

## A report on the indoor residual spraying (IRS) in the control of *Phlebotomus argentipes*, the vector of visceral leishmaniasis in Bihar (India): an initiative towards total elimination targeting 2015 (Series-1)

V. Kumar<sup>a</sup>, S. Kesari<sup>a</sup>, D.S. Dinesh<sup>a</sup>, A.K. Tiwari<sup>b</sup>, A.J. Kumar<sup>a</sup>, R. Kumar<sup>a</sup>, V.P. Singh<sup>a</sup> & P. Das<sup>a</sup>

<sup>a</sup>Rajendra Memorial Research Institute of Medical Sciences, Patna; <sup>b</sup>State Health Society, Patna, Bihar, India

### Abstract

**Background & objectives:** Visceral leishmaniasis, commonly known as kala-azar is endemic in Bihar state, India. Current vector control programme in Bihar focuses mainly on spraying the sandfly infested dwellings with DDT. The Government of India in collaboration with WHO has fixed the target 2015 for total elimination of kala-azar. The present study was carried out to see the impact of DDT and improved IEC in the containment of vector density vis-à-vis disease transmission.

**Methods:** Before the start of the spraying operations training was imparted to all the medical and paramedical personnel regarding the methods of spraying operations. Pre- and post-sandfly density was monitored in four selected districts. Incidences of kala-azar cases were compared for pre- and post-spray periods. Social acceptability and perceptions of households was collected through questionnaires from 500 randomly selected households in the study districts.

**Results:** House index in three study districts reduced considerably during post-spray when compared to pre-spray. Kala-azar incidence in many districts was reduced after the DDT spray. Either partial or complete refusal was reported in 14.4%, while 35% were not satisfied with the suspension concentration and coverage; and 46.6% were found satisfied with the spraying procedure.

**Interpretation & conclusion:** Strengthening the IEC activities to sensitise the community, proper training of health personnel, monitoring of spray, good surveillance, proper treatment of cases and two rounds of DDT spray with good coverage in the endemic districts up to three years are essential to achieve the desired total elimination of kala-azar in Bihar state.

**Key words** Bihar – DDT – IEC – indoor residual spray – *Phlebotomus argentipes* – visceral leishmaniasis

### Introduction

Visceral leishmaniasis, popularly known as kala-azar in Indian subcontinent is a vector-borne disease caused by the trypanosomatid parasite *Leishmania donovani* in the Indian subcontinent and is transmitted by *Phlebotomus argentipes*<sup>1</sup>. According to WHO report about 50,000 cases occur annually. India, Nepal, Bangladesh and Brazil alone accounts for 90% of the global cases. This disease affects mainly socially

marginalized and the poorest communities. In Bangladesh, India and Nepal, approximately 200 million people are ‘at risk’ of visceral leishmaniasis (VL) in more than 109 districts<sup>2</sup>. The WHO classify leishmaniasis as an ‘emerging or uncontrolled disease’ and indicate that the research focus should be for category I diseases<sup>3</sup> aiming towards ‘the acquisition of new knowledge and the design of new disease control tools and systems’. India launched the kala-azar elimination programme with effect from December 2003

with the objective of eliminating the disease by 2015. Current disease control programmes in India and world over are focused on the prophylactic and therapeutic use of anti-leishmanial drugs. Pentavalent antimonial drugs are widely used for the treatment of VL and there is a possibility of development of resistance to these drugs and the longer treatment regime has associated side-effects. Current vector control programme in India focuses mainly on spraying the sandfly-infested dwellings with DDT.

The objective of any vector control programme is to manipulate the mean level of vector abundance so as to prevent disease outbreak of transmission. Keeping this objective in mind since 1991 spraying of DDT is being conducted in the endemic districts of Bihar. Between 1960 and 1970 kala-azar cases have apparently disappeared due to collateral benefit of DDT spray under National Malaria Eradication Programme, however, after withdrawal of DDT spraying in mid-sixties resulted in building up of vector sandfly population. Since the simmering foci of kala-azar existed, cases started reappearing in early seventies<sup>4</sup>. Since the outbreak of kala-azar in 1970s, regular spraying of DDT was undertaken. In 1990 kala-azar was declared as a notified disease. In 1991 two rounds and in 1992 one round of DDT was sprayed in all the endemic districts of Bihar. Since, then DDT spraying was done on focal basis. Despite this effort kala-azar cases were galloping and in 2006 the total number of cases was 29,711. Even this data are not accurate because it accounts only those patients who have reported in public health centres. Due to development of resistance against sodium antimony gluconate (SAG)<sup>5</sup> and scarcity of medicine a sizeable number of patients preferred treatment in private nursing homes which were not included in the present data. Therefore, the actual number of cases must have been higher than the figure presented. More importantly there is report of development of tolerance in *P. argentipes* against DDT<sup>6-9</sup>. It is imperative to see the impact of DDT on vector species and simultaneously on disease prevalence. Keeping this objective in mind a study was conducted in the endemic districts of Bihar.

## Material & Methods

The Bihar Government started extensive DDT spraying programme under the banner of State Health Society, Bihar. The spraying was done from 15 February to 15 April 2007. Rajendra Memorial Research Institute of Medical Sciences (RMRIMS) initially imparted training to all the DMOs, Malaria Inspectors and Basic Health Workers of 31 endemic districts of Bihar on preparation of spray suspension as per the WHO method; checking of discharge rate; spraying operations, etc. One day before the start of spraying operation with the help of mike villagers were given prior information by the staff of the respective PHCs regarding the spraying schedule. The community was sensitised regarding IRS of DDT and cooperation was sought to make the DDT spray programme successful.

Monitoring of spraying operation was conducted by the staff of respective PHCs and also by the staffs of National Vector Borne Disease Control Programme (NVBDCP), Delhi, National Institute of Communicable Diseases (NICD), Regional Health Office, Patna and RMRIMS. During monitoring, spraying operation was checked, DDT suspensions were verified, and houses were visited randomly to assess the quality of spray.

Sandfly density was evaluated in 119 endemic villages in Vaishali, Muzaffarpur, East Champaran and Saran districts prior to DDT spraying, one month and three months after the spray. The sandfly density was evaluated by standard aspirator method with the help of three-celled torch by the skilled insect collectors and technicians.

Incidence of kala-azar cases in the state was obtained from State Health Society. Cases reported in the month of December 2006 were considered as a base line data just before the start of spraying operation and monthly incidence of cases from June–September, and December 2007 were considered to assess the impact of DDT on the incidence of kala-azar cases. During the monitoring of DDT spraying

programme, 500 houses were interviewed randomly in all the study districts regarding social acceptability and perceptions of the spray operation.

### Results & Discussion

Pre- and post-spray sandfly house indices (percentage of houses positive for *P. argentipes*) are presented in Table 1. The results indicate that after the DDT spray the house index of *P. argentipes* decreased considerably when compared to pre-spray data in the study districts. Statistical analysis showed significant difference in the density of sandflies during pre- and post-spray periods in Vaishali, Saran and East Champaran districts ( $p < 0.05$ ) and there was no significant difference in Muzaffarpur district ( $p > 0.05$ ). These findings indicate the effectiveness of DDT in controlling the sandfly population.

Incidences of kala-azar cases in 22 districts of Bihar state in December 2006, and June to September and December 2007 are presented in Table 2. To see the impact of DDT in the incidence rate of kala-azar we have compared the number of cases in December 2006 with that of December 2007. In Begusarai, Gopalganj, Khagaria, Katihar, Madhepura, West Champaran, East Champaran, Samastipur, Kisanganj, Patna, Sitamarhi, Munger, Araria, Siwan and Supaul which are endemic districts, the incidence of kala-azar cases reduced considerably over the base line year and the percent reductions in incidence after one year were 88.73, 76.87, 48.7, 100, 74.2, 52.38, 100,

82.28, 65.79, 68.75, 49.35, 100, 49.19, 56.59 and 70.73, respectively. In most of the districts, the incidence of kala-azar cases reduced after the DDT spray coupled with IEC activities and efforts by the state government like compensation of wages, paying of Rs. 100 for reporting of cases, use of Miltefosin and Fungizone for treatment, etc. However, there are few endemic districts like Saharsa, Saran, Muzaffarpur and Vaishali districts that have shown increase in the incidence of cases in the month of December 2007 in comparison with December 2006. The possible reason of increase in the number of cases even after one year of spray is use of Miltefosin and Fungizone in these districts due to which patients are registering themselves even from far flung areas and also encouragement by the government for registering of cases at health facilities. These four districts are exceptional which require special attention during next round of spray. Similar findings have been reported by Thakur *et al*<sup>10</sup>.

Regarding the social acceptability of IRS programme, the study shows that out of the 500 households examined, 4.8% has totally refused the spraying due to different reasons and 9.6% refused partially. Although they accepted the spraying but they did not allow all the rooms to be sprayed like worship room, newly painted rooms, etc. and 35% mostly from the low socioeconomic group reported that spraying was not good in the sense of maintaining the concentration of DDT and coverage due to lack of supervision. About 4% households were locked at the time of

**Table 1. Pre- and post-spray *P. argentipes* house index**

Districts	Pre-spray				Post-spray (after one month)				Post-spray (after three months)			
	HH searched	<i>P. argentipes</i> collected	HH +ve for <i>P. argentipes</i>	% HI	HH searched	<i>P. argentipes</i> collected	HH +ve for <i>P. argentipes</i>	% HI	HH searched	<i>P. argentipes</i> collected	HH +ve for <i>P. argentipes</i>	% HI
Vaishali	328	31	29	8.84	105	0	Nil	Nil	215	17	8	3.72
Muzaffarpur	294	37	30	10.20	150	14	8	5.33	117	24	8	6.83
E. Champaran	235	3	3	1.27	—	—	—	—	305	35	22	7.21
Saran	314	70	53	16.87	—	—	—	—	242	23	5	2.06

(—) Data not collected; HH—Households; HI—House index.

**Table 2. Kala-azar case incidence during 2006–07 in endemic districts of Bihar**

Districts	Dec 2006		Jun 2007		Jul 2007		Aug 2007		Sep 2007		Dec 2007	
	Cases	Death	Cases	Death	Cases	Death	Cases	Death	Cases	Death	Cases	Death
Begusarai	213	5	101	4	–	–	89	5	60	1	24	2
Darbhanga	–	–	–	–	–	–	180	0	–	–	177	1
Gopalganj	320	0	–	–	–	–	1143	0	122	0	74	0
Katihar	115	0	–	–	385	5	–	–	72	1	0	0
Khagaria	154	0	–	–	–	–	44	0	–	–	79	0
Madhepura	345	0	255	0	–	–	–	–	706	0	89	0
Madhubani	–	–	92	0	–	–	154	0	199	0	35	0
West Champaran	42	0	83	0	26	1	18	1	36	0	20	0
East Champaran	209	2	281	1	233	1	310	3	243	1	0	0
Purnia	–	–	692	0	–	–	184	0	–	–	92	0
Samastipur	237	2	230	2	363	3	126	1	76	0	42	0
Kisanganj	38	0	65	0	22	0	–	–	14	0	13	0
Patna	48	0	–	–	59	0	24	1	25	0	15	0
Sitamarhi	77	1	104	4	107	2	94	2	55	0	39	1
Saharsa	81	0	1126	–	145	0	479	3	341	0	181	0
Munger	14	0	–	–	–	–	11	0	1	0	0	0
Araria	431	0	–	–	–	–	–	–	2565	0	219	0
Muzaffarpur	167	3	574	2	468	4	263	3	521	7	172	0
Saran	111	0	153	0	126	1	–	–	279	1	163	2
Siwan	129	0	233	0	109	0	110	0	62	0	56	0
Supaul	41	0	66	2	120	0	84	0	48	0	12	0
Vaishali	173	0	389	2	217	0	263	1	229	0	206	0

Source: By the courtesy of State Health Society, Bihar; (–) Data not available.

spray and the remaining 46.6% were found satisfied with the spraying programme. During the survey it was observed that out of 500 visited households, 39 were mud plastered on different ceremonies after one month of spray.

After a gap of more than one decade the entire endemic districts of north Bihar were covered under DDT spraying operation and efforts were also taken to implement the IEC programme prior to spraying operation. Declining trend of kala-azar cases in Begusarai, Gopalganj, Khagaria, Madhepura, West Champaran, East Champaran, Samastipur, Kisanganj, Patna, Sitamarhi, Munger, Araria, Siwan and Supaul reflects the vital role of IEC and monitoring of IRS spray in the containment of kala-azar. Further, it is suggested to strengthen the IEC activities to sensitise the community and thorough monitoring of spraying operation is essential to achieve the desired result in

stipulated time. Hence, with proper monitoring and training, two rounds of DDT spray with good house coverage in all the endemic districts up to three years and proper treatment of cases are essential for total elimination of kala-azar in Bihar state.

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*Corresponding author:* Dr P. Das, Director, Rajendra Memorial Research Institute of Medical Sciences (RMRIMS), Agam Kuan, Patna–800 007, India.  
E-mail: drpradeep.das@gmail.com

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