Ann Natl Acad Med Sci (India), **41**(1&2): 23-34, 2005

Public Health Significance of Leptospirosis – A Neglected Disease in India

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SUMMARY

Leptospirosis is the most widespread zoonosis in the world. The existence of leptospirosis in India was proved in 1929 through studies conducted in Andaman Islands. Since 1988 outbreaks of febrile illness with haemorrhagic tendencies locally known as Andaman Haemorrhagic Fever have been occurring in the islands. In 1993 the case of the disease was established as leptospires. Leptospirotis is also common in many states of the country, particularly those in the east and west coast. A study conducted by an ICMR Task Force showed that leptospirosis exists in most parts of the country. Epidemiologically there are four distinct form of leptospirosis viz. rural, urban, recreational and disaster-related. The transmission cycle of leptospirosis involves carrier animals, environment and human beings. Control can be achieved by intervention measures targeting several points on the transmission cycle. However, measures targeting human beings are the only feasible ones in the present situation. The public health significance of leptospirotis has been overlooked for several decades and the disease has emerged as an important health problem. A multi-sectoral approach is necessary to combat this environmentally acquired infection.

INTRODUCTION

Leptospirosis is the most widespread zoonosis in the world (1). It is caused by spirocheates belonging to various pathogenic species of the genus Leptospira. Leptospirosis affects human beings and many other species of vertebrates. It can present in a wide spectrum of clinical manifestations in human beings. The syndrome of icteric leptospirosis with renal involvement is referred to as Weil's disease. Another recognized clinical form is that presenting with severe pulmonary haemorrhage (2, 3, 4). Other complications include Acute Respiratory Failure (5), myocarditis (6), meningitis and renal failure (7).

Eighty-five years back the Japanese scientists Inada and Ido identified Leptospira, which was later confirmed by the German scientists Uhlenhuth and colleagues. Since the discovery of

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leptospires and its association with Weil's diseases, several other disease syndromes prevailing in different parts of the world have been added to the list of diseases caused by these bacteria. Leptospirosis occurs in a large number of countries in all the five inhabited continents. In most of the countries, leptospirosis was considered as an uncommon disease till recently and hence was given low priority in health programmes. The International Leptospirosis Society (ILS) made an attempt to compile data on occurrence of leptospirosis in various countries (8). The data shows that on an average 10,000 severe cases requiring hospitalization occur annually all over the world.

Leptospirosis is known to be endemic in Andaman Islands since early years of 20th century. The first report of bacteriologically confirmed leptospirosis in India originated from Andaman Islands in 1931 (9). The disease was common among the free-living convicts of South Andaman who were engaged in rice cultivation and other occupations that expose them to wet conditions. The occurrence of the disease had close association with rainfall and the peak occurrence used to be during the post-monsoon period. No information about the status of leptospirosis in Andamans between 1931 and 1993 is available in literature.

Andaman Haemorrhagic Fever

In the post-monsoon season of 1998, an outbreak of febrile illness with haemorrhagic manifestations appeared, first in Port Blair and other areas of South Andaman and then in Diglipur of North Andaman (Fig 1). The first case was an 18 year old girl, who was admitted to G.B. Pant Hospital, Port Blair with fever, cough and haemoptysis. The provisional diagnosis was miliary tuberculosis based on X-ray findings. In addition to antituberculous drugs she was also put on penicillin. She recovered completely within one week after initiating therapy and her X-ray shadows disappeared. Later similar cases occurred among the labourers camping at a forest camp at Jirkatang in South Andaman. Since the aetiology of the disease was unknown, it was named as Andaman Haemorrhagic Fever (AHF). AHF outbreaks recurred ev-

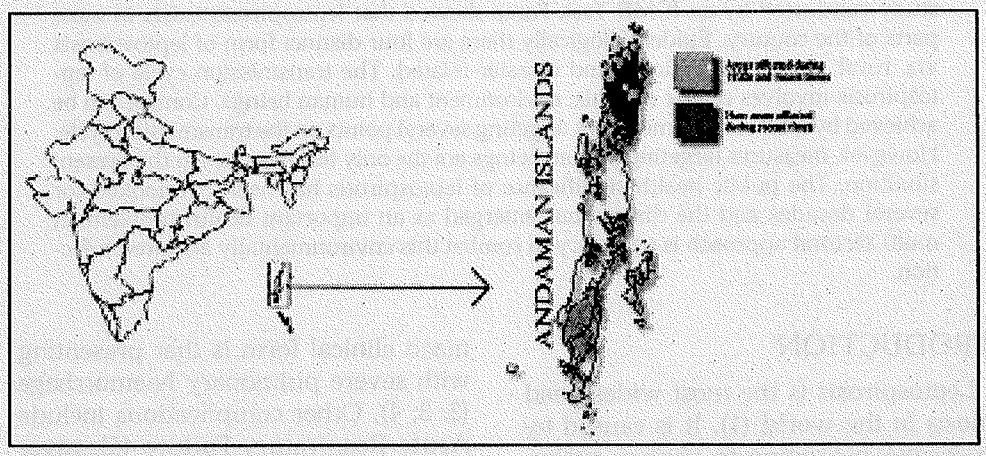

Fig. 1. Map of Andaman islands showing areas affected by AHF outbreak

ery year since then, but the aetiology remained unknown in spite of investigations conducted by several national level organizations. An outbreak occurred in Diglipur in 1993 was investigated by us and the etiology was established serologically as leptospires. This was later confirmed by isolation of leptospires from the blood of AHF patients.

There were a lot of epidemiological similarities between the outbreaks of leptospirosis that occurred during the first half of 20th century and the outbreaks of AHF.

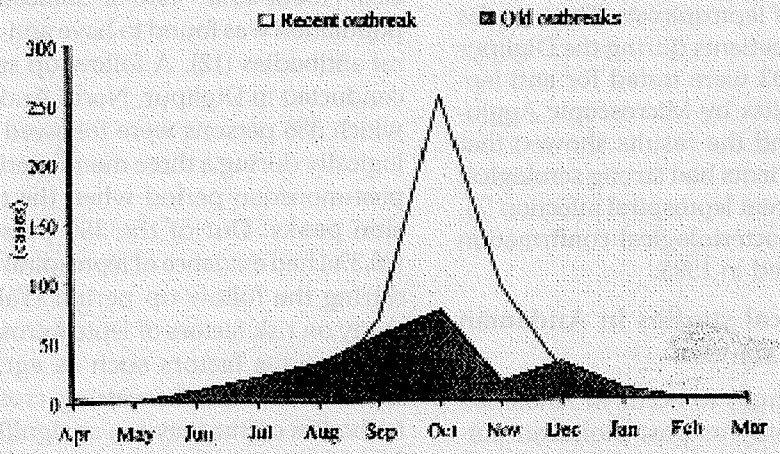

Fig. 2. Seasonal trend in the occurrence of leptospirosis cases during 1921 - 26 and AHF case during 1988 - 93

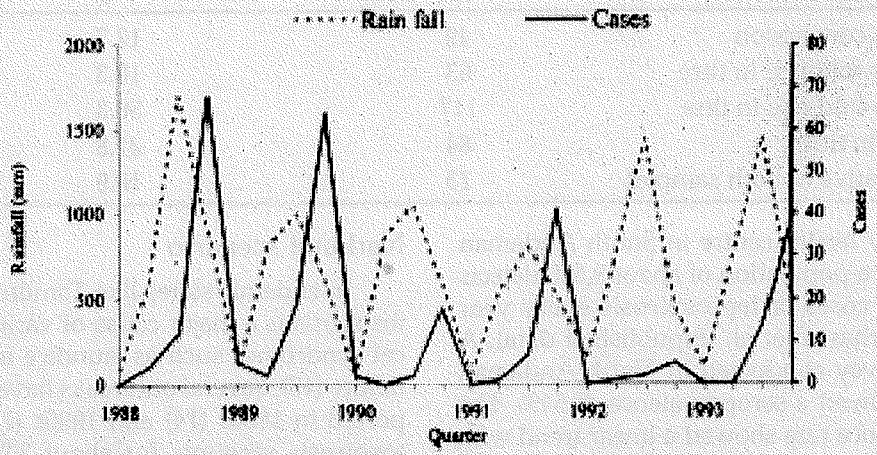

Fig 3. Association between rainfall and occurrence of AHF cases

The seasonal variation (Fig 2), association with rainfall (Fig. 3), occupation of patients and affected areas were similar. However, the important common clinical features of AHF were different from those of earlier outbreaks. Because of the epidemiological similarities between AHF and earlier outbreaks, we considered it worthwhile to investigate AHF for it being a different clinical syndrome of leptospirosis. The samples collected from patients during the Diglipur outbreak in 1993 were tested for anti-leptospiral antibodies by Microscopic Agglutination Test and the results showed that 66.7% of the patients had strong serological evidence of current leptospiral infection (2). Subsequently bacteriological confirmation was also obtained in 1995.

Epidemiological studies in Andaman and Nicobar Islands

AHF continues to occur in Andaman Islands commonly as post-monsoon outbreaks and occasionally as sporadic cases (4). A surveillance system based at a rural primary health centre in South Andaman serving a population of about 9,500 detects 40 - 70 cases of leptospirosis every year (Vijayachari P et al, unpublished data). A serosurvey conducted in North Andaman (10) showed a seroprevalence of 54%. The prevalence rate showed a linear trend with age and was more than 72% in those aged above 30 years. Seroprevalence studies were conducted among the tribes of Andaman and Nicobar Islands also. All the tribes had seroprevalence rates lower than the settler population except Shompens living in the jungles of Great Nicobar, who had a seroprevalence of 53.5% (11). Seroprevalence studies were conducted among the animal population of the islands also. About 30% - 45% of domestic animal population was found to have anti-leptospiral antibodies (12). A follow up study was conducted in Diglipur, North Andaman, in which 386 persons were followed up serologically during a three month period in the post-monsoon period when the transmission peaks. Out of the 386 persons, 113 (29.3%) had evidence of leptospiral infection during the follow-up period (Table 1). A study on risk factors of leptospirosis identified various factors such as agricultural work, forest work, harvesting, crossing water bodies on the way etc. as significant risk factors associated with seropositivity to leptospires (10).

Table 1. Results of serological follow up of 386 persons during peak transmission

Serological result	No. (n=386)	(%)
Sero-conversion	49	12.7
Four-fold rise in titre	63	16.3
Two-fold rise in titre	117	30.3
Fall in titre	84	21.8
Negative in both samples	73	18.9

National scenario

In endemic states like Tamilnadu, leptospirosis is a major cause of various clinical syndromes such as jaundice and renal failure (13). Several outbreaks have been reported in 1980s (14) and 1990s (15). Leptospirosis accounts for about 30% of the cases of pyrexia of unknown origin (PUO),

in Chennai city during monsoons. Leptospirosis has been identified as an occupational hazard of pineapple farmers in Kolancherry in Kerala. During a 10 year period, 976 patients among pineapple worker were identified with a case fatality ratio of 5.2% (16). During the period 1990 - 1998, leptospirosis was suspected in 1909 patients in Kolancnerry and 173 isolates were recovered from the patients (Kuriakose M, personal communication). Leptospirosis outbreaks occur every year in Surat and Valsad districts in Gujarat, in various places in Tamilnadu and Kerala and frequently in the coastal areas of Maharashtra and Karnataka. About 30% of paediatric patients presenting with clinical presentation matching the Indian Leptospirosis Society's working definition for clinically suspecting leptospirosis were confirmed to have leptospirosis based on a rapid diagnostic test (17).

Several outbreak occurred in various parts of the country were investigated. In 1999, after the super cyclone an outbreak of febrile illness with haemorrhagic tendencies occurred at several villages in Orissa that were submerged in flood waters for several days. An investigation was carried out in these villages and it was found that an outbreak of leptospirosis with an attack rate of about 14% occurred in these villages after the cyclone (18, 19). In 2000, an outbreak of a mysterious illness occurred in Mumbai and Thane following heavy rainfall and floods. We investigated these outbreaks and established the leptospiral etiology.

The Indian Council of Medical Research (ICMR) constituted a Task Force on leptospirosis to assess the disease burden due to leptospirosis in the country. The Task Force conducted a nationwide study to estimate the proportion of leptospirosis cases among all the fever cases that fulfilled a case definition. Thirteen centres in different parts of the country participated in the study. The results of the study showed that about 14.7% of the fever cases included in the study had leptospiral infection as diagnosed by a rapid diagnostic test. The proportion of leptospirosis cases was higher in states in western and eastern coasts compared to northern and central parts of the country (Fig 4). Patient

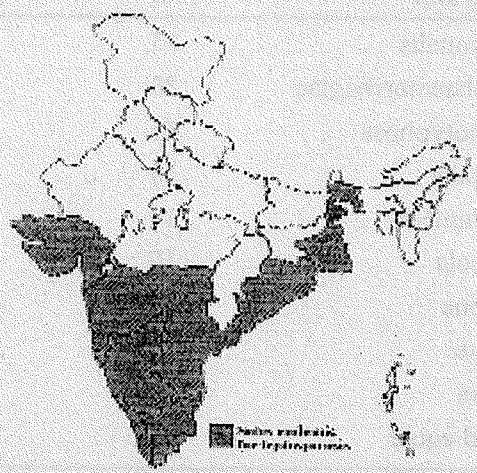

Fig 4. Map of India showing endemic states

inclusion showed a peak in July- August months (Fig 5), which is the peak monsoon season in most parts of the country. The commonest infecting serogroup (as per MAT titre) was Autumnalis followed by Icterohaemorrhagiae, Grippotyphosa and Australis (Table 2). Serogroups Autumnalis, Australis, Ballum and Grippotyphosa were present in all the 11 serogroup tested in MAT were present in Southern region.

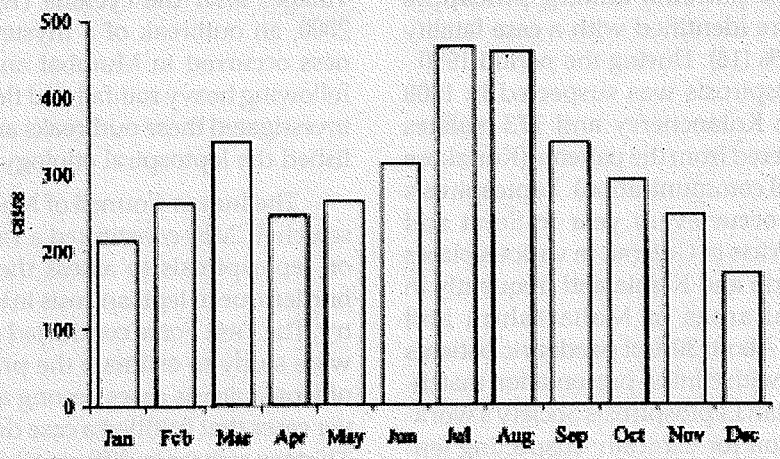

Fig. 5. Month-wise patient inclusion in ICMR Task Force study on leptospirosis

Table 2. Commonest infecting serogroups (as per MAT titres)

Sl No	Serogroup	No.	(%)
1	Autumnalis	73	27.7%
2	icterohaemorrhagiae	38	14.4%
3	Grippotyphosa	25	9.5%
4	Australis	25	9.5%
5	Hebdomedis	19	7.2%
6	Canicola	10	3.8%
7	Pomona	10	3.8%
8	Ballum	9	3.4%
9	Others	10	3.8%
13	Mixed equal	45	17.0%
	Total	**264**	**100.0%**

Clinical presentation

The severity of illness in leptospirosis can vary from mild flu like illness to severe and fatal forms with multiple organ failure. The mild form is characterized by non-specific symptoms/signs such as fever, headache and myalgia with very few patients showing symptoms/signs of organ involvement, whereas in severe forms symptoms/signs of organ system involvement are common (Table 3). There are two major clinical types of severe leptospirosis, the hepato-renal type and the pulmonary type (4), though some overlap between these types are occasionally seen. Other complications such as myocarditis, meningitis etc. are less common. Biochemical and pathological abnormalities indicating organ involvement are also more common in severe forms (Table 4).

Table 3. Frequency of different symptoms/signs among mild and severe cases

Symptom/sign	Mild cases (N=70)	Severe cases (n=58)
Fever	100.0	100.0
Headache	79.0	51.7
Body aches	77.6	39.7
Vomiting	39.2	29.3
Muscle tenderness	39.2	82.8
Cough	19.6	70.7
Rigors	16.8	12.1
Abdominal pain	15.4	6.9
Icterus	5.6	51.7
Oliguria	5.6	50.0
Conjunctiva suffusion	5.6	50.0
Hypotension	5.6	39.7
Haemoptysis	4.2	50.0
Lung crackles	0.0	44.8
Subconjunctival haemorrhage	0.0	29.3
Neck stiffness	0.0	12.1
Altered sensorium	0.0	12.1
Hepatomegaly	0.0	6.9

Table 4. Biochemical abnormalities among mild and severe cases

Abnormality	Severe	Mild
Abnormal LFT	51.7%	11.2%
Serum Bilirubin	1.7 - 15.5 mg/dL	1.6 - 2.5 mg/dL
SGOT	47 - 258 IU	
SGPT	52 - 290 IU	
Abnormal RFT	51.7%	1.4%
Blood Urea	53.1 - 301.6 mg/dL	
Serum Creatinine	1.7 - 7.4 mg/dL	1.4 - 2.3 mg/dL
Abnormal LFT & RFT	45.6%	1.4%
X-Ray Shadows	62.1%	1.4%

Transmission cycle

Leptospirosis transmission involves carrier animals, human beings and environmental vehicles of transmission (Fig. 6). The natural habitat of leptospires is the renal tubules of their animal host. Almost every known species of rodent, marsupial and mammal can be carrier and excretor of leptospires (20). Although leptospires are susceptible to environmental factors, such as drying, acidic or highly alkaline pH, low humidity, salinity and presence of detergents and other bactericidal chemicals, under favourable circumstances they can survive for long periods in water and wet soil. Lep-

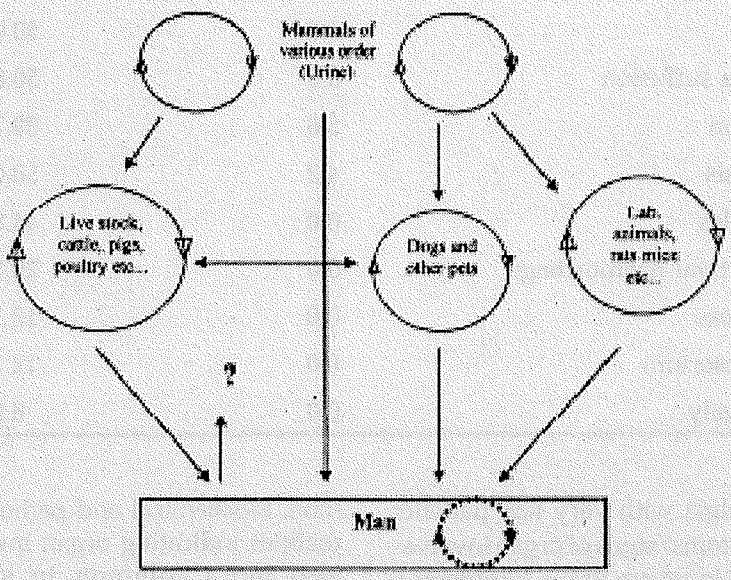

Fig. 6. Schematic diagram of transmission cycle of leptospiro

tospires can infect human beings when they come into contact with environment contaminated with urine, tissue or body fluids of carrier animals. Although direct infection from carrier animals to humans occurs occasionally, indirect infection through environmental vehicles contaminated with leptospires is far more common and hence epidemiologically more important. Therefore, leptospirosis can be viewed as an environmentally acquired infection.

Various occupational groups are at high risk of leptspiral infection either because their occupation requires close contact with animals or because they are occupationally exposed to possibly contaminated soil and surface water. These occupational groups include agriculaural workers involved in wet as well as dry farming, sewage workers, forest workers, butchers, veterinarians, miners, fresh water fishermen, sports persons involved in water sports etc. However, in many tropical countries with wet, warm and humid climate where water-logging is common, whole communities could be at risk. The risk increases substantially when flooding occurs as a result of natural disasters, thus making leptospirosis a hazard during the aftermath of natural disasters such as cyclones and floods.

Epidemiological patterns

There are four epidemiological forms of leptospirosi viz. rural, urban, recreational and a sequelae of natural disasters.

Rural leptospirosis: Rural form is usually associated with farming activities, particularly wet farming such as rice. People working in flooded fields get exposed to leptospires in the ground water or wet soil while working in water-logged fields leading to outbreaks. This form is commonly associated wit agricultural cycles. Leptospirosis is a known health hazard of rice farmers in countries such as Indonesia and Thailand. High incidence of leptospirosis has been recorded in Thai provinces with large populations of farmers (21). Outbreaks have occurred in Korea on several occasions when the fields were flooded before harvest (22). The outbreaks of AHF in Andamans is also an example of this epidemiological form (2).

Urban leptospirosis: The urban form is a result of the poor environmental hygiene in the cities and towns. People get exposed to over-flowing sewers that are often contaminated with leptospires excreted by carrier animals. During rainy season, the sewage canals over-flow onto roads posing risk to whole communities living in such areas. Outbreak of leptospirosis in Mumbai and Thane in 2000 and 2005 following heavy rainfall and flooding was an example of this epidemiological form of leptospirosis. Urban epidemiological form is also seen in Chennai city, where during monsoons every year the incidence of leptospirosis increases sharply.

Recreational leptospirosis: The recreational form usually occurs in developed countries or among people from developed countries who visit tropical countries and participate in water-related recreational activities such as canoeing and swimming. Although rarely reported in India, outbreaks following water sports events have been reported in other Southeast Asian countries such as Malaysia (23) and in developed countries including Japan (24) and USA (25).

Leptospirosis following natural disasters: Natural disasters such as floods often trigger large outbreaks of leptospirosis. Such disasters lead to a closer contact between animals and human beings. Floodwaters are often contaminated with urine from carrier animals and people exposed to such waters contract the infection. During the past decade several outbreak have been reported

in India (18, 19) and other tropical countries following natural disasters such as cyclones and floods.

Control of leptospirosis

Control of leptospirosis involves breaking the transmission cycle at any of the target points (fig 7). Primarily there are four points along the transmission cycle that can be targeted. These are measures targeting reservoir host, those targeting carrier hosts, environmental measures and host (human being) targeted measures. Measures targeting carrier animals and environment can be formulated after sufficient information on the specific nature of transmission cycle existing in a community is generated, whereas measures targeting humans can be instituted without a prior knowledge of the actual transmission dynamics. The possible measures targeting human beings are promoting protective gear at workplace, vaccination and chemoprophylaxis. Community acceptance of protective gear may be poor in the present settings. Till now, no vaccine effective against the multitude of serovars of leptospires is available. It is unlikely that such a vaccine will be developed in the foreseeable future. Chemoprophylaxis, though not practicable in endemic situations, could be of use during epidemics. A study conducted at Andaman Islands has shown that chemoprophylaxis, though not effective in preventing infection, offers 54% protection against symptomatic leptospirosis and reduces severity (26).

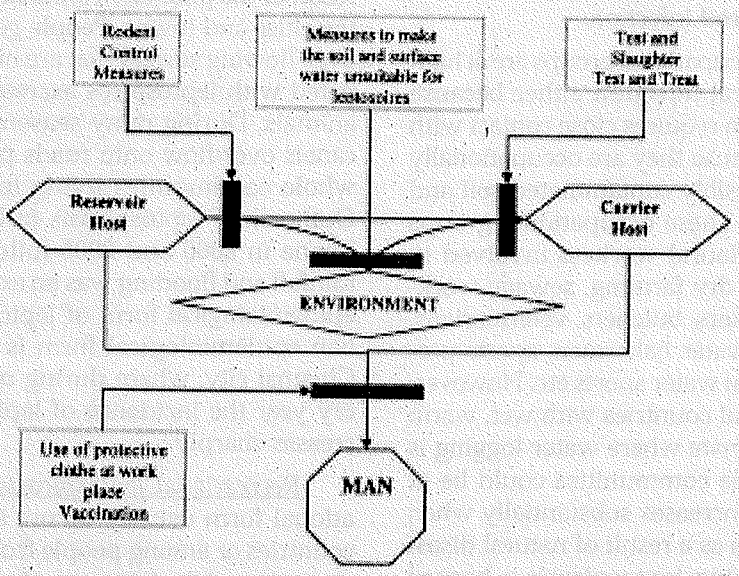

Fig 7. Target points for intervention for control of leptospirisos

CONCLUSIONS

For several decades we have overlooked the importance of leptospirosis as a potential public health problem. The pathogen, its survival characteristics, our environment and lifestyle of people all make leptospirosis an inevitable hazard of people of

tropical developing countries. A major chunk of our population lives under perpetual threat of this infection. About 60% of the 744 million strong work force of the country is engaged in agriculture and a significant section of this workforce is engaged in cultivation of water-intensive crops such as rice. The farming techniques are by and large conventional leading to unprotected exposure of the agricultural workers to possibly contaminated soil and surface water. We have large population of free-grazing and stray animals that can pollute the environment with the pathogen. The city-dwellers are at no less risk. Environmental sanitation of the cities and towns is poor. Drainages are often blocked resulting in flooding of the roads even during a light rain. Overflowing sewers contaminate the flood waters and the people exposed to this become at risk of contracting the infection. The disease causation is multi-factorial and hence intervention strategies should target multiple factors, which can be achieved only by an inter-sectoral collaboration involving health, agricultural, animal husbandry and environmental sectors. The need of the hour is a networking of multiple sectors and organizations for a joint effort to control this long overlooked infection.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the contributions of the scientists and technical staff of the leptospirosis unit of the Regional Medical Research Centre, Port Blair, without whose active participation the studies described in this article wouldn't have been possible

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