

# MONITORING & EVALUATION

indicators for  
Integrated Vector Management



**World Health  
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# MONITORING & EVALUATION INDICATORS FOR INTEGRATED VECTOR MANAGEMENT



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## PREFACE

The main purpose of this document is to provide guidance for countries in monitoring and evaluating implementation of their national integrated vector management (IVM) strategy, in order to make any improvements required. The secondary purpose is to propose standard methods for monitoring and evaluation at regional and global levels.

This document were prepared according to the operational framework outlined in the Handbook for integrated vector management (7). The target audience is multidisciplinary technical working groups preparing procedures for monitoring and evaluating IVM and people carrying out the monitoring and evaluation.

The outcomes of a workshop on monitoring and evaluation of IVM, held on 16–19 August 2011, in Geneva, Switzerland served as the basis for this document. WHO acknowledges all those experts who helped to develop this document during this workshop. These experts are: Dr Majed S. Al-Zedjali, Director, Directorate of Malaria Eradication, Ministry of Health, Muscat, Oman; Dr Chioma Nkasiobi Amajoh, Director, Federal Ministry of Health, National Malaria and Vector Control Division, Abuja, Nigeria; Dr John Githure, RTI International, Kigali, Rwanda; Dr P. Jambulingam, Director, Vector Control Research Centre, Pondicherry, India; Dr Gamini Manuweera, Secretariat of the Stockholm Convention, International Environment House, Geneva, Switzerland; Professor Noboru Minakawa, Department of Vector Ecology and Environment, Institute of Tropical Medicine, Nagasaki University, Nagasaki, Japan; Dr Henk van den Berg, Visiting Scientist, Laboratory of Entomology, Wageningen University, Timmerhout, Arnhem, The Netherlands; and Dr Jacob Williams, Director, IVM, RTI International, Washington DC, United States of America.

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## 1. INTRODUCTION

Vector-borne diseases, including Chagas disease, dengue, human African trypanosomiasis, leishmaniasis, lymphatic filariasis, malaria, onchocerciasis and schistosomiasis, continue to cause tremendous human suffering (2, 3). Prevention by vector control has an important role in reducing morbidity and mortality due to vector-borne diseases, especially when vector control is adapted to the behaviour and local ecology of the vectors, and used when and where people are at risk of pathogen transmission. Nevertheless, the preventive power of vector control is grossly underused in public health (4). Furthermore, vector control has largely been based on a few classes of insecticides, which has resulted in the spread of insecticide resistance in many places.

To promote a better strategy for vector control, the World Health Organization (WHO) adopted a global strategic framework (7) and in 2008 issued a position statement on integrated vector management (IVM), inviting Member States to set national policies and strategies (5, 6). A handbook was published to assist countries in putting IVM into practice, providing guidance on adapting existing vector-borne disease control to the principles of IVM (7).

IVM is defined as “a rational decision-making process for the optimal use of resources for vector control”. Its aim is to improve the efficacy, cost-effectiveness, ecological soundness and sustainability of disease vector control. The main elements of an IVM strategy are (i) advocacy, social mobilization and legislation; (ii) collaboration within the health sector and with other sectors; (iii) an integrated approach; (iv) evidence-based decision-making; and (v) capacity-building. These elements should be supported by legislation and regulation.

The core of IVM is an evidence-based, integrated, management approach to vector control. Use of a range of vector control interventions is promoted – alone or in combination – selected according to local knowledge about the vectors, diseases and their determinants. The IVM approach is applicable to multiple diseases, because some vectors can transmit several diseases and some interventions are effective against several vectors. IVM strategies reduce the pressure imposed by insecticides to select for insecticide resistance and involve use of tools and resources from sectors other than health.

This document is designed to guide countries in monitoring and evaluating implementation of their national IVM strategy in order to make any necessary improvements. Furthermore, the proposed standard methods will allow monitoring and evaluation at the global level. The target audiences are the multidisciplinary technical teams preparing procedures for monitoring and evaluating IVM and those involved in carrying out those tasks.

Section 2 of this document outlines the requirements for monitoring and evaluation; section 3 presents the outcome indicators and suggests possible process indicators; and section 4 presents the impact indicators of the IVM strategy.



## 2. MONITORING AND EVALUATION

### 2.1 GENERAL CONCEPTS

A functioning system for monitoring and evaluation is vital to the success of an IVM strategy. Monitoring and evaluation have several purposes: to guide the planning and implementation of the strategy, to assess its effectiveness, to identify how the strategy should be improved and to account for the resources used. Hence, monitoring and evaluation represent a feedback mechanism.

Monitoring and evaluation have separate functions, although there is some overlap. Monitoring involves routine data collection and reporting to determine progress made in implementation of a programme or, in the case of IVM, a strategy. Progress is monitored in terms of the use of inputs and the expected outcomes and impacts. Evaluation involves a rigorous assessment of the impacts that can be attributed to a programme or strategy, to demonstrate its value. Evaluation should be designed so that impacts can reliably be attributed to the intervention (see section 4.1).

The combination of monitoring and evaluation allows understanding of the cause-and-effect relations between implementation and impact. This reveals any shortcomings, which are used to improve the programme or strategy. For example, the absence of an outcome can often be traced back to a lack of input or activity.

A major challenge in monitoring and evaluation is identifying valid indicators that can be measured objectively and systematically, especially in a complex field like IVM. Systematic data are essential for measuring progress or impacts and for making cross-sectional comparisons. The most useful types of indicator are quantitative (numbers, percentages) or logical (presence or absence). Some changes or processes, however, cannot be measured in quantitative terms but require a descriptive narrative. Such 'descriptive indicators' can help programmes or countries to better understand the causes and reasons behind an observed outcome. Consequently, a combination of strong quantitative indicators and 'soft' descriptive indicators is often desirable.

### 2.2 ORGANIZATION

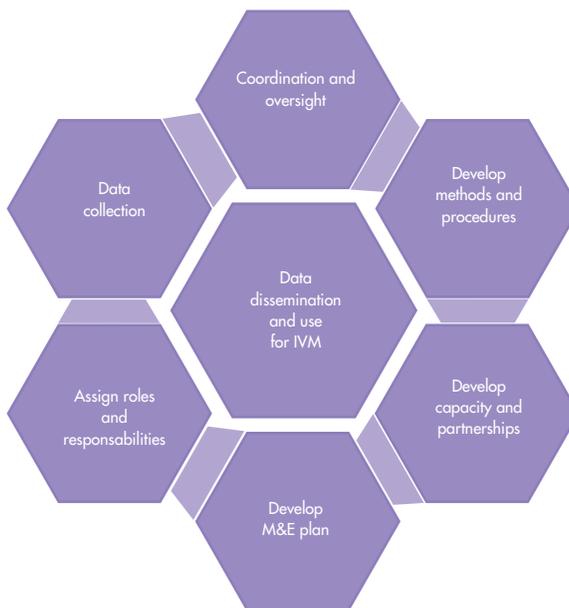
A functioning monitoring and evaluation system requires adequate human capacity, partnerships and a structure, with coordination and oversight (Figure 1). A coordinating authority in the form of an intersectoral steering committee should oversee monitoring and evaluation, assign roles and mobilize the required resources. Under the auspices of this authoritative body, a technical working group should establish appropriate standards, procedures and guidelines on monitoring and evaluation, including a mechanism for collecting, analysing and feeding-back data.

A plan for monitoring and evaluation, with a costed work plan, is then prepared in consultation with the major stakeholders, outlining the required resources; roles and responsibilities; data needs; agreed indicators with baselines, milestones and targets; and methods for collecting, processing, disseminating and using data. The plan should

be linked to the activities and timelines of the IVM strategy. Special attention should be paid to providing systematic, routine analysis and feedback to all levels.

Baselines for each indicator are determined by analysing the situation before implementation of the IVM strategy. A common problem in monitoring and evaluation is that baseline values are not established at the onset of a programme, because it is considered counter-intuitive to start an evaluation before activities have started; nevertheless, it is essential. Targets for each indicator are set by identifying the requirements for IVM and taking into account the anticipated constraints (e.g. funds, human resources or infrastructure) to meeting those requirements.

Figure 1. Elements of monitoring and evaluation for integrated vector management (IVM)



## 2.3 COLLECTING DATA

Most process indicators require routine monitoring, with record-keeping, to determine the use of inputs and the implementation of activities. Collection of data for most indicators of expected outcomes of IVM relies on interviews or surveys with the relevant government bodies, supplemented or verified by copies of formal government documents, where applicable.

Information on the impacts on vectors, disease, cost and the environment requires systematic data from sentinel sites, epidemiological surveillance systems or specially designed studies. Detailed descriptions of these methods are beyond the scope of this document. Instead, reference is made below to the disease-specific guidelines that are available on these aspects.



## 2.4 DATA DISSEMINATION AND USE

Data collected by established methods and procedures must subsequently be processed, analysed and interpreted to assess the status of implementation and the outcomes and impacts of the IVM strategy. In accordance with the purpose of monitoring and evaluation, the results should be packaged and disseminated to assist people involved in programme planning and policy formulation, as well as the wider public. The results will be used to determine where the strategy has worked well and where it should be improved and, more generally, to determine whether the investment has paid off. Seminars or workshops could be used to disseminate data and to discuss any improvements in programme planning, taking into consideration the viewpoints of the wider public.

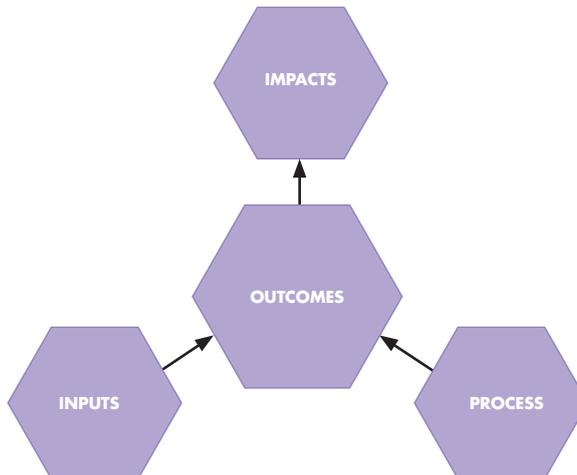
To ensure effective use of data, dissemination should be timely and the results packaged and presented in a way that is suitable for its users. Moreover, technical assistance must be provided where appropriate to help in implementing the findings of monitoring and evaluation in programme planning and policy reform

## 3. OUTCOME INDICATORS

### 3.1 BACKGROUND

The purpose of IVM is to reorient, or transform, the way vector control is structured and implemented to improve efficacy, cost-effectiveness, ecological soundness and sustainability. This 'transformation' is considered to be the outcome, whereas improved efficacy, cost-effectiveness, ecological soundness and sustainability are the expected impacts (Figure 2).

Figure 2. Relations among inputs, process, outcomes and impacts of an integrated vector management strategy



The components of IVM identified in the IVM Handbook are: policy; institutional arrangements; organization and management; planning and implementation; advocacy, communication and social mobilization; and capacity-building. Transformation is needed for all the components of IVM. For example, without strong policy support or without the required capacity, it will be difficult to achieve the expected impacts.

The challenge in monitoring and evaluation is in measuring the ‘transformation’ of vector control, assessing positive change in each IVM component, from policy to capacity-building. Therefore, indicators should be identified that are specific to each expected outcome and are easy to measure. Table 1 outlines the proposed outcome indicators of IVM. Each outcome indicator is a simplification of reality, as it demands either a yes-or-no answer or a number. Such simplicity is necessary in order to determine objectively whether progress has been made or milestones achieved and to allow straightforward comparisons among countries at regional or global level.

The reality is more complex than that expressed in simple indicators. For example, a country may not yet have a national IVM policy in place but may have made preparations and taken steps towards achieving one. Hence, countries should measure not only the core outcome indicators but also the associated input and process indicators in order to determine what is required to achieve the expected outcome.

This section gives guidance on each of the proposed outcome indicators, outlining the purpose, methods and interpretation. The strengths and weaknesses of each indicator are described, and guidance is given on the essential inputs and processes for achieving the expected outcome.

**Table 1. Proposed outcome indicators, arranged according to the main components of integrated vector management (IVM)**

Component	No.	Outcome indicator	Data type
Policy	1	National IVM policy in place	Logical
	2	National policy on pesticide management in place	Logical
Institutional arrangements	3	National steering committee on IVM in place	Logical
	4	National coordinating unit on vector control in place	Logical
Organization and management	5	Standards for professions and careers in vector control and public health entomology in place	Logical
	6	Number (and percentage) of staff with job descriptions that make reference to vector control	Numerical
Planning and implementation	7	National strategic and implementation plan on IVM in place	Logical
	8	Number (and percentage) of staff trained in IVM	Numerical
	9	Epidemiological surveillance system on vector-borne diseases in place	Logical
	10	Number (and percentage) of sentinel sites with functioning vector surveillance and insecticide resistance monitoring	Numerical
	11	Number (and percentage) of operational research priorities on vector control that have been addressed	Numerical
	12	Number of operational research outcomes on vector control that have been used in implementing programmes	Numerical
Advocacy communication and social mobilization	13	National strategic and implementation plan on IVM in place	Logical
	14	Number (and percentage) of staff trained in IVM	Numerical
	15	Number (and percentage) of sites at which campaigns on behavioural change on vector control were conducted	Numerical
	16	Number (and percentage) of villages in which communities have been mobilized for vector control	Numerical
Capacity building	17	Certified training courses on IVM and judicious use of pesticides in place at national or regional level	Logical

Logical data, yes or no

## 3.2 POLICY

### Indicator 1: National IVM policy in place

#### Purpose

The existence of a national policy on IVM is indicative of a country's commitment to providing an enabling environment for implementation of IVM.

#### Methods

To determine the presence or absence of a national policy, an interview or survey should be conducted with the relevant government body. The information can be verified by obtaining a copy of the policy document.

#### Interpretation

This indicator, requiring a simple yes-or-no answer, reveals a government's endorsement of IVM. It does not, however, reveal how comprehensive the policy is, such as whether it addresses all the elements of IVM; nor does it show how the policy originated or the roles of the major stakeholders, although some of this information can be obtained from the policy document. Moreover, the absence of a national IVM policy does not exclude the possibility that elements of the IVM approach have been included in other policies.

Countries might wish to examine how their policy originated or the steps taken to develop the policy, by measuring the inputs and processes used. If a policy has not been prepared, the country could determine which of the necessary inputs and processes are in place and which are missing. This kind of supplementary evaluation gives countries information about the causes and reasons for the achieved output or lack thereof, as a basis for further action.

Several supplementary process indicators can be measured, as answers to the following questions:

- Has a focal person for IVM been identified?
- Has the economic impact of important vector-borne diseases been assessed and documented?
- Has a working group been constituted to review all existing policies and regulations related to IVM?
- Has a situation analysis or comprehensive 'vector control needs assessment' been conducted?
- In preparing the national IVM policy, were all stakeholders adequately consulted?
- Does the policy contain provisions for monitoring and evaluation to ensure that it is regularly updated or revised?

### Indicator 2: National policy on pesticide management in place

#### Purpose

The existence of a national policy on pesticide management is indicative of a country's commitment to providing an enabling environment for sound management of pesticides, including their judicious use for vector control and the effective management of insecticide resistance.

## Methods

In order to determine the presence or absence of a national policy on pesticide management, an interview or survey should be conducted with the relevant government body. The information obtained can be verified by referring to a copy of the policy document.

## Interpretation

This indicator, which requires a simple yes-or-no answer, reflects the government's endorsement of sound management of pesticides (7). It does not reveal how comprehensive the policy is, such as whether it addresses the full scope of pesticide management, although some of this information could be obtained from the policy document. Moreover, the absence of a national policy on pesticide management does not exclude the possibility that aspects of pesticide management have been incorporated into other policies.

Pesticide management covers all stages of the pesticide life-cycle, from product manufacture to waste disposal, some of which are outside the scope of IVM. Pesticide management and IVM overlap as far as the use of pesticides is concerned. Judicious use of pesticides is essential for achieving the cost-effectiveness and ecological soundness goals of IVM.

To clarify the factors that resulted or failed to result in a policy on pesticide management, several process indicators could be measured, in addition to the indicator, as answers to the following questions:

- Has a working group been constituted to review all existing policies and regulations related to pesticide management?
- Has a situation analysis of pesticide management been carried out?
- Have all stakeholders been adequately consulted?
- Does the policy contain provisions for its monitoring and evaluation to ensure that it is regularly updated or revised?

## 3.3 INSTITUTIONAL ARRANGEMENTS

### Indicator 3: National steering committee on IVM in place

#### Purpose

The existence of a national steering committee indicates that implementation of IVM is coordinated intersectorally.

#### Methods

An interview or survey will be required to obtain information from the relevant government body to determine the presence or absence of a national steering committee devoted to IVM.

#### Interpretation

This indicator, in the form of a simple yes-or-no answer, reveals the presence or absence of a formal body for senior-level interministerial coordination on IVM (8). This indicator



does not show whether the committee represents all the major stakeholders or whether it functions effectively. Process indicators are needed to establish whether this is the case; some pertinent examples can be derived as answers to the following questions:

- Have the major stakeholders to be represented on the committee been identified?
- Has the committee been mandated and empowered to perform its functions?
- Have senior-level representatives of major stakeholders become active members of the steering committee?
- Has a plan for overseeing the IVM strategy been formulated, and have the roles of partners been assigned and resources mobilized?
- Has the committee constituted and coordinated the required technical working groups?
- Have the results of monitoring and special studies been used to review and adjust the policies, strategies and workplans for IVM?

#### Indicator 4: National coordinating unit on vector control in place

##### Purpose

A national coordinating unit on vector control ensures that existing vector control activities and programmes are harmonized to increase efficient use of resources.

##### Methods

To determine the presence or absence of a functioning national coordinating unit on vector control, an interview or survey should be conducted with the relevant government body, probably within the ministry of health.

##### Interpretation

To achieve the goals of IVM, it is desirable to have a coordinating or core unit on vector control at national level. This unit will help ensure coordination between vector control programmes and development programmes that incorporate vector control activities, so that they are aware of each other's activities and harmonize their efforts, thereby maximizing cost-effectiveness, avoiding duplication and reducing wastage of resources.

As the response to this indicator is a simple yes-or-no answer, it gives no qualitative information about whether a coordinating unit is functioning. Countries are encouraged to determine the functionality of their coordinating unit, in addition to the indicator, by addressing several process indicators as answers to the following questions:

- Have all relevant vector control programmes and activities been identified?
- Have terms of reference for the coordinating unit been prepared?
- Is the coordinating unit mandated and empowered to make any necessary modifications or adjustments to vector control programmes?
- To what extent has the coordinating unit managed to harmonize vector control operations (e.g. in terms of geographical coverage, use of the same interventions for similar vectors, and use of common infrastructure and resources)? This is a descriptive indicator.

## 3.4 ORGANIZATION AND MANAGEMENT

### Indicator 5: Standards for professions and careers in vector control and public health entomology in place

#### Purpose

The existence of standards for professions and careers in vector control and public health entomology is an indication that a career structure with opportunities for advancement exists in the areas of control and research. A career structure is an important incentive for people to seek training and is necessary to keep graduates in their profession.

#### Methods

For this indicator, surveys or interviews should be conducted in relevant government units and tertiary institutions. The response should be verified by reference to documents outlining the standards.

#### Interpretation

The existence of standards for positions in vector control shows that the country intends to establish a career structure in public health entomology. A suitable career structure is necessary, because training has only limited benefit if the graduates have no subsequent opportunities and are transferred to other areas of work. This indicator, in the form of a yes-or-no answer, simplifies the reality, as it does not show whether steps have been taken to set standards or whether the created professions are legally protected. For this purpose, countries could consider the indicators in the answers to the following questions:

- Is a task force in place to set professional standards on vector control and public health entomology?
- Are professions in vector control legally protected?
- Are new positions created for vector control specialists and public health entomologists?
- Are managerial or directorship positions in vector-borne disease control programmes open to vector control specialists and public health entomologists?

### Indicator 6: Number (and percentage) of staff with job descriptions that make reference to vector control

#### Purpose

The intention of the IVM approach is to increase the participation of units, departments and sectors in vector control. One way of achieving this is by modifying job descriptions. Reference to vector control indicates alignment with IVM policy and implies a commitment of the unit or department to implementation of IVM.

#### Methods

This indicator is applicable to staff in the health sector and in other sectors. For both groups, the numerator of this indicator is the total number of staff (any unit or department) for whom 'vector control activities' is added to their job description (i.e. the phrase 'vector control' or 'mosquito control' is mentioned). The denominator is the targeted number of health staff for whom vector control is to be added to their job description.



This information is collected from interviews or surveys in the relevant government bodies. The information is verified, if possible, by obtaining copies of both the revised and the previous job descriptions. *Table 2* gives an example.

**Table 2. Hypothetical example of targeted and actual numbers of staff for whom vector control is added to their job description**

Sector	Unit or department	Number of staff	
		Targeted	Actual
Health	Malaria control	25	15
	Neglected disease control	25	3
	Public health services	20	0
	Environmental health	12	0
	<b>Total</b>	<b>82</b>	<b>18 (22%)</b>
Other	Agriculture	8	0
	Irrigation	8	0
	Environment	4	4
	Construction	8	0
	<b>Total</b>	<b>28</b>	<b>4 (14%)</b>

Progress in achieving this indicator is measured by comparing the number of health staff for whom 'vector control' has been added to their job description with that at baseline or during the previous reporting period (e.g. 1 year)<sup>1</sup>.

### Interpretation

This indicator helps to determine whether job descriptions are being aligned to IVM policy. The simplicity of this indicator has shortcomings, because it does not reveal, for example, whether vector control is a minor or major part of the job descriptions. Additional process indicators could be added to clarify the status of revised job descriptions, as answers to the following questions:

- Have coordinating meetings on IVM been held between health sector units or programmes or with major stakeholders?
- Have targets been set for the number of staff for whom vector control will be added to their job description?
- Have task forces or working groups been constituted to revise job descriptions, and are the operating procedures revised accordingly?
- Do workplans and budgets incorporate key elements of IVM?

<sup>1</sup> Throughout this document, a reporting period of 1 year is suggested.

### 3.5 PLANNING AND IMPLEMENTATION

#### Indicator 7: National strategic and implementation plan on IVM in place

##### Purpose

The existence of a national strategic and implementation plan for IVM indicates that policy has been translated into a plan for concrete action and that national coordination and planning for IVM have taken place.

##### Methods

An interview or survey should be conducted in the relevant government body (usually the ministry of health) to determine the presence of a national strategic and implementation plan. This indicator should only be answered with “yes” if both a strategic plan and an implementation plan exist.

##### Interpretation

This indicator, in the form of a simple yes-or-no answer, reveals the presence or absence of a formal national plan on IVM (8). It does allow a qualitative appraisal of the plan, for example, whether it is adequately aligned with national policy on IVM. Process indicators such as those provided by the answers to the following questions are required to establish whether this is the case:

- Has the national implementation plan been costed?
- Have the resources necessary for implementing IVM been forecasted and mobilized?
- Does the national plan harmonize the plans of separate vector-borne disease control programmes?
- Does the national plan adequately incorporate the key elements of IVM?

#### Indicator 8: Number (and percentage) of staff trained in IVM

##### Purpose

The number of staff trained in IVM indicates the capacity for implementing IVM.

##### Methods

This indicator can be used for staff in the health sector and in other sectors. For both groups, the numerator is the number of staff in any unit or department who have been trained in IVM, and the denominator is the total number of staff targeted for such training. ‘Training in IVM’ is defined as certified training on managing vector control, including policy, institutional arrangements, planning, organization, implementation, advocacy and communication, according to the core structure for training curricula (9). Courses on medical entomology and the use of vector control methods are not included.

An interview or survey will be required with the relevant government bodies of the health sector and other stakeholders to determine the number of personnel targeted for training. Progress with regard to this indicator is measured by comparing the number of staff trained during the reporting period with that at baseline or during the previous reporting period.



### Interpretation

This indicator provides a simple measure of achievement in reaching the required capacity for implementation of IVM. One limitation of this indicator is that it does not show the quality of training for implementing IVM. This requires further study. Two additional process indicators can be measured, as answers to the following questions:

- Have targets for the required staffing levels and competence for IVM been set by the health sector and other stakeholders?
- Have resources for training been mobilized by the health sector and other stakeholders?

## Indicator 9: Epidemiological surveillance system on vector-borne diseases in place

### Purpose

An epidemiological surveillance system is needed for evidence-based decision-making in planning control activities and evaluating their impact on disease. Geographical stratification of disease prevalence and detection of disease outbreaks are used for designing and evaluating control strategies or outbreak responses.

### Methods

The existence of an epidemiological surveillance system can be verified by consulting reports on national surveillance from vector-borne disease control programmes.

### Interpretation

This indicator, which requires a simple yes-or-no answer, has several limitations. It does not show whether the surveillance is representative of all eco-epidemiological differences and zones within a country, nor does it show how frequently surveillance data are updated. Moreover, this indicator does not show whether the data are effectively managed and used in targeting and using interventions. Countries are encouraged to adopt an integrated disease surveillance system covering all prevalent vector-borne diseases; as such a system can support IVM implementation.

The supplementary process indicators that can be measured are found as answers to the following questions:

- What are the sources of the surveillance data?
- How many eco-epidemiological zones, regions or districts are represented in the data?
- How frequently are the data updated?
- Is the system disease-specific, or is an integrated system in place for surveillance of more than one vector-borne disease?
- Are the results disseminated to programme managers?
- Are the results used in decision-making by programme managers?
- Are the results used for evaluating the impact of control strategies on disease?

## Indicator 10: Number (and percentage) of sentinel sites with functioning vector surveillance and insecticide resistance monitoring

### Purpose

The number of sentinel sites with active vector surveillance and insecticide resistance monitoring gives an indication of the evidence base for decision-making on vector control.

### Methods

This indicator covers sentinel sites for vector surveillance and for insecticide resistance monitoring. For vector surveillance, the numerator is the number of functioning sentinel sites with vector surveillance, and the denominator is the number of sentinel sites targeted for vector surveillance. Similarly, for insecticide resistance monitoring, the numerator is the number of functioning sentinel sites with insecticide resistance monitoring, and the denominator is the number of sentinel sites targeted for insecticide resistance monitoring.

To determine the numbers of functioning and targeted sentinel sites, national vector surveillance reports should be obtained from the coordinating unit on vector control or from individual vector-borne disease control programmes. The methods for vector surveillance and insecticide resistance monitoring are described in separate publications (10–12).

Progress in achieving this indicator is measured by comparing the number of functioning sentinel sites with those at baseline or during the previous reporting period.

### Interpretation

The strength of this indicator is that it establishes whether data on vector densities and insecticide susceptibility status are being collected. Its limitations are that it does not include details, such as which disease vectors are being surveyed and tested and whether all the important eco-epidemiological zones are represented. Moreover, this indicator does not show whether the data are effectively managed and used in decision-making on vector control. Additional indicators that would be useful for evaluating the status of sentinel sites in a country can be obtained from the answers to the following questions:

- Are all the relevant eco-epidemiological zones covered by sentinel sites?
- Which vector species and vector-borne diseases are included?
- At what frequency are vectors surveyed?
- Which vector-related parameters are measured?
- At what frequency is insecticide resistance tested?
- Are the results disseminated to programme managers?
- Are the results used in decision-making by programme managers?
- Are the results used for impact evaluation?

## Indicator 11: Number (and percentage) of operational research priorities on vector control that have been addressed

### Purpose

The number of operational research priorities that have been addressed is an indication that new evidence is being generated to support decision-making and, ultimately, improve the efficacy, cost-effectiveness, ecological soundness and sustainability of vector control.



## Methods

The denominator for this indicator is the number of national priorities for operational research in vector control that have been formally identified. The numerator is the number of those priorities that have been or are being studied. The necessary information can be obtained from technical reports or from surveys or interviews with relevant government units or research institutions.

Progress with regard to this indicator is measured as the number of priorities addressed during the reporting period in comparison with that at baseline or during the previous reporting period. The number is probably a better measure of progress than the percentage; the percentage depends on the number of priorities, which is not a fixed value but may change during implementation of IVM. Consequently, a 'percentage of gaps addressed' should be interpreted with caution; nevertheless, it indicates the work that is still required.

## Interpretation

This indicator shows the extent to which operational research priorities are being tackled. It does not, however, show whether practicable solutions are being found, disseminated to and used in implementing programmes. Use of research outcomes is discussed under indicator 12.

Additional process indicators that would be useful are found as answers to the following questions:

- Have operational research priorities been identified at national level?
- Have the appropriate institutions to conduct operational research been identified?

## Indicator 12: Number of operational research outcomes on vector control that have been used in implementing programmes

### Purpose

Use of the outcomes of operational research is an indication that practical methods or solutions have been found and adopted for implementing programmes.

### Methods

This indicator is the number of operational research outcomes that have actually been used during the reporting period. An outcome that has been used is a distinct method, tool or decision rule resulting from operational research that has been successfully adopted for an implementation programme, not as part of field-testing but as an accepted method.

Information on operational research can be obtained from technical reports or from surveys or interviews with the relevant government units or research institutions.

Progress with regard to this indicator is measured by the number of outcomes that have been used within the reporting period.

### Interpretation

Use of operational research outcomes in programmes is an indicator of whether applicable solutions and acceptable methods have been found and adopted. Nevertheless, the indicator has several limitations. It does not specify the types of solutions found, the extent to which they are being adopted or whether the outcomes are being used to update policy,

guidelines and workplans. Moreover, it does not indicate whether outcomes are not being used because the results are not applicable or were not disseminated or because the implementers are unable to interpret or understand the results. Additional process indicators are needed to resolve these issues, as answers to the following questions:

- Have the methods or solutions found been disseminated to programme managers and programme implementers?
- Have the researchers given adequate technical assistance to programme implementers in adopting the methods or solutions in their programmes?
- What types of methods and solutions are being used, and what priority gaps and problems do they address? This is a descriptive indicator.
- Have the research outcomes been used to update policies, guidelines and workplans?

### 3.6 ADVOCACY, COMMUNICATION AND SOCIAL MOBILIZATION

#### Indicator 13: Advocacy meetings on IVM in place

##### **Purpose**

Advocacy meetings with senior officials of the main stakeholders are an indication that efforts have been made to increase their awareness about and commitment to IVM.

##### **Methods**

Whether advocacy meetings on IVM have been held can be ascertained from the minutes or reports of meetings, government gazettes or documents listing resolutions on IVM.

##### **Interpretation**

Advocacy is an important element of IVM, and advocacy meetings with senior-level stakeholders are desirable. Nonetheless, the mere existence of such meetings is no assurance that advocacy is creating awareness or increasing commitment. Nor does the absence of such meetings indicate that there has been no advocacy.

Additional indicators that could be used are found in the answers to the following questions:

- Have advocacy materials been prepared?
- Have case studies on IVM been conducted and documented?
- Have all relevant stakeholders been represented at advocacy meetings?
- Have other means of advocacy been used?
- Have the stakeholders issued formal statements or resolutions on IVM as a result of the advocacy meetings?

#### Indicator 14: Number (and percentage) of stakeholders that have allocated resources for vector control

##### **Purpose**

The number of stakeholders that allocate resources for vector control is a simple indicator of the breadth of commitment and participation in programmes and sectors for vector control.



## Methods

The numerator of this indicator is the number of stakeholders that have allocated resources for vector control, and the denominator is the number of stakeholders targeted for active participation in vector control. 'Stakeholders' are counted as either individual units, departments or programmes in the public or private sector.

Surveys or interviews with relevant government or private sector units, supplemented by information from reports, is required to determine whether financial or in-kind resources were allocated to vector control during the reporting period. Allocation of resources is verified, when possible, by consulting the actual budget lines for vector control.

Progress with regard to this indicator is measured by comparison with the baseline or with the previous reporting period.

## Interpretation

The strength of this indicator is that it shows whether stakeholders are committed to vector control beyond the conventional programmes and whether the number of committed stakeholders is increasing. A limitation of this indicator is that it does not reveal the actual amount of resources that each stakeholder has committed to vector control, nor does it show whether those resources are being used effectively. Moreover, the way in which similar units or programmes are counted – separately or together – can obviate comparisons with previous assessments.

To obtain more detailed information on the types and amounts of allocations for vector control, descriptive indicators could be used, as answers to the following questions:

- Have the stakeholders identified the requirements for vector control?
- How much has each stakeholder allocated for vector control?
- What is the human resource allocation for vector control by each stakeholder?
- Is the allocation of resources among different stakeholders coordinated?

## Indicator 15: Number (and percentage) of sites at which campaigns on behavioural change for vector control were conducted

### Purpose

Awareness campaigns are important for communicating information on behaviour for vector control to communities at risk for vector-borne disease. The number of sites (e.g. villages) at which such campaigns have been conducted indicates the extent to which there has been communication at community level.

### Methods

The numerator of this indicator is the number of sites (villages or smallest administrative units) in which campaigns or community-wide communication on behavioural change for vector control were conducted during the reporting period. The denominator is the total number of villages targeted for campaigns or community-wide communication.

This indicator is restricted to field campaigns in relation to personal protection and vector control; the use of broadcast media is excluded.

Data are obtained through surveys or interviews with the relevant government or private sector units or civil society organizations, supplemented by information from reports. Some countries may have detailed data on the number of people covered by such campaigns. Progress on this indicator is determined by comparing the result with the baseline or with the previous reporting period.

### Interpretation

The strength of this indicator is its simplicity, while its limitations are that it does not indicate the number or percentage of people reached, the suitability or quality of the communicated information or the effectiveness of these activities in changing people's behaviour for personal protection and vector control.

Additional process indicators that could be used to evaluate these aspects are found as answers to the following questions:

- Have targets been set for the number of villages to be covered by campaigns and community-wide communication on behavioural change for vector control?
- Have people been trained and resources allocated for campaigns and community-wide communication?
- What is the estimated number of people who will benefit directly from campaigns or community-wide communication?
- Have changes in knowledge, attitudes, practice and behaviour in relation to vector control been measured in communities?

## Indicator 16: Number (and percentage) of villages in which communities have been mobilized for vector control

### Purpose

The number of villages with community mobilization is an indication of the extent of local commitment to and participation in vector control. Local participation by communities and leaders is essential for increasing the cost-effectiveness and sustainability of vector control.

### Methods

The numerator of this indicator is the number of villages (or smallest administrative units) in which communities have been mobilized for vector control. A community is considered "mobilized" if there is plausible evidence that residents have planned, implemented and evaluated their vector control activities. 'Community mobilization', which can result in empowerment, occurs when a group of people become aware of a common problem, organize themselves and decide together to take action to solve the problem. Community mobilization can be initiated by an external facilitator.

The denominator is the total number of villages targeted for community mobilization on vector control.

Information on this indicator can be obtained from detailed surveys or interviews with relevant government units or civil society organizations to determine whether a village meets the definition of community mobilization. Supplementary information can be obtained from reports. Progress on this indicator is determined by comparing the result with that at baseline or during the previous reporting period.



### Interpretation

The indicator is a simple measure of community mobilization; however, it may be difficult to classify villages with and without mobilized communities. For example, a community may be only partially mobilized or only few people may be active in vector control. Also, it is not clear whether mobilized communities are effective in controlling disease vectors. In villages in which there has been no community mobilization, it would be useful to determine whether the process indicators represented by answers to the following questions were in place:

- Was a target set for the number of villages for community mobilization on vector control?
- Have efforts been made to facilitate or guide local leaders and communities in organizing and planning common activities on vector control?
- Have local leaders and community representatives received adequate information about the biology, ecology and control of disease vectors?

## 3.7 CAPACITY-BUILDING

### Indicator 17: Certified training courses on IVM and judicious use of pesticides in place at national or regional level

#### Purpose

The existence of certified training programmes is indicative of the infrastructure and preparedness for human resource development on IVM and judicious use of pesticides.

#### Methods

To determine the presence or absence of certified training courses, surveys or interviews must be conducted with relevant government units, supplemented by information from reports and training manuals. For the purpose of this indicator, training courses qualify only when they are certified, cover IVM as well as judicious use of pesticides and took place during the reporting period.

A training course is certified only if it awards certificates recognized by the stakeholders after successful completion. The course can be at national level or at regional level, with several countries sharing the same training resources and using the services of tertiary institutions.

#### Interpretation

Although certification implies that the training courses are of acceptable quality, there is no guarantee that the curricula and training manuals of regional courses are adequately adapted to the conditions in each country. The absence of certified training does not indicate whether steps have been taken to establish the infrastructure for training. Process indicators that might be useful for countries are found as answers to the following questions:

- Does the country have a training curriculum covering the key elements of IVM?
- Has the curriculum been adapted to the country situation?
- Has a training or tertiary institution for holding the training session been identified?
- Have arrangements been made for certification and regular assessment?
- Have adequate resources been allocated to training?

## 4. IMPACT INDICATORS

### 4.1 BACKGROUND

IVM is expected to reduce the risk for transmission, reduce disease burden, improve the cost-effectiveness of operations, improve ecological soundness and be sustainable. Indicators to measure these impacts are proposed in *Table 3* and discussed below.

**Table 3. Expected impacts and proposed indicators for measuring the effect of integrated vector management (IVM)**

Expected impact	No.	Indicator
Reduced risk for transmission	18	Vector characteristics
Reduced disease burden	19	Prevalence and incidence rates of vector-borne disease
Cost-effectiveness	20	Cost per case of disease averted per year
Ecological soundness	21	Toxic units of insecticide used per case of disease averted per year
Organization and management	22	Strategy in place to ensure continued mobilization of resources for vector control

Evaluation of impacts is more difficult than measurement of outcome indicators. The main challenge in impact evaluation is attributing an observed effect to the intervention.

Monitoring involves recording changes over time, and progress is measured as the observed change relative to the baseline or to a previous assessment. This approach may be adequate for measuring outcome indicators but not for assessment of the impact on the vector and on disease. For example, an expected impact is that vector populations will decline as a result of IVM; however, the density of vector populations will be influenced not only by the intervention but also by other contemporary factors, such as climate, season and environmental changes. To determine whether an observed change in vector density is attributable to the intervention, the effects of 'confounding' variables must be accounted for or filtered out.

This problem can be addressed by using an experimental design for the evaluation, by comparing the IVM intervention with a control group or area, in a setting without IVM. When the baselines for both the intervention group and the control are known, the sources of confounding can be filtered out and any observed difference can be attributed more reliably to the intervention. Careful selection of intervention and control groups, preferably by random selection, is essential, to ensure that the two groups are comparable at baseline (13).

In practice, the option of an experimental design may not be available. In many settings, ethical considerations prevent purposeful deprivation of at-risk populations from access to proven disease control tools so that they can serve as control group. Hence, evaluators are not usually in a position to select a control group randomly. Furthermore, if areas not



covered by the programme are selected as the control, it is likely that the conditions and risks for disease will not be comparable with those targeted as intervention areas.

The most suitable evaluation design must be carefully chosen. In certain settings, so-called 'step-wedge' schemes have been used as a compromise between the requirements of operations and the demand for systematic evaluation (14). Data collection procedures should be adapted to the purpose of the evaluation, for example to evaluate the ecological soundness of the vector control strategy. Studies can be based on routine surveillance data, for example on disease incidence, vector density or insecticide use, or separate surveys may be required.

## 4.2 IMPACT ON VECTOR AND DISEASE

### Indicator 18: Vector characteristics

#### Purpose

Vector characteristics must be known in order to attribute an impact to vector control activities and not (or unlikely to be) to interventions against the disease parasite or pathogen. This distinction is important, because most vector-borne disease control programmes involve a combination of interventions, targeted at both the vector and the disease pathogen. The appropriate vector characteristic depends on the type of vector and the type of pathogen. No universal indicator is suitable for all disease vectors.

#### Methods

Various vector characteristics can be used to measure the impact of an IVM strategy on the vector. The most basic measure is the density of the population, while other methods focus on the risk for disease transmission, including vector longevity, pathogen infection rate and entomological inoculation rate (estimated number of infective bites received by a person during one season or year).

Detailed descriptions of these methods are beyond the scope of this document; they are described in other documents in relation to the vectors of malaria (10), dengue (15), Chagas disease (16), leishmaniasis (17, 18), onchocerciasis (19), schistosomiasis (20) and human African trypanosomiasis (21). Other useful resources are also available (11, 22).

*Density:* The density of the developmental stages or adults of insect or mollusc vectors is a direct measure of the success of vector control interventions to reduce vector populations, for example by eliminating breeding places or killing larvae or adults. Commonly used methods for measuring the density of disease vectors are: number of indoor resting mosquitoes, number of human biting mosquitoes, percentage of houses infected (triatomids), number of pupae per water container (*Aedes* mosquitoes), number per sticky trap (sandflies), number per bait trap (blackflies) and number per 25 water scoops (snails, mosquito larvae and pupae).

*Longevity:* In some vector control methods, residual insecticides are used to reduce the longevity of vectors, of malaria mosquitoes in particular, to less than the time for the disease pathogens to develop and thus be transmitted to human hosts. Determining the age of an adult vector requires dissection and examination of the ovaries.

*Infection rate:* The infection rate is the proportion of the vector population that is infected with the disease parasite or pathogen, which can be transferred to human hosts. The infection rate of mosquitoes is determined by dissecting and examining the salivary glands for the presence of parasites or pathogens with visual aids or immunological methods.

*Entomological inoculation rate:* The entomological inoculation rate, defined as the number of infective bites per person per night, is a powerful measure of the intensity or risk of transmission. It is calculated by multiplying the human biting rate by the infection rate of the vectors (x 100%).

### **Interpretation**

A positive impact on a vector would suggest a positive impact on the vector-borne disease itself; however, a decrease in a vector characteristic is not generally followed by a similar decrease in the incidence of disease. A number of factors contribute to the complex relation between a vector and disease morbidity, including acquired immunity and personal protection. Consequently, a positive impact on a vector should be interpreted with caution.

## **Indicator 19: Prevalence and incidence rates of vector-borne disease**

### **Purpose**

The prevalence and incidence<sup>2</sup> of a disease indicate whether the strategy has been effective in reducing it.

### **Methods**

Standard measures of disease morbidity include the prevalence or incidence of infection, the incidence of illness or disease symptoms and the incidence of a severe stage of the disease. The methods for measuring disease are beyond the scope of this document; they have been described in relation to malaria (23, 24), dengue (15), Chagas disease (16), leishmaniasis (17, 18), lymphatic filariasis (25), onchocerciasis (19), schistosomiasis (20) and human African trypanosomiasis (21).

As each measure has technical and operational advantages and disadvantages for different vector-borne diseases, methods should be chosen on the basis of the prevalent diseases, the available data and practical considerations. Data can be obtained by passive or active surveillance, detection and diagnosis. The data sources include health service statistics, health facility surveys and population-based surveys. Data on disease can also be used to identify epidemics and to study changes in distribution.

### **Interpretation**

A reduction in disease morbidity or mortality is ultimately the best measure of impact. The incidence and prevalence of disease can, however, be influenced by many factors, including vector control. Other factors, such as interventions against the parasite or pathogen and environmental and socioeconomic factors, also influence the disease situation. Hence, attribution of an impact on disease to vector control requires a carefully designed study.

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<sup>2</sup> 'Prevalence' is the total number of cases of disease divided by the number of people in a population. 'Incidence' is the number of new cases divided by the number of people in the population who were initially free of disease.



## 4.3 OTHER IMPACTS

### Indicator 20: Cost per case of disease averted per year

#### Purpose

The cost of averting a case of disease indicates the cost-effectiveness of the IVM strategy in comparison with a conventional or previous strategy for vector-borne disease control. The purpose of this indicator is to measure whether more cases are averted at less financial cost as a consequence of IVM.

#### Methods

Calculating the cost of a disease control programme is complex and requires specialized study. Programme costs include capital costs (vehicles, equipment, buildings) and recurrent costs (personnel, operating expenditures) (26). The recurrent costs should also include the costs for management, training and operations to support a combination of interventions, each of which might have an impact on disease. Hence, it is difficult to separate the costs for each intervention. Cost calculation requires records of expenditures or estimates for a range of items.

Costs are divided by the number of cases averted in the programme area during the reporting period. For example, if the cost of a programme is US\$ 1 million per year and the number of cases of dengue was reduced by 5000 in that year, the cost per case averted in that year is US\$ 200 (US\$ 1 million/5000). However, a costing exercise should also factor the savings in hospital services by reducing the number of severe dengue cases.

Progress can be monitored by comparing the cost per case averted during the reporting period with that at baseline or during the previous reporting period. A difference from the previous period might not necessarily be attributable to the disease control strategy but might have been influenced by other factors. Alternatively, cross-sectional comparisons can be made, by selecting areas with and without an IVM strategy. The costs and numbers of cases are determined for both areas, and the cost per case averted is compared. Particular care must be taken to ensure that the two areas have similar epidemiological or socioeconomic conditions.

#### Interpretation

The cost per averted case is a powerful measure of cost-effectiveness, although attribution of a difference in cost-effectiveness to an IVM strategy must be done with caution. Also, as disease incidence decreases, the cost of averting the last few cases will inevitably increase. Therefore, cost-effectiveness should always be evaluated in the context of the local epidemiological situation of a disease.

The issue of cost can also be evaluated in a broader context, in a descriptive case study on the indirect effects of the IVM approach on public health services; for example, increasing the access and participation of communities, reducing costs by combined service delivery or increasing the status and motivation of health staff in districts and villages. The results of such case studies could be used for advocacy in the health sector.

## Indicator 21: Toxic units of insecticide used per case of disease averted per year

### Purpose

The number of toxic units of insecticide used per disease case averted indicates the ecological soundness of the strategy and the effectiveness of the control programme. If disease control is achieved with less use of insecticides, the risk for adverse effects on humans and the environment will be reduced.

### Methods

This indicator requires a study with data on insecticide use and the toxicity of each insecticide. Toxic units of annual insecticide use are calculated by determining, for each insecticide, annual national use in kilograms of active ingredient. This figure is multiplied by the 'toxicity index' for that insecticide to obtain the toxic units per insecticide used.

Two standard toxicity indices are proposed: the median lethal dose ( $LD_{50}$ ) and the no-observable-adverse-effect level (NOAEL). The  $LD_{50}$  value is an estimate of the number of milligrams of active ingredient of the pesticide per kilogram of body weight required to kill 50% of a large population of test animals (27); this measure is based primarily on the acute oral and dermal toxicity of a compound in rats. The NOAEL is the highest level that does not cause observable harm (28). The  $LD_{50}$  and NOAEL values for common insecticides are available from the reports of the FAO/WHO Joint Meeting on Pesticide Residues (29).

To calculate toxic units per case of disease averted, the total number of toxic units is divided by the reduction in the number of cases during the reporting period. If the total number of toxic units is 10 000 per year and the number of cases of malaria was reduced by 2000 in that year, the number of toxic units per case averted is 5 (10 000/2000).

Progress could be monitored by comparing the number of toxic units per case averted in the reporting period with that at baseline or during the previous reporting period.

### Interpretation

The calculation and use of toxic units of insecticides used requires further research.

## Indicator 22: Strategy in place to ensure continued mobilization of resources for vector control

### Purpose

As vector control programmes in many countries rely heavily on external funding, the sustainability of control efforts is a concern. The existence of a strategy for continued mobilization of resources is an indication of the sustainability of vector control, as it will be funded by the government of a country as part of its budgetary allocation.

### Methods

In order to determine whether there is a strategy for continued mobilization of resources for vector control, an interview or survey should be conducted with the relevant government bodies. The information can be verified by obtaining a copy of the strategy document.

### Interpretation

A strategy for resource mobilization is an important sign that vector control might be continued beyond its current phase; however, the existence of a strategy is no guarantee that a country will continue to provide resources for vector control, as other priorities may emerge.



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Integrated vector management (IVM) aims to improve the efficacy, cost-effectiveness, ecological soundness and sustainability of vector control in order to achieve the global targets set for control of vector-borne diseases. This guidance document provides indicators and standard methods for countries to monitor and evaluate implementation of their national IVM strategies. It will also harmonize methods for monitoring and evaluation of IVM practices at regional and global levels.



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