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Guide for decision making and implementation of vector control as Alternative Treatment Strategies for elimination of onchocerciasis

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Preface

Great progress has been made towards elimination of onchocerciasis in Africa and 23 African countries are expected to have reduced infection to low levels by 2020 that control activities can safely be stopped and the phase of post-treatment surveillance can begin. And to eliminate onchocerciasis in the remaining countries by 2025, annual CDTI or intensified control activities need to be implemented in areas that are now not yet being treated; acceleration through intensified control activities may be required. A strategy other than annual CDTI has to be used to accelerate elimination of Onchocerciasis in some of the projects in Africa. Vector control is one of the Alternative Treatment Strategy (ATS), and aims to break the human-fly contact thus leading to interruption of transmission. Ground larviciding will be used based on OCP guidelines and also experiences from some other African countries.

This document on vector control is meant to guide countries in decision making role in undertaking this strategy to supplement ongoing intervention of Onchocerciasis to accelerate the elimination of the disease. It was prepared by experts and contains background information and lays out operational framework for conducting vector control based on ecological setting.

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Preamble

Vector Control was the main method for controlling onchocerciasis before late 1980s in the Onchocerciasis Control Programme (OCP) of West Africa, Kenya, Uganda and a number of other African countries (Barnley, 1956; Davies, 1983, 1994; Garnham, et. al; 1947, McMahon, 1967, Roberts, et. al, 1967). In OCP, it was very expensive and out of reach for the countries due to the use of aerial spraying, yet its benefits are overwhelmingly undeniable (De Sole,et. al., 1990; Dadzie, et.al., 1990). However, this approach was not a method that countries could pick up and sustain in order to realize elimination of Onchocerciasis. When ivermectin, a largely safe drug for onchocerciasis became available free from Merck & Co, (WHO, 1995) the belief was that vector control was no longer a cost effective method for use in onchocerciasis control.

However, recent experiences have shown that elimination is a realistic goal as interruption of transmission has been attained in many foci in Equatorial Guinea(Bioko), Mali, Senegal, Sudan and Uganda (Traore, et. al. 2009; Diawara, et.al, 2009; Higazi, et.al., 2013; Katabarwa, et.al, 2014; ). Indeed, where vector control was applied as a complementary alternative treatment strategy (ATS), acceleration of transmission interruption has been observed (Lakwo, et.al, 2013). Many of these foci have halted interventions and are under post treatment surveillance (PTS) with no sign of disease recrudescence. In most of the cases where vector control has been applied recently, ground larviciding by well-trained local personnel in affected communities has been the norm. This approach has been deemed affordable in terms of building capacity in endemic countries and accelerating disease elimination (Garms, et. al, 2009).

This guide is therefore recommended to endemic countries to implement vector control in order to break the human-fly-contact and accelerate the elimination of onchocerciasis within the world Health Organization (WHO) agreed targets. Vector Control is a well-documented alternative treatment strategy (ATS) aimed at eliminating the vector or reducing its density to levels where the disease is eliminated (Davies, 1994).

Vector Control through ground larviciding is directed against Simulium larvae by treating their breeding sites using OCP guidelines (WHO, 2002) with WHO approved and environmentally safe insecticides. This guide emphasizes that within the framework of Alternative Treatment strategy (ATS), vector control is a complementary tool to accelerate elimination of Onchocerciasis and can even become a key tool in Onchocerciasis endemic areas where Ivermectin cannot be safely used.
Section 1: Information needed to decide on implementation and objectives of Vector Control

The information that will be necessary for making decision for vector control is the following:

a. Mapping of rivers/potential breeding sites over at least 2 years in the project site

Map of river systems and potential breeding places of the project site should be obtained to enable the team assess the general hydrological network and feasibility of vector control in the targeted area. This map should be of the scale 1:250,000 and 1:50,000 to clearly provide river net-work in project area.

b. Impact of seasonality on breeding sites and source of flies

Information on seasonal variation based on rainfall pattern of the country/project site should be made available. The relationship between the seasonal variations of the rainfall and the existence of vector breeding sites should be established. Related information on the vector migration from other places to the project site should also be assessed.

c. Definition of transmission zones

Transmission zone is defined as a geographical area, where transmission of *O. volvulus* occurs by locally breeding vectors. Vector control for the acceleration of the elimination of onchocerciasis is likely to be more successful when the transmission zone is more localized and isolated Therefore, the extent of the transmission zone should be well established in a project area before an effective vector control option is taken.

d. Characterization of the *Simulium* species of the transmission zone

The knowledge of the vectors species of the project area is very important. The *Simulium* complexes should be well characterized and the species determined (*S. damnosum*, *S. sirbanum*, *S. squamosum*, *S. neavei* etc.) The capacity of those species to migrate and to transmit the parasite efficiently should also be known.

Section 2: How to obtain information needed for vector control

a. Mapping of hydrological conditions / river systems (including seasonality)

To conduct mapping of breeding sites for the vector (*S. damnosum*, *S. squamosum*, *S. neavei*) one needs a map of the project area, preferably scales 1:250,000 or 1:50,000. On seasonality, the available metrological unit can be contacted to provide accurate information on rainfall.. Information can also be obtained from satellite data sources

b. Identification of potential breeding sites and their productivity across the seasons

Tracking the potential breeding places of *Simulium* species is an important component of the vector control effort that will determine its success or failure. Information on waterfalls, fast flowing places can be obtained from the population. The assessment of the productivity of the breeding sites is made by collecting larvae on trailing vegetation. Member of the *S. neavei* group are however found in phoretic association on crabs. Hence assessing productivity will require trapping specific crabs and collecting larvae fond on them.
Collected larval samples should be identified and preserved for further use. Geographical coordinate of breeding places should be taken using GPS.

c. Species identification/determination

Collected samples can morphologically be identified at site by using hand lens or taken to a laboratory to be identified by a technician. The identification will involve the use of morphological keys, extraction of chromosomes for cytotaxonomy and DNA for PCR (Boakye, 1993; Krueger, 2006; Krueger et al 2006).

d. Experimental treatment to determine source of flies

When mapping has been completed in a river basin and you are ready to start vector control, you need to carry out an experimental trial(s) to ascertain the following:

- How far your insecticide can be carried downstream
- The efficacy of the insecticide in use
- The presence of vector migration in the project area

e. Optimization of approaches to Vector Control

The optimization of the vector control approach can be done through the following:

- Vector control within the framework should be made affordable to most countries if it is to be adopted and sustained by countries. In order to do this we can scale down our interval of ground larviciding say after every 2 or 3 months based on the level of vector population. This saves the cost of larvicides and operation.
- Larviciding can be done during dry season at sites that are still maintaining breeding so that at the beginning of the rains there are limited sites that can scale up high vector population in a project area.

Section 3: Prerequisites for successful vector control

a. Establishment of vector control structure

In order for proper planning of vector control activities in a project there must be a structure established. This should be within the disease control department of the Ministry of Health. Once this is integrated planning can be done at national regional and district levels to support vector control activities. Countries can also use any relevant existing structure that is available to coordinate vector control activities without necessarily creating a new one to ensure sustainability.

b. Expertise needed at national/regional/district level

The availability of trained field entomologist is a critical component of the vector control system. For this, first degree holders in biology (Zoology) could be given specific training in the form of workshop to suit the need of the vector control project. Given the importance that vector control may have for the elimination of onchocerciasis and other vector borne diseases, it could be envisaged to negotiate with Universities and research institutes to organize those specific training programmes. However, this is assuming that such vector control expertise exist in those institutions which may not always be the case.
At the national level, regional and district there is need to identify available entomologists that can be responsible for planning and ensuring that vector control activities are on course. Their role will be:

- Obtaining relevant maps for project area
- Drawing operation plan for mapping
- Identifying suitable field staff
- Compiling list of field equipment and supplies
- Creating data base for vector control and analyzing data.
- Training field staff
- Making technical decision on the direction of vector control in a project
- Preparing technical report

c. Budget

A realistic budget should accompany the plan of action of vector control project. The budget should be realistic and tied to activities. The main budget line should include the following:

- Personnel Perdiem/Allowances
- Fuel for vehicle or motorcycles
- Equipment- flow-meter, spray pumps, GPS machine, microscopes etc
- Field supplies: protective wears, reagent etc
- Larvicides
- Stationery

d. Cross-border/cross-district/cross project issues

In the project where vector control is to be implemented make effort to obtain information whether there are prospects for cross-border transmission. This can be obtained from communities at the borders with countries, districts or projects. When river network is shared by two countries or projects, all parties involved should be brought on board for planning. This minimizes cross-border re-infestation.

e. Selection of suitable larvicides

The selection of suitable larvicides should be made by an entomologist/relevant technical person who have a good knowledge of larvicides suitable for Simulium control. It would also be necessary to have standby insecticide to overcome the possibility of resistance to the first line one.

f. Ground larviciding

Several methods of ground larviciding can be used. The simplest consist of mixing at the river edge the requisite dose of insecticide in a bucket and throwing the preparation in water courses (WHO, 2002, 1994). The second methods is measuring the quantity of insecticide pouring it in a knapsack sprayer/Hudson Expert sprayer, pre-mix with water, shake and apply it at the breeding site for a period of 30 minutes (Garms, et. al, 2009). Finally, in very large rivers, a mixture of insecticide and water is released from a drum carried out in a boat; the boat’s screw churns this mixture into the river water (WHO, 2002, 1994). Choice for a method to use will be based on the nature of the river system, but application can be made using a sprayer assisted by a boat.
g. Susceptibility testing and environmental considerations, systematic monitoring of susceptibility.

Resistance is the faculty for an insect population to tolerate insecticide doses which would be lethal for a normal population of the same species (WHO, 1994). The issue of vector resistance in S. damnosum species have been earlier reported (Kurtak, et, al. 1982). Aware of this, regular susceptibility testing should be undertaken. During this testing an assessment should be made on the population of other non-target fauna. Data on susceptibility should be compiled in a standard form and reviewed regularly to establish any emerging case of resistance. If there is a detection of any resistance, larvicide should be changed immediately.

Section 4: Criteria for deciding on where to implement VC as ATS

a. Rationale for vector control / elimination

Vector control strategy is to reduce transmission and accelerate elimination of onchocerciasis in conjunction with other control measures. When opting to conduct vector control, the reason should be clearly identified. Reasons could be:

- very high biting vector density
- Poor performance of project
- Need to accelerate elimination because of late CDTI start?
- Co-endemicity with L. loa that affect compliance to the treatment
- Need to eliminate the vector because the focus is isolated and there is a high chance of achieving elimination of the vector.
- Combination of any of the above factors?

b. Area characteristics-ecology, river network etc.

Determine the type of breeding sites existing in the project area: - Is it large rivers, narrow rivers, river with forest cover, hilly or in mountainous areas? How accessible are the breeding sites? Are settlements close to or far away from rivers? How is the river network in relation to settlements?

c. Elimination of vectors

In the project areas in your country try to establish if there are areas with isolated transmission zones. This can be done by studying your river network in relation to the relief and the type of vector species. If S. neavei there is available evidence that they have short flight range due to their peculiar breeding sites ecology. Although some members of the S. damnosum complex are are long-distance flyers, especially in the savannah most forest dwelling specieshave restricted distribution range (Boakye et al 1998).

d. Areas not yet under control

In areas still not under control of oncho assess the feasibility of vector control as you wait for the establishment of CDTI.

NB: This document is not exhaustive. For further information you are advised to read the references shown below.
References


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