



Vector control

METHODS FOR USE BY INDIVIDUALS AND COMMUNITIES

Prepared by Jan A. Rozendaal



World Health Organization
Geneva

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1997

WHO Library Cataloguing in Publication Data

Vector control : methods for use by individuals and communities / prepared by Jan A. Rozendaal.

1. Insect control — methods 2. Pest control — methods
3. Disease vectors 4. Manuals 1. Rozendaal, Jan Arie

ISBN 92 4 154494 5 (NLM Classification: QX 600)

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TYPESET IN HONG KONG
PRINTED IN ENGLAND
94/10136—Best-set / Alden Press—7500

Foreword

The development and production of this manual have been an enormous task. Relevant information has been assembled on the control of disease vectors, reservoir species and household pests with the specific objective of providing practical guidance to non-professionals. The target species addressed in this book and the control methods described have been selected for an audience of individuals and communities whose potential contribution to vector control is considerable, but may be restricted by factors such as lack of financial resources and limited education. The decision-making structure of the community and control activities undertaken by local health services are also important in determining which control methods are appropriate.

Most of the research, data collection and field visits needed for this book were carried out by Dr Jan A. Rozendaal between 1988 and 1991. The resulting draft manuscript was then reviewed by various specialists in vector-borne disease control, who made a number of suggestions for changes to the text. In preparing the final manuscript, Dr Rozendaal has incorporated information on new developments in vector control to ensure that the text is as up to date as possible.

This book is particularly timely, since it appears as vector control is coming to depend less on large-scale control programmes organized by governments and more on community participation at the local level. In addition, it is now clear that many of the traditional methods used to prevent and control vector-borne and other infectious diseases are either incorrectly applied or no longer effective. Under the combined pressures of economic development, environmental and demographic changes, and increasing human migration, diseases are reappearing in new environments or are re-emerging in more virulent forms. Many of the agents of these diseases have become resistant to commonly used drugs or their vectors have developed resistance to pesticides. The methods described in this book, especially those directed at permanent modifications of housing and other components of the living environment, will help to prevent and control these diseases, which hinder economic progress and affect the well-being of populations in many parts of the world.

Dr K. Behbehani
Director, Division of Control of Tropical Diseases

Preface

Diseases transmitted by arthropods and freshwater snails are among the major causes of illness and death in many tropical and subtropical countries, and to a lesser extent, in temperate zones also. In addition to the toll they exact in terms of premature death and disability, such diseases—which include malaria, filariasis, leishmaniasis, schistosomiasis, dengue and trypanosomiasis—represent a significant impediment to economic development, as a result of lost working hours, and the high costs of treating the sick and controlling the vectors of disease.

Large-scale campaigns for vector control are often unworkable for both financial and practical reasons, as well as being damaging to the environment. For these reasons, attention has shifted to methods that can be applied by individuals and communities to protect themselves from vector-borne disease. Unfortunately there is little widely available information to guide non-specialists in vector control techniques. This book attempts to fill that gap, by describing methods that are suitable for self-protection by individuals and communities and that require only limited involvement by the health services in planning and community education. In general these techniques are relatively simple and cheap, do not require much training and, if properly applied, are safe for the user and the environment.

The manual includes practical information on all major disease vectors and pests, only some of which will be relevant in any particular community. The manual is therefore intended for adaptation to the local situation or to special target groups, such as travellers. The World Health Organization would welcome feedback from readers, particularly regarding use of this manual in the field. Comments and suggestions for improvement should be sent to Division of Control of Tropical Diseases, World Health Organization, 1211 Geneva 27, Switzerland.

Acknowledgements

The production of this manual was made possible by the support and contributions of a number of individuals.

Dr J.A. Rozendaal, Associate Professional Officer, former Division of Vector Biology and Control, WHO, carried out most of the research, data collection and field visits needed for the book and prepared the manuscript.

Dr R. Slooff, Director, former Division of Vector Biology and Control, WHO, and Dr C.F. Curtis, Department of Entomology, London School of Hygiene and Tropical Medicine, reviewed the text and provided comments on its content and structure.

WHO gives special thanks to the experts named below for their valuable contributions to individual chapters.

Chapter 1

Dr C.F. Curtis, London School of Hygiene and Tropical Medicine, London, England

Dr C.E. Schreck, United States Department of Agriculture, Gainesville, FL, USA

Dr V.P. Sharma, Malaria Research Centre, Delhi, India

Professor Yap Han Heng, Malaysia Sains University, Penang, Malaysia

Chapter 2

Mr J. Lancien, French Institute for Cooperative Scientific Research for Development (ORSTOM), Entebbe, Uganda

Dr C. Laveissière, Pierre Richet Institute, Organization for Cooperation against the Major Endemic Diseases (OCCGE), Bouaké, Côte d'Ivoire

Chapter 3

Dr R. Briceno-León, Central University of Venezuela, Caracas, Venezuela

Dr A.M. Oliveira Filho, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

Dr I. Paulone, National Institute of Diagnosis and Investigation of Chagas Disease

Dr Mario Fatale Chaben (INDIECH), Buenos Aires, Argentina

Dr E. Segura, INDIECH, Buenos Aires, Argentina

Chapter 5

Dr D.G. Cochran, Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

Chapter 6

Mr J. Keiding, Danish Pest Infestation Laboratory, Lyngby, Denmark

Chapter 8

Dr R.K. Clumpp, formerly with Division of Vector-borne Diseases, Ministry of Health, Nairobi, Kenya

Dr R. Sloomweg, Centre for Environmental Studies, State University of Leiden, Leiden, Netherlands

Contributions to individual chapters were also made by the following WHO staff members: Mr R. Bos, Division of Operational Support in Environmental Health; Dr A.W.A. Brown, former Division of Vector Biology and Control; Mr P.D. Cattand, Division of Control of Tropical Diseases; Dr N.G. Gratz, former Division of Vector Biology and Control; Dr A.B. Knudsen, formerly with Division of Control of Tropical Diseases; Dr K.E. Mott, Division of Control of Tropical Diseases; Dr P.J.A. Ranque, Division of Control of Tropical Diseases; Dr C. Schofield, formerly with Special Programme for Research and Training in Tropical Diseases; Dr A.R. Seim, Division of Control of Tropical Diseases; Mr G. Shidrawi, formerly with Division of Control of Tropical Diseases.

WHO also thanks the following people for their valuable advice, suggestions and other support: Dr P. Carnevale, Pierre Richet Institute, OCCGE, Bouaké, Côte d'Ivoire; Mr R. Carroll, Building Research Establishment, Watford, England; Dr M. Coosemans, Institute for Tropical Medicine, Antwerp, Belgium; Mr M. Dubbelman, Siamdutch Mosquito Netting Co., Bangkok, Thailand; Dr A. Fenwick, Schistosomiasis Research Project, Ministry of Health, United States Agency for International Development, Cairo, Egypt; Dr J. Goose, Cambridge Animal and Public Health Ltd, Hauxton, Cambridge, England; Dr G. Hesse,

Bayer AG, Leverkusen, Germany; Dr T.W. Hofman, Cyanamid International, Louvain-la-Neuve, Belgium; Mr J.F. Invest, Roussel Uclaf, Berkhamsted, England; Professor J.J. Laarman, University of Amsterdam, Amsterdam, Netherlands; Mr S. Matsuo, Sumitomo Chemical Co., Osaka, Japan; Mr G.A. Matthews, International Pesticide Application Research Centre, Sunninghill, Berkshire, England; Professor D.H. Molyneux, Liverpool School of Tropical Medicine, University of Liverpool, Liverpool, England; Professor M.S. Mulla, University of California, Berkeley, CA, USA; Dr R. Sonneck, Bayer AG, Leverkusen, Germany; Dr R. Sturrock, Department of Medical Helminthology, London School of Hygiene and Tropical Medicine, London, England; Mr Teoh Kim Teik, Fumakila, Malaysia; Professor H.J. Van Der Kaay, formerly with State University of Leiden, Leiden, Netherlands; Professor G. Webbe, formerly with Department of Medical Helminthology, London School of Hygiene and Tropical Medicine, London, England; Dr G.B. White, Zeneca Public Health, Fernhurst, Haslemere, England.

Advice and suggestions were also provided by the following current and retired WHO staff members: Dr J. Akiyama, Dr D. Barakamfitiye, Dr P.F. Beales, Dr P. de Raadt, Dr C.W. Hays, Dr P.R.J. Herath, Dr R.L. Kouznetsov, Mr F.A.S. Kuzoe, Dr R. Le Berre, Dr S. Litsios, Dr A. Moncayo, Dr J. Najera Morrondo, Dr M. Nathan, Dr R. Plestina, Dr G. Quélenec, Dr H.R. Rathor, Dr C. Ravaonjanahary, Dr A.E.C. Rietveld, Dr L. Self, Dr J. Storey, Dr J. Verhoeff and Dr M.H. Wahdan.

The illustrations for the cover and for the text, except where otherwise indicated, were prepared by Lois Robertson, Amsterdam, Netherlands.

The financial support of the Ministry of Foreign Affairs of the Netherlands is gratefully acknowledged.

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Introduction

History and background of vector control

At the end of the nineteenth century, it was discovered that certain species of insects, other arthropods and freshwater snails were responsible for the transmission of some important diseases. Since effective vaccines or drugs were not always available for the prevention or treatment of these diseases, control of transmission often had to rely mainly on control of the vector. Early control programmes included the screening of houses, the use of mosquito nets, the drainage or filling of swamps and other water bodies used by insects for breeding, and the application of oil or Paris green to breeding places.

The discovery of the insecticide dichlorodiphenyltrichloroethane (DDT) in the 1940s was a major breakthrough in the control of vector-borne diseases. The insecticide was highly effective for killing indoor-resting mosquitos when it was sprayed on the walls of houses. Moreover, it was cheap to produce and remained active over a period of many months. DDT also appeared to be effective and economical in the control of other biting flies and midges and of infestations with fleas, lice, bedbugs and triatomine bugs.

In the 1950s and early 1960s, programmes were organized in many countries which attempted to control or eradicate the most important vector-borne diseases (malaria, Chagas disease and leishmaniasis) by the large-scale application of DDT. Because of their high costs, these programmes were generally planned for limited periods of time. The objective was to eradicate the diseases or to reduce transmission to such a low level that control could be maintained through the general health care facilities without the need for additional control measures.

Initially these programmes were largely successful and in some countries it proved possible to interrupt or reduce the vector control activities. However, in most countries, success was short-lived; often the vectors developed resistance to the pesticides in use, creating a need for new, more expensive chemicals. Suspension of control programmes eventually led to a return to significant levels of disease transmission. Permanent successes were mostly obtained where the environment was changed in such a way that the vector was prevented from breeding or resting.

Alternatives to the use of insecticides

Interest in alternatives to the use of insecticides, such as environmental management and biological control, has been revived because of increasing resistance to the commonly used insecticides among important vector species and because of concerns about the effects of DDT and certain other insecticides on the environment.

Environmental management involves altering the breeding sites of the vectors, for instance by filling ponds and marshes on a permanent basis or by repeatedly removing vegetation from ponds and canals and cleaning premises.

Biological control is the use of living organisms or their products to control vector and pest insects. The organisms used include viruses, bacteria, protozoa, fungi, plants, parasitic worms, predatory mosquitos and fish. The aim is generally to kill larvae without polluting the environment. Biological control often works best when used in combination with environmental management.

Reorganization of vector control

In parallel with the investigation of alternative methods of control, attempts have been made in many countries to reorganize the delivery of services. Where possible, programmes for the control of vector-borne diseases have been decentralized and integrated with the basic and district health services. This is intended to improve the sustainability of control programmes while allowing substantial savings in financial input and in staff costs. District and village health workers have assumed more responsibility.

In the past decade, much emphasis has been given to adapting existing vector control techniques and developing new methods to enable general health personnel, communities and individuals to take action in defence of their own health. Priority has been given to the development of simple, safe, appropriate and inexpensive measures for vector control. Insecticide-treated nets and curtains have been developed for the control of mosquitos and sandflies. Traps have been developed to control tsetse flies in Africa. House design and construction methods have been modified to control triatomine bugs in South America. Special water filters have been developed to eliminate the cyclops vectors of guinea worm from drinking-water. New irrigation techniques prevent mosquitos and snails from breeding but do not damage crops.

Vector control at community level

The particular vector control methods to be applied in a community will depend on the local situation and the preferences of the population. It is essential that communities are well informed about the options available, and that they participate actively in choosing and implementing vector control activities that are appropriate to their circumstances.

Vector control methods suitable for community involvement should:

- be effective;
- be affordable;
- use equipment and materials that can be obtained locally;
- be simple to understand and apply;
- be acceptable and compatible with local customs, attitudes and beliefs;
- be safe to the user and the environment.

Methods that are suitable in one place are not necessarily so elsewhere, even if the characteristics of the disease and its vector are unchanged. Thus insecticide spraying of walls may be the preferred method for controlling malaria in one area while the use of insecticide-treated mosquito nets or environmental management may be more appropriate in another.

The important differences between the various methods are related to the type and amount of involvement required from community members, village and district health workers, and vector control specialists. The choice of method will often depend on the availability of funds and trained personnel, the level of economic and social development of the community or area, and the level of development of local health services.

Selecting the appropriate control measures

In selecting appropriate control measures, it is generally possible to distinguish two types of situation requiring different solutions:

- nuisance caused by pests;
- diseases carried by bloodsucking insects and other vectors.

In both cases, solutions can be found in the protection of individuals and the protection of communities.

It is important to distinguish between measures offering adequate protection from disease and ones that are not sufficient on their own but are of value in conjunction with other measures.

Before starting any vector control activity, it is important to ask two questions:

- What result do you want to achieve: merely to protect yourself or your family from biting pests and the diseases they carry, or to reduce disease in the community?
- Are the health authorities already carrying out control measures and do you want to provide the community or your family with additional protection from disease?

Answering these questions is essential for the selection of the most appropriate control measures. For the correct diagnosis of a disease or identification of a vector or pest species, you may need to consult local health workers who should preferably also be involved in discussions about the need for and possibilities of control. People with experience in the control of agricultural pests may be of help.

This manual provides background information that will help you to identify the vectors and diseases of importance in your community. Each chapter is divided into three sections. The first section, on biology, should enable you to confirm the groups of arthropods to which the pests and vectors belong. It also provides background information indicating what to expect from specific control measures. The second section, on public health importance, briefly reviews the diseases transmitted. For each disease, the place of vector control measures in strategies for disease control is described. Finally, practical information is given on a variety of control measures. The most detailed information concerns methods suitable for self-protection and community participation. Methods that have to be implemented by specially trained personnel are presented with minimum technical detail.

Self-protection

Self-protection measures are used to protect yourself, your family or a small group of people living or working together from insect pests or vectors of disease. These measures include personal protection, i.e., the prevention of contact between the human body and the disease vector, and environmental measures to prevent pests and vectors from entering, finding shelter in, or breeding in or around your house. These measures are usually simple and inexpensive, and can often be adopted without help from specialized health workers.

Community control

It is more difficult to protect a whole community from a vector-borne disease or major pest. The type of control may be the same as for the protection of an individual or a family, but is, of course, larger. A considerable effort is required in order to obtain the active participation of all members of the community.

Before investing resources in community-wide control efforts, advice should be obtained from health workers on the type of measures most likely to be successful under local conditions. Many factors need to be taken into account: the vector species and its behaviour, the compatibility of control methods with the local culture, affordability in the long term, the need for expert advice, etc. In certain circumstances it is more cost-effective to improve the detection and treatment of sick people than to undertake vector control measures. On the other hand if the diagnosis of a disease is difficult or if adequate treatment is not available, vector control offers the only prospect of controlling the disease.

After studying a particular situation, the community can use this manual to select the most suitable control measures; this selection should be based not only on the effectiveness of particular measures but also on their sustainability and affordability. It is also important to consider the type and amount of support local health services can provide on a sustainable basis.

Input required from health services and communities for different types of control measures

*Community
input*

*Health
service
input*

high	<p>Simple, inexpensive self-protection methods, requiring the active participation of the whole community. Examples: impregnated bednets, house improvement, prevention of breeding in and around houses.</p> <p>Technically simple methods to prevent breeding in the field, requiring active participation of some members of the community under direct guidance of trained personnel. Examples: source reduction, larvivorous fish, larvicides.</p> <p>Methods requiring equipment, trained personnel, and financial and technical involvement of the community. Example: insecticide spraying of house walls.</p> <p>Methods for the eradication of diseases or their vectors, requiring high investment for a limited period by the health service under the guidance of vector control experts. Examples: Onchocerciasis Control Programme in West Africa, malaria eradication programmes during the 1960s and 1970s.</p>	low
low	<p>Emergency control methods, requiring intense action by health services assisted by vector control experts. Examples: Ultra-low-volume spraying (fogging) with insecticides to control epidemics of dengue.</p>	high