



# Meeting Report: Integrated Mapping of Neglected Tropical Diseases: Developing an Operational Guide

Technical Expert Meeting Co-sponsored with the World  
Health Organization

December 15–17, 2009  
Dakar, Senegal

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## About the Neglected Tropical Disease Control Program

In September 2006, the U.S. Agency for International Development (USAID) launched the Neglected Tropical Disease (NTD) Control Program. The NTD Control Program is the first global effort to support country programs to integrate and scale up delivery of preventive chemotherapy for five targeted NTDs: lymphatic filariasis (elephantiasis), schistosomiasis (bilharzia; snail fever), trachoma (blinding eye infection), onchocerciasis (river blindness), and soil-transmitted helminthiasis (intestinal worm infection).

Our Program supports national NTD control programs' efforts to expand their existing disease-specific control programs by integrating mass drug campaigns for co-endemic NTDs and benefiting from cost-efficiencies that result from streamlined service delivery. The Program also works closely with key global NTD partners and donors to advocate for global policies and initiatives to prioritize treatment and control of NTDs.

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## Acronyms

|       |  |
|-------|--|
| APOC  | African Program for Onchocerciasis Control         |
| OEPA  | Onchocerciasis Elimination Program in the Americas |
| IU    | Implementation Unit                                |
| LF    | Lymphatic Filariasis                               |
| MDA   | Mass Drug Administration                           |
| NTD   | Neglected Tropical Disease                         |
| OU    | Operating Unit                                     |
| PCT   | Preventive Chemotherapy                            |
| PoA   | Plan of Action                                     |
| REMO  | Rapid Epidemiological Mapping of Onchocerciasis    |
| SAC   | School-Age Children                                |
| STH   | Soil-Transmitted Helminthiases                     |
| TF    | Trachomatous Inflammation-Follicular               |
| TT    | Trachomatous Trichiasis                            |
| USAID | U.S. Agency for International Development          |
| WHO   | World Health Organization                          |



## Background

The U.S. Agency for International Development (USAID) and the Neglected Tropical Disease (NTD) Control Program in collaboration with the World Health Organization (WHO) and other partners, promote the integration of control activities for five NTDs that can be targeted with preventive chemotherapy (PCT): lymphatic filariasis (LF), onchocerciasis, schistosomiasis, soil transmitted helminthiasis (STH), and trachoma.<sup>1</sup> Integration of control efforts has been shown to decrease program duplication, increase efficiency, and maximize the use of available resources to enable more people to be reached with treatment.

As Ministries of Health in disease-endemic countries plan integration and scale-up of NTD control activities, it is essential to understand both the geographic distribution of each of the targeted diseases (including where disease overlaps occur) and whether the prevalence of each disease is high enough to warrant treatment intervention. To date, the protocols for “mapping” have been individualized for each disease and thus have required multiple teams to conduct multiple assessments in potentially endemic areas, at considerable expense to each program.

On December 15–17, 2009, in Dakar, Senegal, a meeting of NTD technical experts was convened by WHO and the USAID NTD Control Program, to develop an integrated approach to mapping, allowing countries with multiple diseases to maximize the effectiveness of the limited human, financial, and logistical resources available for mapping. As a product of that meeting, this document provides an assessment of integrated mapping and a suggested approach to mapping the targeted NTDs. All recommendations follow current WHO guidelines for disease-specific indicators and thresholds, as it is critical that the recognized, principal disease-specific objectives be maintained in integrated NTD control programs.

*It should be emphasized that these recommendations are just one step on the road to a set of finalized WHO guidelines for integrated mapping of the NTDs which will follow only after further Organization-wide consultations and deliberations have taken place.*

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<sup>1</sup> Although mapping of *Loa loa* is essential for mass drug administration (MDA) for LF and onchocerciasis in Central Africa, the disease is not addressed in the present guidelines. *Loa loa* mapping is being completed separately, with overall guidance from the African Program for Onchocerciasis Control (APOC).

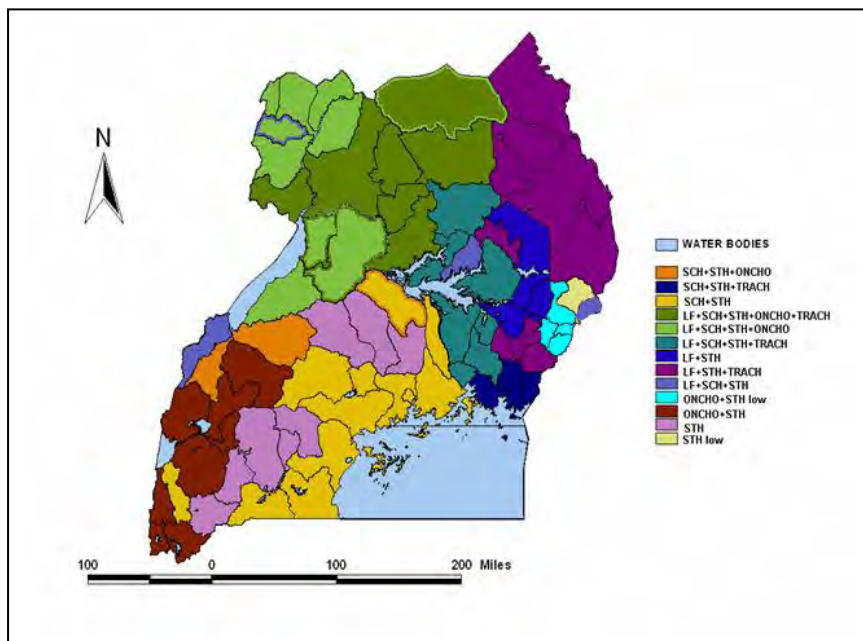
## Introduction

For the purpose of this document and the integrated NTD control programs, the term “mapping” is used to refer to data collection that is conducted at the beginning of NTD control or elimination programs for the purpose of determining whether a public health action is necessary. “Integrated mapping” refers to an effort to identify the elements of disease-specific mapping activities that can be feasibly linked to achieve efficiencies and save valuable human and financial resources. In the case of PCT interventions this mapping provides critical action-oriented information to national NTD programs and their partners. The final result is not a geographic depiction of overlapping disease prevalence, but rather a geographic depiction of *actions to be taken* to target the diseases.

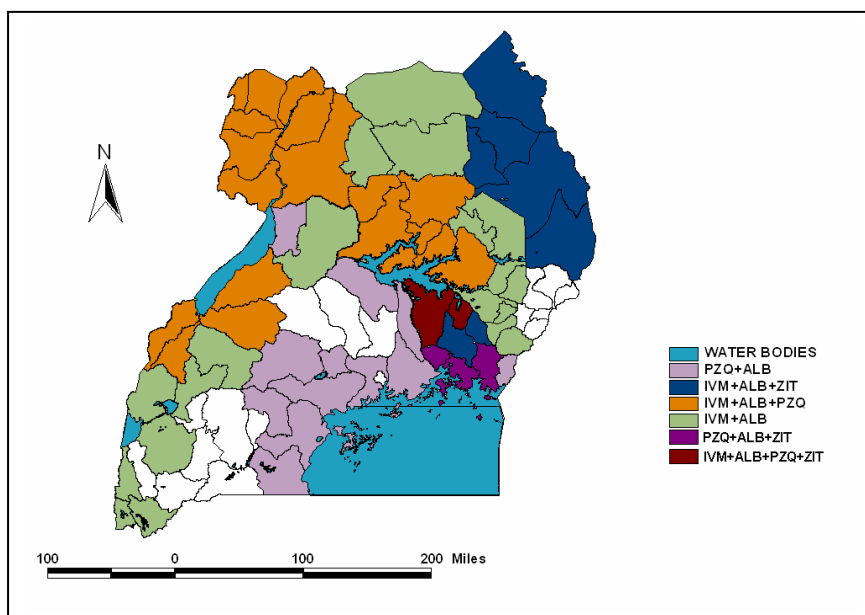
As an example, the NTD co-endemicity mapping for each district in Uganda (Figure 1) is used to develop an action map (Figure 2) to guide logistics (e.g., mapping the drug packages needed in each district for MDA). Importantly, although the country is co-endemic for the targeted diseases, there is limited and variable geographical overlap among the diseases at the sub-national level.

Ideally, all countries that are co-endemic for more than one of the five targeted NTDs should create action maps like that shown in Figure 2, which can be used to guide the development or updates of the National Plan of Action for NTDs.

**Figure 1. Disease Mapping by District, Uganda**



**Figure 2. Action Map for Drug Distribution by District, Uganda**



Whereas an integrated approach to NTDs can maximize effectiveness of program resources, not all elements of disease-specific mapping can or should be integrated. There is no single recipe for integrated mapping that will apply to all countries because countries differ with respect to their disease burden and distribution and their mapping needs.

## Steps towards an Integrated Approach to Mapping

### **Prerequisite: Guidelines for Disease-Specific Mapping and Implementation**

Clear guidelines for mapping each of the specific targeted diseases is absolutely necessary for developing guidelines for integrated action-mapping of the NTDs. These include identifying which population segments need to be assessed with which diagnostic tools and what the thresholds of positivity are that call for implementation of PCT (or other interventions) in a given implementation unit (IU).<sup>2</sup> Table 1 identifies key elements of the most recent WHO guidelines for mapping for each of the five NTDs targeted in current integrated NTD control programs.

<sup>2</sup> An IU is the geographic area defined by the program where a decision is made to treat or not to treat the target population.

**Table 1. Key Elements of Most Recent WHO Disease-Specific Guidelines (or accepted practice)**

| Disease   | Diagnostic Approach for Mapping  | Threshold for Implementation of PCT Interventions  | Unit of Implementation                             |
|---|--|--|--|
| Lymphatic filariasis  | Antigen detection<br>Immunochromatographic Card Test (ICT) or blood microfilaria detection   | Prevalence $\geq 1\%$ in adults in at least one site in an Implementation Unit   | District or other as defined for ease of operation |
| Onchocerciasis–Africa   | Nodule detection using rapid diagnostic techniques (e.g., Rapid Epidemiological Mapping for Onchocerciasis REMO)                                 | Presence of palpable nodules $\geq 20\%$ in adult men (and women where men are not enough to meet the required number) | Community  |
| Schistosomiasis   | Parasitological methods:<br><br>1. detecting eggs in urine or stool (microscopy)<br><br>2. detecting blood in urine (hemastix or questionnaires) | High-risk: Prevalence of infection $\geq 50\%$ in school-age children (SAC)  | Sub-district or community or foci at high risk     |
|   |  | Moderate-risk: Prevalence of infection $\geq 10\%$ but $< 50\%$ in SAC   |  |
|   |  | Low-risk: Prevalence of infection $< 10\%$ in SAC  |  |
| Soil-transmitted helminthiasis (ascariasis, trichuriasis, hookworm) (STH) | Detecting eggs in stool (microscopy)   | High-risk: Percentage of individuals with any STH (Ascaris, Trichuris, or Hookworm) $\geq 50\%$ in SAC                 | District   |
|   |  | Moderate-risk: Percentage of individuals with any STH (Ascaris, Trichuris, or Hookworm) between 20% and 50% in SAC     |  |
|   |  | Low-risk: Percentage of individuals with any STH (Ascaris, Trichuris, or Hookworm) $< 20\%$ in SAC                     |  |
| Trachoma (Blinding)   | Eyelid examination for follicular inflammation (TF)  | High risk: TF prevalence $\geq 10\%$ in 1- to 9-year-olds  | District   |
|   |  | Low risk: TF prevalence 5%-10% in 1- to 9-year-olds  | Village  |

## **Stage-1: Historical Assessment to Determine Where Disease Mapping Is Required**

Collection and examination of all the epidemiologic and treatment information available for each of the diseases should be a basic first step in the process of updating the distribution or on-the-ground mapping of any of the targeted NTDs.

On-the-ground disease mapping is expensive and requires significant staff time. In many cases, appropriate data might already exist and be able to provide enough information for an informed decision as to whether MDA is necessary for a particular disease in a given IU. Therefore, the existing or historical data on disease burden and distribution should be used to the maximum extent possible before any new data collection/mapping has begun.

This historical assessment can be considered as a generalized guideline for all countries seeking to address NTDs, regardless of their unique patterns of disease endemicity. This six-step process is detailed below. Any of the NTD diseases not found in a country can simply be ignored.

### ***Step 1: Collect country-level data for each program***

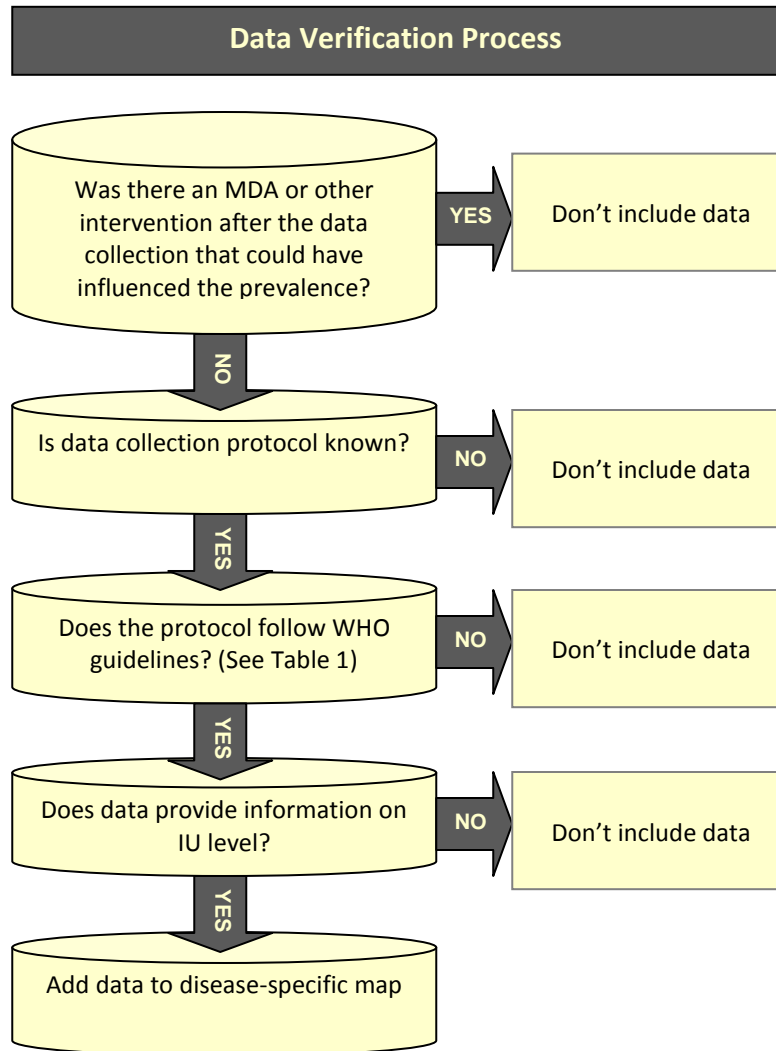
Country-level data can be found in a number of locations within government agencies and local organizations working in NTDs. Potential in-country sources for such data include

- Ministries of Health
- Academic theses
- Non-governmental organizations' reports
- In-country published literature
- In-country disease-specific specialists
- Health facility records/statistics

### ***Step 2: Assess usefulness of the available data***

The available data need to be checked to determine whether they can be a reliable guide for planning interventions. Figure 3 details the steps in this data verification process.

**Figure 3. Flow Chart for Validating Quality of Available Data**



Any data that reliably confirm presence of disease can be of value for planning interventions. Important considerations include the following:

- Year (age) of data: Disease-specific guidelines will indicate age cutoff if applicable.
- Whether interventions or environmental changes/modifications occurred after data collection.
- Sample size: Was a statistically valid sample size assessed?
- Methodology used in assessment: Appropriate methods for collecting data for the targeted NTDs are provided in Table 2.



**Table 2. Methodology for Data Collection by Disease**

| Disease                        | Methodology  |
|--------------------------------|--|
| LF                             | Parasite antigen test (ICT), night blood surveys   |
| <i>Schistosoma haematobium</i> | Urine filtration, sedimentation, dipstix, or WHO standard blood-in-urine questionnaire                         |
| <i>Schistosoma mansoni</i>     | Kato/Katz method; concentration methods, and Circulating Cationic Antigen test                                 |
| STH                            | Kato/Katz method, concentration methods  |
| Onchocerciasis                 | Nodule palpitation, skin snip examination  |
| Trachoma                       | Clinical examination of eyelids for Trachomatous Inflammation-Follicular (TF) and Trachomatous Trichiasis (TT) |

***Step 3: Construct disease-specific map for each IU countrywide and identify gaps in data for each IU***

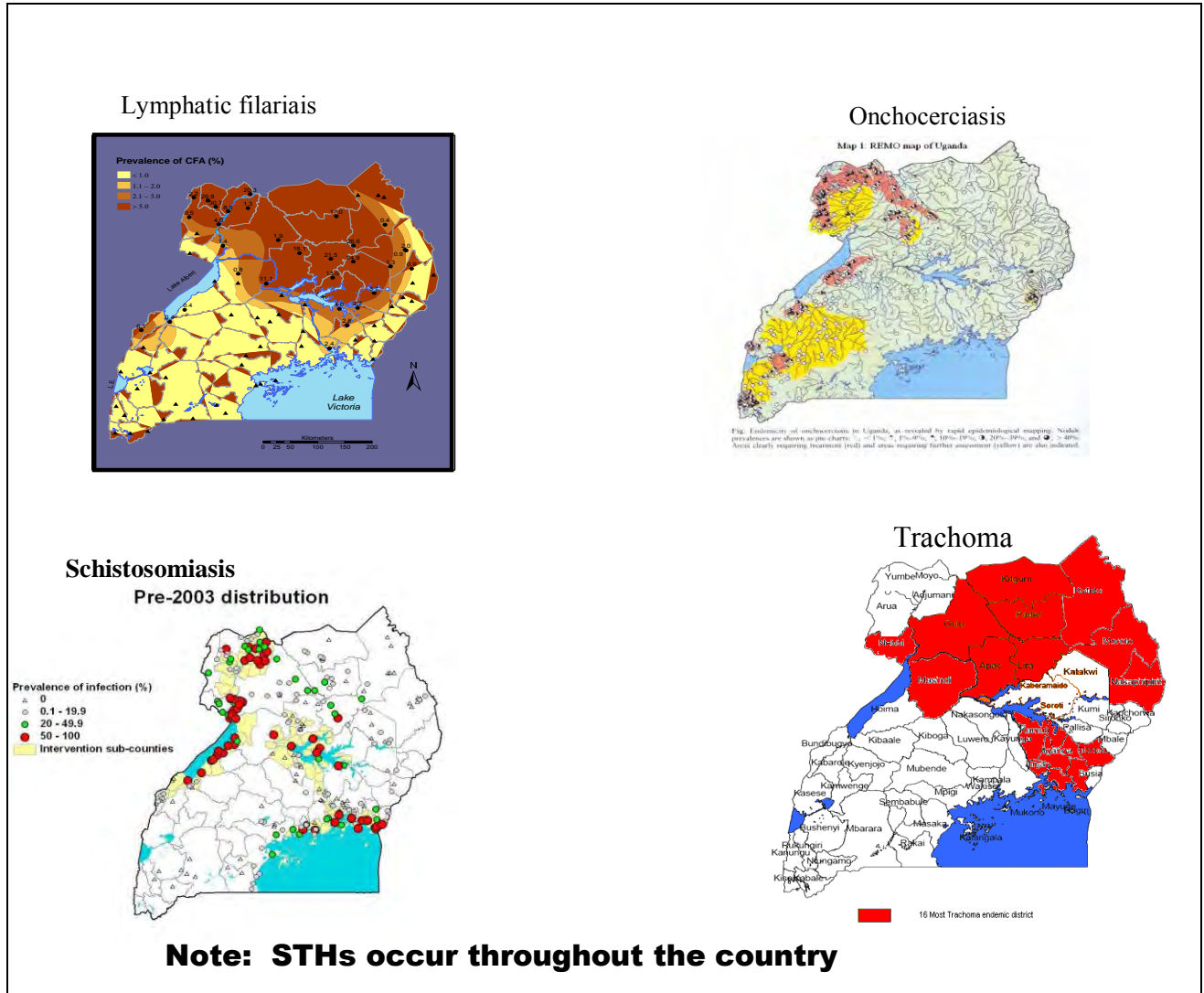
It is next necessary to determine whether the available information satisfies the needs of the country. Are the maps complete? Are there gaps for any of the five diseases?

Geographically map the information derived from this Country Review for each disease. Is each map actionable?

- If yes, complete data tables by district or implementation unit for each disease and create a summary table for use in developing a specific plan of action for intervention.
- If not, review global-level data to seek additional information on disease endemicity.

Examples of disease-specific prevalence maps for Uganda are provided in Figure 4.

**Figure 4. Disease-Specific Prevalence Maps by IU, Uganda**



**Step 4: Review data from available global resources**

If information gaps persist after country data are explored, seek additional disease prevalence data from global sources. Suggested sources of available data for each disease include

- Onchocerciasis: African Programme for Onchocerciasis Control (APOC); Onchocerciasis Elimination Program in the Americas (OEPA)
- Lymphatic filariasis: WHO/AFRO/EMRO and WHO/HQ website
- Schistosomiasis/Soil transmitted helminths: WHO/AFRO/EMRO, WHO HQ website, The Global Atlas of Helminth Infections: [www.thiswormyworld.org](http://www.thiswormyworld.org),

- Trachoma: WHO/AFRO, WHO HQ website, International Trachoma Initiative, Sight Savers International
- Published international literature

**Step 5: Assess the value of the global data**

As with available country data, as discussed in Step 2, an assessment of the value of the global data should be completed.

**Step 6: Finalize/update maps for each disease based on additional data from global-level assessment and determine mapping needs for the country**

Is each map actionable?

- If yes, complete data tables for each disease and summary table (for use in developing plan of action).
- If not, collect additional data (i.e., on-the-ground mapping). Table 3 provides summary information from WHO guidelines for disease-specific mapping.

**Table 3. WHO Guidelines for Disease-Specific Mapping**

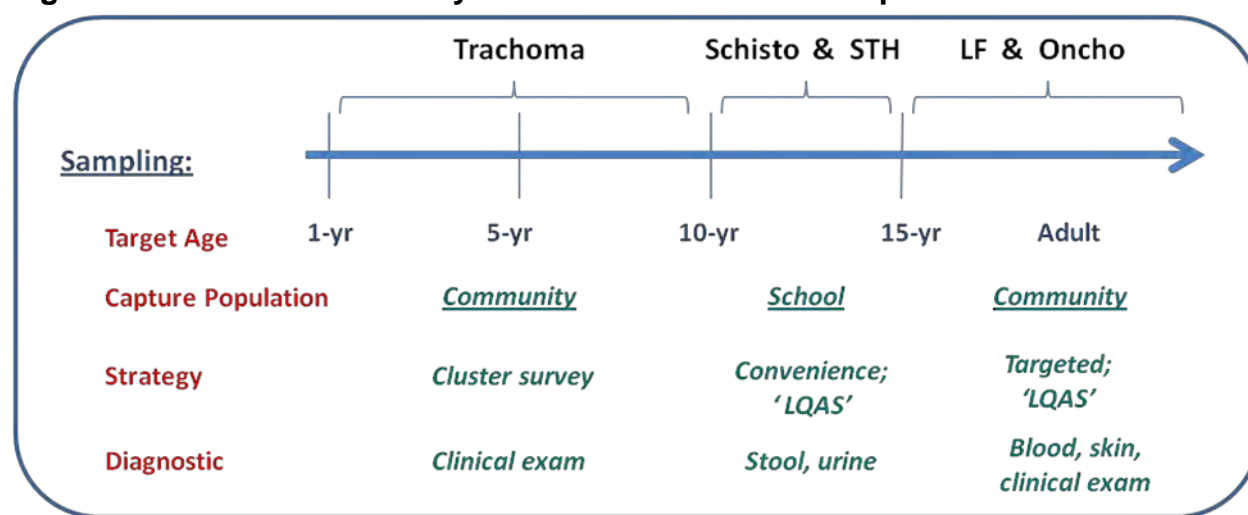
| Lymphatic filariasis   |  |
|------------------------|--|
| <i>Indicator</i>       | Prevalence of <i>W. bancrofti</i> antigen or microfilariae   |
| <i>Persons tested</i>  | > 15 years   |
|                        | Living > 10 years in the community/village   |
| <i>Diagnostic tool</i> | Immunochromatography (ICT) antigen test or parasitological examination of night blood films  |
| <i>Sample size</i>     | 50–100 for ICT prevalence  |
| <i>Sampling frame</i>  | At least one village/site in an IU   |
|                        | Convenience sample or otherwise  |
| Onchocerciasis         |  |
| <i>Indicator</i>       | Prevalence of nodules or <i>O. volvulus</i> microfilariae  |
| <i>Persons tested</i>  | Males aged 20 years and above (include females where males do not meet the required number) or living in the village for >10 years |
| <i>Diagnostic tool</i> | Palpation of nodules or parasitological examination of skin snip   |
| <i>Sample size</i>     | 30–80  |
| <i>Sampling frame</i>  | Convenience or otherwise   |

| <b>Schistosomiasis</b>            |  |
|-----------------------------------|--|
| <i>Indicator</i>                  | Prevalence of haematuria or parasite eggs in urine for <i>S. haematobium</i> |
|                                   | Prevalence of parasite eggs in stool for <i>S. mansoni</i>                   |
| <i>Persons tested</i>             | SAC (7- to 14-year-olds)   |
| <i>Diagnostic tool</i>            | Dipsticks for haematuria/urine filtration for <i>S. haematobium</i>          |
|                                   | Kato-Katz or sedimentation test for <i>S. mansoni</i>                        |
| <i>Sample size</i>                | 50 SAC per school or site  |
| <i>Sampling frame</i>             | At least five villages with expected high prevalence in each ecological zone |
|                                   | In the village: convenience sample   |
| <b>Soil Transmitted Helminths</b> |  |
| <i>Indicator</i>                  | Prevalence of eggs in stool  |
| <i>Persons tested</i>             | SAC (7- to 14- year-olds)  |
| <i>Diagnostic tool</i>            | Kato-Katz  |
| <i>Sample size</i>                | 50 SAC per school or site  |
| <i>Sampling frame</i>             | Five villages with expected high prevalence in each ecological zone          |
|                                   | In the village: convenience sample   |
| <b>Trachoma</b>                   |  |
| <i>Indicator</i>                  | Prevalence of active trachoma (TF) and trichiasis (TT)                       |
| <i>Persons tested</i>             | 1- to 9-year-olds for active trachoma (TF)                                   |
|                                   | > 15 year-olds for TT  |
| <i>Diagnostic tool</i>            | Clinical examination of eyes   |
| <i>Sample size</i>                | 50–100 children per cluster  |
| <i>Sampling frame</i>             | Probability Proportional to Estimated Size                                   |

## Stage-2: On-the-Ground Integrated NTD Mapping

The development of an integrated approach to mapping NTDs must be based on the specific mapping guidelines for each disease. A simplified schematic shown in Figure 5, which highlights key elements of the disease-specific guidelines indicated in Tables 1 and 3, points out some of the potential conflicts in these guidelines that make development of integrated mapping strategies particularly challenging. Although the diagnostic techniques for each disease will remain unchanged until better tools are developed, for other aspects (such as sampling sites and strategies) it is necessary to determine whether they are amenable to changes that would still meet the needs of each disease program, but would allow for development of an efficient integrated approach to mapping.

**Figure 5. Schematic of Key Elements of the Disease-Specific Guidelines**



To overcome these seeming incompatibilities to integrate the mapping strategies of these five NTDs there are two principal options:

- Identify ways of modifying the disease-specific recommendations to make them more easily integrated or
- Identify ways in which the seemingly disparate activities involved in the disease-specific mapping could be logistically accommodated with increased efficiency.

Both strategies have been tried and shown to be potentially successful. For example, in one study<sup>3</sup> the “ideal sample population and sampling strategy” for assessing trachoma prevalence was substituted with one that conformed to the needs of mapping for schistosomiasis and STH so that the two sets of activities could be integrated successfully. In another instance,<sup>4</sup> success was achieved by enlarging the mapping team to include the expertise for mapping multiple diseases and by using schools as assembly

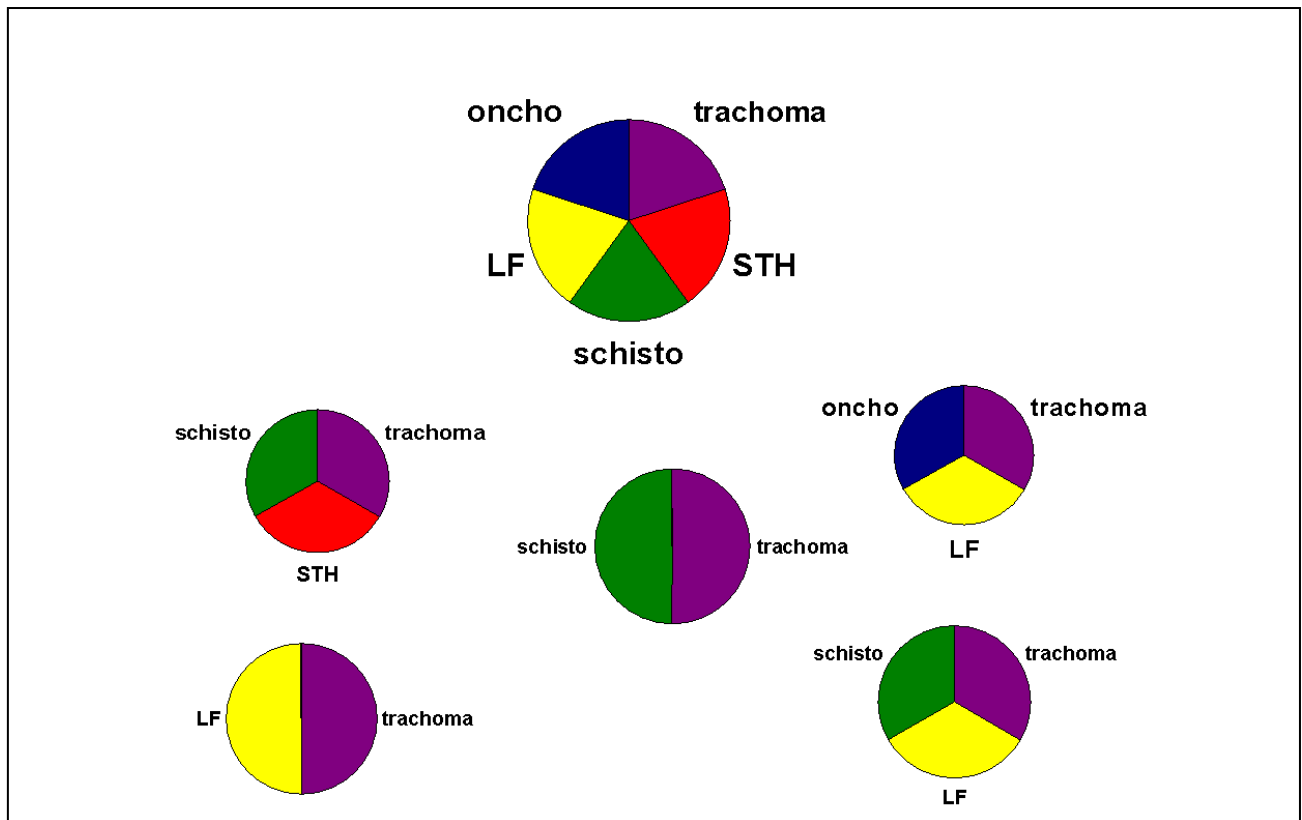
<sup>3</sup> King JD, et al. *Integrating NTD mapping protocols: Can surveys for trachoma and urinary schistosomiasis be done simultaneously?* Am J Trop Med Hyg. 2009 Nov;81(5):793-8.

<sup>4</sup> Dorkenoo M, et al. *Nationwide integrated mapping of three Neglected Tropical Diseases in Togo.* Am J Trop Med Hyg. 2010 Nov; 83: (5, Suppl) 203 (abstract).

points to attract all ages of the population necessary for sampling to meet the different needs of the different disease programs.

Countries will differ in their potential for integrated mapping because of the variable patterns of disease endemicity that exist; indeed, there are 32 different theoretical possibilities for disease overlap among these five NTDs, the more common ones being schematized in Figure 6. And, as if these differences among *countries* were not enough of a source of variability, determining the need for integrated mapping is even more complex because not all *regions* within a country require mapping for the same diseases; in some cases areas have already been mapped for certain diseases but not others, and because in other instances specific disease endemicity is restricted to only certain regions of the country (for geo-climatic reasons, urbanization, etc.).

**Figure 6. Example of Variable Patterns of Disease Co-Endemicity**



For all these reasons, creation of broad generalized guidelines for integrated mapping of the NTDs may be less appropriate than the recognition that guidelines must be individually tailored for each country and its unique patterns of NTD endemicity.

Thus, although one size fits all for the first stages of integrated mapping (the historical assessments), the second stage (on-the-ground mapping) must be individualized, with specific plans determined by careful review and consultation among the national health workers and other experts well apprised of each of the disease-specific WHO guidelines and requirements. For this stage of integrated mapping, one size does *not* fit all; creativity is necessary.