PREVENTIVE MEASURES FOR LEPTOSPIROSIS: RODENT CONTROL

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The Human Capital theory of 1960s denotes that preventing diseases and death increases the population efficiency.1 Further, numerous sociological and economic studies also confirmed that much fertile land lay idle because of human diseases.2 Leptospirosis is one of the commonly occurring diseases highly prevailing in human populations, but most often unidentified. As per the International Leptospirosis Society (ILS) report, the disease incidence range from 0.1-1.0 per 100,000 in temperate climates to 10-100 per 100,000 in humid tropics.3 It is an infectious disease caused by pathogenic bacteria called *Leptospira* that are transmitted directly or indirectly from animals to humans. In India, outbreaks are being increasingly reported since 1980s, especially from the states of Gujarat, Kerala, Karnataka, Maharashtra orissa and Tamil Nadu.4,8 Outbreaks mostly occur as a result of heavy rainfall and consequent flooding, normally during monsoons.8-10

**Permanent maintenance: Hosts or reservoirs**

Mammals form a major source of permanent maintenance hosts or reservoirs. The most important are small mammal species, notably feral and peri-domestic rodents, insectivores like shrews and domestic animals like cattle, pigs and dogs.3,7

The infections are maintained within these populations through vertical and horizontal transmission and form the infection reservoir. They carry a particular strain of *Leptospira* in their kidneys and shed them with their urine for long periods and even for their lifespan, without causing any illness for them. Infected animals transfer leptospires to their offspring.
either in-utero or during neonatal period, thereby making a chain of infection by the maintenance host. Their role can be confirmed after leptospires are cultured from urine or kidneys. Rodents were recognized as the most important and widely distributed reservoirs of leptospiral infection. Several incidences of human and animal leptospirosis in over forty countries are traced to rodent origin. Fifty four per cent serological prevalence of leptospirosis was reported among rodents in Karnataka. Limited work in India indicated four rodent species i.e, Norway rat (Rattus norvegicus), house rat (R. rattus), lesser bandicoot (Bandicota bengalensis) and larger bandicoot (B. indica) as associated with this disease. Humans are dead end hosts and do not provide an infection reservoir. Since 14 rodent species are predominant in the country and the leptospiiral infection is spreading in the country, there is an immediate need for screening these species for their role as vectors for leptospirosis.

Risk factors and risk groups

Farm workers in irrigated crops get indirect exposure to infected rodents or water contaminated with their urine. Sewer workers exposed to sewage contaminated by rat urine and children exposed while playing in yards contaminated by animals like dogs, pigs and rats, also are vulnerable to the infection. Although leptospirosis is reported mostly as a rural disease, people living in urban areas are also exposed notably to rats and thereby infected with leptospirosis. However, the risk of such exposure depends on the level of hygiene both in the house and its immediate environment sometimes, an entire village may be exposed when the drinking water source is inadequately treated.

Interventions to prevent leptospirosis

Prevention and control measures should be targeted at the infection source, i.e., rodent vectors and the route of transmission between them and the humans. Several interventions may prevent the incidence of leptospirosis. The interventions can be technically through (i) rodent vector control and (ii) improved hygiene, preventing rodents in the surroundings. Administratively, it may be through collaborative actions involving agriculture, health and veterinary departments to combat them in urban and rural human habitation areas. The management planning should consider (i) specific areas/villages to be covered for anti-rodent operations, (ii) time of control operations and personnel who deal with the operations, (iii) timely procurement of inputs for control operations and (iv) methods for community-participation for effective prevention of the infection to humans as well as animals.

Rodent vector control

The fifth annual congress of Indian Leptospirosis society, which met during 2005 at Surat recommended rat control measures on community scale on mission mode approach by involving Government, Corporate, Cooperatives and Panchayats for at least 5 to 10 years. Gujarat is the first state to implement large-scale rodent control measures for preventing rodent borne diseases, viz, plague and leptospirosis. During 2005, the state implemented rodent control in 107 villages in three South Gujarat districts [Table 1]. A limited leptospirosis control activity in Chennai reported a rodent control success of 87.9% in a campaign that covered 0.52 sq. km area with 1475 houses using 400 kg. bromadiolone RB. In a community-based rodent control programme in three districts of Andhra Pradesh, closely monitored by the author; a control success of 81.53% was achieved during 2004 by the officials of agriculture department and covered an area of 4.11 lakh hectares with 4,289 kg of bromadiolone CB in broken rice with an expenditure of Rs. 51.47 lakh in 108 Mandalas [Table 2].

Focusing areas for treatment

In order to get such focused attention for vector control, surveillance of the disease is required to be undertaken by the health department and the information be given to agriculture department for planning rodent control measures accordingly. During the surveys, sample collection of both rodent species as well as their infestation levels is required to be done. Sampling involves identification of the rodent species, collection of serum or tissues and transport of samples to the laboratory. Surat Municipal Corporation established such a surveillance system in which rodents are trapped periodically in seven zones for infestation levels and for collection of sera and viscera for laboratory examination.

Data obtained in South Gujarat on the incidence of leptospirosis during 2005 indicated that 123 out of 988 villages were affected in Surat, 70 out of 393 in Navsari and 58 out of 470 in Valsad districts. However, 146 villages in Navsari and 107 villages in Valsad district were treated. Hence focusing on the affected and surrounding villages will reduce the area required for anti-rodent treatment that reduces the effort and consequent costs [Table 1].

Proper timing of rodent control

Timing rodent control is vital due to synchronization of rodent breeding that starts with southwest monsoon leading to more leptospiral infections related to flood waters. India receives more rainfall during southwest monsoon and hence more infections could be witnessed during this period. Higher prevalence of human leptospirosis was reported during post-monsoon months in Kerala. Similar trend could be seen in Andaman. Gujarat receives its rainfall from the southwest monsoon (June to September), its maximum intensity being in the months of July and August. The monthly disease incidence from 1997 to 2005 was from July till October every year. Rodents also breed from the onset of monsoon. This denotes that rodent control measures in pre-monsoon period (summer) would bring better vector control and also prevent the disease.
Particulars | Surat | Navsari | Valsad |
--- | --- | --- | --- |
No. of most affected talukas | 10 | 5 | 2 |
Total talukas in district | 10 | 5 | 5 |
No. of affected villages | 123 | 70 | 58 |
Total villages in district | 988 | 393 | 469 |
No. of affected cases | 185 | 114 | 88 |
No. of deaths | 43 | 26 | 11 |
No. of villages treated | 146 | 146 | 107 |
No. of rat burrows treated | 4,12,200 | 1,629 | 1,58,820 |
Quantity of rodenticide – Bromadiolone RB (Kg.) | 4,118 | 4,122 | 2,647 |
Cost of rodenticide (Rupees in lakhs) | 7.0 | 4.5 | 4.5 |
No of deaths | 1,33,783 | 2,88,600 | 26,057 |

Multi-pronged approach is needed for effective rodent vector control viz, focusing areas for treatment, timing the control operations, appropriate technical know-how, capacity building for concerned implementation staff, awareness creation among farming community and timely procurement of inputs.

Table 2: Particulars of rodent control campaigns organized in Andhra Pradesh during 2003-04

<table>
<thead>
<tr>
<th>Particulars</th>
<th>East Godavari district</th>
<th>West Godavari district</th>
<th>Krishna district</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area treated (in lakh hectares)</td>
<td>1.5</td>
<td>2.0</td>
<td>0.66</td>
<td>4.11</td>
</tr>
<tr>
<td>No. of Mandals treated</td>
<td>50</td>
<td>28</td>
<td>30</td>
<td>108</td>
</tr>
<tr>
<td>Quantity of rodenticide (kg)</td>
<td>1,629</td>
<td>2,000</td>
<td>660</td>
<td>4,289</td>
</tr>
<tr>
<td>Cost of rodenticide - Bromadiolone “C” (Rs. in lakhs)</td>
<td>19.55</td>
<td>24.0</td>
<td>7.92</td>
<td>51.47</td>
</tr>
<tr>
<td>Rodent control success (%)</td>
<td>65</td>
<td>86</td>
<td>93.6</td>
<td>81.53</td>
</tr>
</tbody>
</table>

Among peasants.

**Appropriate know-how on rodent vector control**

Rodents exhibit two types of breeding patterns - normal or ‘k’ and fast breeding or ‘r’. Unless the rodent control operations are planned in larger areas, the residual population would get in to faster (‘r’) breeding mode, and produce litter with 15-20 young ones, while in normal breeding the litter size is around six only. Due to this reason rodent re-establish fast in areas where individual farmlands are treated with rodenticide. Such faster breeding was reported in Andhra Pradesh when post-cyclonic rodent incidence was very high due to increase in the breeding by field rodents, although floods killed part of the field rodent population.

Second major aspect is appropriate rodenticide for application. The third meeting of expert committee on rodent control decided that zinc phosphide might be used at severe infestations (where live burrows are more than 50 per hectare) to bring down the infestation levels and to maintain with anti-coagulant baiting. Under moderate infestation levels up to 50 live burrows per hectare level, single dose anti-coagulant bromadiolone ‘C’ in cereal baits may be used in the field conditions, while multiple dose anti-coagulant, coumatetrayl TP in cereal baits may be used to treat farmhouses, where non-target animals will be more. It was also decided that the bromadiolone RB (ready-to-use cake) might be restricted to inaccessible areas and coconut plantations.

The third aspect is proper application of the rodenticide baits in fields as well as in residential situations. Field areas could be treated with packing the rodenticide baits and keeping three cm inside the rodent burrows to avoid accidental toxicity hazards to non-target species. In crops like sugarcane, the canes are mostly lodged and hence application of baits would be difficult. Under such situations the compact baits could be broadcasted. In residential areas, simple bait stations would give effective results. The bait stations not only attract the rodents, but also prevent access to non-target animals; thereby ensuring their safety. Permanent bait stations with pre-fabricated cement molds were developed at Tirumala for rodent control and are now being used in Surat Municipal Corporation areas.

Lastly, evaluating control success is very essential. Appropriate method of evaluation is to compare rodent infestation before and after control operations. The infestation can be measured either by live burrow count in a randomly selected unit area in crop fields and by tracking at 10 x 10 cm with inert dust in residential premises. Number of dead rats never gives level of control success. Similarly showing number of burrows treated would not reflect the area treated. The progress may indicate the total area covered, since rodent control should be resorted in larger areas, not individual treatment of burrows.
Capacity building

Capacity building through developing human resources on proper rodent control among the technical persons will bring optimum results of rodent control. It should be remembered that even minute leftover rodent population could cause the disease through their urine. Measures of capacity building among health officers of different states during 2005 by National Plant Protection Training Institute, a training wing of Ministry of Agriculture brought encouraging follow-up results in respective states.

Creating public awareness

One possibility is to increase the awareness on the role of rodents in the spread of the disease among the population, risk-groups and health officials so that appropriate measures are initiated. Community education may be made through brochures, videotapes, warning signs, display boards, T-shirts etc.

Access denial to rodents

Denying access to the rodent vectors into the domestic areas would also prevent the infection spread to humans in urban and domestic areas. Such access denial could be direct or indirect. Directly rodents could be denied access to food and drinking water by taking rodent-proofing measures to existing buildings or by constructing rodent proof warehouses. Indirect denial can be achieved by moving all waste food out of reach of pests and blocking their entry points inside the premises.20 They can be deterred from the areas of human habitation by keeping the surroundings clean, removing rubble and installing adequate sanitation and waste disposal.

References


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