

# Monitoring and evaluation **tool kit** for indoor residual spraying

August 2010

Kala-azar elimination in Bangladesh, India and Nepal

#### **WHO Library Cataloguing-in-Publication Data**

Monitoring and evaluation tool kit for indoor residual spraying.

1.Insecticides - toxicity. 2.Mosquito control. 3.Leishmaniasis, Visceral - prevention and control. 4.Program evaluation - methods. 5.Bangladesh. 6.India. 7.Nepal. I.World Health Organization. Regional Office for South-East Asia.. II.UNICEF/UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases.

ISBN 978 92 4 150036 4

(NLM classification: WC 715)

#### **Copyright © World Health Organization on behalf of the Special Programme for Research and Training in Tropical Diseases 2010**

All rights reserved.

The use of content from this health information product for all non-commercial education, training and information purposes is encouraged, including translation, quotation and reproduction, in any medium, but the content must not be changed and full acknowledgement of the source must be clearly stated. A copy of any resulting product with such content should be sent to TDR, World Health Organization, Avenue Appia, 1211 Geneva 27, Switzerland. TDR is a World Health Organization (WHO) executed UNICEF/UNDP/World Bank/World Health Organization Special Programme for Research and Training in Tropical Diseases.

This information product is not for sale. The use of any information or content whatsoever from it for publicity or advertising, or for any commercial or income-generating purpose, is strictly prohibited. No elements of this information product, in part or in whole, may be used to promote any specific individual, entity or product, in any manner whatsoever.

The designations employed and the presentation of material in this health information product, including maps and other illustrative materials, do not imply the expression of any opinion whatsoever on the part of WHO, including TDR, the authors or any parties cooperating in the production, concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delineation of frontiers and borders.

Mention or depiction of any specific product or commercial enterprise does not imply endorsement or recommendation by WHO, including TDR, the authors or any parties cooperating in the production, in preference to others of a similar nature not mentioned or depicted.

The views expressed in this health information product are those of the authors and do not necessarily reflect those of WHO, including TDR. WHO, including TDR, and the authors of this health information product make no warranties or representations regarding the content, presentation, appearance, completeness or accuracy in any medium and shall not be held liable for any damages whatsoever as a result of its use or application. WHO, including TDR, reserves the right to make updates and changes without notice and accepts no liability for any errors or omissions in this regard. Any alteration to the original content brought about by display or access through different

media is not the responsibility of WHO, including TDR, or the authors. WHO, including TDR, and the authors accept no responsibility whatsoever for any inaccurate advice or information that is provided by sources reached via linkages or references to this health information product.

Web version only.

# Monitoring and evaluation tool kit for indoor residual spraying

*Kala-azar elimination in Bangladesh, India and Nepal*

August 2010

In collaboration with:

WHO Regional Office for South-East Asia (SEARO)

**Bangladesh:** Directorate General of Health Services (DGHS), Ministry of Health & Family Welfare; National Institute of Preventive and Social Medicine (NIPSOM); International Centre for Diarrhoeal Research, Bangladesh (ICDDR,B)

**India:** National Vector Borne Disease Control Programme (NVBDCP); Rajendra Memorial Research Institute of Medical Sciences (Indian Council of Medical Research)

**Nepal:** Epidemiology & Disease Control Division (EDCD), Ministry of Health; Institute of Medicine at Tribhuvan University; B P Koirala Institute of Health Sciences (BPKIHS)

## **Preface**

Integrated vector management is one of the key elements of the kala-azar (KA)/ visceral leishmaniasis (VL) elimination strategy in the three target countries – Bangladesh, India and Nepal. A research programme coordinated by the Special Programme for Research and Training in Tropical Diseases (TDR) and the World Health Organization (WHO)/WHO Regional Office for South-East Asia (SEARO) has shown that indoor residual spraying (IRS) in particular – but also long-lasting insecticide treated nets (LNs) and environmental management – are efficacious in reducing sandfly densities (Joshi et al. 2009; Das et al. 2010). However, in spite of enormous efforts, research has also shown that national vector control programmes need to be strengthened in order to achieve the goal of reducing vector densities to the low level required to interrupt KA transmission (Chowdhury et al. 2010).

This monitoring and evaluation (M&E) tool kit has been developed as an interagency effort involving both public health and academic institutions. Its main purpose is to support IRS programmes through systematic M&E of processes and outcomes, allowing timely detection of gaps and constraints and so ensuring that adequate responses are triggered.

The tool kit is designed not only to assist vector control managers in their daily practice but also as a background document for training and capacity building at all levels of the vector control programme.

This is a working document which will be adapted every two to four years according to experiences gained in field applications and feedback received from those who have applied it in their environments.

**We are grateful to The Federal Ministry for Economic Cooperation and Development (BMZ) and The Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) for their support and cooperation in the production of this document.**

# Contents

Preface	2
Abbreviations	5
<b>CHAPTER 1. INTRODUCTION AND JUSTIFICATION</b>	<b>6</b>
1.1 General features of organizing an IRS programme	6
1.2 Public health authorities involved in the IRS programme	7
1.3 Spray activities	9
1.3.1 Selection criteria for IRS areas	9
1.3.2 Calendar of IRS activities (preparation and implementation)	9
1.3.3 Dosage of insecticide	10
1.3.4 Spray timing	11
1.3.5 Insecticide requirements	11
1.3.6 Personnel requirements for spray activities	11
1.3.7 Spray equipment	13
1.3.8 Training of spray personnel	14
1.3.9 Pre-spray operations	15
1.3.10 Good and poor IRS practices	15
1.3.11 Need for M&E	17
<b>CHAPTER 2. M&amp;E (SELF-EVALUATION)</b>	
<b>AT CENTRAL/NATIONAL LEVEL</b>	<b>19</b>
2.1 Overview	19
2.2 M&E of progress and quality of IRS operations	20

<b>CHAPTER 3. M&amp;E OF PRE-SPRAY CYCLE AND SPRAY CYCLE</b>	
<b>ACTIVITIES AT DISTRICT AND PHC/BLOCK/UPAZILA/VDC LEVELS</b>	<b>24</b>
3.1 Overview	24
3.2 M&E checklists and reporting form	25
3.2.1 Checklist for preparation of IRS activities (pre-spray phase) at district level	25
3.2.2 Checklist for preparation of IRS activities (pre-spray phase) at PHC/upazila/VDC level	25
3.2.3 Reporting form for analysing and reporting PHC/upazila/VDC-level information on IRS activities during and at the end of spray cycle	25
3.3 Data processing and analysis	26
<b>CHAPTER 4. M&amp;E OF OPERATIONAL LEVEL (SPRAY SQUADS AND COMMUNITY)</b>	<b>30</b>
4.1 Overview	30
4.2 Observation of spray squads in sample villages	31
4.3 Verification of target dose of insecticide on sprayed walls (filter paper method)	31
4.4 HH interviews on community satisfaction and IRS coverage	32
4.5 Data processing and analysis	32
<b>CHAPTER 5. M&amp;E OF IRS IMPACT ON VECTOR DENSITIES, BIOEFFICACY AND INSECTICIDE SUSCEPTIBILITY</b>	<b>38</b>
5.1 Overview	38
5.2 Vector density (before and after spraying)	38
5.3 Bioefficacy of insecticide on sprayed surfaces (bioassay)	39
5.4 Insecticide susceptibility (WHO standard chamber method)	40
5.5 Correction of mortality in bioassay and susceptibility tests	40
References	49
Glossary	50

## Abbreviations

<b>AHI</b>	assistant health inspector
<b>BE</b>	budget estimate
<b>CDC</b>	Centers for Disease Control and Prevention
<b>DDT</b>	dichlorodiphenyltrichloroethane
<b>DGHS</b>	Directorate General of Health Services, Bangladesh
<b>DMO</b>	district malaria officer
<b>DPHO</b>	district public health officer
<b>EDCD</b>	Epidemiology and Disease Control Division, Nepal
<b>FCHV</b>	female community health volunteer
<b>HH</b>	household
<b>HI</b>	health inspector
<b>HP</b>	health post
<b>ID number</b>	identification number
<b>IEC</b>	information, education and communication
<b>IRS</b>	indoor residual spraying
<b>KA</b>	kala-azar
<b>LN</b>	long-lasting insecticide treated net (also abbreviated as LIN or LLIN)
<b>M&amp;E</b>	monitoring and evaluation
<b>MI</b>	malaria inspector
<b>MO</b>	medical officer
<b>MODC</b>	medical officer of disease control
<b>MPHW</b>	multipurpose health worker
<b>NVBDCP</b>	National Vector Borne Disease Control Programme, India
<b>PHC</b>	primary health centre
<b>PPE</b>	personal protective equipment
<b>PPS</b>	probability proportionate to size
<b>SI</b>	sanitary inspector
<b>SOE</b>	statement of expenditure
<b>UC</b>	utilization certificate
<b>UHC</b>	upazila health centre
<b>UHFPO</b>	upazila health and family planning officer
<b>VCA</b>	vector control assistant
<b>VCO</b>	vector control officer
<b>VDC</b>	village development committee
<b>WHOPES</b>	WHO Pesticides Evaluation Scheme

# CHAPTER 1. INTRODUCTION AND JUSTIFICATION

## 1.1 General features of organizing an IRS programme

Vector control is an essential element of the KA (or VL) elimination strategy in the Indian subcontinent. Of the various options for vector control, IRS with appropriate insecticides is a key intervention which can be used both to reduce the vector population in a given area and to interrupt transmission of disease-causing parasites.

The successful implementation of any IRS programme depends on well-organized planning, implementation that follows a strict timeline, and proper monitoring and supervision on all levels; timely feedback through monitoring allows appropriate corrective measures.

Technical guidelines on vector control and specifically for IRS are available in the three countries concerned – Bangladesh, India and Nepal. As well as providing technical guidance, central governments provide logistical support and financial assistance for IRS activities in the KA-endemic areas. States or districts<sup>1</sup> submit macro action plans detailing their requirements for insecticides; spray persons' wages; capacity building; mobility support; and information, education and communication (IEC) activities. Budgetary provisions for insecticide procurement are made in current-year budgets for use the following year. However, the cash grants are released from the national level to the districts for undertaking activities during the current year. Release of funds to the respective states or districts is dependent on the submission of utilization certificates (UCs) and statements of expenditure (SOEs). The process to supply the required insecticide is done one year in advance, depending on the spray cycles to be carried out.

State and/or district action plans need to be formulated well in advance, indicating the target population for IRS (based on the official criteria) and projecting the requirements for insecticides, funds, spray persons, spray pumps and other logistics. Training and IEC activities need to be planned in well-framed timelines so that proper training skills are developed to ensure good quality spraying and effective coverage. The advocacy of community leaders and sensitization (awareness raising) of the community plays an important role in achieving the goal for IRS activities. Adherence to the spray cycles is very important for achieving the required impact on the vector population and to interrupt transmission. Insecticides have residual effects, remaining on walls for a period of 10 to 12 weeks up to more than 6 months (see Table 1.2); therefore two rounds of insecticide spray are undertaken each year.

---

<sup>1</sup>This document refers to states (India only), districts (all three countries) and subdistricts. The latter are known as upazilas in Bangladesh, primary health centres (PHCs) in India and village development committees (VDCs) in Nepal.

## 1.2 Public health authorities involved in the IRS programme

The key functions of the public health authorities involved in the vector management programme are presented in Table 1.1 below.

**Table 1.1 Public health staff and their responsibilities in the VL vector control programme**

Hierarchy	Bangladesh	Nepal	India
<b>Central (national level) institution</b>	Directorate General of Health Services (DGHS)	Epidemiology and Disease Control Division (EDCD)	National Vector Borne Disease Control Programme (NVBDCP)
<b>Personnel</b>	Director-General, Director, Centers for Disease Control and Prevention (CDC); VL programme manager; VL deputy programme manager; chief health superintendent; senior entomologists	Director, EDCCD; malaria and KA programme manager; vector control officer; entomologist; malaria inspector (MI)	National KA programme manager
<b>Responsibilities</b>	<ul style="list-style-type: none"> <li>• Prepare annual action plan and budget for vector control activities</li> <li>• Procure logistics for vector control and distribute at upazila level</li> <li>• Plan, implement and evaluate vector control activities at national level</li> <li>• Oversee supervisor training</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare annual action plan and budget for vector control activities</li> <li>• Procure logistics for vector control and distribute at regional level</li> <li>• Plan, implement and evaluate vector control activities at national level</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare annual action plan and budget for vector control activities</li> <li>• Procure logistics for vector control and distribute at state level</li> <li>• Plan, implement and evaluate vector control activities at national level</li> </ul>
<b>State/regional level</b>	Not applicable	Regional health officer; regional medical officer (MO); MI	State KA programme manager; regional director of health and family welfare
<b>Responsibilities</b>		<ul style="list-style-type: none"> <li>• Prepare annual action plan and budget</li> <li>• Receive and distribute logistics to district level</li> <li>• Evaluate and monitor activities at regional level</li> <li>• Prepare annual report for central level</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare annual action plan and budget</li> <li>• Receive and distribute logistics and IEC materials</li> <li>• Evaluate and monitor activities at district level</li> <li>• Prepare annual report for central level</li> </ul>

Hierarchy	Bangladesh	Nepal	India
<p><b>District level personnel</b></p> <p><b>Responsibilities</b></p>	<p>Civil surgeon; district entomologist; health education officer; district health superintendent; district sanitary inspector (SI)</p> <ul style="list-style-type: none"> <li>• Help central level to monitor and evaluate vector control activities at upazila level</li> </ul>	<p>District public health officer (DPHO); vector control officer (VCO); vector control assistant (VCA); MI/statistical officer</p> <ul style="list-style-type: none"> <li>• Prepare annual action plan and budget at district level</li> <li>• Receive and distribute logistics to PHC/health post (HP) level</li> <li>• Monitor and evaluate activities at PHC level</li> <li>• Prepare annual report for regional/central level</li> <li>• Train spray squads</li> <li>• Implement vector control activities</li> </ul>	<p>District malaria officer (DMO)</p> <ul style="list-style-type: none"> <li>• Prepare annual action plan and budget at district level</li> <li>• Receive and distribute logistics to block level (block includes various PHCs)</li> <li>• Monitor and evaluate activities at block level</li> <li>• Prepare annual report for state level</li> </ul>
<p><b>PHC/VDC/upazila-level personnel</b></p> <p><b>Responsibilities</b></p>	<p>Upazila health and family planning officer (UHFPO); medical officer of disease control (MODC); health inspector (HI); SI; assistant health inspector (AHI)</p> <ul style="list-style-type: none"> <li>• Select villages and households (HHs) for vector control</li> <li>• Train spray squads</li> <li>• Implement vector control activities</li> <li>• Supervise spray squad activities</li> <li>• Report to district/central level</li> </ul>	<p>MO; MI</p> <ul style="list-style-type: none"> <li>• Select villages and HHs for vector control</li> <li>• Supervise spray squad activities</li> <li>• Report to district level</li> </ul>	<p>MO; MI</p> <ul style="list-style-type: none"> <li>• Select villages and HHs for vector control</li> <li>• Train spray squads</li> <li>• Implement vector control activities</li> <li>• Supervise spray squad activities</li> <li>• Report to block level</li> </ul>

### 1.3 Spray activities

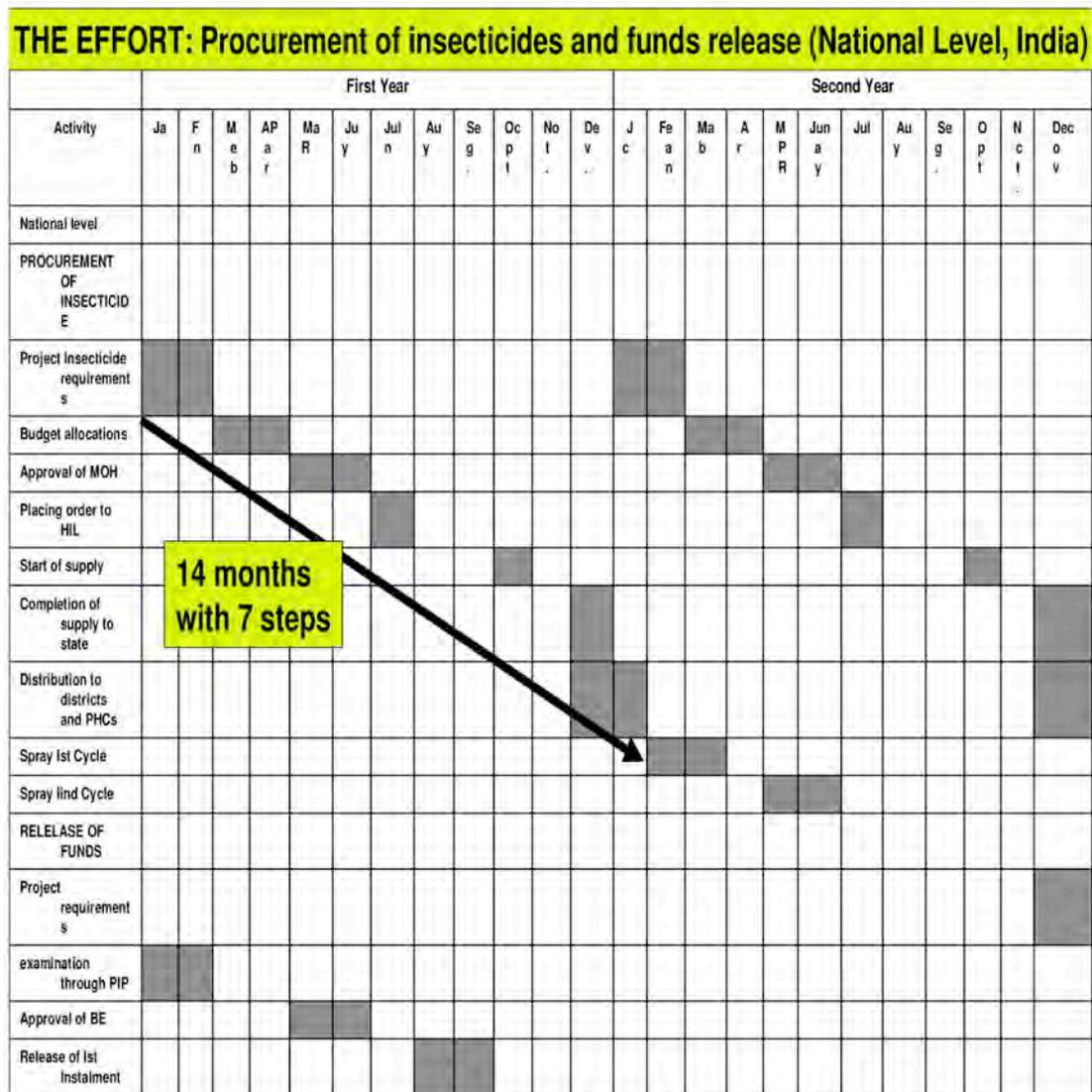
#### 1.3.1 Selection criteria for IRS areas

It is imperative that all VL-endemic villages, whether affected now or in the past, are sprayed with insecticides of acceptable quality. The selection criteria of villages to be sprayed are listed in Table 1.3.

#### 1.3.2 Calendar of IRS activities (preparation and implementation)

Fig. 1.1 below shows a calendar of key activities that have to be carried out at national and state level in India for the procurement of insecticide and for the release of funds. This example illustrates the necessity of careful planning and of ensuring the completion of different tasks within a given time frame.

**Fig. 1.1 The effort: procurement of insecticides and funds release (national level, India)**



#### 1.3.3 Dosage of insecticide

The insecticide application dosage is the same as that for antimalarial spraying. Some characteristics of different insecticides are provided below (Table 1.2). The inside walls of huts and cattle sheds should be treated with insecticide to a height of 1.8 m. Cattle sheds and the houses of KA positive and suspected cases should be prioritized.

**Table 1.2 WHO recommended insecticides for IRS against disease vectors** (updated October 2007)

Insecticide formulation	Class group	Dosages g.a.i. per m <sup>2</sup>	Mode of action	Duration of effective action (months)
DDT WP	OC	1–2	contact	>6
Malathion WP	OP	2	contact	2–3
Fenitrothion WP	OP	2	contact and airborne	3–6
Pirimiphosmethyl WP & EC	OP	1–2	contact and airborne	2–3
Bendiocarb WP	C	0.1–0.4	contact and airborne	2–6
Propoxur WP	C	1–2	contact and airborne	3–6
Alpha-cypermethrin WP & SC	P	0.02–0.03	contact	4–6
Bifenthrin	P	0.025–0.05	contact	3–6
Cyfluthrin WP	P	0.02–0.05	contact	3–6
Deltamethrin WP & WG	P	0.02–0.025	contact	3–6
Etofenprox WP	P	0.1–0.3	contact	3–6
Lambda-cyhalothrin WP & CS	P	0.02–0.03	contact	3–6

a.i. – active ingredient; CS – capsule suspension; EC – emulsifiable concentrate; WP –wetable powder; OC – organochlorines; OP – organophosphates; C – carbamates; P –pyrethroids.

**Note:** WHO recommendations on the use of pesticides in public health are valid ONLY if linked to WHO specifications for their quality control. WHO specifications are available on the WHO Pesticides Evaluation Scheme (WHOPES) web page: <http://www.who.int/whopes/quality/en/>.

#### **1.3.4 Spray timing**

Spraying is usually started to coincide with the build-up of vector populations and before the onset of VL transmission.

- The build-up in the population of the vector *Phlebotomus argentipes* starts in March in India and from April in Bangladesh and Nepal.
- The VL transmission season lasts from June to October in India and July to October in Bangladesh and Nepal.

The effectiveness of insecticide deposits depends on the chemical (Table 1.2 above) and other factors. Hence, two rounds of spraying are undertaken to control the *P. argentipes* population (Table 1.3).

#### **1.3.5 Insecticide requirements**

When insecticide wall spraying is restricted to a height of 1.6 m, it requires approximately half of the amount required for antimalarial spraying. A rural HH requires KA spraying on an average surface area of about 75 m<sup>2</sup>. However, insecticide requirements are often estimated as gram per capita (e.g. 37.5 g DDT 50% powder per capita in India; 15 g lambda-cyhalothrin powder per capita and 25 mg/m<sup>2</sup> in Nepal).

#### **1.3.6 Personnel requirements for spray activities**

In 1995 the WHO Expert Committee on Malaria recommended 26 squads for a 75-day spray period to cover a 1 million population with DDT or synthetic pyrethroids for the control of malaria.

On average, a spray squad of 5 persons can cover 100 houses per day in India; a squad of 4 persons can cover 40 houses per day in Nepal and 50–60 houses per day in Bangladesh. The calculation of manpower requirements is based on the number of HHs to be sprayed.

Some characteristics of the IRS programmes in the three countries are presented below (Table 1.3).

**Table 1.3 National programmes of IRS for VL vector control**

	<b>Bangladesh</b>	<b>Nepal</b>	<b>India</b>
<b>Spray squads</b>	<p>Daily waged spray persons; usually recently trained with no previous IRS experience</p> <p>Each squad includes 5 spray persons with 5 hand compressor pumps (8–10 litre capacity) and 1 squad leader.</p> <p>For 3 squads (1 group) there is 1 government level supervisor</p> <p>One team will spray 50–60 houses per day covering a population of 250–300</p>	<p>Daily waged spray persons, usually recently trained with no previous IRS experience</p> <p>Each squad includes 4 spray persons with 4 hand compression pumps (11 litre capacity) and 1 foreperson</p> <p>For 3 squads (1 group) there is one insecticide distributor and one government level supervisor</p> <p>This group of 17 persons using 12 spray pumps covers a population of 600 in 120 houses (240 houses and structures) per day</p>	<p>Daily waged spray persons, frequently with experience from previous IRS national programmes</p> <p>Each squad has 6 members: 2 pairs of operators + 1 person to prepare formulation in the stirrup pump + 1 supervisor</p> <p>A squad with 2 pumps covers 60–80 houses, an average of 300–400 persons per day</p>
<b>Insecticide</b>	Synthetic pyrethroid (deltamethrin WP)	Synthetic pyrethroid (lambda-cyhalothrin 10% or deltamethrin)	DDT 5% solution (active ingredient)
<b>Insecticide concentration</b>	Use 25 mg/m <sup>2</sup>	Dissolve 50 g lambdacyhalotrin in 8 litres water to reach a concentration of 0.025 g/m <sup>2</sup>	Dissolve 1 kg DDT WP in 10 litres water to reach a concentration of 1 g/m <sup>2</sup>
<b>Insecticide required for 1 million population X 2 cycles</b>	Approx 20 000 kg deltamethrin	15 000 kg lambda-cyhalothrin	75 000 kg DDT 50%
<b>Spray months</b>	March/April, August/September	March/April/May, August/September/October	February/March, May/June (Bihar & Jharkhand)  April/May, July/August (West Bengal & Uttar Pradesh)
<b>Target villages for IRS</b>	<p>a) With reported cases during previous 5 years</p> <p>b) With recent cases focal spray</p>	<p>a) With reported cases during previous year</p> <p>b) With recent 2 or more cases (focal spray in the neighbourhood of cases)</p>	<p>a) With reported VL cases and/or deaths in previous 5 years</p> <p>b) With new cases reported in current year</p>

### 1.3.7 Spray equipment

Each squad requires the following equipment:

- pumps (*India*: 2 stirrup pumps; *Bangladesh/Nepal*: 5 Hudson pumps)
- spray nozzle tips (5)
- leather cups (5)
- springs (5)
- washers (5)
- 15 litre buckets (4)
- 10 litre buckets (2)
- asbestos thread (3 metres)
- measuring mugs (2)
- straining cloth (1 metre)
- plastic sheet (3 x 3 metres) (1)
- register (1)
- stencil and/or chalk (for stencilling)

A good quality nozzle should be used. The squad supervisor must have extra spray pumps, nozzle tips, washers and asbestos thread.

A set of tools for minor repairs should also be available. These include a pipe wrench, pliers, screwdrivers and a set of spanners.

Each member of a squad must also be provided with personal protective equipment (PPE) that includes a towel and soap.



**Protective clothing and compressor pump**



### **Protective clothing and stirrup pump**

*Photos courtesy of NVBDCP*

#### **1.3.8 Training of spray personnel**

Squad recruitment should be undertaken well in advance so that spray persons are able to complete their training *at least one week before* the date scheduled for spray operations.

Training should cover each aspect of the spray operations and include the following topics:

- preparation of suspension/solution;
- various parts and the operation of pumps;
- regulation of flow from nozzle tip;
- regulation of speed of application, including movements of the lance and spray persons;
- care and maintenance of spray equipment;
- safety precautions in handling and spraying insecticides;
- disposal of surplus insecticide suspension and sachets/containers.

Additionally, supervisors should be trained in:

- enumeration of houses
- marking of houses
- mapping
- cleaning procedures
- raising community awareness/provision of advance information
- record keeping and reporting
- safety and precautionary measures.

### **1.3.9 Pre-spray operations**

The following activities must be completed before spraying starts:

- selection of areas to be sprayed
- calculation of quantities of insecticides and equipment required
- hiring and training of spray squads
- notification of the community.

In India these tasks will mainly be carried out by the MO and/or MI at PHC level. In Bangladesh personnel at central level will cover the first two activities; the last two activities will be carried out at district and upazila level. In Nepal the tasks will be completed by the DPHO at VDC level.

### **1.3.10 Good and poor IRS practices**

Bad practice is not uncommon during spray activities. The following highlight the most common issues and what should be done:

- external walls should not be sprayed;
- spray solution should not be carried in damaged buckets;
- hanging objects/pictures/photos etc. should be removed and stored elsewhere before walls are sprayed;
- leaking nozzle tips and lances waste large amounts of insecticide and should be replaced;
- food grains should be covered with plastic sheets before spraying;
- spray persons should mix formulations well away from any source of drinking water;
- ideally, a van with a banner should visit villages to provide advance warning of the next day's spraying;
- supervisors should visit spray squads to ensure work is carried out properly and efficiently.



IRS PERFORMANCE

Outdoor spraying

leaking bucket

spraying of wall covers

Spraying over food

IRS PERFORMANCE

Regular spray

Irregular spray

Irregular Spray

Spraying objects

Photos courtesy of NVBDCP



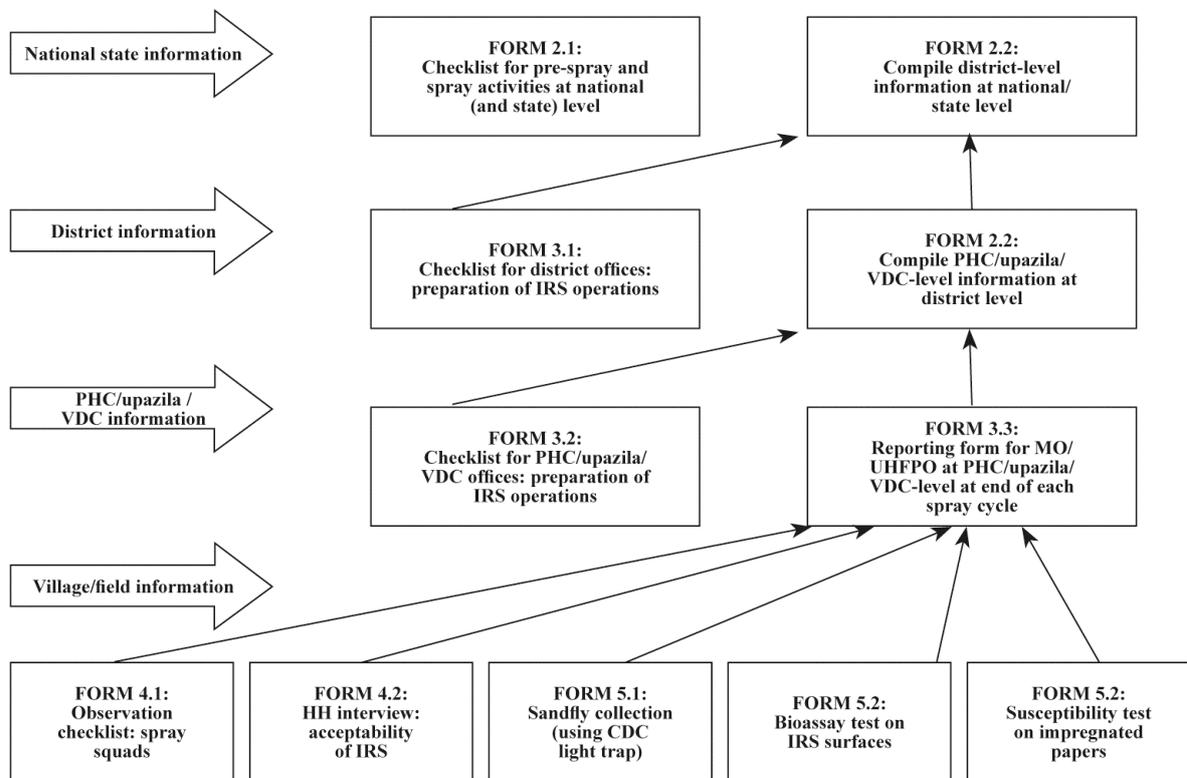
### **1.3.11 Need for M&E**

Recent research in the three target countries has shown that, if done correctly, IRS can be a very powerful tool in substantially reducing the vector population (Joshi et al. 2009). However, serious constraints were identified when spraying was delivered through the public system. For instance, substandard spraying occurred to such an extent that less than 10% of the required insecticide concentration was applied in many villages. Poor training and supervision of staff and defective equipment were identified as the major reasons for these failures (Chowdhury et al. 2009).

This document is intended to help programme managers build an M&E programme in a systematic way so that errors and deviations from planned activities can be identified and corrected at an early stage. However, the tools presented here will be of use only if programme managers apply, analyse and discuss them openly.

This is still a working document which will need adaptations and validation in the field. Feedback from those using this M&E tool kit will help to develop it further.

**Fig. 1.2 Overview of M&E forms to be completed  
(see details in Chapters 2–5)**



## CHAPTER 2. M&E (SELF-EVALUATION) AT CENTRAL/ NATIONAL LEVEL

### 2.1 Overview

The national or central level (and the state level in India) must ensure that:

- districts and upazilas have completed properly all necessary planning before spray cycles start;
- resources are prepared or being delivered to the district/upazila and from district to subdistrict level;
- capacity building has taken place.

**Table 2.1 M&E at central/national level**

Topic area	Indicator	Information source	Measurement frequency	Information collector
<b>Preparation of IRS cycle at central level</b>	% districts/upazilas (states) that have: <ul style="list-style-type: none"> <li>• a macro action plan</li> <li>• a calendar for spraying activities</li> <li>• sent guidelines to PHCs/upazilas/VDCs</li> <li>• defined the target population</li> <li>• established resource requirements and allocated resources</li> <li>• sent resources to districts/upazilas</li> <li>• released funds for wages/IEC</li> <li>• received central IRS roadmap</li> <li>• held preparatory meetings</li> <li>• completed staff sensitization</li> <li>• established an M&amp;E system</li> </ul>	Form 2.1  Documents at central and district/state level	Once per cycle	Central office  District offices
<b>IRS activities</b>	% districts/upazilas that have satisfactorily completed activities concerning: <ul style="list-style-type: none"> <li>• insecticide procurement</li> <li>• spray equipment</li> <li>• squad performance</li> <li>• operational achievements (Chapter 4)</li> <li>• impact achievements (Chapter 5)</li> </ul>	Compilation of district/state data	Once per cycle	PHC/upazila /VDC level information compiled at district/state and central level

## **2.2 M&E of progress and quality of IRS operations**

The achievements and bottlenecks of the programme will be monitored and evaluated at national level during and at the end of each spray cycle, using as much modern information technology as possible.

Form 2.2 indicates the type of indicators to be used by the national/state level for monitoring IRS performance and its final outcomes at district /upazila/VDC level.

## FORM 2.1 Checklist for pre-spray and spray activities at national (and state) level

Name of country: .....

Name of district (state)/PHC/upazila/VDC:.....

State/regional code: /\_\_\_/\_\_\_/ (e.g. 00 for Bangladesh)

Spray year: /\_\_\_/\_\_\_/\_\_\_/\_\_\_/ Spray cycle: /\_\_\_/ ( 1= 1<sup>st</sup> cycle; 2=2<sup>nd</sup> etc.)

Date (dd/mm/yyyy):.....

Name of responsible officer:.....

No.	Topic area/component	Yes	No	Remarks
2101	Macro action plan in place? <i>(based on the district micro action)</i>			
2102	Projected (targeted) population identified for districts/PHCs/upazilas/VDCs following established criteria?			
2103	Exact timing of spray activities decided for all endemic districts/PHCs/upazilas/VDCs? <i>(to be sent by state/district manager)</i>			
2104	IRS roadmap worked out at state/district/upazila level?			
2105	Guidelines distributed to districts/PHCs/upazilas/VDCs?			
2106	Districts/PHCs/upazilas/VDCs have submitted requirements for insecticide, pumps, equipment?			
2107	Insecticide, pumps and equipment made available to districts/PHCs/upazilas/VDCs?			
2108	Funding requirements defined? <i>(release is based on SOEs and UCs)</i>			
2109	Spray squad requirements received for all IRS areas?			
2110	Preparatory meetings held?			
2111	Sensitization of MOs, MIs, UHFPOs, MODCs, HIs, SIs, AHIs and other staff completed?			
2112	IEC activities (i.e. advocacy, meetings, messages, use of electronic and print media planned) made available to states/ districts/PHC/upazilas/VDCs?			
2113	Monitoring and supervisory teams formed?			

Verified by: \_\_\_\_\_ Date: \_\_\_\_\_

**FORM 2.2 Organization and performance of IRS: compiling district information at state/central/national level\***

**(AGGREGATED INFORMATION. NOT TO BE FILLED IN AT NATIONAL LEVEL)**

Name of country: .....

Name of district (state)/PHC/upazila/VDC:.....

State/regional code: /\_\_\_/\_\_\_/ (e.g. 00 for Bangladesh)

Spray year: /\_\_\_/\_\_\_/\_\_\_/\_\_\_/ Spray cycle: /\_\_\_/ ( 1= 1<sup>st</sup> cycle; 2=2<sup>nd</sup> etc.)

Date (dd/mm/yyyy):.....

Name of responsible officer:.....

No.	Component	Indicator	
2201	Functional pumps available	% of functional pumps available	$\frac{\text{No. functional pumps}}{\text{No. all pumps}} \times 100$
2202	Insecticides	% available quantity	$\frac{\text{Kgs or tonnes available}}{\text{Kgs or tonnes needed}} \times 100$
2203	Spare parts for pumps ( <i>can be omitted at national level</i> )	% available spare parts (by type) e.g. nozzle tips, washers, springs	$\frac{\text{No. available}}{\text{No. needed}} \times 100$
2204	PPE	% available PPE e.g. caps/goggles/masks/overalls or long-sleeved shirts and pants/gloves/boots	$\frac{\text{No. available}}{\text{No. needed}} \times 100$
2205	Spray squad	% available squads	$\frac{\text{No. available}}{\text{No. needed}} \times 100$
2206	Training for spray squads before IRS cycle starts	% training sessions/number of days of training	$\frac{\text{No. done}}{\text{No. planned}} \times 100$  <u>No. training days/sessions:</u>
2207	IRS supervision	% IRS villages supervised	$\frac{\text{No. villages supervised}}{\text{No. villages sprayed}} \times 100$
2208	Filter papers analysed for chemical concentration	Number of filter papers sent for analysis	$\frac{\text{No. papers sent}}{\text{No. papers installed}} \times 100$
2209	HHs covered by IRS as reported by spray squads	% of targeted HHs with IRS according to reports	$\frac{\text{No. HHs sprayed (reported)}}{\text{No. HHs targeted}} \times 100$
2210	HHs covered by IRS according to HH survey	% of targeted HHs with IRS according to HH survey	$\frac{\text{No. HHs sprayed (HH survey)}}{\text{No. HHs targeted}} \times 100$
2211	Performance of squads	% squads with overall acceptable quality	$\frac{\text{No. squads with quality score}}{\text{Total squads}} \times 100$

		score	No. squads observed
2212	Personal protection	% squads with adequate protective clothing	$\frac{\text{No. squads with protection}}{\text{No. squads}} \times 100$
2213	Information for HHs	% HHs who have received adequate information	$\frac{\text{No. HHs informed}}{\text{No. HHs surveyed}} \times 100$
2214	HHs satisfied with IRS (as revealed by the HH survey)	% HHs satisfied	$\frac{\text{No. HHs satisfied}}{\text{No. HHs surveyed}} \times 100$
2215	Insecticide susceptibility	Vector mortality above 70%	% mortality in exposure test
2216	Reduction of vector density	Reduction percentage	$\frac{(\text{No. before}) - (\text{no. after})}{\text{No. vectors before}} \times 100$
2217	Adequate bioefficacy	% mortality (and knock-down) in bioassays >80%	Bioassay mortality and % of knock-down

\* It may be better to integrate this form into an electronic information system that semi-automatically compiles the district (state)/upazila information. The form is based on Form 3.3 (see Chapter 3).

## CHAPTER 3. M&E OF PRE-SPRAY AND SPRAY CYCLE OPERATIONS AT DISTRICT AND PHC/BLOCK/UPAZILA/VDC LEVELS

### 3.1 Overview

Together with PHCs/upazilas/VDCs, the district level has to ensure that operational plans are set up, resource requirements are sent to central level and the necessary resources have been received.

At the end of each cycle the operational achievements will be evaluated. Analysis of the impact on the vector population will be presented in Chapter 5 of this document.

**Table 3.1 M&E of pre-spray and spray cycle operations at district and PHC/block/upazila/VDC levels**

Topic area	Indicator	Information source	Measurement frequency	Information collector
Organization of pre-spray activities	% of districts and % of subdistricts/upazilas/VDCs that have: <ul style="list-style-type: none"> <li>• action plan in place</li> <li>• submitted resource requirements</li> <li>• released funds for wages</li> <li>• completed IRS roadmap</li> <li>• held preparatory meetings</li> <li>• completed staff sensitization</li> <li>• hired spray squads</li> <li>• planned and received IEC</li> <li>• organized M&amp;E teams</li> </ul>	Checklists (Forms 3.1 and 3.2)  Document at district and PHC/upazila level	Once per cycle	State/district/upazila
Operational achievements of IRS at district/PHC/upazila/VDC level	<ul style="list-style-type: none"> <li>• % of active squads as fraction of squads required</li> <li>• number of</li> </ul>	Reporting Form 3.3  PHC/upazila	End of each cycle	State/district/PHC/upazila/VDC

	training sessions carried out <ul style="list-style-type: none"> <li>• % of IRS villages supervised</li> <li>• % of HHs targeted for filter paper tests done</li> <li>• HH coverage reported by squads and by HH interviews</li> <li>• % HHs satisfied</li> </ul>	document		
--	---	----------	--	--

### 3.2 M&E checklists and reporting form

#### 3.2.1 Checklist for preparation of IRS activities (pre-spray phase) at district level

This checklist (Form 3.1) can be applied by the district team and/or by a central evaluation team on a sample basis. Districts need to monitor operations during the pre-spray phase in order to establish that all necessary actions have been completed.

#### 3.2.2 Checklist for preparation of IRS activities (pre-spray phase) at PHC/upazila/VDC level

This checklist (Form 3.2) is designed for monitoring pre-spray activities at subdistrict (PHC) levels. It can be applied by the responsible officer at PHC/upazila/VDC level and/or by the district office on a sample basis.

#### 3.2.3 Reporting form for analysing and reporting PHC/upazila/VDC-level information on IRS activities during and at the end of spray cycle

The organization of activities will be analysed at subdistrict/upazila level during and at the end of each spray cycle in order to identify where the main bottlenecks occur and to learn from experience. Information collected at operational level (see Chapter 4) will be compiled by the subdistrict and then by the district. This reporting form (Form 3.3) supports the compilation of information and facilitates the calculation of indicators (see Section 3.1).

### 3.3 Data processing and analysis

Usually, information will be collected in paper form and entered into an electronic system at district level. Information on all endemic areas will then be compiled at state or central level.

#### FORM 3.1 Checklist for *district offices*: preparation of IRS operations (India and Nepal)

Name of country: .....

Name of district (state)/PHC/upazila/VDC:.....

State/regional code: / \_\_\_ / \_\_\_ / (e.g. 00 for Bangladesh)

Spray year: / \_\_\_ / \_\_\_ / \_\_\_ / \_\_\_ / Spray cycle: / \_\_\_ / ( 1= 1<sup>st</sup> cycle; 2=2<sup>nd</sup> etc.)

Date (dd/mm/yyyy):.....

Name of responsible officer:.....

No.	District level	Yes	No	Remarks
3101	Action plan in place?			
3102	Requirements for insecticide, pumps, equipment sent to central level in time?			
3103	Funds for wages released to PHCs?			
3104	IRS roadmap prepared for all PHCs?			
3105	Preparatory meeting held at PHC level?			
3106	Timely hiring of spray squads ensured?			
3107	IEC activities (advocacy, meetings, messages, use of electronic and print media) planned?			
3108	Completed sensitization of MOs/MIs in all PHCs?			
3109	Monitoring and supervisory teams formed?			
3110	Transport issues for supervisors and monitors solved?			

Verified by: \_\_\_\_\_ Date: \_\_\_\_\_

**FORM 3.2 Checklist for PHC/upazila/VDC offices: preparation of IRS operations**

**Identity**

Name of country: .....

Name of district (state)/PHC/upazila/VDC:.....

State/regional code: /\_\_\_/\_\_\_/ (e.g. 00 for Bangladesh)

Spray year: /\_\_\_/\_\_\_/\_\_\_/\_\_\_/ Spray cycle: /\_\_\_/ ( 1= 1<sup>st</sup> cycle; 2=2<sup>nd</sup> etc.)

Date (dd/mm/yyyy):.....

Name of responsible officer:.....

No.	PHC/upazila/VDC level	Yes	No	Remarks
3201	Action plan in place?			
3202	Requirements for insecticide, pumps, equipments sent to district/central level in time?			
3203	Funds for wages of spray persons received?			
3204	IRS roadmap prepared at PHC/upazila/VDC level?			
3205	Preparatory meeting held at PHC/upazila/VDC level?			
3206	Timely hiring of spray squads ensured?			
3207	IEC activities (advocacy, meetings, messages, use of electronic and print media) planned?			
3208	Sensitization of PHC MOs, MIs, multipurpose health workers (MPHWs), HIs, SIs, AHIs completed?			
3209	Transport issues for supervisors and monitors solved?			

Verified by: \_\_\_\_\_ Date: \_\_\_\_\_

**FORM 3.3 Reporting form for MO/UHFPO at PHC/upazila/VDC level at end of each spray cycle**

(see Form 2.2 for an aggregate of information collected at operational level)

**Identity**

Name of country: .....

Name of district (state)/PHC/upazila/VDC:.....

State/regional code: / \_\_\_ / \_\_\_ / (e.g. 00 for Bangladesh)

Spray year: / \_\_\_ / \_\_\_ / \_\_\_ / \_\_\_ / Spray cycle: / \_\_\_ / ( 1= 1<sup>st</sup> cycle; 2=2<sup>nd</sup> etc.)

Date (dd/mm/yyyy):.....

Name of responsible officer:.....

No.	Component	Indicator	
<b>A. Information collected before IRS</b>			
3301	Functional pumps available	% of functional pumps available	$\frac{\text{No. functional pumps}}{\text{No. all pumps}} \times 100$
3302	Insecticides	% available quantity	$\frac{\text{Kgs or tonnes available}}{\text{Kgs or tonnes needed}} \times 100$
3303	Spare parts for pumps	% available spare parts (by type) e.g. nozzle tips/leather cups/washers/springs	$\frac{\text{No. spare parts available}}{\text{No. spare parts needed}} \times 100$
3304	PPE	% available of PPE required e.g. caps/goggles/masks/overalls or long-sleeved shirts and pants/gloves/boots	$\frac{\text{No. PPE available}}{\text{No. PPE needed}} \times 100$
3305	Spray squad	% available squads	$\frac{\text{No. squads available}}{\text{No. squads needed}} \times 100$
3306	Training for spray squads before start of IRS cycle	% training sessions,	$\frac{\text{No. sessions done}}{\text{No. sessions planned}} \times 100$
		Number of training days	No. training days/sessions

<b>B. Information collected <i>after</i> IRS</b>			
3307	IRS supervision	% IRS villages supervised	$\frac{\text{No. villages supervised}}{\text{No. villages sprayed}} \times 100$
3308	How many monitoring visits have been made?	% visits for monitoring	$\frac{\text{No. visits made}}{\text{No. visits planned}} \times 100$
3309	Filter papers analysed for chemical concentration	Number of filter papers sent for analysis	$\frac{\text{No. papers sent}}{\text{No. papers installed}} \times 100$
3310	HHs covered by IRS (reported by spray squads)	% targeted HHs with IRS according to reports	$\frac{\text{No. HHs sprayed (reported)}}{\text{No. HHs targeted}} \times 100$
3311	HHs covered by IRS (according to HH survey)	% targeted HHs with IRS according to HH survey	$\frac{\text{No. HHs sprayed (HH survey)}}{\text{No. HHs targeted}} \times 100$
3312	Performance of squads (see Form 4.1)	% squads with overall acceptable quality score	$\frac{\text{No. squads with quality score}}{\text{No. squads observed}} \times 100$
3313	Personal protection (see Form 4.1)	% squads with adequate protective clothing	$\frac{\text{No. squads with protection}}{\text{No. squads}} \times 100$
3314	Information for HHs	% HHs that received adequate information	$\frac{\text{No. HHs informed}}{\text{No. HHs surveyed}} \times 100$
3315	HHs satisfied with IRS (according to HH survey)	% satisfied HHs	$\frac{\text{No. HHs satisfied}}{\text{No. HHs surveyed}} \times 100$
3316	Insecticide susceptibility	Vector mortality above 70%	% mortality in exposure test =
3317	Reduction of vector density	Reduction percentage	$\frac{(\text{No. before}) - (\text{no. after})}{\text{No. vectors before}} \times 100$
3318	Adequate bioefficacy	% mortality and knock-down in bioassays >80%	Bioassay mortality and knock-down

Verified by: \_\_\_\_\_ Date: \_\_\_\_\_

## CHAPTER 4. M&E OF OPERATIONAL LEVEL (SPRAY SQUADS AND COMMUNITY)

### 4.1 Overview

The district/PHC/upazila/VDC level has to ensure that operational activities are in place, spray squads are properly trained and supervised and that work performance is of acceptable quality and achieves adequate insecticide concentrations on walls. The M&E activities for the topic areas summarized below will help to achieve these goals.

**Table 4.1 M&E of operational level (spray squads and community)**

Topic area	Indicator	Information source	Measurement frequency	Information collector
<b>Availability of equipment</b>	% functional pumps out of required pumps  % insecticide out of quantity required  % available spare parts out of spare parts required  % PPE/PPE required	District/PHC/upazila/VDC level	For each spray cycle	MO/UHFPO/VCO/VCA at PHC HI, SI, AHI at upazila
<b>Quality of spraying</b>	% squads with overall acceptable quality score	Observation checklist	Once per spray cycle	VCO/VCA/MI/HI/SI/AHI
<b>Protective clothes</b>	% squads with adequate protective clothing	Observation checklist	Once per spray cycle	MI/HI/SI/AHI
<b>Quality of information</b>	% HHs given advance information	HH survey	Once per spray cycle	MI/HI/AHI complemented by community health workers/female community health volunteers (FCHVs)
<b>Quality of insecticide application</b>	% target concentration achieved  % samples above 80% of target concentration	Filter paper method	Once per spray cycle	VCO/VCA/MI/HI/SI/AHI sent to central level
<b>HH coverage with IRS reported by squad</b>	% HHs covered by IRS against target	Reported by spray squads	End of each spray cycle	Spray squads
<b>HH coverage with IRS reported by HHs</b>	% HHs covered by IRS against target	HH interview survey	End of each spray cycle	MI/HI with health workers
<b>Peoples' satisfaction with IRS</b>	% HHs satisfied with IRS	HH interview survey	End of each spray cycle	MI/HI with health workers

The operational level is the most important level of vector control activities. If the community and spray persons are not motivated sufficiently before the start of spray activities then the intended outcome cannot be achieved (WHO 2007). Key personnel for implementation and supervision are mentioned in the introductory chapter.

## 4.2 Observation of spray squads in sample villages

Villages in which spray squads are working according to schedule will be visited in order to ask squad members some basic information and to observe the spraying procedures. To ensure the validity of collected information this information should be collected from at least 26 squads<sup>1</sup> using Form 4.1.

## 4.3 Verification of target dose of insecticide on sprayed walls (filter paper method)

Three HHs from each of five IRS villages per district/upazila/VDC will be randomly selected to determine the concentration of the sprayed insecticide on walls. Before spraying, and without the knowledge of spray persons, four filter papers (Whatman No.1, 5 x 5 cm<sup>2</sup>) will be placed on four walls at different heights in each house. The four filter papers should be placed with eight (four coloured + four white) mimic papers in each test house. The filter papers will be collected after they are dry. They will be air dried and kept separately in aluminium foil after coding. Sixty filter papers<sup>2</sup> (five villages x three HHs x four filter papers) will be analysed in each district/upazila/VDC. Chemical analysis will be performed in a specialized laboratory.



### Filter paper fixed on a wall

*Photo courtesy of BPKIHS*

<sup>1</sup> Calculation of sample size for number of squads to be observed/analysed is based on the assumption that 80% (with 10% precision, 80% CI) of squads will have overall acceptable spraying performance.

<sup>2</sup> Calculation of sample size for the number of filter papers is based on the assumption that at least 80% of the collected filter papers (with 10% precision, 95% CI) will have an adequate concentration of insecticides. The minimum required is 61 filter papers per district.

#### **4.4 HH interviews on community satisfaction and IRS coverage**

In each district/upazila, seven HHs in each of 30 villages will be selected for a short HH survey. The selection procedure follows the Expanded Programme on Immunization (EPI) coverage survey method, also known as the WHO 30X7 cluster sampling method. The aim of this sampling is to estimate IRS coverage to within  $\pm 10$  percentage points of the true proportion, with 95% confidence.

The 30X7 cluster survey is a two-stage cluster sample. Before sampling begins the population is divided into a complete set of non-overlapping subpopulations, usually defined by geographical or political boundaries such as villages. These subpopulations are called clusters.

- First stage of sampling – the population of each of 30 of these clusters is sampled by probability proportionate to size (PPS). Sampling with PPS allows the larger clusters to have a greater chance of being selected. In practical terms this is done by allocating two or three identification (ID) numbers to each larger village while two or three of the very small villages are allocated the same ID number. Thus, when random numbers are selected from all the ID numbers, larger villages have a double or triple chance of being selected and smaller villages have a lower chance of being selected.
- Second stage of sampling – seven HHs are selected from each cluster. However, with the 30X7 method, only the first HH in a village will be randomly selected (by various methods). After visiting the first HH, the surveyor moves to the next – defined as the HH whose front door is closest to the one just visited. This process continues until all seven HHs are found. The information from each cluster is then combined to obtain an overall estimate of IRS coverage and HH satisfaction with IRS.

The questionnaire is presented as Form 4.2 and will be applied to the head of each HH.

#### **4.5 Data processing and analysis**

Data collection will usually be performed by health or control personnel who are not involved in the spraying activities. Occasionally, an external academic institution might be hired to carry out the observations and interviews. The data from the data collection forms will be entered into a computer at district or subdistrict level and usually will be analysed at either district/state or central level. The core analysis is related to the construction of indicators presented in various tables in this document and using those indicators to compare achievements with targets.

## FORM 4.1 Observation checklist: spray squads

(Note: results of the observations will be introduced into Form 3.3 for MO/UHFPO at PHC/upazila/VDC level at the end of each spray cycle, particularly indicators 2210, 2213 and 2214)

### Identity

Name of country: .....

Name of district (state)/PHC/upazila/VDC:.....

State/regional code: /\_\_\_/\_\_\_/ (e.g. 00 for Bangladesh)

Spray year: /\_\_\_/\_\_\_/\_\_\_/\_\_\_/ Spray cycle: /\_\_\_/ ( 1= 1<sup>st</sup> cycle; 2=2<sup>nd</sup> etc.)

Date (dd/mm/yyyy):.....

Name of responsible officer:.....

No.	Observations					
4101	Supervisor present during spraying?	Yes	No			
4102	Squad members filled pump correctly?	Yes	No			
4103	Insecticides mixed correctly?	Yes	No			
4104	Pump shaken sufficiently? (for DDT only)	Yes	No			
4105	Use of safety measures: <ul style="list-style-type: none"> <li>• masks</li> <li>• goggles</li> <li>• gloves</li> <li>• apron/long-sleeve shirt &amp; pants</li> <li>• cap</li> <li>• boots/shoes</li> <li>• towel</li> <li>• soap</li> </ul> <p><i>Overall minimum protection (at least masks, goggles, towel and soap)</i></p>	Sprayer:	1	2	3	4
		yes/no	yes/no	yes/no	yes/no	
		yes/no	yes/no	yes/no	yes/no	
		yes/no	yes/no	yes/no	yes/no	
		yes/no	yes/no	yes/no	yes/no	
		yes/no	yes/no	yes/no	yes/no	
		yes/no	yes/no	yes/no	yes/no	
		yes/no	yes/no	yes/no	yes/no	
		yes/no	yes/no	yes/no	yes/no	
		yes/no	yes/no	yes/no	yes/no	
		yes/no	yes/no	yes/no	yes/no	

4106	Proper spraying: <ul style="list-style-type: none"> <li>• bottom to top</li> <li>• clockwise in room</li> <li>• vertical swath 75 cm</li> <li>• swath overlap 5 cm</li> <li>• nozzle proper distance from surface (45 cm)</li> <li>• pump has correct discharge rate (790 ml/min)</li> <li>• overall acceptable spraying</li> </ul>	Sprayer: 1      2      3      4 yes/no yes/no yes/no yes/no  yes/no
4107	Marking sprayed houses: <ul style="list-style-type: none"> <li>• HH ID number (for 1st house of the day)</li> <li>• date of spraying (dd/mm/yy)</li> <li>• spray cycle (mentioned)</li> <li>• team number (mentioned)</li> <li>• overall acceptable marking (date &amp; number of houses sprayed)</li> </ul>	Yes      No  Yes      No  Yes      No  Yes      No  Yes      No
4108	Evidence of insecticide deposit on sprayable surfaces (DDT only)?	Yes      No
4109	Homogenous insecticide deposits on the walls (DDT only)?	Yes      No
4110	Number of rooms in each house sprayed	Satisfactorily      Partially      Not at all
4111	Instruction given to HHs: <ul style="list-style-type: none"> <li>• to stay outside?</li> <li>• for preparation of rooms before spraying?</li> </ul>	Yes      No      Not observed  Yes      No      Not observed
4112	QUALITY SCORE FOR SQUAD (% of maximum score achieved: add number of "yes answers" in questions 4102 to 4111a and 4111b; divide by the number of questions; multiply by 100)	QUALITY SCORE OF PERFORMANCE.....% (corresponds to 2211)

<b>Questions for spray squads</b>					
4113	Have spray persons been trained before spraying in this cycle?	All	Some	None	
4114	How many days training received according to spray persons?	Sprayer 1	2	3	4
4115	Have you been engaged in spraying in previous cycles?	Sprayer 1	2	3	4
4116	What do you do with leftover insecticides?	Correct	Incorrect	Does not have leftover	
4117	Did you have a high percentage of refusals?  If so, what did you do?	Yes	No		
4118	Did you have a high percentage of locked houses?	Yes	No		
4119	Are spray pumps being washed at the end of every spraying day?	All	Some	None	

Verified by: \_\_\_\_\_ Date: \_\_\_\_\_

## FORM 4.2 HH interview for acceptability of IRS (questionnaire)

(Note: results of the survey will be introduced into Form 3.3 for MO/UHFPO at PHC/upazila/VDC level at the end of each spray cycle, particularly Indicators 2210, 2213 and 2214)

### Identity

Name of country: .....

Name of district (state)/PHC/upazila/VDC:.....

State/regional code: /\_\_\_/\_\_\_/ (e.g. 00 for Bangladesh)

Spray year: /\_\_\_/\_\_\_/\_\_\_/\_\_\_/ Spray cycle: /\_\_\_/ ( 1= 1<sup>st</sup> cycle; 2=2<sup>nd</sup> etc.)

Date (dd/mm/yyyy):.....

Name of responsible officer:.....

No.	Subject	Answer (1 = yes, 2 = no)
4201	Did a spray person (local name) spray your house with insecticides to kill mosquitoes and other insects?	
4202	Were all your rooms and animal sheds sprayed?  If no, which rooms were not sprayed?	
4203	Were you informed about the spraying in the days before it happened?	
4204	Are you satisfied with the insecticide spraying?  If not, why not? (multiple answer) <ul style="list-style-type: none"> <li>• no explanation</li> <li>• rude behaviour</li> <li>• sprayed watery solution (dilute spray)</li> <li>• spray did not kill the insects</li> <li>• side-effects</li> <li>• bad smell</li> </ul>	
4205	Were you given any instructions (e.g. remove beds, food, clothes, animals from house before spraying)?	
4206	Were you advised to wait before entering the house after spraying?  If yes (advised), for how long?	.....hrs

4207	<p>Did you have any side-effects after the spraying?</p> <p>If yes, which of the following?</p> <ul style="list-style-type: none"> <li>• coughing</li> <li>• dizziness</li> <li>• fever</li> <li>• headache</li> <li>• itching</li> <li>• runny nose</li> <li>• sore eyes</li> <li>• burning sensation on face</li> <li>• sleeplessness/insomnia</li> <li>• sneezing</li> <li>• stomach ache</li> <li>• others</li> </ul>	
4208	<p>Were you given any instructions on delaying application of mud or lime plaster to insecticide sprayed walls?</p> <p>If yes, how long?</p>	<p>.....months</p>
4209	<p>What would you suggest for improving the spraying services?</p>	

Interviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

Verified by: \_\_\_\_\_ Date: \_\_\_\_\_

## CHAPTER 5. M&E OF IRS IMPACT ON VECTOR DENSITIES, BIOEFFICACY AND INSECTICIDE SUSCEPTIBILITY

### 5.1 Overview

All levels of the IRS programme have to ensure that it reaches its goal of reducing vector densities to low levels during the transmission seasons. This can be assessed by monitoring vector densities, bioefficacy and vector susceptibility to insecticides.

**Table 5.1 M&E of IRS impact on vector densities, bioefficacy and insecticide susceptibility**

Topic area	Indicator	Information source	Measurement frequency	Information collector*
Vector density	Number of vectors per light trap per night	Documentation of light trapping	2–4 weeks before IRS; 2–4 weeks and 3–4 months after IRS	e.g. subcontracted academic/research institution
Bioefficacy of insecticides	% mortality in bioassays >80%	Documentation of bioassays (WHO cone method)	1 month and 3–4 months after IRS	e.g. subcontracted academic/research institution
Insecticide susceptibility	Vector mortality above 80%	WHO tube method with impregnated papers	Once per year before IRS	e.g. subcontracted academic/research institution

\*If not performed by entomologist of the public health service

### 5.2 Vector density (before and after spraying)

Vector density will be measured in six intervention and six sentinel/control houses<sup>1</sup> in each district/upazila two to four weeks before spraying as well as two to four weeks and three to four months after spraying, using Centers for Disease Control and Prevention (CDC) light traps for one night. The density in sprayed houses will be compared to sentinel and/or control HHs.

Sentinel houses are houses in IRS villages in which families are requested not to spray their houses for a short period but in the interim are provided with non-impregnated mosquito nets for personal protection (WHO 2006). Given the ethical concerns of not spraying, locked houses or those for which the owners themselves have refused permission to spray insecticide may be used as sentinel houses. The monitoring of vector densities in sentinel houses shows the mass effect of IRS on the vector population.

Control houses are the houses in neighbouring villages which have not been sprayed. Comparison of vector densities in intervention houses and control

<sup>1</sup>Previous research has shown (Chowdhury et al. 2009) that the difference in average vector density before and after spraying was 4.5 with SD 2.5, giving a power of 90%,  $p = 0.05$ . For determination of vector density the number of HHs must be no fewer than five per district/upazila.

houses over time allows identification of seasonal or social effects (e.g. lime plastering) on sandfly densities which interfere with the spray effect.

CDC light trap set-up and collection will be carried out by trained insect collectors supervised by the entomologist. The CDC light traps will be set up 15 cm away from the wall and 5 cm above the ground in one corner of the main bedroom of a HH. The same room and position will be used for subsequent surveys. Sandflies will be collected from sunset to sunrise on one night. On the collection night, HH members will use the room as usual but should be requested not to use electric lightbulbs, mosquito repellants or mosquito coils. The record sheet is presented as Form 5.1.

Sandflies collected in light traps will be transferred to the laboratory. Sandflies will be separated from other insects and according to species. A binocular microscope will be used to identify the species, number and gender of all sandflies as well as the physical status of female *P. argentipes*. will be preserved separately in 80% alcohol or mounted on Berlese media. Morphological identification will use the criteria listed below.

1. Species:
  - a. *P. argentipes* (Pa): black thorax, silvery shine on tarsal tip of the leg, 3 mm long;
  - b. *P. papatasi* (Pp): brown body, 3 mm long;
  - c. *Sergentomyia* spp (Sr): colour varies from dark brown to dark grey, 1–2 mm long.
2. Sex and physiological status:
  - a. males: external genitalia with claspers
  - b. females: without claspers
  - c. unfed, blood fed, gravid (no undigested blood).

### **5.3 Bioefficacy of insecticide on sprayed surfaces (bioassay)**

Bioassays will be performed to measure the efficacy of IRS two to four weeks and again five months after spraying in the houses in which light traps are fixed. These will be carried out independently by insect collectors/ entomologists not involved in spraying operations, supervised by an entomologist. Six HHs in each of six villages (wards) in each district will be selected for residual activity measurement by bioassay (WHO 2006).

Bioassay tests will be performed by exposing non-fed susceptible female sandflies for a period of 30 minutes. Ten sandflies (collected by aspirators or originating from insectariums) will be introduced into each WHO plastic cone fixed on the insecticide-treated surfaces. There will be four replications of the test on treated walls (four sides of the room) in each of the six selected houses and one test on an untreated wall, to act as a control. After exposure, the females will be placed in 150 ml plastic cups (10 individuals per cup) with sucrose solution provided and maintained in a climatic chamber for 24 hours at 27 °C ±2 °C and 80% ±10% relative humidity (RH). Percentage of knock-down after 60 minutes and percentage mortality after 24 hours will be recorded. Results will be pooled for analysis. The record sheet is presented as Form 5.2.

## 5.4 Insecticide susceptibility (WHO standard chamber method)

The WHO standard chamber method will be used to test insecticide susceptibility to the insecticide used by the country concerned. Wild caught, non-blood-fed nongravid female *P. argentipes* will be introduced into WHO susceptibility chambers (lined with the insecticide impregnated paper) for a period of one hour. Batches of no more than 20 sandflies will be introduced into each chamber in order to minimize the chances of disturbing each other during the exposure. For each insecticide/concentration, 5 replicates and 1 control of 20 *P. argentipes* will be tested.

Results will be pooled for analysis. After exposure, females will be taken out and placed in 150 ml paper cups (20 individuals per cup), with sucrose solution provided, and maintained in a climatic chamber for 24 hours at 27±2 °C and 80% ±10% RH. Percentage of knock-down after 60 minutes and mortality after 24 hours will be recorded.

Requests for equipment and test papers should be made directly to the Coordinator, Vector Control Research Unit, School of Biological Sciences, Universiti Sains Malaysia (Attn: Associate Professor Dr Zairi Jaal, Tel: 604-6574776; Fax: 604-6577200; e-mail: [zairi@usm.my](mailto:zairi@usm.my)).

## 5.5 Correction of mortality in bioassay and susceptibility tests

Test series with control mortality of over 20% will be cancelled. Those with control mortality between 5% and 20% test mortality will be corrected by Abbott's formula (1925) as follows:

$$P = \frac{P1-C}{100-C} \times 100$$

Where P = corrected mortality

P1 = % observed mortality

C = % mortality in control

**FORM 5.1 Sandfly collection record sheet** (using CDC light trap)

(Note: vector density is captured by indicator 3316)

**Identity**

District name:..... PHC/upazila name:.....

Village name:..... Name of HH head:.....

**Batch code: D – P/U – V – S – TH – HH**

District (D-01, 02, 03...); PHC/upazila (P/U-001, 002, 003 ...); village (V-001, 002, 003...); survey number (S-0, 1, 2, 3); type of house (TH- 0 = control, 1 = intervention, 2 = sentinel ); house number (01-12)

Total sandflies collected: / \_\_\_ / \_\_\_ /

Sandfly	Males	Females			Total
		unfed	fed	gravid	
<i>P.argentipes</i>					
<i>P.papatasi</i>		_____	_____	_____	
<i>Sergentomyia</i> spp.		_____	_____	_____	

Comments (if any):.....  
 .....  
 .....

Sandflies collected by: ..... Date of collection (dd/mm/yyyy):.....

Entomologist: ..... Date of speciation: (dd/mm/yyyy):.....

**FORM 5.2 Bioassay test on IRS surfaces**

(Note: bioefficacy is captured by indicator 3317)

Name of country: .....

Name of district (state)/PHC/upazila/VDC:.....

State/regional code: / \_\_\_ / \_\_\_ / (e.g. 00 for Bangladesh)

Spray year: / \_\_\_ / \_\_\_ / \_\_\_ / \_\_\_ / Spray cycle: / \_\_\_ / ( 1= 1<sup>st</sup> cycle; 2=2<sup>nd</sup> etc.)

Date (dd/mm/yyyy):.....

Name of responsible officer:.....

**Batch code: D – P/U – V – S – TH – HH**

District (D-01, 02, 03...); PHC/upazila/VDC (P/U-001, 002, 003 ...); village (V-001, 002, 003...); survey number (S-0, 1, 2, 3); type of house (TH- 0 = control, 1 = intervention, 2 = sentinel); house number (01-12)

1. Name of insecticide used: .....
2. Insecticide concentration per m<sup>2</sup>: / \_\_\_\_\_ /
3. Test performed in: / \_\_\_\_\_ / (1 = lab, 2 = field)
4. Species of sandfly exposed – *P. argentipes*: / \_\_\_ / (1 = yes, 2 = no)  
 – other:.....(specify)
5. Temperature over 24 hours: max:/ \_\_\_\_\_ / min:/ \_\_\_\_\_ /
6. Exposure time: / \_\_\_\_\_ / minutes

**Test**

Surface	Cone no.	1 hour		24 hours		% mortality rate	
		no. tested	knock-down 60 min	dead	alive	test	corrected
	Control						
	1.						
	2.						
	3.						
	4.						
						average	

**Physiological status of exposed sandflies (enter numbers)**

Status after 24 hours	Physiological status			
	male	unfed	fed	gravid
Dead				
Alive				

Comments (if any):

.....  
 .....

Test done by: \_\_\_\_\_ Test date (dd /mm/yyyy): \_\_\_\_\_  
 Verified by: \_\_\_\_\_ Date (dd /mm/yyyy): \_\_\_\_\_

**FORM 5.3 Susceptibility test on impregnated papers**

(Note: insecticide susceptibility is captured by indicator 3315)

Name of country: .....

Name of district (state)/PHC/upazila/VDC:.....

State/regional code: / \_\_\_ / \_\_\_ / (e.g. 00 for Bangladesh)

Spray year: / \_\_\_ / \_\_\_ / \_\_\_ / \_\_\_ / Spray cycle: / \_\_\_ / ( 1= 1<sup>st</sup> cycle; 2=2<sup>nd</sup> etc.)

Date (dd/mm/yyyy):.....

Name of responsible officer:.....

**Batch code: D – P/U – V – S –TH – HH**

District (D-01, 02, 03...); PHC/upazila (P/U-001, 002, 003 ...); village (V-001, 002, 003...); survey number (S-1, 2, 3); type of house (TH- 0 = control, 1 = intervention, 2 = sentinel ); house number (01-12)

1. Name of insecticide used: .....
2. Insecticide concentration per m<sup>2</sup>: / \_\_\_\_\_ /
3. Test performed in: / \_\_\_\_\_ / (1 = lab, 2 = field)
4. Species of sandfly exposed – *P. argentipes*: / \_\_\_ / (1 = yes, 2 = no)  
 – other:.....(specify)
5. Temperature over 24 hours: max:/ \_\_\_\_\_ / min:/ \_\_\_\_\_ /
6. Exposure time: / \_\_\_\_\_ / minutes

**Test**

Surface	Chamber no.	Exposure period		24 hours		% mortality rate	
		no. tested	knock-down 60 min	dead	alive	test	corrected <sup>1</sup>
	Control paper						
	1.						
	2.						
	3.						
	4.						
						average	

<sup>1</sup> Insert numbers only. The correction will be calculated later.

**Physiological status of exposed sandflies**

Status after 24 hours	Physiological status			
	male	unfed	fed	gravid
Dead				
Alive				

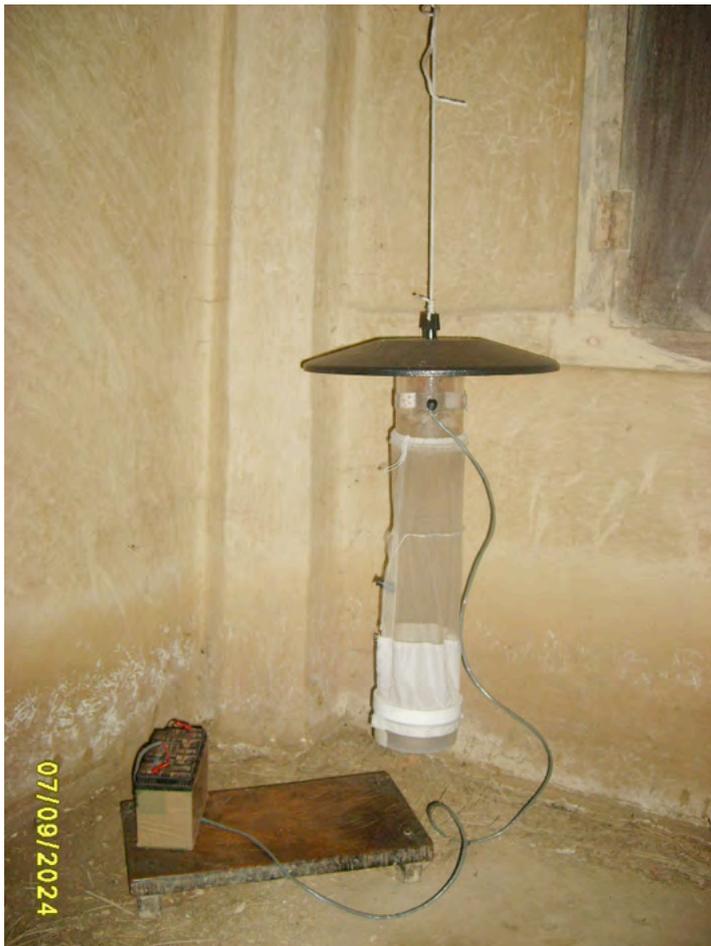
Comments (if any): .....  
.....  
.....

Test done by: \_\_\_\_\_ Test date (dd/mm/yyyy): \_\_\_\_\_

Verified by: \_\_\_\_\_ Date (dd/mm/yyyy): \_\_\_\_\_



**Setting up a light trap**



**Light trap fixed in a corner**



**After-exposure sandflies in holding period**

*Photos courtesy of BPKIHS*



**Cone bioassay on PermaNet® (LNs)**



**Bioassay on untreated net**



**Bioassay on insecticide-sprayed surface**

## References

Chowdhury R et al. (2010). Effectiveness and constraints of indoor residual spraying in the visceral leishmaniasis elimination initiative of India and Nepal: a multi-centre study. (Submitted)

Das M et al. (2008). Cost of three vector control interventions for visceral leishmaniasis in the Indian subcontinent: a multi-centre study. *Annals of Tropical Medicine and Parasitology*, 102(8):729–741.

Das ML et al. (2010). Comparative study of kala-azar vector control measures in eastern Nepal. *Acta Tropica*, 113(2):162–166.

Joshi A et al. (2009). Chemical and environmental vector control as a contribution to the elimination of visceral leishmaniasis on the Indian subcontinent: cluster randomized controlled trials in Bangladesh, India and Nepal. *BMC Medicine*, 7:54.

WHO (1996). *Operational manual on the application of insecticides for control of the mosquito vectors of malaria and other diseases*. Geneva, (WHO/CTD/VBC/96.1000 REV.1).

WHO (2006). *Guidelines for testing mosquito adulticides for indoor residual spraying and treatment of mosquito nets*. Geneva, (WHO/CDS/NTD/WHOPES/GCDPP/ 2006.3).

WHO (2007). *Manual for indoor residual spraying application of residual sprays for vector control*. Geneva, (WHO/CDS/NTD/WHOPES/GCDPP/2007.3).

## Glossary<sup>1</sup>

**Bioassay test:** a test to determine bioavailability and residual activity of an insecticide applied on a surface, assessed by exposing a potentially susceptible insect species to the insecticide.

**Contact insecticide:** an insecticide that shows its action only if the insect comes into direct contact with it.

**Control (of insects):** the restriction of the population density of insects to a level below that at which they can be harmful to the interests of humans.

**Control village:** a village that has not been protected by any insecticides for the last 12 months or more.

**Density:** the number of insects in terms of any unit (e.g. per hour, per light trap, per house etc.).

**Evaluation:** the episodic assessment of any change in targeted results that may be attributed to the programme or project/project intervention. It aims to link a particular output or outcome directly to a programme or intervention after a certain period of time has passed.

**Indoor residual spraying:** the spraying of contact insecticide on inner surfaces of houses/dwellings.

**Insecticide:** a substance (or mixture of substances) used to kill insects. It may take the form of a liquid, powder, fine spray (aerosol, ultra-low volume spray), paint or vapour.

**Intervention:** the taking of decisive action in order to reduce the spread of disease by vectors.

**Light trap:** a trap which uses light to attract insects and an automated fan to force them into a bag.

**Monitoring:** the routine tracking of key elements of programme/project performance (usually inputs and outputs) through record-keeping, regular reporting and surveillance systems.

**Resistance/insecticide resistance:** the ability to tolerate doses of an insecticide which would prove lethal to the majority of individuals in a normal population of the same species of insect.

---

<sup>1</sup> Most technical terms are taken from WHO 1996 (see references).

**Sentinel houses:** houses which are not protected by insecticide (for a short period, on the request of the researcher) when other houses in the village are protected. Sentinel houses are used to assess the mass effect of the insecticide on the vector population.

**Susceptibility:** in a population of insects, the liability to be killed by a particular insecticide.

**Toxicity:** the ability of a substance to cause injury or even death by chemical action.

**Transmission:** the passage of an infectious agent from one host to another.





TDR/World Health Organization  
20, Avenue Appia  
1211 Geneva 27  
Switzerland

Fax: (+41) 22 791-4854  
tdr@who.int  
www.who.int/tdr

The Special Programme for Research and Training in Tropical Diseases (TDR) is a global programme of scientific collaboration established in 1975. Its focus is research into neglected diseases of the poor, with the goal of improving existing approaches and developing new ways to prevent, diagnose, treat and control these diseases. TDR is sponsored by the following organizations:

ISBN 978 92 4 150036 4

