WHO/CDS/WHOPES/2004.9a

Decision-making for the judicious use of insecticides

Participant's Guide

TRIAL EDITION

World Health Organization
Communicable Disease Control,
Prevention and Eradication
WHO Pesticide Evaluation Scheme (WHOPES)

WHO/CDS/WHOPES/2004.9a

DECISION-MAKING FOR THE JUDICIOUS USE OF INSECTICIDES

PARTICIPANT'S GUIDE

TRIAL EDITION

World Health Organization

Contents

Acknowledgements

The Department of Communicable Disease Control, Prevention and Eradication (CPE) wishes to thank Dr R. Zimmerman, Florida Medical Entomology Laboratory, and Dr M.E. Swisher, Department of Family, Youth and Community Sciences, University of Florida, USA, for drafting the document.

CPE also wishes to thank the following for their valuable contribution to the development of this document.

- Dr M.K. Cham, Roll Back Malaria Department, World Health Organization, Geneva, Switzerland
- Dr K. Krishnamoorthy, Vector Control Research Centre, Pondicherry, India
- Dr M. Nathan, Communicable Disease Control, Prevention and Eradication, World Health Organization, Geneva, Switzerland
- Dr E. Renganathan, Director, WHO Mediterranean Centre for Vulnerability Reduction, Tunis, Tunisia
- Dr H. Vatandoost, School of Public Health, Teheran University of Medical Sciences, Teheran, Islamic Republic of Iran
- Dr R. Yadav, Malaria Research Centre, Gujarat State, India
- Dr M. Zaim, Communicable Disease Control, Prevention and Eradication, WHO Pesticide Evaluation Scheme (WHOPES), World Health Organization, Geneva, Switzerland

CPE's sincere appreciation is extended to the managers of vector control, Ministry of Health, Sri Lanka, where the module was first field-tested, for their constructive suggestions.

The guide is still a trial edition and will be finalized after further field-testing. CPE greatly appreciates input and suggestions from readers (coordinators, facilitators and participants), to be incorporated into further editions.

This publication has been funded by Roll Back Malaria (RBM).

Introduction

COURSE GOAL AND OBJECTIVES

Goal

The goal of this course is to enable participants to make evidence-based decisions on the safe and judicious use of insecticides in public health.

Objectives

By the end of this course you will:

- be able to use evidence-based decision-making for the control of vector-borne diseases and for the selection of vector control methods at the workplace;
- know what vector control options exist, their advantages and limitations, as well as their role in different eco-epidemiological and operational situations;
- be able to make decisions on what insecticides to apply and where, when and how to apply them to maximize effectiveness, minimize cost and ensure safe use;
- be able to develop appropriate indicators for monitoring and evaluating the effectiveness of vector control programmes.

COURSE CONTENT

Learning Unit 1: Decision-making for vector-borne disease control

Learning Unit 2: Understanding the problem

Learning Unit 3: Formulating objectives and approaches

Learning Unit 4: Judicious use of insecticides

Learning Unit 5: Monitoring performance

COURSE MATERIALS APPROACH

The ***Participant's guide*** consists of instructional materials designed to enable you to meet the course objectives. The learning objectives summarize the knowledge, skills and attitudes that you should acquire by the end of the Learning Units. The five Learning Units include a number of group exercises and readings that will assist you in reaching the goals of the course. The skills and knowledge contained in one Learning Unit must be acquired before you progress to the next, otherwise you may have difficulty in achieving the objectives of subsequent Learning Units. You must read each Learning Unit before coming to class for that session.

The course uses a problem-solving approach. It will provide you with skills and knowledge that you can use to plan, implement, monitor and evaluate vector control strategies based on the judicious use of insecticides. The course is based on a participatory approach. Throughout, you will work in small groups to solve problems related to vector control. Each group will choose a moderator to lead its discussions and a rapporteur to take notes, and will later present its results in a plenary session.

The course coordinator is responsible for organizing and running the course. Facilitators are professionals, with experience in the subject matter, who assist the course coordinator and participate in your working groups to provide orientation and facilitate discussion.

The working group sessions provide good opportunities for you to express your opinion, develop your ideas and learn from the other participants. Your group will analyse one of three case-studies, focusing on diseases selected because of their importance as vector-borne diseases, the complexity of the decision-making process for developing strategies for their control, and their current reliance on chemical control. Your course coordinator and facilitator will provide the case-studies to you in several parts as you progress through the course.

LEARNING UNIT 1

Decision-making for vector-borne disease control

LEARNING OBJECTIVES

After completing this *Learning Unit* you will:

- understand the important steps in decision-making to solve vector-borne disease problems

The importance of judicious use of insecticides

The judicious use of insecticides has become a very important issue for the following reasons:

- the arsenal of safe and cost-effective insecticides for vector control is rapidly disappearing due to increased insecticide resistance and the scarcity of new compounds under development;
- costs of insecticides have increased greatly; in some countries, insecticide purchases alone account for more than half of the total budget of the vector-borne disease control programme.

These considerations make the judicious use of chemicals essential, both to prolong the life of the pesticides available to vector management specialists and to reduce the recurrent costs of insecticide application.

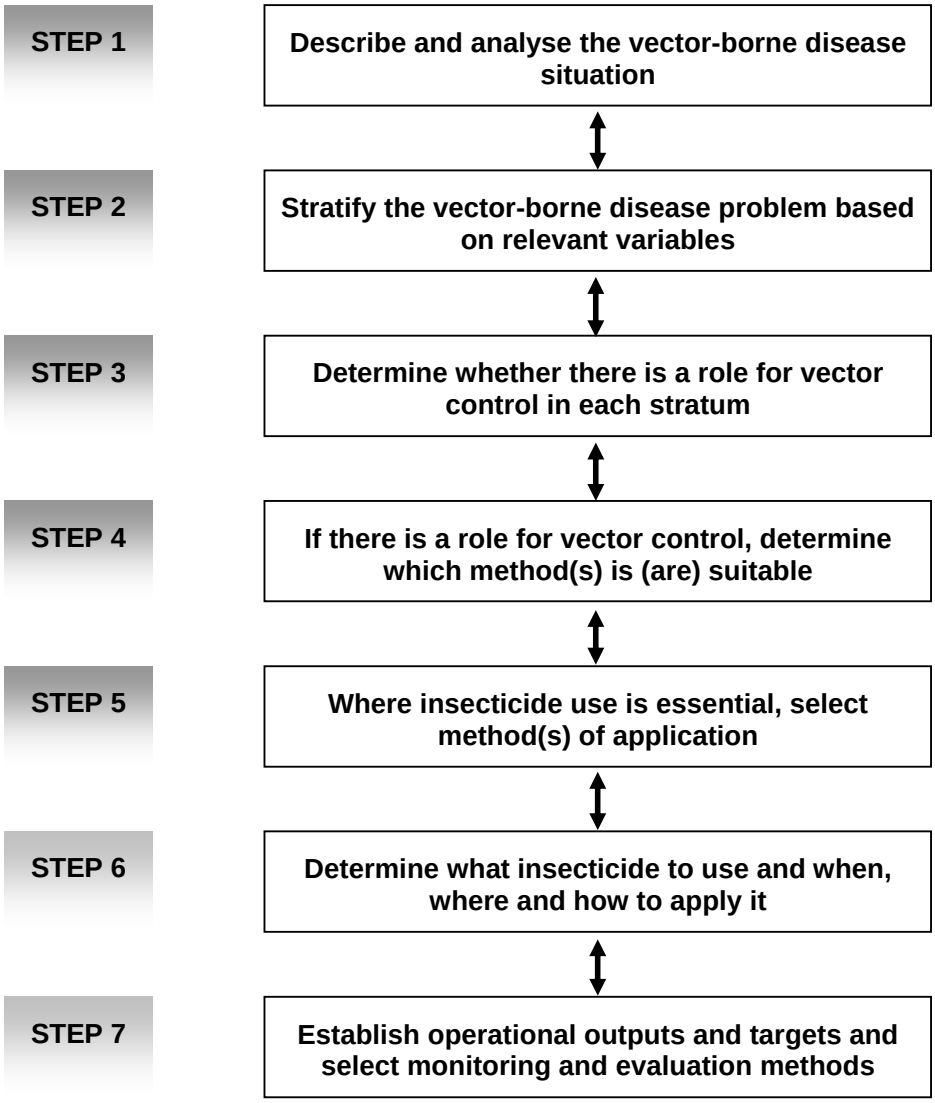
The use of chemicals for vector control therefore requires a thorough understanding of evidence-based vector management.

Key concepts and steps in evidence-based decision-making for vector management

Three concepts are key to effective decision-making, each of which is covered in detail in this Learning Unit.

1. You must be willing to accept outcomes that are less than ideal.
2. You need to break the decision-making process down into logical steps.
3. You need to continually evaluate the outcomes of decisions and change the decisions if needed.

DECISION-MAKING PROCESS



Decision-making as a continuous process

The ultimate goal of vector control is to help to reduce the morbidity and mortality from vector-borne diseases. The ultimate test of the success of a vector control programme, therefore, is whether it contributes effectively to stated health goals. The vector control specialist must remain alert to changes in the health situation in his/her area of responsibility and be willing to change vector control strategy in response to changing conditions.

- Decision-making is a continuous process. The information gained from monitoring is used to determine whether the decisions that have been made are contributing to the achievement of stated health goals. If they are not, new decisions are needed.

- Effective decision-makers operate on the principle that *all decisions are provisional* – you make a decision, you continually check to see whether it is "working", and you are always prepared to make a new decision if performance is inadequate. No decision works "once and for all." The conditions that create health problems will change: organisms become resistant to pesticides; environmental conditions change; people move from one place to another, carrying disease-causing organisms with them.

- Decision-makers must decide ahead of time when a development or change in the health status in an area requires another decision. They must be prepared to act when a decision outcome shifts from "acceptable" or "under control" to "unacceptable" or "out of control" . This requires the development of *performance indicators*, with thresholds that, when reached, indicate the possible need for new operational decisions. If a 10% infection rate for a given disease is acceptable in a given area, for example, you will need to examine your vector control strategy if the rate rises to 15%. It may be time to make a new decision about vector control, or you may find that other factors, outside your field of responsibility as a vector management specialist, are producing the undesired change.

Understanding the problem

LEARNING OBJECTIVES

After completing this *Learning Unit* you will:

- be able to apply a systematic approach to the analysis of vector-borne disease problems
- understand the significance of stratification of vector-borne disease problems and incorporate stratification into the decision-making process

Presentation and discussion

Step 1: Describe and analyse the vector-borne disease situation

Environmental, economic and social conditions vary geographically and over time. As these variables[1] change, they alter the health risks for individuals and groups of people. In order to better identify potential risk factors, diseases may be described in terms of:

who contracts a specific disease? For example, what is the sex, age, ethnicity, or occupation of the individuals who are affected?

when do they contract the disease? Does incidence vary by season? Does transmission occur at specific times of day?

where does transmission occur? For example, does transmission occur outside the community, where people work or when they travel, or at some specific location within the community?

how does transmission occur? Does a vector transmit the disease or does transmission occur through some other mechanisms?

[1] A variable is a changeable condition that influences the expression of health risk factors.

Step 2: Stratify the vector-borne disease problems based on relevant variables

Stratification is a process that permits the decision-maker to characterize geographical areas, groups of people or situations that share important criteria in order to be able to develop solutions to the disease problems in a country, region or local area. Stratification involves three components:

- intensity (prevalence/incidence) of transmission of the disease;
- eco-epidemiological characteristics of the disease;
- ability to intervene to reduce the intensity of transmission, including infrastructure and operational capacity.

Group exercise I

You will receive Part I of your case-study from the course coordinator or facilitator. Answer the questions below. Use the flip charts to organize your ideas and arrange your answers.

1. What health problem(s) can you identify in Part I of the case-study? What evidence is there that these problems exist?
2. What important ecological (environmental) and economic or social variables and factors can you identify that influence the health situation?
3. What other information do you need to understand the situation and be able to decide how to solve these problems?

Group exercise II

After you have completed Part I of your case-study the facilitator will provide you with Part II. Answer the following questions.

1. Do the new data confirm your original assessment of the nature of the problem? Why (or why not)?
2. Based on the data you have now, write a brief (250 words or less) explanation of the vector-borne disease problem and its magnitude. Include: (a) **who** has the disease, (b) **where** you believe transmission occurs, (c) **when** you believe transmission occurs, and (d) **how** you believe transmission occurs.

3. Are the data sufficiently stratified to allow an appropriate decision to be made on vector control? Why (or why not)?

4. How would you present your data graphically (using maps, graphs, or charts)?

5. Are the data sufficiently reliable and accurate to allow you to move forward with decision-making? If not, what additional data do you need?

Formulating objectives and approaches

LEARNING OBJECTIVES

After completing this *Learning Unit*, you will be able to:

- determine when vector control has an important role to play in achieving health goals
- use information about the life-cycle of the disease-causing organism and its vector(s) to determine which of the three main vector control methods are most appropriate to use in a specific situation
- decide when chemical control is essential and select the most appropriate application method(s)

Presentation and discussion: Indications of an important role for vector control

This presentation and discussion focus on Step 3 in the decision-making process.

Step 3: Determine whether there is a role for vector control in each stratum

There are six main indications for vector control in controlling vector-borne diseases:

- prevention and control of epidemics;
- elimination of new foci of infection;

- prevention of seasonal peaks of transmission;
- control of transmission in high-risk situations;
- reduction of transmission in areas of high drug resistance;
- control of an endemic disease.

The reading, *Control strategies for Chagas, dengue, and malaria* presents the disease control strategies for these diseases.[1]

Chagas disease

- Systematic screening of bloods in blood banks.
- Personal protection through housing improvement and reduction/ elimination of vectors' hiding places.
- Reduction/elimination of transmission through indoor residual spraying and other appropriate vector control measures.
- Early treatment and case management.
- Capacity building and research.

Dengue

- Selective integrated vector control, with community and intersectoral participation.
- Active disease surveillance based on a strong health information system.
- Emergency preparedness.
- Capacity building and training.
- Vector control research.

Malaria

- Early diagnosis and prompt treatment.

[1] In: *WHO recommended strategies for the prevention and control of communicable diseases*. Geneva, World Health Organization, 2001 (document WHO/CDS/CPE/SMT/2001.113).

- Selective and sustainable preventive measures, including vector control.
- Early detection, containment or prevention of epidemics.
- Strengthening local capacities in basic and applied research to permit and promote the regular assessment of a country's malaria situation, in particular the ecological, social and economic determinants of the disease.

Now, an additional important consideration is the prevention of the re-emergence of malaria in countries that have either succeeded in reducing malaria incidence to a low level or that have interrupted transmission altogether.

Presentation: Methods of vector control

When vector control *does* have an important role to play in disease control, identifying the appropriate vector control method is a critical step in decision-making.

Step 4: If there is a role for vector control, determine which method(s) is (are) suitable

There are three major vector control methods:

- reduce human–vector contact;
- reduce vector density;
- increase adult vector mortality.

Reduce human–vector contact. This method creates a barrier between the vector and humans, thereby reducing or preventing the transmission of disease. Common methods used to reduce human–vector contact include:

- nets, insecticide-treated nets and curtains;
- window and door screens, house improvement;
- repellents;
- household insecticide products (e.g. coils, mats and aerosol dispensers);
- protective clothing.

Reduce vector density. This method reduces the potential for vectors to transmit disease by lowering their reproductive rate and vectorial capacity. Frequently used methods are:

- environmental management;
- larviciding;
- biological control;
- adulticiding with space sprays.

Increase adult vector mortality (reduce vector survival). This method reduces the expectation of life of the adult vector and therefore the probability that a pathogen will complete its extrinsic incubation period. Common methods include:

- indoor residual spraying;
- community-wide use of insecticide-treated nets.

Key points

General

- Some of the **bionomic** characteristics of different species make them more or less vulnerable to the various methods of vector control.
- Knowledge of **larval habitats** and **adult behaviour** is necessary for selection of the most appropriate control methods.

Immature forms

- The habitats of immature forms vary enormously.
- Identifying both permanent and temporary habitats is important.
- The effectiveness of control of immature forms depends on the number, extent and accessibility of breeding habitats.

Adults

- Biting and resting habits of adults are highly variable.
- Time of feeding influences vector efficiency and effectiveness of control.

- Understanding the resting habits of the vectors is important for ascertaining the feasibility of different vector control methods.
- Understanding the mechanisms of survival during adverse weather conditions is also important.

Discussion: What are the advantages and limitations of each vector control method?

This Learning Unit emphasizes the criteria that are used to decide whether chemical control of the vector is essential, and if so, to decide which chemical control methods are most appropriate.

Step 5: Where the use of insecticide is essential, select method(s) of application

Group exercise III: Vector control methods

The course coordinator or facilitator will provide you with Part 3 of your case-study and a diagram of the life-cycle of the disease vector. Indicate where each of the different vector control methods could be used for the different life stages presented on the diagram. Discuss the advantages and limitations of each vector control intervention. Then select the most appropriate vector control method, or combination of methods, to use for your case-study. Use your flip charts to organize your discussion and results. The rapporteur for your working group should present the completed diagram to the plenary session, explain which of the potential vector control methods was chosen, and describe the specific advantages and limitations of the method or combination of methods selected.

Judicious use of insecticides

LEARNING OBJECTIVES

After completing this *Learning Unit*, you will be able to:

- determine **what** insecticides are most appropriate to use in a given situation
- decide **where** insecticides should be applied to ensure their effective and targeted application
- establish **when** to apply insecticides to maximize their effect
- make decisions about **how** to ensure that insecticides are applied safely and effectively

Presentation

This Learning Unit focuses on the skills and knowledge needed to apply pesticides judiciously.

Step 6: Determine what insecticide to use and when, where and how to apply it

1. **What** insecticide (compound and formulation) should be applied? Which product is most appropriate, taking into consideration its safety, efficacy, acceptability, cost and availability.
2. **Where** to apply? This requires identification of priority geographical areas and specific locations for best targeting and coverage requirements.

3. **When** to apply? This may refer to the time of year or to the time of day and the epidemiological requirements, taking into consideration duration of effect and time required for covering the target area.

4. **How** to apply? What skills and equipment are required to ensure effective and safe application?

Group exercise IV: Develop an intervention plan

Use the criteria that were developed during the previous discussion to develop an action plan for the chemical control method you selected for your case-study in the previous Learning Unit. Answer each of the questions presented in the table at the end of this Learning Unit and for each method or combination of methods selected.

Presentation: Safe use of insecticides

Safety

Human and environmental health are important factors in determining what pesticide to use. A brief discussion on the issues related to the safe use of insecticides is warranted before proceeding with the exercises in this Learning Unit. Use the following information to develop your presentation.

Main risks associated with pesticides

- Toxicity and adverse health effects for applicators and handlers.
- Toxicity and adverse health effects for the population.
- Environmental contamination.

Lethal dose/lethal concentration

The amount of a chemical needed to kill a certain percentage of animals. For example, **LD_{50}/LC_{50}** is the statistical estimate of the number of milligrams (mg) of a chemical per kg of body weight required to kill 50% of test animals.

Toxicity

Toxicity is the inherent poisonous potency of a compound under experimental conditions.

- *Acute toxicity* is the toxicity of a chemical from single or limited exposure. Chemicals are considered highly toxic when the LD_{50}/LC_{50} is low and less toxic when it is high.
- *Chronic toxicity* is the toxicity from a chemical after long-term exposure (i.e. cancer, birth defects and reproductive effects). The threshold dose for chronic toxicity may be lower than that for an acute effect.

Hazard

Hazard is the inherent property to cause a potential harmful effect. The hazard presented by any pesticide depends on the toxicity of the active ingredient, its concentration in a formulation, and the physical form of the formulation.

Risk

Risk is the probability that a harmful effect might result from exposure to a particular hazard.

The label on a pesticide container provides critical information about the material.

Pesticide product label information to indicate the WHO hazard classification

WHO hazard class	Information on label	Hazard statement	Band colour	Hazard symbol
Ia	Extremely hazardous	Very toxic	Red	Skull and cross-bones
Ib	Highly hazardous	Toxic	Red	Skull and cross-bones
II	Moderately hazardous	Harmful	Yellow	Cross
III	Slightly hazardous	Caution	Blue	
Unlikely to present a hazard			Green	

METHOD

What pesticide will be used? Justify the selection based on cost, availability, efficacy and safety.	
Where will the pesticide be applied? Describe the coverage requirements for the method selected and explain why you have selected the specific target area for application.	
When will the pesticide be applied? Explain why you have selected a certain time or times of year and/or time of day for application. Discuss the expected duration of effect and describe the treatment cycle that will be necessary.	
How will the pesticide be applied? Describe the type and quantity of application equipment required, and the skills that staff will need to be able to apply the material effectively. Discuss the safety issues involved in application and describe the kinds of safety equipment and precautions that should be used.	

Monitoring performance

LEARNING OBJECTIVES

By the end of this *Learning Unit*, you should be able to:

- develop monitoring and evaluation plans for vector control programmes
- select process (operational), impact (entomological) and outcome (epidemiological) indicators for vector-borne disease control programmes

Monitoring and evaluation

This Learning Unit focuses on the final step in the decision-making process.

Step 7: Establish operational outputs and targets and select monitoring and evaluation methods

Monitoring is a continual process designed to measure the quality of the activities carried out and progress in relation to the programmed timetable. It identifies obstacles and provides a basis for identifying aspects of the programme that may need to be modified. It requires the identification of appropriate process indicators – the operational indicators that are assigned to the activities performed and to targets.

Evaluation is used to define the periodic assessment of progress towards the achievement of the objectives by measuring impact indicators and the goals of the programme by measuring outcome indicators. The impact indicators are the entomological measurements and the outcome indicators are the health outcomes or epidemiological indicators.

Three kinds of indicators are used in monitoring and evaluation:

- process or operational;
- impact or entomological;
- outcome or epidemiological.

Process indicators

- Tell you whether you and your staff are completing activities in a timely fashion as defined in the operational plan.
- Allow you to track the availability and condition of the resources and materials needed for your programme.

Impact indicators

- Measure the effect of your vector control interventions on the vector population, e.g. the extent to which they have reduced human–vector contact, reduced vector density or increased the mortality of adult vectors.

Outcome indicators

- Measure the impact of your vector control programme on morbidity and mortality due to disease.

Indicators are sometimes classified by how often they are monitored. For example, you would not monitor insecticide resistance as regularly as you would adult density, because it does not change as quickly – it is therefore an indicator of change or trend. Often, you set up specific evaluation studies in which the status of a vector or a disease is observed to answer a specific question such as – has the infection rate of the parasite changed since implementation of the vector control strategy? Such a study would involve collection of vector specimens and testing them for infection. These are special indicators.

Many other indicators are measured in specific situations. If you determined that the community would benefit from a programme of information, education, communication (IEC) you would probably want to select performance indicators that measure the operational performance and impact of IEC. For example, you may want to measure the proportion of people participating in the education campaign or the proportion of partners participating in coordination meetings.

Group exercise V: Monitoring and evaluation

Identify at least one of each of the three types of indicators *for each control method selected* and indicate clearly the type of data that will be collected, who will be responsible for collecting the data, and the frequency of collection (weekly, monthly, etc.). You should also decide whether the indicator should be measured regularly (R), at longer intervals for detecting trends (T) or selectively for specific purposes (S).

METHOD _____

	Process or Operational Indicator	Impact or Entomological Indicator	Outcome or epidemiological Indicator
What type of data will be collected?			
Who will collect the data?			
When will the data be collected?			