The Prevention and Control of Human Leptospirosis

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ABSTRACT

Human leptospirosis is prevalent in several states in India, sporadically or as outbreaks, especially during rainy seasons. It affects predominantly male adults who work in agriculture, causing severe morbidity and unnecessary mortality. Yet, there is no systematic leptospirosis prevention and control programme in the country, as it is not identified as priority under the national health policy. Therefore states with leptospirosis ought to establish public health programme for its prevention and control, as part of building a comprehensive initiative for the control of all-important infectious diseases. After establishing disease surveillance and laboratory support service, the disease burden must be monitored before and during interventions for control. The District is the ideal unit of activity, with full participation of the State Government and Local Panchayati raj. The public health staff must give technical leadership and the risk factors of human leptospirosis must be identified and specific interventions targeted against them. Action must be local-area-specific and coordinated between the Departments of Health, Agriculture, Animal Husbandry, Environment and Forestry. A model leptospirosis control programme has been formulated in Kerala State and is awaiting implementation. A state level Diagnostic and Epidemiology centre has been established to provide technical leadership. This model must be implemented and also replicated in other states. The most important ingredient for the control of infectious diseases is the 'political will'.

KEY WORDS: Leptospirosis, Public health programme, Control

In India, there are public health programmes for the control of several diseases. The Expanded Programme on Immunization against childhood cluster of infectious diseases, control of childhood diarrhoea and pneumonias, vertical control programmes of leprosy, malaria, adult tuberculosis, acquired immunodeficiency syndrome and lymphatic filariasis, are examples. India eliminated smallpox and dracunculiasis, and is currently in the process of eliminating poliomyelitis. All of these were externally motivated, designed or funded in part. India was forced to spend the lion’s share of each of them. In spite of such powerful, rich and vast experience, Indian public health leadership does not seem to have grown in autonomy in problem-identification or intervention-design. Thus we do not have systematic and nation wide control designs for cholera, dysentery, typhoid fever, viral hepatitis, Japanese encephalitis, leptospirosis and many others as they are not on the international agenda for India.

Another vertical programme to control leptospirosis is not proposed

There are common threads of principles and practicalities in the control of the many ‘orphan’ diseases of Indian public health, some of which are listed above. Within a broad national programme of the control of several important diseases, there will be geographic differences in priority, with leptospirosis in some states, Japanese encephalitis or Leishmaniasis in others. The basis of this paper is a plan of action prepared for the state of Kerala under the State Institute of Virology and Infectious Diseases,1 after a district level disease surveillance was established in the entire state.2 The general principles of a public health programme for the control of leptospirosis and the specific technical and management elements of its implementation will form the framework of this paper.

Human leptospirosis is prevalent in many countries in the tropical and subtropical zones3 and is widespread in India.4–6 It kills young adults, with serious economic repercussions to families and to society. Above all, it is preventable. Personal protection and public health control are relevant in this disease; the latter is described here. Every public health preventive measure has elements of personal protection inherent in it. Therefore, they are not described separately.

The principles of control of infectious disease

The definition of control is: ‘the reduction in incidence/prevalence of disease/infection, to a locally decided level, by deliberate efforts’.7

Control is usually targeted at disease, which is the visible ‘snout of the submerged crocodile’ (or tip of iceberg), but in reality what is reduced in most instances is the incidence of infection itself. The decline in incidence/prevalence of disease must be monitored, measured, documented and information disseminated so that the success of the inputs can be demonstrated to the government, health care and public health workers, taxpayers and the general population, without whose support and
participation a control programme will not succeed. In short, • a dynamic public health system, • functioning disease surveillance, • preintervention data on disease incidence/prevalence, • appropriate level of adaptation and implementation of policies, • laboratory support, • scientific monitoring and evaluation are the essential elements of any disease-control programme. For every infectious disease, three pathogen-specific biologic systems are operative, namely, the pathogen amplification, the pathogen transmission and the host-pathogen interaction systems, in that sequence.\[3]\ As physicians, we are mostly concerned with only one of them – the host-pathogen interaction system. So we establish clinical descriptions of the symptoms and signs, the range of severity from the mild form to serious forms of disease, complications and diagnostic clues by laboratory tests, specific antimicrobial and supportive treatments and other ‘patient parameters’ of disease diagnosis and treatment. Then we feel we know everything that is important about the disease.

Public health is interested in the other two systems. The ways in which the pathogen gets to the human host is the transmission system, which is unique for each pathogen. For leptospirosis, the transmission mode is universally the same, namely through human contact with surface waters or moist soil that harbors Leptospira interrogans. This needs translation to the local scene – which water, which soil, is contaminated? What type of contact carries risk of infection? As this bacterium does not multiply ex vivo, the transmission system goes beyond water and soil, to the animals that shed the bacteria into the environment.

Unless the pathogen is in plenty, human contact with them is unlikely. The final human inoculum size would be very small; perhaps even one viable microbe may establish infection. But there have to be millions and billions of them amplified and dispersed in much larger areas than just where humans tread, for some one to get infected. This amplification system is also unique for each pathogen. Public health intervention must address transmission and amplification systems. Much detailed information on both systems in the specific locality must be obtained and updated by the public health personnel, for designing and adapting interventions. The purpose is risk reduction as a means to reduce the probability of transmission, hence the frequency of infection, which alone will reduce disease incidence. Thus both amplification and transmission must be targeted for intervention. Monitoring of effectiveness and efficiency of interventions is through keeping a count on human cases.

The sylvatic amplification of L. interrogans in wild rodents cannot be controlled without intruding into wild life ecology. It is peridomestic amplification that puts humans at risk of exposure. Infection in peridomestic and agriculture-related rodents is the interphase between sylvatic and human-habitat amplification. That interphase is amenable to control inter-

ventions. Occasionally large domestic animals play a role in amplification and that link in the chain can also be easily broken. Transmission channels are relatively simple – direct skin contact with moist soil or surface water where organisms survive due to amplification.

An important principle of control of infection in such complex eco-epidemiology is that it must include as many interventions as are realistically possible. In the past international (and our own) public health leaders had a misconception that one specific and easy intervention is all that takes to control a disease. Thus, outdoor spray of DDT was the only intervention to control malaria and its failure is history. Treatment of only sputum positive adults with tuberculosis was the only intervention to control tuberculosis. Mass treatment with hetrazan is the sole intervention against lymphatic filariasis. Such an approach of public health sans health care makes no sense.

### Defining leptospirosis control

In the case of leptospirosis, what can be predictably reduced is the risk of infection, to achieve reduced frequency of infection, in other words incidence. But what can be measured is the reduction in human disease, to reflect reduced incidence of infection. To measure human leptospirosis incidence, three steps are necessary-
1. The clinical diagnosis must be based on criteria and supported by laboratory data.
2. Every clinically diagnosed case must be reported to a public health officer.
3. The officer must count the reported cases and spot-map their locations.

This sequence must be fulfilled in all districts of the state before embarking on a control mission. The state public health agency must define the degree of control intended to be achieved within a specified time frame (see definition of control). It is all too easy to apply one or two interventions that are evidently rational, and declare that the health department is controlling leptospirosis. This is a common mistake, or a ‘political gimmick’ to satisfy the media or to consume allotted emergency funds during an outbreak. In this context, health officers in some states have resorted to ‘awareness creation’ through various means and called it leptospirosis control. Often the victims are blamed for not taking precautions – an unethical escape route for public health officers. In some districts people were advised such unrealistic measures as wearing boots while stepping into paddy fields or avoiding wading in water altogether. In several localities, campaigns to capture and kill rodents went in the name of leptospirosis control. Some of these are done with good intention, but are obviously professionally inadequate.

The sylvatic reservoir of Leptospirosis will remain irrespective of control, and disease-control in humans is only for the time being. Like tetanus, only human disease can be prevented, not the presence of the pathogen in the environment. There will
always be the potential of its comeback if the system becomes lax. In other words, once launched, control is for long-term. And, the public health system must be competent enough to pick up even one case of human leptospirosis after control has been achieved. It is with this in mind that the Kerala project is named ‘leptospirosis elimination programme’. The terms ‘elimination’ and ‘programme’ were carefully chosen. When the incidence reaches zero over time, elimination of human disease is achieved. Therefore, the term elimination binds public health to keep incidence zero and to detect even one case in the community. The term programme signifies its perpetual placement within public health.

In areas with the sylvatic reservoir, heavy rainfall, particularly with flooding, is a predisposing factor for the outbreak of leptospirosis. Such episodes seem to have occurred in recent years in Gujarat, Orissa and Maharashtra. The increased risk appears to be due to the displacement of large number of rodents, rodent death and discharge of the organisms, distribution of the organisms in wide areas (particularly inhabited) and contact with stagnant water containing the organisms, and perhaps other factors. Forewarned is forearmed – therefore public health officers must be alert to take preventive and pre-emptive measures to caution the medical personnel about the likelihood of the disease in the local population.

**The essential elements of leptospirosis control**

1. A broad based infectious-disease control policy, priority and programme in the government health system are the first requirement. Health system encompasses health care and public health, health care under public and private sectors, but public health under public sector. Every state is empowered to adopt its own priorities and programmes, as health is a subject on the concurrent list. It is unnecessary to wait for a national policy or priority to guide the state. As pointed out earlier, national priorities tend to be determined by outside experts for whom leptospirosis is unlikely to make their grade. State priorities are set by the state.

2. Public health training of all officers of public health is another prerequisite for designing and implementing interventions and their evaluation, meeting professional standards. It will be interesting to ascertain if such requirement exists in each state in which the readers reside. Earlier (preindependence) it was required in every ‘presidency’ or kingdom, but after independence, medical professionals prevailed upon many State governments to change the rules so that doctors without public health training also got the opportunity to rise to such senior posts as district and state health officers. Today its negative side is all too obvious.

3. A functional disease surveillance programme is essential for leptospirosis control. Every physician who sees a patient with fever likely to be leptospirosis must report the event to the local health officer. The revenue district is the ideal unit of reporting. Hence the case report should be addressed to the district health officer or the designated surveillance officer. Doctors in both public sector and private sector health care institutions (including medical colleges) must be required to report selected diseases (including leptospirosis) under the surveillance system. Other diseases to be included under surveillance should be decided by the state. In Kerala, the list of diseases under district-based surveillance includes: acute flaccid paralysis, cholera/cholera-like disease, diphtheria, dysentery (amebic/bacillary/undifferentiated), encephalitis, fever with bleeding tendency, hepatitis, leptospirosis, malaria (falciparum, vivax, mixed, undifferentiated), measles, meningitis (pyogenic, aseptic, undifferentiated), rabies, tetanus neonatorum, tetanus in older age groups, typhoid fever, whooping cough, any other (to be specified). The functional link between health care and public health begins with health care workers informing public health officials of local occurrence of notified diseases. No one will keep the interest going to report only a single disease such as leptospirosis. Within a system of inclusive disease surveillance, leptospirosis must be added in those states in which it has been recognized. A set of criteria for the clinical diagnosis of each disease under surveillance must be made available and reinforced annually to the reporting institutions and physicians. Regular periodic disease summary bulletins must be published and widely distributed.

4. Access to diagnostic laboratory support for public health is essential for monitoring leptospirosis control. The laboratory must have internal quality control protocol in use, participation in an external quality assessment scheme, and facilities for test on demand (instead of batch-testing for convenience). Already a network of leptospirosis laboratories have been identified, and strengthened, under one national reference centre in Port Blair in the Andaman and Nicobar Islands. Once the public health system registers the occurrence of leptospirosis in a specific location (village, block, town, taluka and district), it is important that epidemiological investigations are conducted to measure and monitor the magnitude of its prevalence in the population and to identify the specific risk factors in that particular locale. Risk factor assessment requires the survey of local fauna, especially of rodents, with attention to variety and population, and also investigation of the epizootology of animal leptospirosis – both in the wild and in domesticated mammals.

**Case definition, detection and treatment**

Every infected person may not have a clinically identifiable illness. Many have subclinical infection and others may have a very mild and short-lived fever not reaching medical attention. Symptomatic leptospirosis presents in two phases and clinical forms. The first is the fever phase, lasting 4–9 days. Essentially the diagnostic case definition is: fever lasting more than 3 days; severe myalgia, especially of calf muscles; tenderness of the same muscles and no other clinical syndrome likely. Nonessential but supportive features include conjunctival suffusion, mild bleeding into conjunctivae/skin, or mild jaundice without other features of viral hepatitis. The presence or ab-
sense of rash does not help, unless typical of an exanthematous fever helping to diagnose another clinical syndrome. Headache, chills, etc. may or may not be present. Severe cases may have deeper jaundice, severe bleeding manifestations (due to vasculitis), nephritis or myocarditis, in the acute phase itself. Beyond a week, the second phase may occur in a proportion of patients, with organ-system involvement. Fever might have come down or reappeared. The organ system involvement may manifest as meningitis; hepatitis; nephritis (renal failure); myocarditis or haemorrhagic pneumonia. This sequence is believed to be caused by immune complex related pathology. Often people present only in the second phase, the first phase having been taken lightly. The information of the local occurrence of leptospirosis helps clinicians to maintain high index of suspicion.

Laboratory tests (other than specific ones to detect evidence of leptospiral infection) are more helpful to exclude other illnesses than to confirm leptospirosis. Specific aetiological diagnosis requires detection of the spiral organism in body fluids or tissue, culture of the bacteria or antibody detection (discussed elsewhere in this journal). Recently, a rapid visual assay for IgM antibody has been found to be useful for diagnosis.\(^{[10]}\) Basically, there are three issues for laboratory diagnosis – (i) direct laboratory evidence of leptospiral infection by way of microscopy of body fluids, serology or culture; (ii) indirect supportive evidence such as elevated serum amylase level and\(^{[11]}\) (iii) tests to detect or exclude other possible causes of illness. It is neither necessary nor possible to confirm the diagnosis in every suspected case. Indeed it is important that specific antimicrobial treatment is given early in the course of the first phase illness, by the third or latest fourth day of fever, if the second phase is to be predictably prevented.\(^{[12]}\) If treated within 7 days of fever, the clinical course may be significantly shortened.\(^{[13]}\) Therefore, the knowledge of local prevalence of leptospirosis and the clinical features together must alert the clinician to begin treatment and simultaneously start the tests to assess the validity of diagnosis. Case reporting for surveillance will only state ‘clinical’ or ‘suspected’ leptospirosis. The public health system will have to monitor such reports and when warranted by the number of reports, investigate a sample of cases to arrive at laboratory-supported diagnosis.

The second phase (immune complex disease) is determined by the intensity and duration of antigen-presence in the body. If treated within the first four days of fever, the second phase can be prevented.\(^{[12]}\) Beyond that interval, the predictability of prevention declines – yet, specific treatment is to be given when fever is present – even into the second phase. Such prevention of ‘complications’ and death (secondary prevention) are essential components of disease-control measures – leptospirosis is no exception. Laboratory confirmation of leptospirosis in this phase is unlikely to be of help for the individual patient, but the information is important for epidemiological purposes – to identify locality and season of its prevalence.

**Interventions and time sequence of control programme**

During the first year, the health officer must spot-map every reported case of (suspected) leptospirosis. This will give a spatial and temporal distribution profile of disease. The list of reporting institutions must be made and each of them should be asked if it has a laboratory diagnostic support system. When these data are collated the state will have a clear picture of the geographic prevalence of disease. Although one cannot assume that data in one year will represent the true picture, the cost of intervention could be conserved if nonendemic districts are excluded, until proven otherwise.

A visit by a designated health functionary to the household of every reported case is a necessity once control mode has been activated. A detailed eco-epidemiology questionnaire must be used in order to capture all the relevant elements of risk factors. Where necessary a sample of blood should be collected both from the index patient and as many household members as decided by the public health agency. All such sera must be tested for evidence of recent or past infection with leptospira. In the second year, the first year’s activity must be continued and in addition interventions must be instituted, designed on the basis of risk factors detected in the first year. Obviously, intervention must be focused to the areas where infection is documented; elsewhere there is no need for intervention, but surveillance must continue. In addition to educating people (and doctors in public and private sectors and other health workers) on the nature of disease and its antecedent infection, the following steps may be needed.

- If large animals are found to be infected, then vaccination of pet dogs, cattle, sheep etc. with help from department of animal husbandry.
- A simple question to ask of the household with a case is if any member had seen a rat within the previous 7 days. If the answer is positive, immediate rat ‘control’ is warranted. Rats should be trapped and killed humanely. Rodent trapping and speciation, test bleeding for antibody prevalence, culturing of dissected kidneys for leptospires is recommended with assistance from relevant government agencies and the supporting laboratory. If the answer to rodent sighting is in the negative, rat control is not priority just yet. However, rodents should still be trapped for testing.
- It is important to identify the spots where people appear to have been exposed – whether it is paddy of sugarcane field, or a pond or stream. If surface water is a suspected source, then its pH must be measured and if alkaline, the best local measures to make it acidic should be instituted with help from agriculture department.
- If physical contact with potentially contaminated water is inevitable, e.g. for paddy cultivation, then one dose of doxycycline must be given for prophylaxis. This may be repeated weekly as needed.
- If surface-well is used to draw drinking water (or for other personal use), then heavy chlorination must be done until rodent population is markedly reduced.
The implementation will require partnership between health components of public and private sectors, and within public sector, the dovetailing of Central, State and Panchayati functionaries.

Leptospirosis being zoonotic in nature, coordination between agriculture, animal husbandry/veterinary and forest sectors in support of health system will be necessary for effective control.

The government and the public will be participants in leptospirosis-control and they must be regularly informed of the successes and failures of the activities so that their continued support, financial and operational, will be ensured. The disease-surveillance bulletin is the best medium for this purpose. At the beginning and thereafter the media should be informed of the control programme and its progress.

**Conclusion**

The most important element in leptospirosis control is the ‘political will’ to implement it. Unless its control is state priority, and unless the public health wing is assigned responsibility and accountability by the Government, all that is stated above will remain in the realm of theoretical knowledge. Once a state determines that leptospirosis must be controlled, as in the case of Kerala, thereafter the matter is in the hands of the technical experts of the public health system of the state. Leptospirosis control in isolation is unlikely to take off unless it is integrated with other priority disease control tactics also. The dynamics of real time disease-surveillance, the number of diseases under control mode and the success of leptospirosis control in endemic states – these are yardsticks with which we can measure the Government’s public health commitment.

**References**