n=53) | Percentage (%) |
|--|------------------|----------------|
| Keep household surroundings clean | 48 | 92.3 |
| Control rodents on premises | 15 | 28.8 |
| Educate community members on the disease | 9 | 17.3 |
| Avoid walking barefooted | 4 | 7.7 |
| Wear protective gear | 8 | 15.4 |

Impact of leptospirosis on Public Health

Impact of leptospirosis on individual and family

Respondents identified leptospirosis as having an impact on their health and that of their family, through a loss of income (n=52: 98.1%);

depletion of resources (n=53; 100%); and stress (n=53; 100%).

From a social perspective, it would increase anxiety and stress (n=41; 77.4%); distress to individual and family (n=40; 75.5%), and marginalization of infected individual and family (n=22; 41.5%).

From an economic perspective being affected with leptospirosis would result in a depletion of resources (n=53; 100%); loss of income (n=52; 98.1%); and financial stress (n=53; 100%) (Table 6).

Impact on Country

Respondents perceived that leptospirosis can impact the health services by a large number of cases overwhelming it (n=52; 98.1%); health care workers being overburdened (n=52; 98.1%); and depletion of resources (n=50; 94.3%).

From a social perspective, they indicated that leptospirosis can impact the country by creating increase stress and fear in the society (n=49; 92.5%); stigmatization of infected person and families (n=32; 60.4%); and create extensive fear among the citizens of contracting the disease (n=48; 90.6%).

Respondents perceived that leptospirosis can have an economic impact on the country by negatively impacting the tourist industry (n=48; 90.6%); depletion of livestock (n=20; 37.7%); and reduce income for farmers and infected persons (n=25; 47.2%) (Table 7).

Qualitative Data

A focus group discussion was held in the Community of Norbert, Saint Lucia, to assess the knowledge, attitudes, and practices of community members, and impact of Leptospirosis in the Community.

Participants stated that they had a limited knowledge of Leptospirosis based on information obtained from radio. They explained that leptospirosis was spread by rats;

Table 6. Health, Social and Economic impact of leptospirosis on Individual and family

| Impact on Individual and Family | Frequency (n=53) | | Percentage (%) |
|---------------------------------|---|----|----------------|
| | | | |
| Health | Depletion of resources | 53 | 100 |
| | Loss of income | 52 | 98.1 |
| | Stress | 51 | 96.2 |
| Social | Increase anxiety and stress | 41 | 77.4 |
| | Distress to individual and family | 40 | 75.5 |
| | Marginalization of infected person and family | 22 | 41.5 |
| Economic | Depletion of resources | 53 | 100 |
| | Financial stress | 53 | 100 |
| | Loss of income | 52 | 98.1 |

Table 7. Health, Social and Economic impact of leptospirosis on the Country

| Impact on Country | Frequency (n=53) | | Percentage (%) |
|-------------------|---|----|----------------|
| | | | |
| Health | Health facilities overwhelmed | 52 | 98.1 |
| | Healthcare workers overburdened | 52 | 98.1 |
| | Depletion of resources | 50 | 94.3 |
| Social | Increase stress and fear in society | 49 | 92.5 |
| | Extensive fear of contracting the disease | 48 | 90.6 |
| | Stigmatization of infected person and family | 32 | 60.4 |
| Economic | Negative impact on the tourism industry | 48 | 90.6 |
| | Reduced income for farmers and infected persons | 25 | 47.2 |
| | Depletion of livestock | 20 | 37.7 |

it is a very serious disease and can lead to death. They indicated that it can be spread due to rubbish, rat urine, rat urine on leftover food, improper washing of dishware, rat bites, and contaminated water. The participants mentioned that anyone can contract the disease especially persons with untidy homes and persons who have lots of rubbish within the surrounding areas.

They mentioned that in order to prevent and control the disease, community members must keep the place clean and kill the rats by use of pellets (rat poison). On a community level, it was suggested that the householders dispose of their rubbish only on collection days and to ensure that it is placed correctly at the designated pick up spots for garbage collection.

Although there were no known cases of leptospirosis within the community, the participants mentioned that it can have a great impact on an individual as well as ones' family by creating a financial burden due to loss of jobs and expensive treatment costs.

The participants stated that government can create policies to ensure that garbage is collected on time by erecting signs in the community to ensure that residents are aware of the exact days and time of collection. They also mentioned, that gutters be cleaned and garbage be disposed of properly.

Discussion

The majority of respondents obtained information on leptospirosis from radio and television and were knowledgeable that leptospirosis was a disease; it is spread by animals; and it can be fatal. However, they did not indicate that they were knowledgeable of the different animals that can spread leptospirosis except rats. This knowledge gap is due to inadequate information provided by the radio and television stations on leptospirosis. A few respondents had knowledge of someone who had contracted leptospirosis. They identified the factors contributing to the spread of leptospirosis to be rats; improper disposal of garbage; and eating food contaminated by rats. Regarding measures that can be undertaken at an individual level to prevent leptospirosis, participants indicated keeping their surroundings clean; and dispose of garbage properly. Children and adults were perceived to be most vulnerable for contracting leptospirosis. The rationale given for children was that they are more prone to eating food items without inspecting and washing them.

Whilst this explanation seems logical, the epidemiological data on confirmed cases of leptospirosis between 2008-2019 does not support the rationale, as most of the confirmed leptospirosis cases were in the adult population 178 compared to 40 in 0-19 age group [12]. They perceived leptospirosis to be a very serious disease, with the urban areas being most affected. Reference was made to the city of Castries, particularly in the Castries Housing area, where there is a high population of rodents, which are visible during the day, night and flooding. Improper disposal of garbage provides an ideal medium for the proliferation of rodents. This was evident at the community level. Many individuals infected with leptospirosis attributed the infection to rodents and it is necessary that the existing serovars in Saint Lucia be identified. The major contributing factors to the spread of leptospirosis in Saint Lucia were: poor garbage disposal, rats having easy access to garbage, a large rodent population and a lack of knowledge of leptospirosis in reference to other animals. It is necessary that a rodent control program be developed and implemented.

The majority of respondents were fearful of contracting leptospirosis and had a positive attitude toward their communities as they indicated that their community was kept clean. Water was obtained from the municipal supply and the municipal system was used for the disposal of garbage. A small percentage of householders indicated that rodents had access to their household garbage. The presence of rodents having access to household garbage poses a major threat to persons in these homes and nearby residents and can proliferate the spread of leptospirosis.

Washing of hands after being in contact with soil was practiced, however, those individuals who were engaged in farming and wore protective gear were not at high risk of contracting leptospirosis as those who were not wearing protective gear.

Rodents harbour leptospire in their renal tubules and spread them through contaminated urine in the environment [17]. Infected rats with the leptospire have the capacity to shed the pathogen during their life span which averages three to five years [5,18]. Handling infected soil containing the leptospire without protective gloves can result in contracting leptospirosis [8].

Measures to prevent leptospirosis were perceived as keeping the surrounding clean, and

controlling rodents on premises. The government of Saint Lucia was perceived as playing a vital role in the control of leptospirosis by developing and implementing health education programmes; and improving the collection, storage, and disposal of garbage island-wide.

Leptospirosis can impact on the individual and family, and on the country. The health impact on the individual and family would result in a loss of income, depletion of resources, and stress. Socially, leptospirosis would increase anxiety and stress; distress to individual and family; and marginalization of infected person and family.

The impact of leptospirosis on the country can affect the health services resulting in health facilities being overwhelmed, health care workers overburdened and depletion of scarce resources. The social impact is likely to increase stress and fear in the society; stigmatization of infected persons and families; and extensive fear of contracting the disease among the citizens. An epidemic can likely have a negative impact on the tourist industry; depletion of infected livestock; and reduced income for farmers and infected persons. In 2019, Saint Lucia experienced an epidemic of leptospirosis with 35 confirmed cases being the highest since 2004. The increase in the rodent population, if not controlled island wide, is likely to exacerbate the proliferation of leptospirosis in Saint Lucia.

The management of solid waste at the community level is concerning to residents in Region 1, and the issues raised by participants in the focus group, such as illegal dumping of garbage by outsiders; the absence of signage prohibiting dumping of garbage, and stray animals having access to the garbage need to be addressed by the Solid Waste Management Authority and the Ministry of Health.

Conclusion

The study has identified several factors contributing to the occurrence of leptospirosis in Saint Lucia such as poor garbage disposal; rats have easy access to garbage; a large rodent population and lack of knowledge, particularly to the vectors that can transmit the disease, and how transmission occurs. The respondents articulated that leptospirosis can have a profound impact on the individual, family and country.

In order to reduce the impact of leptospirosis on the individual and country, there is need for an island wide multi - sectoral educational programme on leptospirosis control and

prevention in English and in Kweyol, targeting all the communities, schools, community organizations, religious organizations and the general public; evaluation of the collection, storage, and disposal of household garbage with the aim of improvement; and the enforcement of existing Solid Waste laws.

The presence of rodents in food handling establishments poses a major public health threat to the citizenry and a concerted effort must be made by the Ministry of Health to control and mitigate this threat.

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