Report on the

Intercountry workshop on developing a regional strategy for integrated vector management for malaria and other vector-borne diseases

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EXECUTIVE SUMMARY

In the regional context of integrated disease management, an intercountry workshop was held at Khartoum, Sudan, 21–23 January 2003, to develop a regional strategic framework for integrated vector management (IVM) for malaria and other vector-borne diseases. Participants from 20 countries of the Region attended and the draft IVM strategic framework was agreed. That document has since been discussed at global and inter-regional levels pending finalization for adoption by the WHO Regional Committee for the Eastern Mediterranean in 2003.

Vector-borne diseases of importance in the Region are malaria, lymphatic filariasis and several arboviruses (dengue, Rift Valley fever, Japanese encephalitis, West Nile virus etc.) transmitted by mosquitoes of the species, Anopheles, Aedes, and Culex spp. (various countries); leishmaniasis and sandfly fevers transmitted by Phlebotomus (most countries); trypanosomiasis transmitted by tsetse; Glossina (Sudan only); onchocerciasis transmitted by blackflies, Simulium (Sudan, Republic of Yemen); trachoma transmitted by flies (most countries); schistosomiasis and a wide range of other vector-borne diseases including loiasis, Guinea worm, relapsing fevers, three types of typhus, Crimean–Congo haemorrhagic fever, plague, tularemia and other arthropod infestations and allergens from insects.

Collectively these vector-borne diseases are estimated to be responsible for 17% of disability adjusted life years (DALYs) due to communicable diseases in the Eastern Mediterranean Region. The 15 million DALYs lost annually due to vector-borne diseases in this Region amounts to 11% of the global burden. Therefore, despite the elimination of malaria from more than 10 countries of the Region already, much more has to be done to combat vector-borne diseases in this Region. Hence this workshop convened the national programme managers, WHO advisers and other experts to review country, vector control programmes, in relation to Roll Back Malaria (RBM), and to devise ways to prioritize integrated vector management.

IVM is a process of evidence-based decision-making aimed to plan, deliver, monitor and evaluate targeted, cost-effective and sustainable combinations of regulatory and operational vector control measures, to substantially reduce transmission risks, adhering to the principles of subsidiarity, intersectorality and partnership.

The first part of the workshop reviewed the principles, practices and objectives of IVM in relation to other health sector functions and priorities. The particular needs of vector control require specialist knowledge, equipment and modes of intervention. IVM fits well with malaria control practices, both traditional (house spraying, larviciding, use of larvivorous fishes, environmental modifications) as well as new approaches such as using insecticide-treated nets and curtains to combat vector mosquitoes, giving both personal protection (reduced vector biting) and community protection (reduced vector infectivity) through impact on vectorial capacity. The majority of vector control practices can be applied to achieve multi-disease impact and the workshop readily created the strategic focus to develop such ideas and dividends.
The safe and effective use of pesticides for vector control involves selective targeting, knowing why, when, where and how to apply the right product and dose judiciously and effectively. Of equal, if not greater importance are the non-chemical methods of vector control, especially environmental countermeasures (e.g. elimination of breeding sites), biological control (using biopesticides or larvivorous fish), physical protection (screening, bed nets, protective clothing), intersectoral coordination to minimize exposure to and production of vectors, and cooperation between sectors that can help each other to control vectors by various means. These things together require new types of training, thinking and collective actions for the comprehensive implementation of IVM.

Capacity building for IVM is an urgent priority. There is a serious shortage of human resources for IVM in nearly all countries and municipalities and many current vector control activities are not sufficiently well targeted or applied. Insecticides used for vector control must be handled with due regard for the safety of human health and the environment. Economy and effectiveness; monitoring and surveillance of endemic and epidemic vector-borne diseases requires detailed understanding of the vector identity, competence, behaviour, biology, life cycle and ecology, susceptibility or resistance to appropriate formulations of suitable insecticides, well coordinated with relevant activities of health workers and other sectors. Above all, vector-borne diseases are preventable if IVM is consistently applied in timely, selective and well-targeted ways.

Expert advisers made presentations to the workshop on the spectrum of vector control practices and IVM principles; distribution and importance of vector-borne diseases and epidemiology in countries of the Eastern Mediterranean Region; entomological surveillance and mapping using Geographical Information Systems (GIS), Global Positioning Systems (GPS) and HealthMapper; pesticide management; scaling-up of insecticide-treated nets (ITN) programmes; theory and practice of insecticides for house-spraying and larviciding; insecticide resistance monitoring and management; maximizing coverage and the assessment of vectorial capacity.

Participants themselves gave presentations on programme status in each country and submitted data on their pesticide usage for public health pest and vector control for collation and planning with the Roll Back Malaria unit at the Regional Office for the Eastern Mediterranean. Discussions among participants brought new insights and fresh resolve for many of the national staff. For strategic development of IVM, countries of the Region were grouped as follows:

- malaria-free, or nearly so, where IVM continues to be preventive against multiple, vector-borne diseases (i.e. Bahrain, Cyprus, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Palestine, Qatar, Syrian Arab Republic, United Arab Emirates);

- having continued priority for malaria control, but with different socioeconomic circumstances;

- needing primary capacity building and resources for IVM programme development (i.e. Afghanistan, Somalia, Republic of Yemen);
• needing to develop IVM through revitalized skills and re-focused resources (i.e. Djibouti, Iraq, Sudan);

• well developed vector control programmes in transition to RBM and IVM (i.e. Islamic Republic of Iran, Pakistan, Saudi Arabia).

Most of the workshop time was spent in working groups to develop the Regional IVM Strategic Plan and that was accomplished with easy consensus. Moreover, participants recognized that the time has come to follow the example of integrated disease management. They resolved to employ the best combinations of old and new methods of vector control in the IVM context for multi-disease impact. Commitment to this reorientation is demonstrated by the 10 recommendations adopted unanimously at the closing plenary session of the workshop.
1. INTRODUCTION

An intercountry workshop to develop a Regional Strategy for Integrated Vector Management (IVM) for malaria and other vector-borne diseases was held in Khartoum, Sudan, 21–23 January 2003. The workshop was opened by H.E. Dr Ahmed Belal Othman, Federal Minister of Health, Sudan, who welcomed the participants and expressed support from the Government of Sudan for the successful conduct of the workshop and its outcome. Recognizing the importance and threat of vector-borne diseases throughout the Region, and particularly in Sudan, the Minister strongly encouraged participants to go beyond the Roll Back Malaria (RBM) programme by developing a realistic IVM strategy to tackle all vector-borne diseases.

Dr Guido Sabatinelli, WHO Representative in Sudan, welcomed the participants from nearly all Member States of the WHO Eastern Mediterranean Region. He pointed out that this was the very first time that such an intercountry meeting had been convened to address the regional challenge of controlling all vector-borne diseases. Dr Sabatinelli delivered a message from Dr Hussein A. Gezairy, WHO Regional Director for the Eastern Mediterranean, in which he emphasized the importance of vector-borne diseases such as malaria, leishmaniasis, and schistosomiasis. He reminded participants of the important roles of insects, which was rarely considered in relation to asthma, trachoma and diarrhoeal diseases.

Dr Gezairy noted the range of effective tools already available for vector control, including insecticides for house spraying or larviciding, insecticide-treated nets (ITNs), biological control agents such as larvivorous fish and bacteria, environmental management procedures and so forth. However, most countries still relied largely on insecticides, despite the development of resistance in some situations. There was a need to scale up various interventions and combine their use in a cost-effective manner to achieve integrated vector management (IVM) as a component of integrated disease management at national and regional levels, as already promoted by the WHO Eastern Mediterranean Regional Office (EMRO) Division of Communicable Diseases. Therefore Dr Gezairy encouraged participants to develop and finalize a regional framework for implementation of integrated vector management for malaria and other vector-borne diseases and to set national targets for IVM implementation. He assured Member States of the World Health Organization’s commitment to support them in achieving those targets.

Following these opening presentations all of the 43 participants from 20 countries, and several observers, introduced themselves. To Chair the workshop, Dr Fatih Mohamed Malik (Sudan) was appointed for the first day, Dr Arif Munir (Pakistan) for the second day and Dr Btissame Ameur (Morocco) for the third day. Dr Graham White (WHO/STC) was designated as Rapporteur.

Dr Hoda Atta (RBM/EMRO) then briefed participants on the programme and procedures for conduct of the working sessions. She outlined the four objectives of the workshop:

1. review the current situation of vector control activities for malaria and other vector-borne diseases in the Region;
2. overview the principles of integrated vector management (IVM);

3. propose feasible targets and strategies for the implementation of vector control interventions for malaria and other vector-borne diseases;

4. develop and finalize a regional strategic framework for integrated vector management for malaria and other vector-borne diseases.

The meeting programme and list of participants are attached as Annexes 1 and 2, respectively. The full text of Dr Gezairy's speech is attached as Annex 3. Annex 4 comprises a list of priority vector-borne diseases in countries of the Region. The regional strategic framework for integrated vector management is attached as Annex 5.

2. INTEGRATED VECTOR MANAGEMENT OVERVIEW

2.1 Technical situation

Dr Abraham Mnzava, WHO/EMRO, opened the technical presentations with a brief overview of vector control status and needs in the Region, laying emphasis on the different mosquito vectors of malaria, arboviruses (dengue, Japanese encephalitis, Rift Valley fever, West Nile virus, yellow fever and Bancroftian filariasis); the phlebotomine sandfly vectors of leishmaniasis: anthroponic cutaneous (ACL), zoonotic cutaneous (ZCL), and zoonotic visceral (ZVL); the widespread problems of trachoma transmitted by face flies and diarrheal diseases (Salmonella, Shigella etc.) transmitted partly by cockroaches, houseflies and blowflies. Attention was drawn to the occurrence, in some countries of the Region, of several less prevalent vector-borne diseases such as trypanosomiasis transmitted by tsetse flies (Glossina) in southern Sudan, onchocerciasis transmitted by blackflies (Simulium) in Sudan and the Republic of Yemen, sporadic plague transmitted by fleas and Crimean-Congo haemorrhagic fever transmitted by ticks. The need was indicated for more reporting and mapping of these infections and their vectors using GIS technology (e.g. HealthMapper). The participants were reminded of the available control methods employed against such vectors and other blood-sucking pests:

- source reduction (filling in of breeding sites and intermittent irrigation);
- biological methods (larvivorous fish, bacterial insecticides and parasites);
- use of larvicidal chemicals, oils and insect growth regulators;
- house spraying or indoor residual spraying (IRS);
- insecticide-treated bed nets (ITNs);
- space spraying (during emergency);
- repellents and protective clothing;
- house improvement.

The choice of methods employed for vector control depends on local circumstances (economic, environmental, epidemiological, vector types, behaviour and ecology), with several countries having moved beyond the priority of malaria control towards the
introduction of integrated vector management (IVM) programmes aiming for multi-disease impact. Thus the IVM training manual now available and the guidelines on the use of fish for mosquito control were introduced. The workshop also benefited from recent detailed reports of expert committees on malaria, schistosomiasis, African trypanosomiasis and the long-standing counter measures for dengue haemorrhagic fever, lice, and leishmaniasis. Fortunately some vector-borne diseases are now being tackled by disease-specific treatment programmes, notably the Global Programme for Elimination of Lymphatic Filariasis, based on annual mass drug administration; the International Trachoma Initiative, involving eye medication; and the Guinea-worm Eradication Programme, involving case detection and treatment. Above all, transmission of these diseases must be curtailed by IVM to prevent resurgence and hasten their elimination. Most importantly, the Roll Back Malaria partnership is now restructuring to optimize the facilitation, delivery and impact of all interventions, with renewed emphasis on insecticide-treated nets and appropriate IVM activities as covered by the regional workshop.

Dr Mnzava displayed a map of malaria endemicity in countries of the Eastern Mediterranean Region showing:

Group 1: interrupted transmission (Bahrain, Cyprus, Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Palestine, Qatar, Tunisia, United Arab Emirates);

Group 2: targeting elimination (Egypt, Morocco, Oman, Syrian Arab Republic);

Group 3: low to moderate endemicity (Islamic Republic of Iran, Iraq, Pakistan, Saudi Arabia);

Group 4: high burden (Afghanistan, Djibouti, Somalia, Sudan, Republic of Yemen).

Risks of vector-borne pathogen transmission can be reduced by various interventions aimed to minimize vectorial capacity (C), expressed as: 

\[ C = \frac{ma^2p^3}{n} \cdot \log_e p \]

where:

- \( m \) = density of vectors in relation to man,
- \( a \) = number of blood meals taken on man per vector per day
- \( p \) = proportion of vectors surviving per day, determined from parous rate
- \( n \) = incubation period in the vector (days), usually 8–12 days at 25–35 °C

Different methods of vector control have differential effects on vectorial capacity. For example, larval and adult control impact on vector densities (m); indoor residual house spraying (IRHS) and insecticide-treated nets reduce vector survivorship (p); insecticide-treated nets reduce man/vector contact (a²) better than indoor residual house spraying.

In considering how to optimize the combination of interventions for developing IVM programmes, attention was drawn to the importance of cost efficacy and community acceptance. The need to reduce dependence on chemicals was highlighted, but the inevitable
importance of insecticides for vector control, provided they are used selectively without adverse side effects for people or the environment, was recognized. Dr Mnzava mentioned the difficulties for controlling vector-borne diseases in conflict situations, where the implementation of programmes cannot be sustained. He summarized the WHO technical support recently provided to countries of the Region for vector control in Afghanistan, Iraq, Oman, Pakistan, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic and Republic of Yemen. He listed the known distributions of insecticide-resistant vectors by species and by country, for which more attention must be given to the monitoring and implementation of resistance management strategies.

Regarding the challenges of IVM, the following priorities were suggested:

- capacity-building at all levels, especially field competence;
- development of skills and systems for entomological surveillance;
- providing logistical support for equipment, test-kits, procurement;
- dissemination and sharing of relevant information (manuals and workshops);
- development, adoption and implementation of IVM strategy;
- operational research and consequent re-planning.

2.2 Principles of integrated vector control and management

Dr Robert Bos (WHO/PHE) reviewed the history and development of integrated vector control, with growing emphasis on selective targeting of vectors and the most appropriate combinations of antivector measures for use by programmes as well as by communities and individuals, culminating in the current IVM objectives, based on the following elements:

- It is about process, not contents.
- It spells out the need for an evidence base.
- It retains economics and sustainability as key criteria.
- It mentions both regulatory and operational measures.
- It further defines the output indicator (level of risk of transmission).
- It embraces principles of health sector reform and related issues.

A definition of IVM was given as “a process of evidence-based decision-making aimed to plan, deliver, monitor and evaluate targeted, cost-effective and sustainable combinations of regulatory and operational vector control measures, with a measurable impact on transmission risks, adhering to the principles of subsidiarity, intersectorality and partnership.”

It was explained that the evidence for IVM starts with ecosystem analysis. This facilitates a logical build-up of integrated measures, from environmental management methods, through biological to chemical methods of control. Thus an IVM approach needs reassessment of the conventional categories of chemical, biological and environmental control. Leaving chemicals as a measure of last resort recognizes their value as a resource that needs to be sustained for as long as possible.
A regulatory role and the concept of subsidiarity raise the issue of whether IVM fits in the health sector or in the environment sector, in the core of the health sector (with disease control programmes), or at the boundary where it can better interact with other sectors at various levels (national, provincial, district) so that functions can be divided.

In concluding his presentation, Dr Bos outlined a wide range of possibilities for how to proceed with the development of IVM programmes. He hoped that the role of the World Health Organization in vector control would be extended from technical tools and good technical practice to ensuring good management of IVM programmes. The World Health Organization should mainstream the concept of IVM with a view to making it the core strategy for multi-disease impact against vector-borne diseases. At the regional level, support for Member States could focus on: regional workshops promoting key IVM principles, such as cost-effectiveness analysis, with follow-up; assisting a small number of truly interested countries to completely overhaul their vector control programmes (and serve as models for other countries); documentation of experiences for analysis and dissemination; and capacity building.

2.3 Pesticide management

With regard to insecticides for vector control, Dr Morteza Zaim (WHO/ICDS/CPE/PVC) explained the importance of their safe and judicious use, as comprehensively described in recent manuals on malaria vector control operations. He pointed out that we are rapidly depleting the arsenal of safe and cost-effective insecticides, due to the evolution of resistance, rising costs and concerns over adverse side effects on people and/or the environment. Thus he stressed the need always to make rational decisions on economic and appropriate use of insecticides for vector control, based on the concept diagram shown in Figure 1.

**Figure 1. Chemical control of vectors**
The central role of the World Health Organization Pesticides Evaluation Scheme (WHOPES), whereby products are approved by committees of suitable specialists on the basis of trials conducted by WHO collaborating centres, was outlined. The outcomes for each product are recommended formulations (for which WHO/FAO specifications are issued to facilitate procurement of quality materials), with effective dosages for appropriate applications and due awareness of toxicological and safety issues for each product used in vector control. Good pesticide management practices comprise the regulatory control, proper handling, supply, transport, storage, application and disposal of pesticides to minimize their adverse environmental effects and human exposure. The importance of monitoring insecticide uses and effects, to measure and report validity of expectations based on registration data regarding efficacy, safety and environmental experiences was also stressed. All country participants were reminded to submit annual returns to WHOPES on national pesticide consumption. They were also warned against poor quality products, which do not meet the specifications of the World Health Organization, and may contain toxic impurities, wrong active ingredient concentration, unacceptable physical properties and other failures of quality control that may damage the reputation of the legitimate products. Dr Zaim quoted a joint FAO/WHO press release that reported that about 30% of pesticides marketed in developing countries, with an estimated market value of US$ 900 million annually, do not meet internationally accepted quality standards. Against this, under the umbrella of registration, some key components of good pesticides management were depicted:

- production of the active ingredient;
- quality formulation and packaging;
- safe transport and storage;
- correct application for effective vector control;
- safe disposal of empty containers.

2.4 Role of insecticide-treated nets against malaria and other vector-borne diseases

Dr M Kabir Cham (WHO/HQ) explained the role of insecticide-treated nets and other materials in the control of malaria and other vector-borne diseases. This relatively new method of personal and community protection against vectors and disease transmission depends on the impregnation of bed nets and curtains with low doses of residual pyrethroid insecticide.

Such well targeted and selective use of pyrethroids has a multiple impact on the adult female mosquitoes (deterring, repelling, knocking down and killing them) when they attempt to bite people who are using treated bed nets or curtains, thus protecting individuals and the community. Moreover, insecticide-treated nets can be protective against sandfly vectors of leishmaniasis, as demonstrated in the Syrian Arab Republic.

The impact of insecticide-treated nets was summarized as follows:

- reduced vector survival
- reduced sporozoite rate
- reduced incidence and prevalence of infection in humans
• reduced clinical episodes of malaria (50% reduction overall)
• reduced reservoir of infections in humans
• reduced parasitaemia and anaemia during pregnancy
• reduced childhood mortality (20% reduction overall)
• reduced or eliminated bedbugs, lice and other pests
• raised community confidence in malaria prevention
• increased self-help anti-malaria measures.

It was pointed out that the amount of pyrethroid needed for insecticide-treated nets to protect the occupants of a house is 150 to 300 times less than that required for house-spraying (IRS). This can bring considerable long-term savings on materials, since the nets last for many years, as well as reducing the need for operational teams of spray men for IRS. However, introducing insecticide-treated nets requires considerable reorganization of the anti-malaria programme with much more emphasis on community participation and the effective use of insecticide-treated nets. The social marketing approach is favoured for rapidly increasing coverage, although the implications and practices of cost recovery remain unsettled. Regular reimpregnation raises various practical issues such as when, how, what with, and who pays. Prospects of long-lasting insecticidal nets (LLINs) being supplied soon should help to solve some of these challenges. So far only one type of LLIN has been approved, while others are under evaluation by WHOPES. Meanwhile Roll Back Malaria strongly advocates the insecticide-treated nets approach.

2.5 Entomological surveillance and vector mapping

Two very detailed presentations were given to illustrate the enormous power and benefit of using geographical information systems (GIS) and global positioning systems (GPS) for epidemiological and entomological mapping and surveillance. Dr Ali Nasser Hassan (WHO Temporary Adviser) showed how remote sensing from satellites has been used to understand and map vector habitats in relation to malaria, filariasis and leishmaniasis in Egypt. He emphasized the technological power and flexibility of this system to produce quality images on the global and local scales for correlating layers of information, e.g. climate, vegetation, hydrology, topography, epidemiology, and vector distribution. For example, the Egyptian vector control operations routinely rely on remote sensing for GPS and GIS to stratify and map areas where mosquitoes breed, in order to direct field control activities. With support from the Regional Office, the Institute of Environmental Studies at Ain Shams University, in collaboration with their Research and Training Centre on Vectors of Diseases, have developed a digital database compiling all information relevant to malaria for disease management in the country. This model service is available to assist other countries of the Region to develop their own GIS systems for VBD control. It was recommended that GIS should be transferred to the hands of decision-makers, so that they can shift from reactive to proactive vector-borne disease management. This would be of help in developing IVM and measuring its impact.

The example of Oman was presented by Dr Salim Said Al-Wahabi (Programme Director) showing how the Malaria Eradication Programme of Oman has successfully adopted GIS for all epidemiological and vector data mapping and programme implementation. He displayed detailed maps of malaria incidence in Oman showing how malarialogue data is
plotted, reported and analysed weekly. This information drives the programme, distinguishing between imported, indigenous and introduced cases, so that risks of transmission can be prevented by timely and well targeted interventions to keep the main malaria vectors *Anopheles culicifacies* and *An. stephensi* suppressed. Hence no new indigenous malaria cases have occurred in Oman since 1998, despite the importation of hundreds annually.

Participants enjoyed a wide-ranging discussion on the many attractions and challenges of using GIS/GPS systems for surveillance and monitoring of vector-borne diseases as well as for IVM logistical planning, targeting and implementation. For all vectors, wherever transmission risks should be watched, GIS/GPS facilitates recording, assessing and reacting to information gained from entomological monitoring through sentinel sites.

### 2.6 Insecticide resistance monitoring and management

Dr Hassan Vatandoost (WHO Temporary Adviser) gave an elaborate and well illustrated presentation on the comprehensive programme for monitoring insecticide susceptibility or resistance among the anopheline mosquitoes of the Islamic Republic of Iran. The experience of the Islamic Republic of Iran was used to define the problem and establish routine monitoring nationwide with constant advice to the malaria control programme. By means of standard bioassays with WHO test kits, all *Anopheles* species in all parts of the country have been systematically tested and the resultant data were presented at length. Discriminating concentrations follow WHO guidelines: DDT 4%, dieldrin 0.4%, malathion 5%, fenitrothion 1%, bendiocarb and propoxur 0.1%, permethrin 0.75%, deltamethrin 0.05%, lambdacyhalothrin 0.05% and 0.1%, cyfluthrin 0.15% and etofenprox 0.5%. Samples showing less than 80% mortality after 1 hour of exposure are interpreted as resistant, those with 98%–100% mortality are taken to be susceptible, while the vector is regarded as tolerant (suspected resistant) if up to 20% survive. This has to be clarified by testing progeny.

In the Islamic Republic of Iran, DDT resistance is widespread in *An. sacharovi* and *An. stephensi*, carbamate resistance occurs in *An. sacharovi* and *An. maculipennis*, dieldrin resistance in *An. culicifacies* and probably *An. stephensi*. Fortunately no pyrethroid resistance has been detected, so this class of insecticides is employed for IRS, with current switching between lambda-cyhalothrin and deltamethrin in the hope that this may prolong their efficacy. DDT and carbamates have been discontinued because of resistance. Biochemical assays are not routinely performed but may be applied wherever the resistance mechanisms need to be determined. This information on resistance monitoring allows the authorities of the Islamic Republic of Iran to keep ahead of any resistance problems developing. Since IRS continues to give satisfactory levels of malaria vector control, insecticide-treated nets have not been widely adopted, although pyrethroids remain effective. In future the IRS programme is likely to rotate between complementary classes of insecticides in order to conserve their efficacy without consistently selecting for any more resistance.

Dr Vatandoost is already involved advising several other countries in the Region and he is responsible for regular courses on vector biology and control, with emphasis on resistance monitoring and management, held at the Teheran School of Public Health and Institute of Health Research, with field activities conducted at the Malaria Training Centre in Bandar
Abbas. Discussion among participants showed how concerned they were about possible problems of insecticide resistance, particularly in the key vector *Anopheles*, as well as how little awareness the countries have on making use of information from resistance testing. Hence the need for better coordination through the establishment of a regional network for resistance monitoring and management, while encouraging IVM to help reduce dependence on insecticides for vector control.

3. **PROGRAMME SITUATION**

3.1 **General issues**

*Scaling up of insecticide-treated nets and other materials*

Following his previous presentation on the principles of insecticide-treated nets, Dr Kabir Cham gave a step-by-step account of how RBM aims to achieve the Abuja target of insecticide-treated nets coverage by 2005 for at least 60% of the children ‘at risk’ of malaria in each country. The vital priority of scaling up insecticide-treated nets coverage is a principal component of IVM in all countries affected by malaria and other vector-borne diseases transmitted by mosquitoes and other vector arthropods that usually try to bite when people are sleeping. RBM workshops have already been conducted in most countries to develop the national insecticide-treated nets strategic plans for scaling up insecticide-treated nets use at country level, as a part of adapting global strategy for malaria prevention and control. This IVM workshop therefore reinforced the resolve to adopt insecticide-treated nets without delay against the other vulnerable vectors, i.e. sandfly vectors of leishmaniasis and sandfly fever, mosquito vectors of arbovirus and filariasis, flies and lice as vectors of various bacteria etc.

A detailed account of the Strategic Framework for Coordinated National Action for Scaling up ITN programmes was given. Enabling factors for ITN programmes include:

- a national task force to coordinate “going to scale”
- subsidies to go to vulnerable groups
- cost-recovery engendering sustainability
- gaining support of the private sector (suppliers/donors/partners etc).

Discussion revealed that few countries of the Eastern Mediterranean Region were really committed to insecticide-treated nets as an alternative to IRS and larviciding for malaria vector control. The exceptions were countries facing operational problems, such as Afghanistan, Sudan and the Republic of Yemen, where relatively small-scale insecticide-treated nets activities had begun in limited areas, especially for emergency situations, through various ad hoc distribution channels, notably via clinics and nongovernmental organizations (NGOs). Sudan has long-term but disappointing experience of insecticide-treated nets being promoted against leishmaniasis, but the small mesh size supplied for sandfly control proved to be unpopular as it restricts ventilation. Thus the Eastern Mediterranean Region has far to go with the country level development of activities where appropriate. In many situations insecticide-treated nets are not appropriate for the shift from IRS to IVM activities.
Increasing coverage by other vector control interventions

Among the workshop presentations were some country examples of greatly increased levels of effective coverage, primarily for malaria control, by particular anti-vector interventions. Further efforts are already under way to evolve these programmes towards IVM by judicious use of complementary combinations of vector control methods such as:

- encouraging larvivorous fish (Bahrain, United Arab Emirates, Republic of Yemen)
- intensive/extensive larviciding (e.g. Oman, United Arab Emirates, Socotra island of the Republic of Yemen)
- timely IRS with high coverage (e.g. Islamic Republic of Iran, Jizan of Saudi Arabia)
- focal space spraying (Kuwait, Khartoum of Sudan, United Arab Emirates)
- drainage and water management (e.g. Egypt, Jordan, Gezira of Sudan)
- habitat destruction/environmental management (e.g. Morocco, Qatar).

3.2 Survey of pesticide use and vector control implementation

Prior to the workshop, country vector control teams were requested to prepare presentations summarizing their vector control activities, including RBM and IVM where relevant.

The country presentations are varied in length and style so some of the key points are distilled below. Some countries are still completing their returns on pesticide consumption for public health pest and vector control activities, while many have submitted their data on insecticides employed (in the format requested by the Regional Office) together with routine results of susceptibility and resistance tests where available. This information is being collated and analysed by the regional RBM team and will be discussed at the next regional RBM workshop (Lahore, May 2003) for planning and evaluation purposes.

3.3 Country experiences and challenges

Overview

Countries where malaria transmission has been interrupted, or nearly so, are: Bahrain, Cyprus, Egypt, Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Morocco, Oman, Palestine, Qatar, Syrian Arab Republic, Tunisia and United Arab Emirates. Workshop presentations by most of these countries show that they have generally maintained the structures and commitment for vector control, but in some cases have lost the necessary skills following the elimination of malaria. However they are mostly vulnerable and receptive to the reintroduction of malaria and should not neglect vector control. In several cases the continuing pest control operations are well maintained and are well equipped to prevent vector-borne disease transmission if outbreaks occur. Representatives of these countries were all very keen to recruit and train suitably committed staff for IVM and to develop the programme activities advocated by this workshop and the regional IVM strategy.
In the countries of the Region where malaria control continues to be a priority, workshop presentations show an extremely wide range of situations, both epidemiologically and in terms of programme activities. Some have the vicious cycle of poverty and disease that needs tremendous programme development with assistance to provide resources and develop skills (i.e. Afghanistan, Somalia, Republic of Yemen); others probably have adequate resources but the vector control programme needs revitalization (Djibouti, Iraq, Sudan); the rest have sufficient or plentiful resources and maintain fairly strong vertically-structured vector control programmes with considerable success, well capable of shifting to IVM and RBM strategies (Islamic Republic of Iran, Pakistan, Saudi Arabia). The following sections give key points from their contributions to the IVM workshop.

**Afghanistan**

Dr Abdul Wasi Asha gave a comprehensive presentation on the distributions and vectors of malaria and leishmaniasis (ACL and ZCL) in Afghanistan, dating from information sources from before 1979. Ratio of *P. falciparum* to *P. vivax* was approximately 1:4 or 1:5 in most parts of the country. The former malaria control programmes (MCP) achieved high rates of IRS coverage nationwide, with DDT or malathion, for control of endophilic vectors. Larvivorous fish (*Gambusia affinis*) and larviciding with temephos were employed. Insecticide-treated nets have been introduced since 1993, supported by WHO and Health Net and many other nongovernmental organizations, plus treatment of traditional chadors with permethrin for personal protection. High rates of coverage are being achieved in some parts of the country (totalling at least 1.5 million population). Current progress against vector-borne diseases includes health education and community awareness, empowerment of women, use of repellents, sponging of cattle with deltamethrin (to control zoophilic vectors of human malaria), introduction of LLINs, leishmaniasis survey, operational research and capacity building for VBD control with IVM through an intersectoral approach.

**Djibouti**

Dr Abro Mohamed Moussa reported that malaria, transmitted by *Anopheles arabiensis*, is the only serious VBD problem recognized in Djibouti, having become more serious after the floods of 1989. Control operations comprise routine larviciding with temephos, adulticiding (indoors and outdoors) with malathion (95% tech) and insecticide-treated nets with deltamethrin 2.5% emulsifiable concentrate. Despite economic limitations, efforts are being made to survey the vectors of Djibouti in collaboration with the Military Health Service, for completion in 2004.

**Islamic Republic of Iran**

Dr Ahmad Raeisi described the very advanced malaria control programme of the Islamic Republic of Iran, whereby the incidence of malaria (ratio 1:9 *falciparum:vivax*) has been reduced to only 13 717 cases reported in 2002 (46% in non-Iranians). Among 19 species of *Anopheles* found in the Islamic Republic of Iran, eight species have been implicated as malaria vectors: *An. culicifacies*, *An. d’thali*, *An. fluviatilis*, *An. pulcherrimus*, *An. stephensi*, *An. superpictus* and *An. sacharovi* plus *An. maculipennis* complex. Surveillance of malaria
and its vectors is conducted comprehensively in the Islamic Republic of Iran. For IRS, pyrethroids replaced carbamates for cost-benefit reasons, whereas organochlorines (DDT and dieldrin) were phased-out due to early resistance in some situations. Routine larviciding employs Bti (*Bacillus thuringiensis israelensis*) and organophosphates (temephos, pirimiphos-methyl, chlorpyrifos-ethyl) plus widespread use of larvivorous fishes (*Gambusia affinis* and some indigenous species). Insecticide-treated nets have been introduced for malaria control and are being promoted in some parts of the Islamic Republic of Iran.

It was reported that other vector-borne diseases of importance in the Islamic Republic of Iran are CCHF (95 cases) and leishmaniasis (14,431 cases). A vector control sub-unit of the National Expert Malaria Committee was established in 2001. In preparation for an IVM approach, workshops have been conducted recently (2 × 4 days) on the strengthening of vector control activities in the Islamic Republic of Iran. Also, for the first time, a supplementary budget has been allocated for malaria operational research.

**Pakistan**

Dr Muhammad Arif Munir presented a comprehensive account of vector-borne diseases in Pakistan and the long-term control perspective. Malaria is by far the priority, the principal rural vector *An. culicifacies* species A being favoured by widespread irrigation schemes, with the unusual phenomenon of urban malaria transmitted by *An. stephensi* breeding in domestic water-storage tanks. Leishmaniasis is widespread in Pakistan with all three types occurring. The epidemiology and vectors of both malaria and leishmaniasis are well known in Pakistan. Scrub typhus and Crimean–Congo haemorrhagic fever (CCHF) are endemic with sporadic outbreaks. Mosquito-borne arboviruses of occasional importance in Pakistan are dengue (1994–1995 epidemic of DEN-2 in Karachi area, probably transmitted by *Aedes aegypti*) plus high rates of seropositivity in 1985 to Japanese encephalitis and West Nile fever among the population of Karachi. Vector control operations are conducted nationwide, with annual house spraying and routine larviciding, organized through vertical structure under traditional malaria control programme. For IRS the insecticide of choice has changed over time, due to the development of resistance in *An. culicifacies*: DDT was used until 1979; benzene hexachloride until 1983; organophosphates (fenitrothion and mainly malathion) during 1976–1996 and deltamethrin since 1996. The presentation concludes that there is a strong need for IVM, which is currently lacking in Pakistan, despite the previous workshop held in Lahore.

**Saudi Arabia**

Dr Nader Mahmoud Al Sharif displayed a map of malaria vector distribution in Saudi Arabia, showing *An. sergenti* throughout the malaria endemic western areas, together with *An. arabiensis* in the southwest, while *An. stephensi* and *An. superpictus* are potential vectors in other areas where transmission no longer occurs. He raised the question of whether *Anopheles gambia* also occurs in the southwest, giving his reasons to suspect it, but was informed that identifications were all *An. arabiensis*. He described the vector control programme involving regular house spraying, space spraying, larviciding, use of larvivorous fish and environmental counter-measures targeting malaria vectors. He reported the intensification of these efforts against all mosquitoes, together with veterinary interventions, to combat the unprecedented
outbreak of Rift Valley fever in the Jizan area during 2000. Plans for IVM include the use of GIS. Dengue was first identified in 1994 at Jeddah (nearly 1000 cases reported) and has reappeared periodically: its vector, *Aedes aegypti*, is widespread in southwest Saudi Arabia.

Both cutaneous and visceral leishmaniasis is widespread: control depends on physical and mechanical methods (vegetation clearance, destruction of rodent burrows and the removal of unwanted materials), aimed at preventing, eliminating or reducing the habitats of both vectors and reservoir hosts.

About 2 million people in Saudi Arabia live in areas with endemic schistosomiasis, mostly due to widespread *Schistosoma mansoni*, plus *S. haematobium* in south-western areas.

National control programmes are established for these diseases. Vector control methods include chemical, mechanical and environmental measures. Some problems and constraints exist, although efforts are being undertaken to overcome them. The control programmes are vertical with a separate directorate for malaria, schistosomiasis and leishmaniasis. Recently, these programmes were integrated at the central, provincial and village levels.

The primary health care concept was introduced in 1984. However, the contribution of such in vector control remains to be developed. Community participation is restricted to health education of the people by community leaders, schoolteachers, tribal chiefs and religious leaders. In addition, communities are encouraged to participate when control teams make home visits and are taught through audiovisual programmes, conducted countrywide.

Biological control was tried in the Jizan area in 1984 using indigenous larvivorous fish such as *Aphanius dispar*, which was found cheap and effective in some localities, but the results of trials using biological control agents against schistosomiasis were not satisfactory. Environmental management in malaria control is carried out using methods such as drainage and filling of ponds; for schistosomiasis control, environmental modifications by partial or complete elimination of habitats have been undertaken.

**Somalia**

The working paper presented by Mursal Ali Barre shows three strata of malariogenic potential in Somalia: hypoendemic with *An. arabiensis* as the key vector, mesoendemic and hyperendemic transmitted by the more anthropophilic *An. funestus* as well as *An. arabiensis*. The ratio of *P. falciparum* to *P. vivax* is said to be 9:1 in all three strata. Details were shown for the Somalia insecticide-treated net programme, with training and distribution having begun, but plans for IVM in Somalia are remote.

**Sudan**

Several speakers gave the host country presentations for Sudan. Dr Fatih Mohamed Malik (RBM coordinator) described RBM progress with emphasis on the improvement of diagnosis, the treatment and the reduction of malaria mortality, Mustafa Y. H. Dukeen described the long history of research on vector-borne diseases in Sudan. Field visits were
made to see the well-funded facilities and effective activities of the Khartoum and Gezira Malaria Free Initiative (KGMFI) covering the two states around the capital city. Participants also received a briefing from 'Plan Sudan' a nongovernmental organization charged with boosting malaria control with special emphasis on vulnerable groups.

Dr Siddiq Mohd Ismael (IVM focal point) gave an overview of vector-borne diseases and their control; malaria is hyperendemic in most parts of Sudan, transmitted by Anopheles arabiensis in savanna and desert areas, by An. gambiae s.s. In southern Sudan and by An. funestus south of latitude 13°N. Leishmaniasis has major foci of ZVL transmitted by Phlebotomus orientalis in at least five States of Sudan (Blue Nile, Gedaref, Sennar, Unity, and Upper Nile), plus widespread ZCL transmitted by P. papatasii. Other important vector-borne diseases in parts of Sudan are widespread schistosomiasis (no details supplied), sleeping sickness transmitted by tsetse (Glossina fuscipes, G mortitans, G palpalis) in southern forest areas; widespread loiasis transmitted by Chrysops dimidiaturn in south-eastern areas; onchocerciasis transmitted by blackflies of the Simulium damnosum complex in five main foci associated with major rivers; lymphatic filariasis due to Wuchereria bancrofti transmitted by mosquitoes in southern Sudan; yellow fever outbreaks transmitted by Aedes simpsoni in central Sudan; and various fly problems including myiasis, widespread trachoma transmitted by face-flies (Musca sorbens) and diarrhoeal diseases carried mechanically by Calliphorid and Muscid flies. Vector control activities are limited to localized larviciding, ultra low volume (ULV) operations and IRS in priority situations, using various insecticides. Discussion revealed prevailing uncertainty over the resistance status of An. arabiensis for DDT and malathion. Insecticide-treated nets have been introduced since 1995 and have mainly targeted two sectors of the population: ZVL foci and pregnant women (16% coverage) at risk of malaria. During the 1980s these problems were greatly reduced in the area covered by the Blue Nile Health Project, proving that it can be done. Thus Dr Ismael is newly charged with building IVM capacity, intersectoral cooperation and improving vector surveillance. Further commitment was demonstrated by enthusiastic participation in the workshop by other staff of the Federal Ministry of Health, notably the Minister, Dr Ahmed Bilal Osman, and Ms Nuha Hamid Yousif, responsible for leishmaniasis control.

Republic of Yemen

Among seven countries of the Arabian peninsula, the Republic of Yemen has by far the most malaria (90%–95% P. falciparum) combined with the most difficult terrain. The country report by Dr Shawki Al-Mawri recognizes four main topographic strata: coastal plains; foothills and mid-altitude; highland plateau; arid slopes to the Arabian Desert. Vectors from Africa and Asia overlap in the Republic of Yemen; An. arabiensis predominating in the west, An. culicifacies predominating eastwards, with at least two more widespread malaria vectors; An. d’talai and An. stephensi.

Other vector-borne diseases include small foci of onchocerciasis transmitted by Simulium rasyani; recently discovered LF and widespread leishmaniasis and schistosomiasis; a major epidemic of Rift Valley fever in Tihama area during 2000, plus an outbreak of dengue transmitted by Aedes aegypti in Shabwa governorate in 2002. For these reasons, capacity building for IVM is recognized as a priority and has support from the highest level.
After the interruption of operations during the past decade, the malaria control programme of the Republic of Yemen is being revitalized and major steps are being taken to develop the RBM approach with intersectoral support. Pilot malaria control projects with different emphasis have been launched in three areas, Al-Gaffir, Hodeidah and Socotra. Special efforts are made to encourage insecticide-treated nets use by vulnerable groups. However, for sociocultural reasons, IRS is generally preferred more than insecticide-treated nets as the main anti-vector intervention. Larviciding and environmental management are being implemented, plus the use of larvivorous fishes (including indigenous Aphanius dispar) in appropriate situations. Localized, intensive, space spraying proved to have good impact against outbreaks of malaria and arboviruses.

A presentation by Dr Jamal Ghilan Amran as country experience showed that to achieve a major RBM success and so raise MCP profile, a special effort has been launched to eliminate malaria from the island of Socotra (area 3600 km², population 90 000), beyond the Gulf of Aden, 350 km south of the Republic of Yemen mainland and 200 km from Somalia. The major vector on Socotra is An. culicifacies breeding mostly in wells and irrigated habitats. Baseline malariometry and mapping and knowledge, attitudes and practices (KAP) studies and vector surveys started in 2000. Community sensitization was followed by the provision of improved malaria diagnosis and treatment plus targeted vector control interventions. As an alternative to annual IRS, some villages were offered insecticide-treated nets and so far 3500 bednets have been distributed with an 80% subsidy plus free treatment kits. Also larval control has been implemented for the capital, and the surrounding densely populated area.

At national level between 2001 and 2005, RBM has 8 strategic activities providing a basis for IVM programme planning and development in the Republic of Yemen:

- human resource development to foster competent national cadre;
- early diagnosis followed by prompt and correct treatment of malaria cases (and other vector-borne diseases);
- selective integrated vector control through multiple and sustainable preventive measures;
- epidemic preparedness and response for efficient forecasting and control of outbreaks;
- prevention of malaria in pregnancy to ensure safer pregnancy;
- strengthening the information system and surveillance of malaria (and other vector-borne diseases);
- increasing capacity of the community to recognize, prevent and control malaria (and other vector-borne diseases);
- developing the capacity to plan and implement operational field research.

4. CAPACITY-BUILDING

Dr Hoda Atta outlined the issues and challenges for capacity building for vector control operations in the context of IVM programmes. Strengthening both human resources and institutional capacity are essential to achieve IVM, which requires a wider range of
competence and coordination than for vertical programmes targeting only one vector-borne disease. Many countries lack the necessary expertise and human resources at national level to plan and evaluate, and at the intermediate and peripheral levels to manage and implement. Capacity building starts with primary assessment of needs, followed by the establishment of a human resources development programme for all levels of health services delivery. Dr Atta itemized the following steps to be taken by Member States for IVM capacity building:

- provision of an effective cadre of senior staff at various levels (central, governorate, local) for planning, monitoring and evaluation at all levels;
- preparation and provision of training manuals, modules and facilities;
- training of trainers (national core);
- training and retraining of operational personnel;
- material resources and supply systems;
- technical support mechanisms: information, guidelines, communications;
- enabling environment, including the development and implementation of appropriate recruitment and career policies.

Participants from most countries voiced their common concern for the urgency of adopting these steps for IVM capacity building, since few countries had planned for IVM and there was a general problem of discontinuity due to the retirement of experienced vector control staff.

5. OPERATIONAL RESEARCH

Dr Atta Hoda invited country delegates to apply for RBM operational research support, by submitting well prepared proposals via the process posted on the Regional Office RBM website (www.emro.who.int/rbm). Two country presentations were made on operational research for malaria vector control.

Dr Salim Said Al-Wahabi gave an overview of research conducted by the Oman programme, including vector susceptibility testing of currently used and alternative insecticides; comparing three operational strategies of larviciding; evaluation of biological control agents, particularly to further develop the use of larvivorous fishes. It was made clear that Oman's malaria eradication programme has been fully researched step by step to ensure that all activities are properly understood and refined. Having reached the maintenance phase, Oman has redoubled its efforts to investigate all aspects of the programme (case checking, drug testing, shifting to more environmentally friendly insecticides) in preparation for the maintenance phase in 2005 (i.e. withdrawal of routine operational intervention).

In contrast, Mustafa Dukeen presented a more historical view of research on malaria vectors in Sudan, begun exactly a century ago by Henry Wellcome. Hence the many vectors of arboviruses, leishmaniasis, trypanosomiasis, onchocerciasis, schistosomiasis and malaria are extremely well known in Sudan. Pioneering research continues with current steps towards trials of the sterile insect technique for the elimination of *Anopheles arabiensis* from some isolated areas, supported by the International Atomic Energy Agency (IAEA), for proof of the
principle. However the vector-borne disease control programmes of Sudan are poorly resourced for such a huge and difficult country. Apart from logistical and epidemiological problems, there is a serious brain drain, often benefiting other countries of the Region. Due to constant monitoring and the careful choice of insecticides used for malaria vector control (e.g. switching from DDT to organophosphates and judicious alternation of organophosphates used for IRS and larviciding), incipient problems of resistance among malaria vectors have been minimized. In adopting IVM, the malaria control programme has undertaken KAP studies as insecticide-treated nets are introduced. Also there is renewed interest in working out the most appropriate ways of using biological larvicides and larvivorous fishes.

6. **REGIONAL IVM STRATEGIC FRAMEWORK**

The main objective and activities of the workshop were to sensitize country delegates to the importance of IVM and to involve them in the development of the Regional Strategy for IVM. Following the many and varied presentations reported above, Dr Mnzava briefed the participants on what was needed for the strategy. Dr Bos then launched discussions and a brainstorming session ensued, particularly focusing on:

- creating an enabling environment;
- restructuring of programmes and relationships within a country;
- re-allocation of resources and securing sufficient support;
- ensuring sufficient knowledge of local vectors (evidence-base);
- capacity building;
- monitoring and evaluation.

Working groups were delegated to produce particular parts of the draft regional framework for implementation of IVM. After reviewing each of the contributions, the sub-groups merged their parts of the IVM strategy and all sections were reviewed rapidly in plenary. Finalization of the draft Regional Strategic Framework for IVM was achieved readily by consensus, together with ten priority recommendations from the workshop. The full text of the draft IVM strategy was further discussed, refined and presented to the closing plenary session in the presence of dignitaries and WHO representatives.

7. **RECOMMENDATIONS**

1. All participants from Member States in the Eastern Mediterranean Region should agree to adopt the principles of integrated vector management at the regional and national levels and fully endorse the importance of an integrated management approach to the control of vector-borne diseases.

2. Ministries of health should initiate a process of consultation with relevant stakeholders, leading to the incorporation of IVM principles into the existing framework of national policies.
3. Efforts should be made by each Member State to promote non-chemical methods of vector control and more selective use (better targeting) of insecticides (e.g. insecticide-treated nets).

4. Member States should carry out a situation analysis and needs assessment to provide a solid basis for strategic capacity building and IVM planning.

5. Member States should establish effective institutional arrangements for intersectoral, intrasectoral and cross-border collaboration in support of IVM.

6. WHO should continue to provide support to develop capacity for planning, implementation, monitoring and evaluation of integrated vector management.

7. WHO should support Member States in the management of insecticides, including their safe and judicious use in vector control.

8. WHO should establish a regional network for monitoring resistance in major disease vectors.

9. WHO should continue to support Member States in the use of GIS and remote sensing in integrated vector and disease management.

10. WHO should continue to support operational research leading to the development of vector-borne disease early warning systems.
PROGRAMME

Tuesday, 21 January 2003

08:30–09:00 Registration

09:00–10:00 Opening session
Address by H.E. Dr Ahmed Belal Othman, Federal Minister of Health, Sudan
Message from Dr Hussein A. Gezairy, WHO Regional Director for the Eastern Mediterranean
Introduction of participants
Election of officers

10:00–10:10 Objectives of the meeting and method of work/ Dr Atta

10:10–12:00 Integrated vector management—concept and challenges
Vector control progress report for EMR and challenge of implementing IVM/ Dr Mnzava
Overview and principles/ Dr Bos
Judicious use and management of pesticides in public health/ Dr Zaim
Country experiences (Oman and Sudan)
Discussions

12:00–14:30 Entomological surveillance and vector mapping
Use of GIS and remote sensing in the study of the distribution and mapping malaria vectors and other vectors (Egypt and Morocco)
Entomological monitoring through sentinel sites (Iraq)
Distribution of mosquito vectors of diseases in Saudi Arabia using GIS (Saudi Arabia)
Discussions

14:30–16:30 Scaling-up of insecticide-treated bednets and other materials for malaria vector control and other vector-borne diseases
The role of ITNs and other materials in the control of malaria and other vector-borne diseases/ Dr Cham and Dr Guillet
National ITN strategic plans for scaling-up use at country level as a part of adapting global strategy/ Dr Cham
Role of LLNs in complex emergency situation/ Dr Guillet and Dr Mnzava
Country experiences (Afghanistan, Somalia and Yemen)
Discussions

16:30–18:00 Increasing coverage in vector control through other interventions
Timely implementation of insecticide house spraying and high coverage/ Dr Mnzava
Larval control, suitability and limitations (United Arab Emirates)

Wednesday, 22 January 2003

08:00–10:30 Insecticide resistance monitoring and management
Defining the problem and establishing a regional network/ Dr Guillet
Lessons learned, AFRO experience/ Dr Manga
Country experiences (Islamic Republic of Iran and Iraq)
Discussions

10:30–13:30 Capacity building and operational research
Pertinent issues and challenges/ Dr H. Atta
Country experience in operational research for malaria vector control (Oman and Sudan)
Discussions

13:30–13:45 Draft regional framework for implementation of integrated vector management
Introduction and brainstorming (enabling environment, knowledge/evidence-base, capacity building)/ Dr Mnzava

13:45–16:00 Group work on draft regional framework for implementation of integrated vector management

16:00–18:00 Field visit

Thursday, 23 January 2003

08:00–09:30 Continuation of group work on draft regional framework for integrated vector management

09:30–10:30 Conclusion and harmonization of draft regional framework for integrated vector management

Merging of appropriate sections by different groups

11:00–11:30 Finalization of draft regional framework for integrated vector management

11:30–12:30 Discussion of draft report and recommendations

12:30–13:00 Closing session
Annex 2

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MESSAGE FROM DR HUSSEIN A. GEZAIRY
REGIONAL DIRECTOR
WHO EASTERN MEDITERRANEAN REGION
to the
INTERCOUNTRY WORKSHOP ON DEVELOPING A REGIONAL STRATEGY
FOR INTEGRATED VECTOR MANAGEMENT FOR MALARIA AND OTHER
VECTOR-BORNE DISEASES

Khartoum, Sudan, 21–23 January 2003

Ladies and Gentlemen,

It gives me great pleasure to welcome you all to this meeting in Khartoum, Sudan. I would like to take this opportunity to thank the Government of Sudan for hosting the meeting and to extend my deep gratitude to His Excellency Dr Ahmed Belal Othman, Federal Minister of Health of Sudan, for his keen interest and the excellent support extended in facilitating this meeting. I am sure that participants will not only benefit from the experience of Sudan in malaria vector control, particularly their Khartoum and Gezira Malaria Free Initiative (KGMFI), but also from their great hospitality.

As you are aware, in the Eastern Mediterranean Region, vector-borne diseases contribute to about 2.2% of the total burden of disease and approximately 7% of all communicable diseases. Such diseases include malaria, leishmaniasis, schistosomiasis and lymphatic filariasis, which occur in several countries in the Eastern Mediterranean Region, and African trypanosomiasis, onchocerciasis and dracunculiasis, which occur only in Sudan. These diseases also include arboviral infections, such as yellow fever and Rift Valley fever and the emerging dengue and Crimean–Congo haemorrhagic fever. Other diseases, such as diarrhoea, trachoma and asthma are also carried by insect pests but are rarely considered or seen as vector-borne diseases.

The distribution of vector-borne diseases and their burden varies greatly within and between the countries of the Region. Unfortunately, the situation with regard to some of those diseases is getting worse in a number of countries, partly due to the breakdown of health services because of war, political instability and economic crisis. The Region has witnessed in recent years epidemics of malaria (Afghanistan), leishmaniasis (Afghanistan and Pakistan) and Rift Valley fever (Saudi Arabia and the Republic of Yemen).

Ladies and Gentlemen

As you all know we have effective tools for vector control. These include: the use of insecticides for spraying homes; use of insecticide-treated bed nets and other materials; larval control through environmental management, use of biological control agents such as
larvivorous fish and bacteria, or larviciding with chemicals. The efficacy of each of these tools varies from country to country depending on the local epidemiological situation.

Most of the countries however, rely solely on the usage of insecticides. As a result a number of vectors have been reported to have developed resistance to one or more than one group of insecticides in such countries. For example, malaria vectors are resistant to both DDT (organochlorine) and malathion (organophosphate) in Sudan. Methods of detecting and monitoring the distribution of insecticide resistance and its management are crucial as countries implement vector control.

In the Eastern Mediterranean Region, the potential to use one or several of these interventions to address more than one vector-borne disease exists and should be promoted. There is also a need to scale up some of these interventions in a cost-effective manner. For example, realistic methods to finance and distribute insecticide-treated nets to ensure high coverage rates in countries must be sought, and inevitably will have to rely on genuine and meaningful public/private partnerships.

Ladies and Gentlemen,

Well-planned and coordinated vector control interventions contribute significantly to the reduction of the incidence in vector-borne diseases. Effective vector control methods exist but their implementation, as part of integrated disease management, is limited. Recognizing this need, the Division of Communicable Diseases in the Regional Office has been actively promoting integrated disease management as a cornerstone of regional and national strategies to control communicable diseases.

Ladies and Gentlemen,

The objectives of this meeting are to review the status of vector control activities in Member States and to develop and finalize a regional framework for implementation of integrated vector management for malaria and other vector-borne diseases. It is therefore, expected that during this meeting specific and achievable evidence-based targets to implement integrated vector management will be formulated. I assure Member States of our commitment to support them in achieving the targets set.

I wish you a very successful meeting and a pleasant stay in this hospitable country and beautiful city of Khartoum.
Readiness for IVM assessed from country reports presented at the workshop:
A = staff and circumstances most ready for IVM: if given suitable training, strategy and resources
B = possibly capable of shifting to IVM if given suitable training, strategy and resources
C = unready for various reasons

<table>
<thead>
<tr>
<th>Country</th>
<th>Population (millions)</th>
<th>Area (km² × 1000)</th>
<th>Vector-borne disease</th>
<th>Main vectors</th>
<th>Remarks</th>
<th>IVM readiness</th>
</tr>
</thead>
</table>
| Afghanistan              | 22                    | 652               | Malaria              | North: An. *hyscanus*, *pulcherrimus*, *superpictus*
|                          |                       |                   | South: An. *Culicifacies*, *fluvatilis*, *stephensi*, *superpictus*         |                                  | C             |
| Bahrain                  | 0.7                   | 0.7               |                      | Leishmaniasis                                                              | ACL, *P. sergenti*; ZCL, *P. papatasi* | A             |
| Cyprus                   | 0.8                   | 9.3               | Leishmaniasis        | Mosquitoes, flies, phlebotomines                                           | transmission-free                | A             |
| Djibouti*                | 0.7                   | 23                | Malaria              | An. *arabensis*                                                            |                                  | C             |
| Egypt*                   | 69                    | 1000              | Diarrhoea            | Flies                                                                       |                                  | A             |
|                          |                       |                   | Lymphatic filariasis  | *Culex pipiens*                                                            | LF eliminated by MDA            |               |
| Islamic Republic of Iran*| 71                    | 1648              | Malaria              | *An. multicolor*, *An. pharoensis*, *An. sergenti*                        | Almost eliminated               |               |
| Iraq*                    | 24                    | 438               | Leishmaniasis        | ZCL, *P. papatasi*; ZVL, *P. langeronii*                                   |                                  |               |
|                          |                       |                   | Malaria              | *An. culicifacies, d’halil, fluvatilis, sacharovi, stephensi*              |                                  |               |
|                          |                       |                   | Leishmaniasis        | ACL, *P. sergenti*, ZCL, *P. papatasi*; ZVL, *P. major*                  |                                  |               |

† Countries with endemic *Schistosoma mansoni* causing intestinal bilharzia

* Countries with endemic *Schistosoma haematobium* causing urinary bilharzia
<table>
<thead>
<tr>
<th>Country</th>
<th>Population (millions)</th>
<th>Area (km²)</th>
<th>Vectors:</th>
<th>Main vectors</th>
<th>Remarks</th>
<th>IVM resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jordan</td>
<td>5.1</td>
<td>89</td>
<td>Leishmaniasis</td>
<td>ZCL, P. papastai, P. sergenti; ZVL, P. syriasis</td>
<td>Malaria eliminated in 1970.</td>
<td>A</td>
</tr>
<tr>
<td>Kuwait</td>
<td>2.0</td>
<td>19</td>
<td>-</td>
<td>Mosquitoes, flies, phlebotomines</td>
<td>Malaria eliminated</td>
<td>A</td>
</tr>
<tr>
<td>Lebanon</td>
<td>3.6</td>
<td>10</td>
<td>Leishmaniasis</td>
<td>ZCL, P. papastai, ZVL, P. syriasis</td>
<td>Malaria eliminated</td>
<td>A</td>
</tr>
<tr>
<td>JordanianCY</td>
<td>5.4</td>
<td>1760</td>
<td>Leishmaniasis</td>
<td>ZCL, P. papastai, ZVL, P. perniciosus</td>
<td>Malaria eliminated</td>
<td>B</td>
</tr>
<tr>
<td>Morocco</td>
<td>30</td>
<td>447</td>
<td>Malaria</td>
<td>An. labranchiae</td>
<td>Almost eliminated</td>
<td>A</td>
</tr>
<tr>
<td>Oman</td>
<td>2.6</td>
<td>652</td>
<td>Leishmaniasis</td>
<td>ACL, P. sergenti; ZCL, P. papastai, ZVL, P. syriasis</td>
<td>Transmission stopped</td>
<td>A</td>
</tr>
<tr>
<td>Pakistan</td>
<td>145</td>
<td>797</td>
<td>Leishmaniasis</td>
<td>Urban, An. stephensi; rural, An. culicifacies</td>
<td>Reservoir host unknown</td>
<td>B</td>
</tr>
<tr>
<td>Palestine</td>
<td>3.3</td>
<td>172</td>
<td>Malaria</td>
<td>ZCL, P. papastai</td>
<td>Widespread and increasing</td>
<td>B</td>
</tr>
<tr>
<td>Qatar</td>
<td>0.6</td>
<td>21</td>
<td>Leishmaniasis</td>
<td>ACL, P. sergenti; ZCL, P. papastai; ZVL, P. syriasis; P. falciparum</td>
<td>-</td>
<td>B</td>
</tr>
</tbody>
</table>

* ZCL: Ziehl-Neelsen culture; ZVL: Viermarck culture; P. arbovirus.
<table>
<thead>
<tr>
<th>Country</th>
<th>Population (millions)</th>
<th>Area (km² × 1000)</th>
<th>Vector-borne disease</th>
<th>Main vectors</th>
<th>Remarks</th>
<th>IVM readiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somalia*</td>
<td>9.2</td>
<td>638</td>
<td>Malaria</td>
<td><em>An. arabiensis, An. funestus</em></td>
<td>Hyperendemic in most areas</td>
<td>C</td>
</tr>
<tr>
<td>Sudant*</td>
<td>32</td>
<td>2506</td>
<td>Malaria</td>
<td><em>An. arabiensis, An. gambiae, An. funestus</em></td>
<td>Hyperendemic in most areas</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leishmaniasis</td>
<td><em>ZCL, P. duboscqi, P. papatasi</em></td>
<td>Outbreaks in Khartoum</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>ZVL, P. martini, P. orientalis</em></td>
<td>Epidemics widespread</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trypanosomiasis</td>
<td><em>Glossina fuscipes, G. morsitans, G. palpalis</em></td>
<td>Serious in southern Sudan</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leishmaniasis</td>
<td><em>Simulium damnosum complex</em></td>
<td>Riverine foci</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Onchocerciasis</td>
<td><em>Musca sorbens</em></td>
<td>Widespread</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trachoma</td>
<td><em>An. funestus, An. gambiae</em></td>
<td>Southern Sudan only</td>
<td></td>
</tr>
<tr>
<td>Syrian Arab Republic*</td>
<td>17</td>
<td>185</td>
<td>Malaria</td>
<td><em>An. claviger, sacharovi, sergenti, superpictus</em></td>
<td>Entomological monitoring discontinued</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leishmaniasis</td>
<td><em>ACL, P. sergenti; ZCL, P. bergeroti, P. papatasi; ZVL, P. syriacus, P. tobbi</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunisia</td>
<td>9.6</td>
<td>164</td>
<td>Leishmaniasis</td>
<td><em>ACL, P. chabaudi, P. sergenti; ZCL, P. papatasi; ZVL, P. longicuspis, P. perfiliewi, P. perniciosus</em></td>
<td>Malaria eliminated</td>
<td>A</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>2.7</td>
<td>84</td>
<td>Leishmaniasis</td>
<td><em>ZVL, P. alexandri</em></td>
<td>Malaria eliminated</td>
<td>A</td>
</tr>
<tr>
<td>Yemen*</td>
<td>19</td>
<td>528</td>
<td>Malaria</td>
<td><em>An. arabiensis, An. culicifacies</em></td>
<td></td>
<td>B</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

1.1 Background

Globally, vector-borne diseases are responsible for almost 20% of the estimated burden of infectious diseases affecting humanity, largely due to malaria and other parasitic diseases in developing countries. In the 23 countries of the WHO Eastern Mediterranean Region, vector-borne diseases contribute to over 2% of the total estimated burden of disease. While 8% of the world population lives in the Region (2001), almost 11% of the global burden of vector-borne diseases is found here (Table 1 in Appendix 1). Regionally, vector-borne diseases represent about 17% of the burden of all infectious disease and are disproportionately distributed to only a few countries. These countries suffer most from the vector-borne disease burden and its socioeconomic consequences.

As detailed in Appendix 1, the most important vector-borne diseases harming human health in the Region are malaria and lymphatic filariasis transmitted by mosquitoes, leishmaniases transmitted by sandflies, schistosomiasis from aquatic snails and diarrhoeal diseases and trachoma transmitted by flies. Also present, but of more limited importance as vector-borne diseases, are trypanosomiasis carried by tsetse flies, onchocerciasis carried by blackflies and several mosquito-borne arboviruses: notably Rift Valley fever, dengue and Crimean–Congo haemorrhagic fever. On the other hand, the potential for spread of West Nile fever and yellow fever in the Region is very high. Other arthropod pests and potential vectors include fleas, ticks, cockroaches and rodents of many species. These pests, vectors and vector-borne diseases are unevenly distributed within the Region and have patchy foci within individual countries. The dynamics of vector populations, the level of transmission risks and the incidence of diseases fluctuate seasonally.

The everyday reality of this widespread burden makes the control of vector-borne disease a key component of health sector activities to protect and promote health. Moreover, due to the complexities of ecology, epidemiology and risks of exposure, these diseases are particularly important targets for intersectoral action for health.
Zoogeographical zones in the Eastern Mediterranean Region

The Eastern Mediterranean Region comprises various zoogeographical zones, Afrotropical, Oriental and Palaearctic (Figure 1). Each of these zones has a specific cluster of dominant vector species. At the margins of their distribution within each zone, vector populations may be less stable and therefore easily controlled by vector control interventions; however, at the core of their distribution area, they are likely to be well-entrenched and will require a more powerful package of interventions to control them to a degree sufficient to have a significant impact on transmission risk. Within each zone, different species will have different ecological requirements. Knowledge of these requirements is fundamental to the development of integrated vector management, which bases itself on an ecosystems approach. An imbalance, caused by extreme weather conditions, floods or drought, or by human actions that change the hydrology or land-use patterns, can lead to explosive increases in vector populations with dire consequences for vector-borne disease transmission risks. Chemical interventions in agro-ecosystems, for example, can have similar adverse impacts. Strategies aimed at reducing disease transmission while maintaining or restoring ecosystem integrity are therefore needed.

Figure 1. Zoogeographical zones in the Eastern Mediterranean Region
1.2 Vector control interventions

Historically the main vector control measures in the majority of countries in the Region have been indoor residual spraying and larval control using insecticides and larvivorous fish. These interventions, combined with environmental management and improved housing, have reduced and eliminated malaria and, incidentally, other vector-borne diseases in most countries.

During the past decade, insecticide-treated nets (ITNs) have been introduced for protection against the transmission of malaria and leishmaniasis. Space spraying is part of the vector control programmes in some countries, but is often over-employed. Bacterial larvicides are preferred because they specifically control mosquito larvae, whereas chemical larvicides also affect a wider range of non-target organisms. More attention should be given to cost-effectiveness analysis of vector control operations to ensure the most judicious and beneficial application of insecticides and other potential interventions.

One of the problems countries are facing is the limited choice of safe insecticides because of widespread insecticide resistance. In most countries of the Region, resistance has been reported in several vectors, apparently resulting from exposure to agricultural insecticide usage in some cases. More effort is needed to monitor the extent and effects of insecticide resistance using the latest methods and criteria.

For vector control programmes, guidance is needed for countries to show how, what, when, and where, each precaution and intervention should be selected and used; especially the synergies that may be derived from combining several methods. Merging different control programmes is a priority so that more than one vector-borne disease can be jointly targeted where the vectors occur together and have similar behaviour or ecology (Table 1 in Appendix 1). The strategic framework for integrated vector management has been developed to provide the necessary guidance to countries.

1.3 Reasons for employing integrated vector management

The key reason for employing an IVM strategy is to strengthen impact through complementary methods of vector control with operational flexibility, while respecting ecosystem integrity. Ideally IVM should reduce vectorial capacity (defined in Appendix 2) to the point of preventing transmission risks. IVM programmes usually involve:

- carrying out a sound ecosystem and eco-epidemiological analysis to reveal the critical points in disease transmission that can be targeted for maximum impact on disease interruption;

- designing a series of incremental interventions, whereby each additional intervention yields maximum health gains at the least additional cost;
• coordinating and re-focusing pre-existing resources for IVM against multiple vectors, through both intersectoral and intrasectoral cooperation to maximize benefits and cost-efficient use of available resources;

• using alternate and/or multiple interventions, so as to reduce dependence on the use of pesticides;

• achieving sustainable long-term prevention of vector-borne diseases at minimal cost.

In the short term, IVM should multiply the impact of individual interventions to achieve critical reduction of risks. This may mean that the resources required for IVM are greater than for any single intervention, but if properly implemented the effectiveness of interrupting transmission through IVM will be proportionally greater than the increase in overall costs.

In the long term, IVM should also help to prevent and overcome costly setbacks, such as those that may arise due to changes of vector behaviour or development of insecticide resistance.

2. JUSTIFICATION AND GUIDING PRINCIPLES

2.1 Institutional justification

In 1989, the World Health Assembly issued resolution WHA 42.31, which urged Member States to reinforce capacity to that effective vector control measures are taken for the control of disease vectors, and to develop and maintain adequate human resources for this purpose. The Director-General is requested to ensure that input in the development of safe and effective methods for the control of disease vectors continues to be based on sound ecological considerations, in accordance with the principles of sustainable development.

Resolution WHA 50.13 (1997) called upon Member States take steps to reduce reliance on insecticides for control of vector-borne diseases through promotion of integrated pest management approaches. It also called upon them to ensure that the use of dichlorodiphenyltrichloroethylene (DDT) is authorized by governments for public health purposes only, and that such use is limited to government-authorized programmes that take an integrated approach.

During an informal consultation on the integrated approach to control communicable diseases in 2002, the Division of Communicable Diseases in the Regional Office for the Eastern Mediterranean Regional adopted IVM as one of its strategies to control communicable diseases.

2.2 Technical justification

Well-planned and coordinated vector control interventions can help reduce the incidence and burden of vector-borne disease. Although effective vector control methods exist, in the
past they have only addressed one disease at a time, so that their implementation as part of integrated disease management packages has been limited.

In many countries, decentralization is providing opportunities for vector control with community participation, using focal persons at the community level and outreach services to implement IVM. Limited financial resources of vector-borne disease control programmes and the limited number of safe, cost-effective pesticides require selective and careful application of pesticides within integrated vector management.

The IVM approach builds on the concept of selective vector control with the targeted use of different vector control methods, alone or in combination, to prevent or reduce human-vector contact. In addition, IVM should be cost-effective and sustainable, involve intersectoral cooperation and have no adverse side effects for people or the environment.

2.3 Guiding principles for the development and implementation of IVM interventions

- IVM is an essential element of vector-borne disease control.
- IVM should be economically feasible, cost-effective, sustainable, environmentally sound and socially acceptable.
- Vector control interventions are components of integrated vector-borne disease control programmes, which are in line with national health sector reform.
- Wherever and whenever possible, vector control interventions should be planned for multiple vector-borne disease prevention and control.
- Incentives and regulatory or institutional arrangements need to be designed and employed to ensure effective intersectoral collaboration.
- Programme management can be optimized by enabling decision-making at local levels. This should be considered in the context of health sector decentralization and the need for active community participation.

3. OBJECTIVES OF THE STRATEGIC FRAMEWORK

The general objective of the strategic framework for IVM is to provide countries of the Region with guidance on the optimal use of resources (financial, human and technical, including insecticides) for IVM programmes. Using the strategic framework, each country is expected to prepare, adopt and implement a national plan of action for IVM by 2004.

Specific objectives of the framework are to:

- promote regional implementation of IVM principles
- promote efficient allocation of resources to vector control
- foster strengthening of the capacity for IVM
promote the use of non-chemical vector control interventions and appropriate management of pesticides
promote integrated disease control
promote intersectoral and intrasectoral collaboration and partnership, including community participation.

The aim is for all countries of the Region to adopt and implement well integrated and cost-effective programmes for vector management and control in order to prevent, reduce or interrupt transmission of vector-borne diseases and prevent the re-establishment of local transmission.

4. PRIORITY ACTIONS FOR IMPLEMENTATION OF INTEGRATED VECTOR MANAGEMENT

• Incorporating IVM principles into national health policies;

• Strengthening vector control capability within the national health system;

• Establishing or strengthening national capacity to implement IVM, including providing training, promoting career opportunities, enhancing collaboration, guiding re-orientation of vector control activities and ensuring availability of skilled staff;

• Engaging in advocacy to ensure political commitment for IVM as an important component of communicable disease control (CDC), and developing policies and legislation to increase community participation, empowerment and mobilization of human and financial resources;

• Promoting intersectoral and intrasectoral cooperation to optimize allocation of resources within the health sector (e.g. environmental health and different vector-borne disease programmes) and intersectoral collaboration between different government sectors, (especially agriculture, environment and local government/municipalities) supported by appropriate policies, legislation and impact assessment;

• Establishing partnerships to mobilize public and private sectors, together with civil society, nongovernmental organizations and donors, to optimize allocation of resources and ensure effective implementation of IVM;

• Monitoring and evaluating ongoing vector control activities by employing entomological surveillance and conducting operational research, including post-registration monitoring of pesticide use.
5. TARGETS FOR IMPLEMENTATION OF INTEGRATED VECTOR MANAGEMENT

5.1 Role of Member States

Depending on the situation in each country, effective implementation of IVM will require the establishment, strengthening or re-organization of vector control services to facilitate multidisciplinary and intersectoral collaboration. The first step for all countries is implementation of a comprehensive needs assessment, to be used as a basis for fulfilling the following targets:

- Identification of the technical, human and financial resources or deficiencies for the implementation of IVM activities.
- Development of a proposal for the establishment of IVM services within the existing framework of national health policies and health systems, and reaching an agreement with relevant authorities.
- Establishment or strengthening of a structure for the planning, implementation, monitoring and evaluation of an IVM programme. A core group will guide, support and when necessary, participate in IVM activities.
- Development of national guidelines for the planning, implementation, monitoring and evaluation of IVM activities.
- Establishment of mechanisms to ensure intersectoral and intrasectoral collaboration, public–private partnership, cross-border coordination and community participation.
- Planning and carrying out of operational research for evidence-based IVM interventions.

5.2 Role of WHO

To assist countries in fulfilling the targets listed above, WHO will:

1. Finalize and disseminate the draft regional strategic framework among Member States for comments and suggestions (by June 2003).
3. Prepare and disseminate technical guidelines for conducting the situation analysis and needs assessment of IVM activities (by the end of 2003).

5. Provide the necessary technical support for Member States to conduct situation analyses, needs assessment, planning, implementation, monitoring and evaluation of vector control interventions based on the IVM approach.
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Appendix 1

REGIONAL DISTRIBUTION AND BURDEN OF VECTOR-BORNE DISEASES

1. Regional distribution of vector-borne diseases

Major vector-borne diseases

Malaria: caused by human infection with *Plasmodium falciparum* and *P. vivax*. Anopheline mosquito vectors of malaria are present in all 23 countries of the Region. Even so, malaria transmission has been effectively interrupted in 10 countries (Bahrain, Cyprus, Egypt, Kuwait, Lebanon, Libyan Arab Jamahiriya, Oman, Qatar, Tunisia, the United Arab Emirates). Active malaria transmission continues in at least the following countries: Afghanistan, the Islamic Republic of Iran, Pakistan due to transmission mainly by *Anopheles culicifacies* and *An. stephensi*; Djibouti, Saudi Arabia, Somalia, Sudan and the Republic of Yemen due to transmission mainly by *An. arabiensis*; Iraq and the Syrian Arab Republic due to transmission by *An. sacharovi* and other vectors. Due to the widespread prevalence of competent vectors, most parts of the Region remain vulnerable and receptive to malaria. Irrigation schemes and other water resources projects provide conditions for malaria in what is otherwise a semi-arid to arid region and therefore become foci of intense transmission.

Leishmaniasis: caused by *Leishmania* protozoa transmitted by phlebotomine sandflies. Three forms of leishmaniasis affect this Region, namely: visceral (VL due to *L. donovani* in Sudan and widespread *L. infantum*), zoonotic cutaneous (ZCL due to *L. major*) and anthropopotic cutaneous (ACL due to *L. tropica*). These diseases are focal in the Islamic Republic of Iran, Iraq, Sudan, the Syrian Arab Republic, and Tunisia and cause important public health problems in Afghanistan and Pakistan. Leishmaniasis is a lesser problem in Djibouti, Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Morocco, Oman, Saudi Arabia, Somalia, and the Republic of Yemen, and has been eliminated from Egypt, the United Arab Emirates and the Gulf States. There are more than 20 vector species of *Phlebotomus* in the Region, with obscure breeding sites. The most widespread and important are *P. papaiasi* as vector of *L. major*; *P. sergenti* as vector of *L. tropica*; *P. perniciosus* as vector of *L. infantum* and *P. orientalis* as vector of *L. donovani*.

Lymphatic filariasis: caused by the nematode *Wuchereria bancrofti* transmitted by mosquitoes. Extreme symptoms are known as elephantiasis. As transmission of the microfilariae requires high humidity, distribution is limited by the generally arid climate of this region. Foci in the Nile delta of Egypt and probably in the Republic of Yemen are transmitted by urban pest mosquitoes of the *Culex pipiens* complex. Lymphatic filariasis endemicity across southern Sudan is transmitted by anopheline mosquito vectors, as for malaria. There is a potential risk that expanding practices of wastewater re-use for agriculture may lead to the increased propagation of *Culex* vectors and an intensification of transmission of the disease.

Schistosomiasis: caused by to trematode worms. *Schistosoma haematobium* causes urinary bilharzia and *S. mansoni* causes intestinal bilharzia. The latter occurs in Egypt, Oman, Saudi
Abdul, Sudan, Republic of Yemen, whereas *S. haematobium* is more widespread across North Africa and the Arabian peninsula. Intermediate hosts are aquatic snails of the genus *Bulinus* for *S. haematobium* and *Biomphalaria* for *S. mansoni* living in marshes and irrigation systems where infection is acquired when people bathe or work in infested waters.

**Trachoma**: caused by *Chlamydia trachomatis* bacterial infection of the eyes, transmitted mostly by face-flies *Musca sorbens*. This occurs in most countries of the Region, but has been poorly mapped.

**Vector-borne diseases of lesser or more local importance**

**Onchocerciasis** (river blindness): caused by the filarial nematode *Onchocerca volvulus*, transmitted by blackflies of the *Simulium damnosum* group that breed in fast-flowing waterways. Largely a disease of tropical Africa, two countries of the Region have endemic onchocerciasis. The Republic of Yemen harbours small foci in a few highland valleys, while Sudan has foci along several river systems.

**Loiasis** (Calabar swelling): caused by the filarial nematode *Loa loa*, transmitted by *Chrysops* flies breeding in muddy areas, associated with rainforests of tropical Africa and endemic across southern Sudan.

**Guinea-worm** (dracunculiasis): caused by nematode *Dracunculus medinensis*. Ingested with drinking water via the intermediate copepod hosts (*Cyclops*), it was formerly endemic across Africa and Asia, but is now limited to foci in several tropical African countries, mostly in Sudan.

**Trypanosomiasis** (sleeping sickness): caused by trypanosomes transmitted by tsetse flies (*Glossina*). Also mostly a disease of tropical Africa, transmission extends across southern Sudan. Due to the economic importance of trypanosomiasis affecting livestock, a continent-wide campaign is taking shape: the Pan African Tsetse and Trypanosomiasis Eradication Campaign.

**Borrelioses**: due to spirochetes transmitted by several types of ectoparasites: body lice (*Pediculus humanus*) vectors of *Borrelia duttoni* causing louse-borne relapsing fever (LBRF); soft ticks (*Ornithodoros*) vectors of *Borrelia recurrentis* causing tick-borne relapsing fever (TBRF); hard ticks (*Ixodidae*) carrying *Borrelia burgdorferi* causing Lyme disease. While these arthropods and infections are probably widespread, little recent information is available on their distributions in each country.

**Scrub typhus**: caused by the zoonotic bacterium *Rickettsia tsutsugamushi* transmitted by trombiculid mites, is zoonotic across South-east Asia. In Pakistan the vector is *Leptotrombidium deliae*.

**Diarrhoeal diseases**: caused by enteric bacteria (e.g. *E. coli* O157, *Salmonella*, *Shigella*) and viruses are partly transmitted by houseflies, blowflies, face-flies and cockroaches, widespread throughout the Region. The main transmission pathway is via direct faecal–oral transmission.
Plague: caused by *Yersinia pestis* bacteria transmitted by *Xenopsylla* fleas. Scattered foci of enzootic plague exist across the Region, with human cases of zoonotic origin recorded occasionally in Iraq, Islamic Republic of Iran, Libyan Arab Jamahiriya, Morocco, Saudi Arabia and Tunisia.

Typhus: due to zoonotic bacteria of three types is widespread across the Region: louse-borne *Rickettsia prowazeki* causing classical typhus, transmitted by *P. humanus*; flea-borne *Rickettsia typhi* causing murine typhus, transmitted by various species of fleas; tick-borne *R. conori* causing boutonneuse fever transmitted by *Haemaphysalis* ticks.

Arboviruses (arthropod-borne viruses) of many types are widespread zoonoses, mostly transmitted by quite specific vectors. Sporadic outbreaks are difficult to foresee and usually pass quickly, for ecological and epidemiological reasons. Some cause serious public health problems if the epidemic is not contained. Those vectored by mosquitoes include:

Dengue: (four serotypes) causes dengue fever with mild transient symptoms, sometimes progressing to dengue haemorrhagic fever or dengue shock syndrome. No dengue vaccine is available. Dengue viruses are transmitted by *Aedes (Stegomyia) aegypti*, which is very anthropophilic and breeds in domestic water containers. Another vector spreading around the Mediterranean is *Aedes (Stegomyia) albopictus*, raising the likelihood of dengue outbreaks. Recurrent major epidemics of dengue occur across tropical Asia and the Americas, but so far dengue remains uncommon in the Eastern Mediterranean Region. Cases of dengue have been reported from Pakistan, Saudi Arabia, Somalia and Sudan and recently from Djibouti and the Republic of Yemen.

Japanese encephalitis: transmitted by many types of mosquitoes, especially *Culex* spp. breeding in irrigated rice fields. Japanese encephalitis virus is disseminated by egrets and other birds associated with irrigation and marshland. Amplifier hosts include domestic livestock, especially pigs. Fortunately Japanese encephalitis vaccines are available: children and pigs are routinely vaccinated in some countries. Cases have been reported in the Indus valley of Pakistan and suspected in Afghanistan, but the incidence remains unclear in the Eastern Mediterranean Region. As the principal vector *Culex tritaeniorhynchus* is widespread from Southeast Asia to West Africa, further spread of Japanese encephalitis across the Region is a real possibility.

Rift Valley fever: transmitted mostly by various *Culex* spp. during epidemics and carried through dry seasons in dormant eggs of *Aedes* mosquitoes (vertical transovarial transmission) from which the resultant females become infective and transmit to amplifier hosts at the start of the next rainy season. No vaccine is available. Serious outbreaks have occurred recently in Somalia, Saudi Arabia and the Republic of Yemen, causing large-scale mortality of livestock and some human deaths.

West Nile virus: transmitted by many types of mosquitoes, mostly *Culex* spp. West Nile is disseminated by birds, which often die. Amplifier hosts include horses that often die. Human symptoms vary from mild fever to serious complications with significant mortality rate. No vaccine is available. West Nile outbreaks occur frequently around the Mediterranean but none
of the countries of the Region have officially reported cases. The potential for outbreaks exists in Egypt, Jordan, Morocco, Palestine and Tunisia.

Yellow fever: virus causes very severe fever and jaundice with a high mortality rate. In tropical Africa, the sylvatic cycle of yellow fever involves monkeys and various aedine mosquito vectors, with *Aedes simpsoni* and other link vectors to villages. Urban epidemics are vectored by *Aedes aegypti* with human-to-human transmission, as for dengue. Vaccination is very effective and compulsory for international travellers from countries such as Sudan and Somalia that lie in the infection zone of yellow fever.

*Arboviruses transmitted by other arthropods in the Region*

Crimean-Congo haemorrhagic fever: virus transmitted by ixodid ticks (mainly *Hyalomma*) and carried by livestock (goats and sheep) has spread to Afghanistan, Islamic Republic of Iran, Iraq and Pakistan. Cases are reported annually with localized outbreaks from these countries.

Sandfly fever: causes mild symptoms in humans due to zoonotic phlebovirus and is carried by rodents and transmitted by various phlebotomine sandflies. It is widespread in most countries of the Region.

Other potential vectors occurring in most, probably all, countries of the Region include biting midges (*Culicoides, Leptoconops*), stable flies (*Stomoxys*), horseflies (*Tabanidae*) and hard ticks (*Ixodidae*), which occasionally transmit the bacterium *Francisella tularensis* causing tularemia. Larvae of some larger flies (e.g. *Chrysomya, Lucilia, Wolfhartia*) cause myiasis when they invade human flesh (by burrowing) or intestines (by ingestion). Despite much speculation and conjecture, all evidence indicates that blood-feeding insects cannot transmit HIV/AIDS. Conversely, there is some experimental evidence for transmission of hepatitis B virus by bedbugs (*Cimex*), although epidemiological evidence indicates no significant role of bedbugs as vectors of any infection.

Rodents are carriers of haemorrhagic fever viruses, poorly known in this Region, and other zoonotic infections such as leptospirosis and those mentioned above, i.e. Lyme disease, typhus and plague.

Extensive and largely successful vector control programmes have influenced the distribution patterns and prevalence of vectors and vector-borne diseases for many years during the past century. Although mainly targeted on malaria, these interventions have also affected other pests and vectors.

2. Burden of vector-borne diseases in the Eastern Mediterranean Region

Ten vector-borne diseases are sufficiently prevalent in the Region to be listed in the *World health report 2002* as significant contributors to the burden of disease (Table 1).
Table 1. Estimated disability-adjusted life-years (DALYs) lost in 2001 in countries of the Eastern Mediterranean Region due to infections from selected vector-borne diseases

<table>
<thead>
<tr>
<th>Vector-borne disease</th>
<th>Burden in DALYs*</th>
<th>Endemic</th>
<th>Epidemic-prone</th>
<th>Non-endemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhoeal diseases¹</td>
<td>10 784 000</td>
<td>All</td>
<td>All</td>
<td>0</td>
</tr>
<tr>
<td>Malaria</td>
<td>2 050 000</td>
<td>Afghanistan, Djibouti, Somalia, Sudan, Republic of Yemen</td>
<td>All</td>
<td>18</td>
</tr>
<tr>
<td>Trachoma</td>
<td>602 000</td>
<td>Afghanistan, Djibouti, Egypt, Iraq, Islamic Republic of Iran, Libyan Arab Jamahiriya, Morocco, Oman, Pakistan, Somalia, Sudan, United Arab Emirates, Republic of Yemen</td>
<td>–</td>
<td>Bahrain, Cyprus, Jordan, Kuwait, Lebanon, Palestine, Qatar, Saudi Arabia, Syrian Arab Republic, Tunisia</td>
</tr>
<tr>
<td>Lymphatic filariasis</td>
<td>489 000</td>
<td>Egypt, Sudan, Republic of Yemen</td>
<td>–</td>
<td>20 countries</td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td>278 000</td>
<td>17</td>
<td>Afghanistan, Pakistan, Sudan</td>
<td>Bahrain, Cyprus, Djibouti, Kuwait, Qatar, United Arab Emirates</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>202 000</td>
<td>Egypt, Iraq, Morocco, Saudi Arabia, Somalia, Sudan, Republic of Yemen</td>
<td>Jordan, Libyan Arab Jamahiriya, Oman, Syrian Arab Republic</td>
<td>Afghanistan, Bahrain, Cyprus, Djibouti, Islamic Republic of Iran, Kuwait, Pakistan, Palestine, Qatar, Tunisia, United Arab Emirates</td>
</tr>
<tr>
<td>Dengue</td>
<td>85 000</td>
<td>Djibouti, Pakistan</td>
<td>Republic of Yemen</td>
<td>20 countries</td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>81 000</td>
<td>–</td>
<td>Afghanistan, Pakistan</td>
<td>21 countries</td>
</tr>
<tr>
<td>Onchoerciasis</td>
<td>46 000</td>
<td>Sudan, Republic of Yemen</td>
<td>–</td>
<td>21 countries</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>40 000</td>
<td>Sudan</td>
<td>–</td>
<td>22 countries</td>
</tr>
</tbody>
</table>

Top 10 vector-borne diseases total 14 657 000 = 11% of DALYs attributed to vector-borne diseases globally = 17% of DALYs attributed to communicable diseases regionally.

¹ Enteric infections causing diarrhoeal diseases are only partly transmitted by vectors, being more often acquired directly from faecal/oral route or via contaminated water and foodstuffs.

*Source: World health report 2002
Appendix 2

TERMINOLOGY AND DEFINITIONS

*General terms*

**Disability-adjusted life years (DALYs):** one DALY can be thought of as one lost year of “healthy” life. DALYs are calculated as the sum of the years of life lost due to premature mortality (YLL) in the population, and the years lost due to disability (YLD) for incident cases of the health condition.

**Framework:** circumstances surrounding and possibly affecting policies, strategies, programmes

**Integration:** an approach to overcome fragmentation in policies and programmes, in order to maximize benefits from synergies and economies of scale, and exclude inefficiencies resulting from redundancies and overlap.

**Integrated vector management (IVM):** a process of evidence-based decision-making procedures aimed to plan, deliver, monitor and evaluate targeted, cost-effective and sustainable combinations of regulatory and operational vector control measures, with a measurable impact on transmission risks, adhering to the principles of subsidiarity, intersectorality and partnership.

**Intersectoral:** involving two or more sectors, e.g. health and agriculture; public health and military

**Intrasectoral:** involving two or more sub-sectors of the same sector, e.g. IEC and IVM; malaria and leishmaniasis; diagnostic and preventive

**Management:** an orderly and replicable approach to tackling challenges and solving problems.

**Plan:** defined course of action.

**Policy:** a set of decision-making criteria and procedures to achieve an agreed development goal.

**Programme:** an agreed course of action within the framework provided by the policies.

**Project:** a self-contained building block or module of activities, one unit of a programme.

**Receptive:** situation (e.g. country) where a particular disease is not currently transmitted, but where conditions are suitable for its transmission (e.g. susceptible hosts and, for vector-borne diseases, competent vectors with adequate vectorial capacity) if introduced.

**Strategy:** the optimal allocation of (limited) financial, human and technical resources to support the most efficient process of achieving the goal.
Subsidiarity: the concept of optimizing programme implementation by ensuring decision-making at the lowest possible level in the political or administrative hierarchy

Vulnerable: situation where infection and/or vectors are likely to be introduced.

Vector: carrier and transmitter of infection

Vector competence: biological and/or mechanical ability to transmit infection

Potential vector: species that is competent to transmit infection, but apparently not currently involved

Vector control: interventions targeting vectors to reduce their vectorial capacity

Vectorial capacity: mathematical expression to measure vector efficiency, used to assess risk and impact of interventions. Vectorial capacity (C) is expressed as: $C = ma^2p^n - loge p$ where:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>density of vectors in relation to man</td>
</tr>
<tr>
<td>a</td>
<td>number of blood meals taken on man per vector per day</td>
</tr>
<tr>
<td>p</td>
<td>proportion of vectors surviving per day</td>
</tr>
<tr>
<td>n</td>
<td>incubation period in the vector (days) – 8 days</td>
</tr>
</tbody>
</table>

When they survive $(1-loge p)$ days

Theoretically, incidence of infection rises when $C>1$, incidence falls when $C<1$

Indicators of vector control interventions

Impact indicator: a measurement of the immediate effect of an intervention in achieving its immediate objective (e.g. number of breeding places eliminated)

Outcome indicator: a measurement of the effect in relation to achieving the final goal (e.g. EIP or disease morbidity)

Process indicator: a measurement of the correct implementation of a sequence of essential actions

Economic evaluation

Cost-effectiveness analysis: a comparative economic evaluation which offsets the costs of alternative actions against their effectiveness using agreed effectiveness indicators common to all interventions

Cost-benefit analysis: a comparative economic evaluation which offsets the costs of alternative actions against their benefits, expressed in monetary terms

Cost-utility analysis: a comparative economic evaluation which offsets the costs of alternative actions against their utility as expressed in composite indicators that include a weighting for certain social and demographic factors and take into consideration certain externalities (such as DALYs)