REPORT OF AN INFORMAL
CONSULTATION ON
SCHISTOSOMIASIS
CONTROL

Geneva, Switzerland, 30 March – 1 April 2011

Preventive Chemotherapy and Transmission Control (PCT)
Department of Control of Neglected Tropical Diseases (NTD)
World Health Organization
20, Avenue Appia
1211 Geneva 27, Switzerland
http://www.who.int/neglected_diseases/en
REPORT OF AN INFORMAL CONSULTATION ON SCHISTOSOMIASIS CONTROL

Geneva, Switzerland

30 March – 1 April 2011
WHO Library Cataloguing-in-Publication Data:


ISBN 978 92 4 150501 7 (NLM classification: WC 810)

© World Health Organization 2013
All rights reserved. Publications of the World Health Organization are available on the WHO web site (www.who.int) or can be purchased from WHO Press, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland (tel.: +41 22 791 3264; fax: +41 22 791 4857; e-mail: bookorders@who.int).

Requests for permission to reproduce or translate WHO publications – whether for sale or for non-commercial distribution – should be addressed to WHO Press through the WHO web site (www.who.int/about/licensing/copyright_form/en/index.html).

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers’ products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by the World Health Organization to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall the World Health Organization be liable for damages arising from its use.

Printed by the WHO Document Production Services, Geneva, Switzerland.

WHO/HTM/NTD/PCT/2013..3
Contents

Introductory address v
Purpose of the consultation vii
Executive summary viii
The current strategy and its limitations viii
Impact of preventive chemotherapy on schistosomiasis viii

1. Preventive chemotherapy in schistosomiasis: defining objectives in different epidemiological settings – country summaries 1
   1.1 China: controlling morbidity 1
   1.2 Egypt: adapting the treatment strategy 3
   1.3 Uganda: scaling up, and impacting on morbidity 5
   1.4 West Africa: expanding control 7
      1.4.1 Burkina Faso 7
      1.4.2 Niger 8

2. Mapping of schistosomiasis: defining the implementation unit for preventive chemotherapy, and identifying levels of prevalence to determine the appropriate regimen 10
   2.1 Mapping the distribution of schistosomiasis: historical data, risk mapping and rapid surveys 10
   2.2 Validation of schistosomiasis distribution and mapping at country level 12
   2.3 Considerations for targeting communities for treatment 14
   2.4 Targeting schistosomiasis treatment at the sub-district level 16

3. Identifying the preventive chemotherapy strategy to achieve the objective for each implementation unit: treatment regimen, monitoring of progress, decision-making regarding future treatment 18
   3.1 The evolution of preventive chemotherapy for schistosomiasis 18
      3.1.1 Going beyond the health system 19
      3.1.2 Adjusting the treatment strategy 20
      3.1.3 Going beyond morbidity control 21
   3.2 Reducing the frequency of treatment 21
   3.3 Community and school-based interventions for schistosomiasis control 22
   3.4 Modifying strategies during the course of schistosomiasis control programmes 23
   3.5 Data requirements and reporting tools 27
   3.6 Access to praziquantel for neglected tropical disease control programmes 29

4. Assessment of schistosomiasis programme impact 30
   4.1 Monitoring impact in schistosomiasis control programmes 30
   4.2 Impact of schistosomiasis treatment: assessment of long-term follow-up 31
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>Integration of schistosomiasis control with other programmes for control of neglected tropical diseases</td>
<td>33</td>
</tr>
<tr>
<td>5.1</td>
<td>Planning for control: best practices</td>
<td>33</td>
</tr>
<tr>
<td>5.2</td>
<td>Resources for control: large-scale support for implementation of preventive chemotherapy</td>
<td>35</td>
</tr>
<tr>
<td>5.3</td>
<td>Schistosomiasis within the control plan for neglected tropical diseases in the WHO African Region</td>
<td>37</td>
</tr>
<tr>
<td>5.3.1</td>
<td>Regional strategy for control of schistosomiasis, 2001–2010</td>
<td>37</td>
</tr>
<tr>
<td>5.3.2</td>
<td>Status of schistosomiasis control in the region</td>
<td>37</td>
</tr>
<tr>
<td>5.4</td>
<td>Integrating schistosomiasis treatment into control programmes</td>
<td>38</td>
</tr>
<tr>
<td>5.5</td>
<td>Monitoring needs for control programmes: lessons from lymphatic filariasis</td>
<td>40</td>
</tr>
<tr>
<td>5.5.1</td>
<td>Evolution of guidelines</td>
<td>42</td>
</tr>
<tr>
<td>5.6</td>
<td>Capacity building</td>
<td>42</td>
</tr>
<tr>
<td>6.</td>
<td>Points raised during the discussions</td>
<td>43</td>
</tr>
<tr>
<td>7.</td>
<td>Recommendations for refining the control strategy</td>
<td>48</td>
</tr>
<tr>
<td>7.1</td>
<td>Setting objectives and defining the problem: mapping and identifying communities at risk</td>
<td>48</td>
</tr>
<tr>
<td>7.2</td>
<td>Maintenance strategies decision after the attack phase</td>
<td>50</td>
</tr>
</tbody>
</table>

Annex 1. Agenda 56
Annex 2. List of participants 60
**Introductory address**

I warmly welcome you to Geneva and this Informal Consultation on Schistosomiasis Control. I am happy to see the room so full, and thank you for taking the time to participate.

There have been successes in schistosomiasis control, but the disease continues to be a public health problem. On 14 October 2010, WHO launched its first report on neglected tropical diseases – *Working to overcome the global impact of neglected tropical diseases* – which explains how much preventive chemotherapy has expanded. However, impediments to control include country programmes that do not always perform well; for example, that available drugs are not distributed regularly and the amount of praziquantel is limited.

The number of reported cases of schistosomiasis has been the same for the past 30 years or more, due to growth of the population and the fact that this growth is not responding to the increase in intervention. Many feel also that within the preventive chemotherapy package, schistosomiasis does not have the same political visibility as other neglected tropical diseases, whereas in fact schistosomiasis is the major tropical disease in Africa after malaria. The disease is a major public health issue associated with severe mortality and morbidity; it blocks the capacity to develop agriculture infrastructure, is linked with water development, and associated with underdevelopment and poverty.

There are successes in terms of increased funding – the United Kingdom’s Department for International Development committed £25 million to fight schistosomiasis, the Global Health Initiative and the Gates-funded SCORE (Schistosomiasis Consortium for Operational Research and Evaluation) initiative; and success in reducing disease prevalence was achieved in many countries (e.g. Uganda, Niger, Burkina Faso) and beyond the African continent.

Considering all the different schistosome species infecting humans, the disease has been controlled in many places, and in many cases transmission has been stopped. We should aim for a different goal: maybe we can change the way we address schistosomiasis. Perhaps we have been too conservative in the past in emphasizing only morbidity control and making policy-makers think that schistosomiasis cannot be eliminated in most endemic settings.

We are here to listen and to address schistosomiasis with policy changes you think possible.

**Dr Lorenzo Savioli**

*Director, WHO Department of Control of Neglected Tropical Diseases, WHO*

---

1 [http://score.uga.edu/](http://score.uga.edu/)
I will go into more detail of what we expect of this Consultation. In 2001, when we laid down the control strategy in our Expert Committee report, we were rather conservative in approach. The aim was morbidity control and the main target group was school-aged children. We still stand by this, but in the meantime the whole area of preventive treatment has evolved.

There have been more donations for other diseases, and this has encouraged us to be more ambitious in our approach. Schistosomiasis has followed this, and there have been requests from the field for WHO to further tailor the strategy, particularly with regard to treatment of adults. Adults were always included, but there were not many details.

So we expect recommendations about what changes are needed in the strategy. Last year there was a meeting on praziquantel treatment in preschool children, and we know what is possible and what is not possible, and our main target group remains school-aged children. But what do we need to do for our adult populations? We know praziquantel is not widely available, so we may not be able to be as generous as with other drugs for other diseases. So we must anticipate that in the first few years praziquantel will not be as widely available as other drugs against other neglected diseases. So how do we move forward? We cannot penalize populations with schistosomiasis, so we have to be generous enough to respond to the needs of those who have the disease, yet we cannot be unnecessarily generous: we cannot waste praziquantel. What is the optimal use of praziquantel within the integrated strategy of preventive chemotherapy, such that schistosomiasis control can keep pace with the control of other diseases, even though with less availability of the drug of choice? Otherwise, schistosomiasis in Africa will become increasingly an “orphan” disease, yet we know that with the means and enough praziquantel we can really do something. Some countries are close to elimination, so there are no technical hurdles. We therefore hope to have clear recommendations at the end of this meeting to put schistosomiasis at the same level of international commitment as the other diseases eligible for preventive chemotherapy.

Dr Dirk Engels
Coordinator, Preventive Chemotherapy and Transmission Control, WHO
Purpose of the consultation

The intention of this consultation was to begin the process of revising the strategy for schistosomiasis control within the context of the control of neglected tropical diseases. The consultation considered the current strategy and how it has been applied in different endemic settings, how to identify target populations who require interventions, and how to assess the interventions once they are implemented. Schistosomiasis is still a major public health problem, but there have been some successes: the question now is whether schistosomiasis control should continue as is, or whether it should be modified and, if so, how.
Executive summary

The World Health Organization convened an Informal Consultation at its headquarters in Geneva, Switzerland, on 30 March – 1 April 2011 to review the current schistosomiasis control strategy and discuss possible changes in the light of progress made during the past few years. The meeting was attended by more than 50 control programme managers, scientists and public health experts from around the world. The List of participants is given in Annex 1 and the agenda in Annex 2.

The current strategy and its limitations

The current strategy focuses on treatment with praziquantel of populations at high risk of morbidity from schistosomiasis. Treatment intervals and target groups vary with the level of endemicity. As countries succeed with morbidity control, they adapt the strategy to their specific epidemiological conditions.

Use of the strategy has led to remarkable achievements in some countries. Despite these successes, the goal of WHA54.19 to regularly treat, by 2010, 75% of school-aged children at risk, was not met.

The major impediment to schistosomiasis control is limited access to praziquantel.

Impact of preventive chemotherapy on schistosomiasis

China adopted mass chemotherapy in high prevalence areas from 1992; animal reservoirs were also treated. By 2001, the number of people infected was reduced more than 50%. Egypt scaled up treatment in 1996 when 1146 villages had a prevalence ≥10%. By 2010, only 20 villages had a prevalence of 3−5%. In both programmes, generous use of praziquantel resulted in significant reductions in morbidity, prevalence, and amount of the drug required. Thresholds for mass treatment were continually adjusted to maintain pressure in high-transmission areas. These programmes now aim for elimination using diverse and multisectoral interventions.

Preventive chemotherapy has also had a significant impact on infection levels and morbidity in highly endemic countries such as Burkina Faso, Niger and Uganda. With basic infrastructure, it has been possible to scale up to countrywide coverage with praziquantel within a few years. The challenge is to consolidate the gains and to adjust the strategy and use praziquantel efficiently while reaching high-transmission areas.
For the individual, the beneficial effects of repeated treatment during childhood and adolescence persist into adulthood. In people treated for *Schistosoma haematobium* infection, bladder disease, moderate–severe haematuria, and hydronephrosis are minimal 10–18 years after treatment. The number of treatments during childhood makes a significant difference, independent of current infection status. In Kenya, multi-year treatment programmes led to improvements in height and weight, and decrease in egg burden up to the age of 17. More studies of long-term outcomes of antischistosomal therapy are required.

**Identifying whom to treat**

New resources for mapping and quantifying needs are being developed, including atlases and databases. Risk mapping is undertaken to find out which areas are likely to support transmission, and define the limits of transmission; then more detailed surveys – at school or community level – determine which communities are at risk. Because schistosomiasis is a focal disease, surveys at the lowest administrative level provide the most accurate data. Several survey methodologies have been evaluated.

**Reaching school-aged children**

Schools may provide a good means to reach children of school age with preventive chemotherapy. However, community-based approaches in Niger, Nigeria, Uganda and the United Republic of Tanzania reached at least 80% of enrolled and non-enrolled school-aged children. Schistosomiasis control should be integrated into ongoing public health activities.

**Using praziquantel efficiently**

While there is some large-scale support for implementation of preventive chemotherapy for neglected tropical diseases, including generous donations from the pharmaceutical sector and some bilateral funding (mostly USAID and DFID), there is a limited donation for praziquantel. Thus there is a need to ensure rational use of resources. USAID has supported development of a budgeting tool to track funding and assess gaps so that resources are deployed more rationally and efficiently.

Treatment with praziquantel should be organized according to recommended thresholds and the endemicity of schistosomiasis. Using the 10% prevalence threshold for the moderate-risk category means that more people are treated but there is a higher consumption of praziquantel. For more efficient use, in Egypt for example, mass treatment is now focused on transmission hot-spots detected through annual monitoring. In Nigeria, an interval following at least 3 years of annual treatment was found to produce the best outcomes.
Monitoring progress
A number of tools for data collection and dissemination are being developed. These include a Joint Reporting Form to standardize national reporting of implementation outcomes and improve the availability and coordination of data, and various platforms to improve data flow e.g. a Preventive Chemotherapy and Transmission Control databank, a new monitoring and evaluation web site, the Global Health Observatory and a pharmacovigilance system for severe adverse events.

Assessing impact
A number of parameters are measured. Preventive chemotherapy can reduce prevalence and intensity of infection of schistosomiasis, reduce or eliminate transmission and significantly decrease associated morbidities, resulting in improved quality of life, nutritional status and cognitive ability. Height and weight, growth spurts, body mass index, fitness, nutritional status, haemoglobin (anaemia) and genital involvement can be measured. There may be changes in school attendance and performance after treatment. Morbidity is reversible, at least in part, with therapy.

Integrating with programmes for control of neglected tropical diseases
To foster integration, “best practices” are being documented by WHO and USAID/RTI. Best practice involves doing a situation analysis, setting a national plan of action, carrying out a funding gap analysis, identifying resources and implementation, as well as monitoring and evaluation. WHO has a rollout package for integrating neglected tropical disease control programmes, and a variety of tools to facilitate scale-up of this package are being developed.

The benefits and challenges of integration have been documented in Nigeria since 1999, with different diseases and interventions being included over the years. Recently included was triple drug administration – with albendazole, ivermectin and praziquantel – for the control of lymphatic filariasis, onchocerciasis and schistosomiasis. Triple drug administration also has complementary effects on soil-transmitted helminthiases, taeniasis, other flukes, scabies, lice, etc. A cost study indicated a 41% reduction in costs of triple drug administration compared with stand-alone distributions of the three drugs. Trachoma control can also be integrated into preventive chemotherapy with the coordinated distribution of azithromycin + tetracycline 1% ointment.


Building on experience and current platforms
The lymphatic filariasis elimination programme is being used as a platform to scale up schistosomiasis control within a package of preventive chemotherapy for neglected tropical diseases in WHO’s African Region. Elimination programmes carry out coverage surveys, and use sentinel sites established at baseline to monitor implementation and guide decision-making, for example of when to stop mass drug administration (MDA) and transition to post-MDA surveillance. During post-MDA surveillance, transmission assessment surveys are repeated every 2–3 years.

Recommendations
The Informal Consultation made recommendations for refining the current strategy for schistosomiasis control:

- **Mapping and identifying communities** – the consultation produced a conceptual framework and sequence of activities for morbidity control, and for transitioning from morbidity control to infection control.
- **Treatment strategy** – the participants proposed certain changes, including: reduction of treatment thresholds; use of reagent sticks for haematuria as equivalent to parasitological diagnosis; inclusion of adults (not only those at high risk) in highly endemic communities; and treatment of 33% of school-aged children annually in low-risk communities (instead of twice during schooling).
- **Maintenance strategies** – the consultation outlined four possible outcome scenarios of the 5–6-year attack phase, with proposed actions, and recommended that efforts be focused on hot-spots of transmission, which requires fine-scale mapping.
- **Advocacy** – the consultation recommended formation of a schistosomiasis alliance focused on implementation (rather than research) with essential participation of Member States, to lobby, advocate increased praziquantel supply, help mobilize resources, etc.
1. Preventive chemotherapy in schistosomiasis: defining objectives in different epidemiological settings – country summaries

1.1 China: controlling morbidity

In China, schistosomiasis is caused by *Schistosoma japonicum*. This species has many reservoir hosts; 31 mammalian species have been found infected, of which cattle and buffaloes are the most important for contaminating the environment with parasite eggs. There are three epidemiological situations in China: swamp and lake areas; plain regions with waterway networks; and hilly and mountainous areas. Transmission is highest in the swamp and lake regions.

Great achievements have been made in controlling schistosomiasis over the past 60 years, but immense challenges remain. Schistosomiasis control in China has gone through three major stages with different strategic foci:

*Between 1950 and 1980*

The strategy was to integrate methods for schistosomiasis elimination – snail control, health education, chemotherapy, water supply and sanitation – although priority was given to snail control, which was primarily by environmental management. There was less emphasis on treatment in these early stages because the drugs available at the time (mainly trivalent antimonials) were toxic.

*Between 1980 and 2000*

The strategy was to integrate methods for schistosomiasis morbidity control, giving priority to chemotherapy (mass or selective). Praziquantel became the drug of choice in the mid 1980s; being safe, and highly efficacious when administered as a single dose, and having a broad spectrum of activity, it replaced all other drugs. Since that time, the cost of this drug has been steadily reduced.

Three main approaches were taken:

- Mass treatment – treatment of the entire population aged 5–65 years without preliminary screening. This strategy was later modified so that treatment was given to those people at high risk (e.g. by reducing the areas treated to those where prevalence exceeded 20%, or by excluding those who never came in contact with infested water).
- Selective treatment – treatment of people identified as being infected by diagnostic survey (either faecal examination or serological tests) of the entire population.
- Phased treatment – use of the above strategies in a sequence of progressively greater selectivity. In highly endemic areas, after two or three rounds of mass chemotherapy, a significant decrease in both prevalence and intensity of infection might be reached such that the
frequency of chemotherapy can be reduced, from once a year to once every other year, or chemotherapy can be given selectively to those infected, based on screening results.

In China, animal reservoirs present a big problem for schistosomiasis control, especially in lake regions. Reduced prevalence and infection intensity have been achieved by synchronous chemotherapy given to humans and bovines during the same intervention period. This, however, has not resulted in the interruption of transmission, probably because of the continued presence of snail habitats and the few parasite eggs reaching the environment.

From 1992 to 2001, China implemented a World Bank Loan Project, scaling up morbidity control. The objectives of this phase were set at one of three levels, according to the epidemiological situation:

- Reduction of the prevalence rate and control of schistosomiasis outbreaks
- Effective control of transmission and maintenance of prevalence at a low level
- Interruption of transmission of the disease, with no appearance of new cases.

The strategy used to reach these objectives was in line with the level of endemicity. In highly endemic areas (≥15% prevalence of infection), the strategy was to:

- implement mass chemotherapy in populations aged 6–60 years every year, with coverage rates of 90%
- administer treatment twice a year in high-risk populations frequently in contact with infested water (e.g. fishermen and their families).

In areas of moderate endemicity (>3% and <15% prevalence), the strategy was to:

- administer treatment to all positive cases identified after screening by Kato–Katz
- administer treatment twice a year without prior screening to high-risk populations frequently in contact with infested water (e.g. fishermen and their families).

In low endemicity areas (≤3% prevalence), the strategy was to:

- screen target populations with serological tests (target populations include: children aged 7–14 years, once every 2 years; populations frequently in contact with infested water, once a year; people suspected of being infected with *S. japonicum*, examined as necessary; all family members, neighbours and colleagues of a person infected with *S. japonicum*, once a year)
- administer treatment to all serology-positive cases.
During the 10 years of the World Bank Loan Project, significant changes were seen in endemic areas, in the number of infected people, number of acute and advanced cases, and number of infected bovines and infected snails. By the end of 2001, the estimated number of people infected with schistosomiasis had decreased by over 50%, the prevalence in humans and livestock had decreased by over 50%, and the densities of infected snails in the different epidemiological strata had all decreased by more than 75%.

**Current strategy**
The latest strategy for schistosomiasis control further consolidates praziquantel-based morbidity control while shifting the main emphasis back to transmission control. The strategy is to:

- reduce contamination of the environment by bovine hosts
- prevent parasite eggs in human stools from reaching the environment
- control snails by using molluscicide and by modifying the environment
- deliver health education
- treat all those infected with schistosomiasis.

The methods include: the mechanization of agriculture, including replacement of water buffaloes with tractors; prevention of keeping of livestock in snail habitats; improving access to clean water; and improving sanitation.

This revised integrated control approach can be adapted to different eco-epidemiological settings due to its modular design. Across the country, four pilot sites at county level were selected in 2005 to study the impact of this approach on the prevalence of *S. japonicum* infection in humans and intermediate host snails. In all the sites, after three or four transmission seasons, the prevalence of *S. japonicum* in humans was significantly reduced, being <1% at two sites, and the number of infected *Oncomelania hupensis* snails in the sampling sites was also significantly reduced. In one study, the general risk of infection from lake water had also significantly decreased.

The renewed emphasis on transmission control, towards the interruption of transmission, by implementing a diverse set of interventions in an integrated manner, proved feasible and effective in the lake and marshland areas of China. As well as significant reductions in the prevalence of *S. japonicum* in humans and the intermediate host snails, significant reduction was also achieved in the prevalence of soil-transmitted helminthiases.

**1.2 Egypt: adapting the treatment strategy**
In Egypt, *S. mansoni* is endemic in the Delta governorates and *S. haematobium* in Upper Egypt. Implementation of the National Schistosomiasis Control Program started in 1977, through the primary health-care system. At first, pilot projects, using either snail control or chemotherapy, were implemented.
The treatment strategy has evolved over the years. From 1988, praziquantel was distributed free of charge for all diagnosed cases of schistosomiasis, through all governmental health facilities. From 1997 until 2002, treatment was in mass campaigns without prior diagnosis in communities with a prevalence of infection above 20%. As the programme progressed and the disease prevalence decreased, the threshold for mass chemotherapy was changed. In 1997, the threshold was a prevalence of infection >20%, which was successively reduced through a prevalence of ≥10% in 1999, 5% in 2000, and ≥3.5% in 2002, to ≥3% in 2003. Since 2003, mass chemotherapy has been applied only in hot-spots (micro-focal control).

Before the mass chemotherapy campaigns began in 1996, there were 168 villages with prevalence >30%, 324 villages with prevalence 20–30%, and 654 villages with schistosomiasis prevalence 10–20%. By the end of 2010, in the whole country only 20 villages had prevalence more than 3–5%, and none had prevalence more than 10%.

The prevalence of both *S. mansoni* and *S. haematobium* has consistently decreased under the pressure of treatment. In 1983, the prevalence of the two species was 38.6% and 35% respectively, reducing to 11.9% and 5% in 1996, and to 2.7% and 1.9% in 2002. In 2003, when mass chemotherapy began to be targeted on “hot-spot” areas, the prevalence of *S. mansoni* was 2.6% and of *S. haematobium* was 1.7%; by 2010, these were 0.3% and 0.4% respectively.

These achievements were reached after treating a total of 38.8 million people with praziquantel, and a further 9 million after screening. In parallel to the national programme focused on treatment and snail control, other government departments provided almost universal access to potable water at household level and access to adequate sanitation was also significantly increased.

Egypt’s current objectives are to:

- reduce the prevalence of schistosomiasis to <0.1% for the whole population and to zero among schoolchildren
- protect young age groups and the population at risk from new infections
- prevent transmission in areas of land reclamation to protect new settlers
- prevent the spread of *S. mansoni* into Upper Egypt.

To achieve these objectives, Egypt currently has four control strategies:

1. Selective population chemotherapy and mass chemotherapy for rural schoolchildren and populations at risk.
2. Focal snail control – niclosamide is used for focal snail control around hot-spot villages and in water courses where snails are found infected. This strategy reduced the infection rate of *Biomphalaria* spp. from 0.27% in 1997 to 0.05% in 2010, and of *Bulinus* spp. over the same period from 0.11% to 0.03%. While 86 tonnes of niclosamide were used in 1997, in 2010 only 8 tonnes were used.

3. Health education and social mobilization – the national programme produces posters for use at community and school level and also undertakes educational campaigns for community leaders.

4. Environmental improvement – the Egyptian population has very good access to potable water, with >90% of households having tap water, although small rural communities still lack sanitation.

Egypt is taking a multisectoral approach. It aims to interrupt transmission and achieve elimination through wider integration of the present strategy with other interventions – through mass chemotherapy campaigns for school-aged children and populations in hot-spot areas, together with improvement of health awareness, social mobilization, snail control within the activities of the primary health-care system and environmental sanitation. A different approach is taken to control in each of three epidemiological strata:

- in newly developed areas with no transmission and no autochthonous cases: surveillance and routine screening
- where transmission is <3% prevalence: active population screening, monitoring after treatment, snail control, provision of potable water and adequate sanitation
- where active transmission is >3% prevalence: mass treatment, snail control, provision of potable water and adequate sanitation.

A challenge is to shift the strategy from morbidity control to transmission control and towards elimination. Egypt hopes to achieve elimination of schistosomiasis in the next few years.

1.3 Uganda: scaling up, and impacting on morbidity
Of the total 56 districts in Uganda, *S. mansoni* is a public health problem in 38, and *S. haematobium* in two. Some 4 million people are infected, and 16.7 million are at risk. The majority of people are infected by the age of 5 years.

Until 2003, schistosomiasis was a serious public health problem, with high transmission especially around lakes and along rivers; morbidity was severe, and egg loads were commonly heavy. In the 1960s and 70s in north-west Uganda, schistosomiasis was the second leading cause of hospital admissions. The
The Schistosomiasis Control Initiative and other partners began support to Uganda from 2003.

Control began with a pilot phase in 2003, in one sub-county in each of 18 most affected districts, mainly based on mass treatment and health education. Activities included planning, advocacy, training of teachers and supervisors, selection and training of community drug distributors, health education, supervision, monitoring of side-effects to treatment, reporting of treatment coverage and drug accountability.

During the pilot phase, 400,000 people were treated. The objective was to gain experience and use it to formulate appropriate approaches to drug delivery and health education in order to maximize treatment coverage and change behaviour. In 2004, 1.4 million people were treated in 18 of the 38 endemic districts; in 2005, 3 million were treated in 23 districts. Annual meetings were held at national level to review constraints and plan the way forward.

Through interventions and monitoring, it became apparent that scaling up treatment to more districts could be achieved if its frequency was reduced: the interval between treatments was therefore lengthened (holidays), and health centre based treatment was introduced in 11 (of the total 38) districts. In areas where there was no laboratory, treatment was based on reported symptoms.

In 2006, two million people were treated in 27 of the 38 endemic districts; in addition there were 11 districts offering health centre based treatment. Thus countrywide coverage was achieved.

The main aspects monitored were: programme performance and the impact of treatment campaigns, severe adverse events, and drug utilization and efficacy. Monitoring showed that yearly mass treatment with praziquantel impacted on *S. mansoni* infection levels and on pathology, pattern B fibrosis, and prevalence of anaemia, all of which were progressively reduced.

The impact of yearly mass treatment with praziquantel on infection status and morbidity of *S. mansoni* in school-aged children was evident in several ways. Clinical palpation in 2003 revealed 62.5% were affected by firm liver and 3.2% by hard spleen, whereas in 2005 these were 0.8% and 0.0% respectively. On ultrasound examination, dilated portal vein in children was also reduced, from 17.8% affected in 2003 to 3.3% in 2005, and pattern B fibrosis from 39.4% affected in 2003 to 1.7% in 2005. Anaemia was also reduced.

In adults, yearly treatment significantly reduced both the prevalence and the intensity of *S. mansoni* infection between 2003 and 2006, as well as the incidence and severity of fibrosis. Reversibility of morbidity was influenced by age; it is less reversible in those over 30 years of age.
Although people continue to have low per capita incomes and live in unsanitary conditions, the intensity of infection and morbidity has been reduced significantly.

However, where transmission occurs in relation to large bodies of water, for example, lakes, transmission has not been affected and prevalence is still well above 50% in most foci. Thus, there is great potential for intensity of infection to become high again and for morbidity to rebound. In such areas, treatment could be given every 3 or 6 months, depending on the availability of praziquantel, in order to significantly reduce the reinfection rates.

In areas where transmission occurs in relation to small bodies of water, however, morbidity may have been eliminated, with transmission possibly interrupted. In such situations, either treatment holidays should be continued and people treated, for example, every 2 or 4 years (advantage: saves on drugs and resources that can be used to scale-up elsewhere in sub-Saharan Africa; disadvantage: is not a good advocacy message to political leaders), or the aim should change from morbidity control to transmission control (advantage: is a good advocacy message to political leaders and nongovernmental organizations; disadvantage: means there is need for strengthened surveillance, monitoring and evaluation; more sensitive diagnostic tools; intensive sensitization and mobilization of the people to participate in schistosomiasis preventive measures and improved supply of safe water; and for reviewing the existing guidelines, tools and methods to align them with transmission rather than morbidity control).

1.4 West Africa: expanding control

1.4.1 Burkina Faso

In Burkina Faso, which has both *S. haematobium* and *S. mansoni*, a programme in schistosomiasis control was established in 2004, when about 3 million people were affected by the disease.

Treatment started in 2004, targeting children in four regions; in 2005, all children in the remaining nine regions were treated, reaching a national coverage. In 2006, treatment was given to children and adults in the four priority regions; in the remaining nine regions, children and adults at risk were treated in turns in 2007 and 2008. The third round of preventive chemotherapy was delivered across the country in 2009 and 2010, and both children and adults were treated. Thus, between 2004 and 2010, children aged 5–15 years received three rounds of treatment and adults received two rounds of treatment. Drug coverage was >90% and geographical coverage was 100%.

Urine and stool samples were collected, height and weight of children measured, and ultrasound examinations made, through a cohort of children. After 3 years, a significant reduction of *S. haematobium* infection had occurred in four regions –
intensity of infection was reduced from 83.55 eggs/10ml urine in 2004 to 0.94 in 2007. By 2010, in sentinel sites *S. haematobium* intensity of infection was reduced to 0.012 eggs/10ml urine. For *S. mansoni*, intensity was reduced from 8.04 eggs/g stool (epg) to 0.0017 epg.

An integrated neglected tropical disease programme began in 2007. Monitoring and evaluation for integrated control of lymphatic filariasis, schistosomiasis, soil-transmitted helminths, and trachoma were undertaken in 22 sentinel sites. Challenges encountered included delays in drug procurement and delays in treatment due to competing programmes (vaccination campaigns or disease outbreaks), finding storage for the drugs, doubts about financial resources, funds for morbidity control, and motivation and incentives for community drug distributors.

### 1.4.2 Niger

In Niger, *S. haematobium* and *S. mansoni* are also both present. A prevalence survey was carried out in more than 130 locations in 2004–2005. Rapid assessment in all risk villages was undertaken by questionnaire and visual examination of urine (60 schools per district).

Two treatment strategies were employed:

- school-based distribution, whereby trained teachers and/or health workers distributed the drugs to students in schools; other children who were not attending school could also be treated in schools.
- community-based distribution, whereby trained community drug distributors, health workers, or trained teachers offered treatment in the villages to all individuals in moderately and highly endemic communities.

In 2004–2007, two mass-treatment campaigns in each region were conducted in a vertical programme supported by the Schistosomiasis Control Initiative. After 2007, treatment took place every 2 years in an integrated drug distribution (praziquantel; Mectizan + albendazole; Zithromax + tetracycline 1% ointment) over 6 weeks. Surveillance and monitoring included sentinel site follow-up and cross-sectional surveys when Hemastix® dipsticks were used to identify infected children; children testing positive were treated with praziquantel. Also included were subtle morbidity studies and snail studies.

Successes of this approach included government ownership through a budget line for neglected tropical disease control; aggregation of neglected tropical disease control efforts at the regional and district levels; integration of training, supervision, evaluation, information education and communication activities, and reporting, etc.; maintenance of the gains made by regular schistosomiasis treatment; reinforcement of school health programmes, and surveillance and monitoring activities.
Significant decreases in *S. haematobium* prevalence and mean intensity of infection and associated morbidity were seen. However, there was increasing prevalence of *S. mansoni* infection in the Niger River valley despite regular treatment. While treatment every 2 years was efficacious and cost effective, high transmission foci need to be targeted for treatment every year. There is a need for surveys to refine the strategy.

Thus the programme is continuing with preventive chemotherapy campaigns – annually in highly endemic foci, and every 2 years countrywide. Monitoring and evaluation are being strengthened to better measure the impact of treatment – there are cross-sectional prevalence surveys, and follow-up of sentinel site cohorts, and of praziquantel efficacy. Also, the population is being sensitized, and safe water and basic sanitation are being advocated for.
2. Mapping of schistosomiasis: defining the implementation unit for preventive chemotherapy, and identifying levels of prevalence to determine the appropriate regimen

2.1 Mapping the distribution of schistosomiasis: historical data, risk mapping and rapid surveys

The focal nature of schistosomiasis transmission makes it important to map and quantify the distribution of the infection and identify communities at risk. In areas where there have been no recent surveys, historical data may still be valid. A 2003 survey in Eritrea confirmed the data from papers published in the 1950s. The Global Atlas of Schistosomiasis, published in 1987 and summarizing data from surveys collected until then, provides a valuable reference for endemic countries.4 Recent country implementation data are contained in the WHO PCT databank.5 Other historical data, country reports, maps of states/regions, etc. are on the web site of WHO’s Department of Control of Neglected Tropical Diseases. When historical data are available, it has to be determined whether they are useful for detailed planning of a control programme.

Several initiatives are under way to provide more up-to-date data for planning control programmes. The Global Atlas of Helminth Infection (GAHI6) is being developed as an open-access, global information resource on the distribution of schistosomiasis and soil-transmitted helminthiases. The project aims to: collate all available information on the prevalence of schistosomiasis and soil-transmitted helminthiases; describe and predict the global distribution and prevalence of schistosomiasis and soil-transmitted helminthiases to quantify needs for control; provide an information resource to guide control efforts and help with targeting; and highlight areas where further survey information is required.

The GAHI database contains different types of map:

- survey data map – showing the prevalence of worm infection based on surveys
- predictive risk map – showing the probability that infection prevalence warrants mass treatment according to recommended WHO thresholds
- control planning map – showing which districts require mass treatment or where further surveys are probably needed.

The GAHI database also includes systematic literature (including grey) searches, abstracting data (source of data and date, etc.), and geo-positioning data. However, some data are very old and Africa has changed a lot, so not all the data

4 www.who.int/wormcontrol/documents/maps/en/
5 www.who.int/neglected_diseases/preventive_chemotherapy/sch/en/index.html
6 www.thiswormyworld.org/
are relevant. In particular, there is a dearth of information, including historical, from the countries of central Africa.

A similar initiative seeks to develop a Global NTD database\(^7\) that has been created through the European Union-funded CONTRAST project. The focus of this database in 2010 was on schistosomiasis, but over time the database will be expanded to cover all neglected tropical diseases. Efforts are under way to explore how the GAHI and the Global NTD database can be linked.

To help fill the gaps in the data, risk mapping can be used to predict infection risk in unsampled areas. Since the 1980s, satellite data could be used to predict schistosomiasis, but this was not readily taken up. In 2001, satellite sensor data were used to predict the distribution of urogenital schistosomiasis in the United Republic of Tanzania. The probability of prevalence of \(S.\ haematobium\) exceeding 50% was predicted based on frequentist logistic regression modelling.\(^8\)

More recently, a Bayesian approach to risk mapping has also been used. The probability of prevalence of \(S.\ haematobium\) exceeding 50% in West Africa was predicted based on Bayesian geostatistical logistic modelling.\(^9\) Other work has predicted the prevalence of infection.\(^10\) Prevalence predictions for \(S.\ haematobium\) and \(S.\ mansoni\) in the United Republic of Tanzania\(^11\) indicated that Bayesian geostatistical analysis is a useful tool for identifying high-prevalence areas in a heterogeneous and imperfectly known environment.

Risk mapping is useful for determining the limits of transmission, quantifying regions on a scale, and identifying areas that are endemic at national level. But surveys are needed to indicate areas to be given priority for intervention.

For school-level targeting, there are various options for rapid surveys. One approach is to go to every school and take samples, e.g. 15 (lot quality assurance sampling – LQAS). Or the approach can be at sub-district level or district level; in either case, a number of schools in a district are sampled, with 50 children selected per school.

A comparison of estimated total costs of different survey approaches, including blanket treatment, blanket treatment with ecological exclusion, LQAS, grid

---

\(^7\) http://globalntddatabase.org
sampling (10 km) and prediction,\textsuperscript{12} showed that the amount of treatment can be reduced if sampling is carried out.

LQAS was compared with sub-district sampling with respect to performance and cost-effectiveness in three provinces in Kenya. In low-prevalence settings, LQAS was more cost-effective than a sub-district approach. But in high-prevalence settings, it was better to use the sub-district approach.

For urogenital schistosomiasis, the bloody urine questionnaire is useful and can be used for determining areas at risk of schistosomiasis. In 2008, the questionnaire was tested in Kenya, and it was found to overestimate the prevalence of infection, but in a consistent fashion.\textsuperscript{13} The bloody urine questionnaire was sent to schools; there were 80% returns, which were linked to a database and mapped. Schools that require mass treatment can be identified this way, as well as those that do not need intervention.

\subsection*{2.2 Validation of schistosomiasis distribution and mapping at country level}
Control of neglected tropical diseases started in Ghana in 2007, and mapping of schistosomiasis was undertaken in 2008. The countrywide mapping exercise led to the generation of schistosomiasis predictive maps and provided data for planning and undertaking control activities within the integrated NTD control programme at district level.

The mapping method involved selecting 77 schools (about one school per selected district) from a total of about 16 400 schools in the country. Of the 138 districts in the country, 119 were identified as being endemic for schistosomiasis. While two districts had high prevalence of \textit{S. mansoni}, 10–15 districts had high prevalence of \textit{S. haematobium}.

During pilot treatment (2008–2009), about one million school children were treated in the selected schools, with 86% coverage. Pilot treatment was based on predictive maps as follows:

- Predictive prevalence of >50\% – the whole community (adults and school-aged children) received treatment annually
- Predictive prevalence of 10–50\% – all school-aged children and all adults at risk received treatment every other year


• Predictive prevalence of <10% – all school-aged children received treatment 2 times during their primary-school years (once on entry and once on exit).

In some areas, predictive mapping had suggested prevalence to be lower than expected, for example in the northern region, with its extensive water system and numerous small dams which provide suitable habitats for the snail vectors, and where sanitary habits and infrastructure are poor. Earlier surveys had shown S. mansoni to be more widely distributed than the predictive maps suggested.

In Volta Region, the predictive map suggested that every district was endemic, and it was not possible to select non-endemic sites for the validation. However, with new data obtained in 2010, nine districts were identified as non-endemic.

In all, the predictive maps had overestimated about 18 of 59 districts. With the use of point prevalence maps, it should be possible to select for treatment sub-districts or even communities that are highly endemic – the Onchocerciasis Control Programme method for rapid epidemiological mapping (REMO) is a good example to follow. Significant savings could be made in this way.

Before the second round of praziquantel treatment, validation surveys were carried out. These were done in a phased approach: data were first collected from endemic districts (quickly followed by treatment) and later from those districts where the treatment was not planned for that year.

The whole country was assessed during this validation exercise. In selecting schools for the survey, the location of water bodies and irrigation sites was the major consideration, while areas where adequate data had already been collected were excluded from the survey. In total, 123 schools from about 100 districts were selected, and 50 children aged 10–12 years from each, with GPS coordinates collected for all sites.

In comparing the mapping and validation results, 59 of 170 districts mapped in 2010 had not been treated during 2008–2009. In 29 (50%) districts, results of the two procedures concurred, but 9 districts (16%) had been underestimated and 20 districts (34%) had been overestimated by predictive mapping.

Based on this, it was recommended that districts not requiring treatment be identified and excluded, and that the endemic sub-district be the area for implementation of future treatment. Predictive risk mapping can guide, even though it is only 50% correct; it is good for estimating populations at risk, and the limits of transmission, and for guiding surveys with respect to low and high prevalence areas.
2.3 Considerations for targeting communities for treatment

Several studies from areas assisted by the Carter Center in Nigeria were presented to explore the topic of targeting communities for praziquantel treatment. Because going to every community is resource intensive, the question of whether an area larger than the community could be used to target treatment was explored in Nigeria, in Plateau and Nasarawa states. Also investigated was the question of whether surveys for urogenital schistosomiasis and trachoma could be done simultaneously\(^\text{14}\) and can guide programme interventions.

Eight districts were mapped for both trachoma and urogenital schistosomiasis to compare district-based cluster survey with community-based school survey methodology. In the community-based school survey, all rural primary schools in 8 districts were surveyed, with systematic sampling of all eligible pupils (pupils aged <10 years eligible for trachoma examination; pupils aged 10–14 years eligible for urine analysis).

In the district-based cluster survey, 20 enumeration areas per district were systematically sampled, with all households in one randomly selected segment of each enumeration area being examined (all ages examined for trachoma; ages 6–15 years selected for urine analysis).

It was easy to integrate the surveys, but in this setting, the school-based survey was more useful for identifying which communities warranted intervention, and so better for guiding programme interventions. As well, village-by-village school surveys provide opportunities for assessing other diseases. Applying the >10% threshold to a district-level estimate of haematuria prevalence from a cluster random sampling design could result in some endemic schools and communities (e.g. those being located in districts where the district-level estimate is <10%) where intervention is warranted not being treated. In the work reported, use of the district-level survey would have missed 49 of 59 communities who qualified for praziquantel treatment in school-aged children, and missed 8 of 8 communities that qualified for expanded mass treatment for all ages.

In another study in Plateau and Nasarawa states, \textit{S. mansoni} prevalence was determined in districts left untreated because they were below the intervention threshold for \textit{S. haematobium}. It was discovered that over half of these untreated districts warranted mass treatment for \textit{S. mansoni}.\(^\text{15}\) To investigate whether praziquantel should be administered presumptively throughout the two states,


without mapping, a cost study was undertaken to determine the five-year costs of four different treatment scenarios:

- Village screening for *S. haematobium* and annual targeted praziquantel treatment in villages of >20% prevalence
- Village screening for *S. haematobium* and *S. mansoni* and annual targeted praziquantel treatment in villages of >20% *S. haematobium* or >10% *S. mansoni*
- Presumptive annual praziquantel treatment to all school-aged children
- Presumptive annual praziquantel treatment to entire eligible population.

The analysis involved construction of a hypothetical district of 30,000 persons, 60 villages, 500 people per village, 100 school-aged children, and 400 eligible population (non-pregnant and >94 cm tall), and based on actual costs from earlier studies and the various assumptions (e.g. the percentage of villages needing treatment; number of schoolchildren needing praziquantel, and number needing mass treatment; costs for delivery, supplies, laboratory etc., and cumulative costs over 5 years), it was concluded that presumptive treatment in schoolchildren is the least costly strategy in this hypothetical district, and universal praziquantel treatment was recommended for all school-aged children in Plateau and Nasarawa states.  


The final study considered whether it is necessary to treat adults in areas where schistosomiasis is hyper-endemic (>50%) in school-aged children. The study design was to determine the prevalence of urogenital schistosomiasis in adults in communities with 20–49% and ≥50% prevalence of haematuria in children. A sample of 4 districts and 19 communities was selected from villages mapped in 2008. Urine analysis (reagent stick + filtration to identify eggs) of adults older than 19 years was undertaken and, in a random selection of households, all adults were examined.

There was no difference in *S. haematobium* infection or haematuria prevalence between adults in the 20–49% and ≥50% baseline communities; there was low-intensity adult infection in both communities. Thus, in this setting, there was no evidence for prioritizing adults for treatment in the ≥50% communities over adults living in the>20% communities. The conclusions, however, may not be valid in other *S. haematobium* areas or in areas endemic for *S. mansoni*.

It can be concluded that in meso- and hyper-endemic settings, large areas can be targeted for intervention, but in low-endemicity situations interventions should be limited to hot-spots of transmission. Distribution of praziquantel to all school-
aged children presumptively might be suitable and cost-effective in some situations, depending on endemicity.

### 2.4 Targeting schistosomiasis treatment at the sub-district level

Given the limited availability of praziquantel, it is important to use the available amount judiciously. Integrated mapping of neglected tropical diseases means conducting surveys to determine if a certain threshold, triggering public health action, has been reached. The WHO survey methodology was compared with the integrated CDC methodology in Mali and Senegal.

Among neglected tropical diseases, schistosomiasis-specific mapping-related issues include differing interpretations of the current WHO mapping guidelines and in the definition of ‘ecological zone’. The term ‘implementation unit’ may not be appropriate for schistosomiasis, which can be highly focal and vary from village to village. Neglected tropical disease control programmes should work within national health structures, and where interventions are targeted should be defined at the lowest administrative level. An advantage of sub-district level is that the peripheral health facility can oversee programme implementation.

The indicators used were those recommended by WHO (haematuria, and eggs in stool; ICT card test; dipstix and Kato-Katz). One neglected tropical disease mapping team was used; task-sharing activities included planning, field organization and eliciting informed consent. Mapping activities are cross-cutting neglected tropical disease control programmes, and their integration was demonstrated. Using the CDC integrated protocol and the sub-district as the implementation unit, two villages per sub-district were sampled, one randomly selected and the other selected based on highly probable schistosomiasis prevalence (haematuria, and the presence of possible infested water source). The WHO/AFRO integrated protocol used a grid sampling procedure, and the district as the decision-making level for implementation.

In Mali, it was found better to use sub-district data. Nearly 33 500 school-aged children would have missed treatment if the ecological zone had been used as the sampling unit (WHO method). In Senegal, 39 258 would have missed treatment using the ecological zone as the sampling unit.

In Togo, where there was a national mapping exercise of 29 districts, nearly all the districts (except 4) would have been treated if the district had been used as the implementation unit. By sub-district however, schistosomiasis is not so equally distributed and some areas would have been over treated and others under treated.

Regarding costs, comparing the WHO and integrated protocol costs using the integrated methodology resulted in a 29% total cost savings in Mali and a 19% cost savings in Senegal.
It may be better to implement at the sub-district level. Because schistosomiasis is a focal disease, the lower you go in terms of mapping, the more accurate the data are. Sampling and surveying certainly save drugs, but not necessarily money – it depends on the area, etc.

In conclusion, integrated mapping and treatment at the sub-district level is feasible, but more analysis is needed (of, for example, the relationship between schistosomiasis and trachoma prevalence). However, village-level mapping would be best, even a sub-district is too large. This, however, has cost implications.
3. Identifying the preventive chemotherapy strategy to achieve the objective for each implementation unit: treatment regimen, monitoring of progress, decision-making regarding future treatment

3.1 The evolution of preventive chemotherapy for schistosomiasis

In 2009, the latest year for which data are available, 20 million people were treated globally for schistosomiasis including 2.9 million in China, even though China only has around 600,000 infected people. While elimination or eradication is feasible in some countries, it may not be a practical goal in most endemic countries of sub-Saharan Africa, where 90% of the disease burden is and where the aim should be morbidity control.

The global target of preventive chemotherapy for schistosomiasis was to treat 75% of all school-aged children by 2010. However, only 8.3% were reached by this date, and thus this goal was not attained.

Of the three main strategies for control, transmission control may be enough to eliminate the disease in low-transmission areas; it includes snail control, provision of potable water and adequate sanitation, and environmental modification. The second strategy is for morbidity control through treatment; this may be selective, whereby only those infected are treated (most expensive option), targeted, whereby groups at high risk or heavily infected are treated, or mass, whereby entire at-risk populations are treated (the most cost-effective option). As well as relieving morbidity, treatment also reduces transmission by preventing the release of eggs into the environment. The third strategy is health education, which can increase population compliance with interventions.

Operational components of these three strategies are not mutually exclusive, and all result in reduced levels of infection and disease. The strategy chosen will depend on the epidemiological situation and available resources. Ideally, all three components should be used in a control programme, but it will depend on the ecological situation. In the 1970s, a comparative evaluation was made of snail control, chemotherapy, and provision of water supplies in the control of *S. mansoni* transmission in three isolated valleys on the Caribbean island of Saint Lucia. After 2 years of control, chemotherapy had reduced incidence from 18.8% to 4%, snail control had reduced incidence from 22% to 9.8%, and water supplies had reduced incidence from 22.7% to 11.3%. Chemotherapy was the cheapest and most rapidly effective method for achieving transmission control, and also provided disease control. A disadvantage of chemotherapy is that it requires population cooperation and stable communities. Cooperation is also required for water supplies to be effective because people have to be convinced to use the installed water supply.
3.1.1 Going beyond the health system

By 1984, disease due to schistosomiasis was known to be related to the prevalence and intensity of infection, and high-risk groups (e.g. school-aged children, fishermen, irrigation workers) could be easily identified. Simple field applicable diagnostic tests (Kato–Katz for intestinal schistosomiasis, urine filtration and reagent strips for urogenital schistosomiasis) to rapidly identify heavy infections were available. Also available were safe, single-dose oral drugs (metrifonate, oxamniquine, praziquantel) that could reduce and regress morbidity, and reduce overall transmission if treatment coverage was high. Reduction in disease through morbidity control was thought to be a feasible objective for most endemic countries. Because of the availability of safe single-dose oral drugs, the Expert Committee in 1984 recommended going beyond the health facility to the community level where schistosomiasis treatment could be administered by community health workers, paramedics and teachers to attain higher coverage of the at-risk populations.

For urogenital schistosomiasis, prevalence and intensity of infection as well as morbidity can be reduced quickly with treatment, but can rebound within 2 years. This was shown in a study conducted in the United Republic of Tanzania and led to the recommendation to treat those with S. haematobium infection once in 2 years. Long-term regression of pathology due to S. mansoni was also noted following praziquantel treatment. While the excretion of eggs goes down following treatment, the number of eggs and pathology can increase to pretreatment levels within 24 months (United Republic of Tanzania).

Since the adoption of the strategy of preventive chemotherapy in 2006, treatment interventions for schistosomiasis have been targeted at high-risk, moderate-risk and low-risk communities depending on the prevalence of infection among schoolchildren (Table 1). Preventive chemotherapy allows for schistosomiasis treatment to be coordinated with the control interventions for lymphatic filariasis, onchocerciasis, soil-transmitted helminthiasis and trachoma.

---

Table 1 Recommended treatment strategy for schistosomiasis in preventive chemotherapy

<table>
<thead>
<tr>
<th>Prevalence thresholds for schistosomiasis intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>If prevalence of infection ≥ 50% (high-risk community),</td>
</tr>
<tr>
<td>Treat all school aged children and other at risk groups once a year</td>
</tr>
<tr>
<td>If prevalence of infection ≥ 10% and &lt; 50% (moderate-risk),</td>
</tr>
<tr>
<td>Treat all school aged children and other at risk groups once every two years</td>
</tr>
<tr>
<td>If prevalence of infection &lt; 10% (low-risk),</td>
</tr>
<tr>
<td>Treat all school-age twice in childhood, and symptomatic cases in health facilities</td>
</tr>
</tbody>
</table>

While preventive chemotherapy for schistosomiasis control is implemented beyond the health facility, it is not always well integrated into primary health-care systems. Praziquantel can be available to the outreach teams conducting treatment campaigns, with none in the health facilities serving the populations living in endemic areas. Where praziquantel was also available in health facilities, almost 40% of those requiring treatment could be reached passively. In low-risk areas, people can be treated in health facilities. Also, in going beyond the health system, even where morbidity control and chemotherapy are being advocated, it is still prudent to advocate also for sanitation and water, as well as health education.

### 3.1.2 Adjusting the treatment strategy

The treatment strategy can be adjusted in a number of ways. Firstly, treatment should be monitored according to the risk category of the community. Thus, where the risk category is for treatment every year, it would be prudent to monitor the situation in selected sites every year. The impact of treatment depends on the prevalence and intensity of infection as well as the timing of treatment. Where the risk category changes, then the frequency of treatment, as well as monitoring, should be changed.

Secondly, treatment can be integrated into health facilities within ongoing public health interventions. Preventive chemotherapy should be an integral part of the health system, and where there is large-scale drug administration, praziquantel should be available in primary health-care facilities for the treatment of those with symptoms or infective water contact (passive treatment at health facilities can

---

reach up to 40% of the population requiring treatment). In low-risk areas, treatment of those infected and schoolchildren can be in health facilities. Integration with primary health-care facilities would also mean strengthening the diagnostic capacity at that level and some monitoring and surveillance could be delegated to these facilities, especially in low-transmission areas.

Thirdly, other operational components for control can be included in the strategy. Although access to water and snail control is still probably beyond the budgets of most neglected tropical disease control programmes in African countries, appropriate sanitation could reduce environmental contamination. Health education should be revitalized.

### 3.1.3 Going beyond morbidity control

With the success achieved in some countries (see section 1), it is possible to contemplate going beyond morbidity control for schistosomiasis. Where transmission sites are discrete and transmission unstable, some countries (e.g. Morocco) have interrupted transmission. Interruption of transmission can be contemplated in many areas; some successful programmes have reached a prevalence of infection <10% in endemic areas and have opted for going towards elimination.

Going beyond morbidity control does not mean abandoning preventive chemotherapy. Both China and Egypt continue to implement preventive chemotherapy towards interruption of transmission. But the preventive chemotherapy strategy can be adapted towards elimination. As seen in Egypt in 1988–1996, selective population treatment first had an impact on prevalence and intensity of infection. To try to have a greater impact, a strategy of mass chemotherapy was adopted for all eligible people in high-transmission villages without confirmed diagnosis. The prevalence threshold for mass treatment was progressively lowered, and the prevalence of both species of schistosome was consistently reduced. The threshold for mass treatment can be adjusted downwards to ensure that all the infected people in the hot-spots of transmission are treated.

### 3.2 Reducing the frequency of treatment

In order to determine when and how to reduce the frequency of anthelmintic administration, a survey should be organized after 4 years of consecutive annual treatments in high-transmission areas. In areas of moderate risk, the survey could be done after two (biennial) treatment rounds. For consistency, the same thresholds suggested for decision-taking at baseline are considered but a more intense intervention for each threshold is suggested (i.e. after years of drug administration, even a moderate prevalence of 10% indicates that transmission is high). A further decision on the frequency of drug administration is suggested after 4 years to allow evaluation of the trend.
If, after 4 years of intervention for schistosomiasis (of coverage >75%), the prevalence measured in sentinel sites is:

– >10%: continue with the intervention previously implemented for the following 4 years;
– 5–10%: continue with one round of praziquantel every 2 years for the following 4 years;
– 1–5%: treat 33% of children once annually, meaning one class out of three every year. It will be important to identify the foci of transmission;
– <1%: preventive chemotherapy can be discontinued and the situation reevaluated after 2 years.

3.3 Community and school-based interventions for schistosomiasis control
At least 50% of the people suffering from schistosomiasis are school-aged children, and chemotherapy – the cornerstone for morbidity control – is mostly targeted at school-aged children. The challenge is to ensure high and sustainable treatment coverage of this target group.

High coverage among school-aged children can be achieved, of up to 80–82% as seen in studies in Uganda and the United Republic of Tanzania.\textsuperscript{23,24} However, the success of the school-based approach depends on the level of school attendance, and although enrolment in schools is increasing in Africa, the number of out-of-school children is still extensive. Such children may be the most vulnerable group, as indicated in some studies, where out-of-school children were more affected than school-going children. Some school-based programmes have successfully extended their treatment to reach out-of-school children.\textsuperscript{25} However, despite this, studies continue to show that even more children are missing treatment.\textsuperscript{26,27} So there is a need to supplement this school-based effort with a community-based approach.

In the community-directed approach, endemic communities themselves have full responsibility for selecting, organizing and implementing their own method for distributing drugs. Community members select their own drug distributors, who handle the distribution and are trained to deliver the treatment to children. Several studies have shown the approach to ensure high coverage. In a study in the United Republic of Tanzania, coverage of 80.1% was obtained among enrolled school-aged children, and a similar coverage among non-enrolled school-aged children. The control programme in Uganda achieved coverage of 85%.

The community-based approach has been well received and implemented in schistosomiasis control. Villagers have accepted the approach and community drug distributors have generally expressed willingness to continue with no incentives. However, in some studies, the distributors have indicated a desire for incentives. Another challenge is the children who live in remote sub-villages and who are away during the first visit of the community drug distributor, because of the difficulties inherent in distributors making extra visits to outlying areas.

The school-based approach is effective in ensuring high treatment coverage of school-aged children but misses some out-of-school children. The community-based approach is also effective in ensuring high coverage of school-aged children, and as well can obtain high coverage of non-enrolled children. The choice of approach will depend on the ongoing interventions, but both approaches can be used to reach as many school-aged children as possible for treatment. These approaches can be complementary, depending on the epidemiological and practical situations.

3.4 Modifying strategies during the course of schistosomiasis control programmes
It is important to identify and agree on the appropriate preventive chemotherapy strategy for schistosomiasis control in order to achieve the specific objective for each endemic area or focus. This strategy must take into account monitoring of progress towards achieving the objective, and making of decisions about future treatment. The chosen strategy, and changes to it, should be guided by the epidemiological situation, data from monitoring and available resources.

---

In 1991, the WHO Expert Committee on Schistosomiasis recommended several approaches for delivering treatment to endemic communities. These approaches include:

- mass treatment: treatment of entire populations without individual diagnosis
- selective population treatment: treatment of infected individuals based on a diagnostic survey of the whole population
- selective group treatment: targeted treatment to high-risk age or occupational group.

These approaches could be implemented in phases depending on the impact of treatment interventions. For programmatic decision-making concerning phased treatment, modification of strategy was examined by the Carter Center-assisted health programme in Nigeria in three studies: (i) different rapid diagnostic (use of history of haematuria vs reagent dipsticks vs nurse visual diagnosis); (ii) frequency of praziquantel treatment (the use of praziquantel holidays); and (iii) the implications of shifting the treatment threshold from 20% to 10%.

(i) Different rapid diagnostics (use of history of haematuria vs reagent dipsticks vs nurse visual diagnosis): the eight villages assessed for impact on schistosomiasis were in Ndokwa East, Delta Local Government Area, Nigeria. As history of haematuria and nurse visual diagnosis are measures of heavily infected individuals, these indices identified only three highly endemic villages for intervention, whereas dipstick haematuria showed that prevalence was high enough for intervention in all eight villages. Decisions for large-scale treatment were based on diagnosis at baseline (2003) and follow-up (2005). After 2 years of treatment with praziquantel, there was reduction of haematuria of up to 89% in Delta State (Table 2). With the high sensitivity and specificity of dipsticks in detecting haematuria, it was recommended to retain the reagent dipsticks for the diagnosis of urogenital schistosomiasis, as in the WHO guidelines.

---

(ii) Frequency of praziquantel treatment (the use of praziquantel holidays): in two villages, after two annual rounds of treatment, haematuria prevalence of 80% and 50% was reduced to 3.1% and 5.0% respectively, and after 3 more years there was 3.3% dipstick positivity, so no additional impact was apparent (Table 3). Programme staff decided that, based on these observations and while praziquantel is in such short supply, annual treatment should be discontinued in such areas and rotated elsewhere. This is in line with the WHO strategy for preventive chemotherapy for schistosomiasis: where repeated treatment lowers prevalence of infection below the 10% threshold, then treatment for schistosomiasis should be done in health facilities with school-aged children treated two or three times during childhood.\(^{32}\)


Table 3 Schistosomiasis treatment impact studies in Pankshin local government area

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Positive</td>
<td>% Positive</td>
<td>No.</td>
<td>Positive</td>
</tr>
<tr>
<td>Mungkohot</td>
<td>30</td>
<td>24</td>
<td>80.0%</td>
<td>222</td>
<td>7</td>
</tr>
<tr>
<td>Timjim</td>
<td>30</td>
<td>15</td>
<td>50.0%</td>
<td>240</td>
<td>12</td>
</tr>
<tr>
<td>Gille</td>
<td>30</td>
<td>15</td>
<td>50.0%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wuseli</td>
<td>30</td>
<td>10</td>
<td>33.3%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Duk</td>
<td>30</td>
<td>9</td>
<td>30.0%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Takkas</td>
<td>30</td>
<td>12</td>
<td>40.0%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kwassam</td>
<td>30</td>
<td>23</td>
<td>76.7%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dungye</td>
<td>30</td>
<td>10</td>
<td>33.3%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lankan</td>
<td>30</td>
<td>12</td>
<td>40.0%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Jannaret</td>
<td>30</td>
<td>6</td>
<td>20.0%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>300</td>
<td>136</td>
<td>45.3%</td>
<td>466</td>
<td>19</td>
</tr>
</tbody>
</table>

Treatment rotation strategies were examined to try to determine the most efficient use of the available praziquantel. Lengthened treatment intervals – ‘praziquantel holidays’ – started in 2004 in Plateau and Nasarawa states because of the scarcity of funding for praziquantel and the unmet needs for the drug. Entire local government areas were rotated off treatment. In areas where treatment was stopped, surveillance for recrudescence took place in sentinel villages by testing 30 school-aged children per sentinel village with dipsticks (all positive children were treated during the holiday period). Preliminary (unpublished) data are presented in Figure 1.

Results (Figure 1) indicated that 2 years of praziquantel treatment followed by 2 years without treatment did not reduce prevalence of infection below the 20% threshold. In contrast, 3 years of treatment followed by 2 years of holiday kept prevalence below 20%; however, it did not keep prevalence below the currently recommended threshold of 10%. Results for 5 years of treatment appeared to be no better than results for 3 years. Based on these findings, in Plateau and Nasarawa states the best rotation strategy appears to be at least 3 years of annual treatment followed by a 2-year treatment holiday. In Delta State, 4 years of treatment followed by 3 years of holiday gave similar results to 3 years of treatment and 2 years of holiday (data not shown). In all cases, these conclusions applied only to the 20% threshold; all rotation schemes failed when the current 10% preventive chemotherapy threshold was used.
(iii) The implications of shifting the treatment threshold from a 20% to a 10% haematuria. In Delta State, a shift of treatment threshold from 20% to 10% increased the number of children to be treated throughout the state by more than 20% (adding 42,947 children in 78 villages). Thus, the programme required an additional 90,000 praziquantel tablets. Shifting from a 20% to a 10% treatment threshold could limit the ability to expand to more areas where praziquantel is limited, or prevent the programme from treating adults in more highly endemic villages.

3.5 Data requirements and reporting tools

In order to measure progress in scaling up schistosomiasis control, it is necessary to have the appropriate tools for monitoring and evaluating implementation of interventions. A number of WHO publications and guidelines for schistosomiasis are in use.33,34,35

Collection, dissemination and use of data are critical to the efficiency of disease control programmes. However, decentralized and fragmented reporting challenge the data generated from the implementation of preventive chemotherapy activities – data are collected from a variety of sources, methods and reporting forms; data flow through different channels and systems; and data validation, compilation and analysis are minimal or absent.

A Joint Reporting Form proposed by WHO aims to standardize national reporting of implementation outcomes and improve the availability and coordination of preventive chemotherapy data across WHO regions. The form is to be completed annually and covers NTDs including schistosomiasis. Data are used to generate prevalence maps included in the country profiles.

The goal of resolution WHA54.19 adopted by the World Health Assembly in 2001 is “regular administration of chemotherapy to at least 75% ... of all school-age children at risk of morbidity by 2010”. To improve monitoring of activities, a preventive chemotherapy manual was launched in 2006.36

Monitoring of drug coverage includes programmatic, geographical and national coverage; coverage by age group; and coverage by gender. Recommended data-capture tools include registers (for use over several years) and tally sheets (for each round of preventive chemotherapy) at baseline level; simple tabular format (paper-based or electronic) for mid level; and the Joint Reporting Form for top level (for mainly national, then regional and global analysis).

To improve data flow, WHO has developed various platforms for collection and dissemination. The PCT Databank37 presents critical data and analyses of preventive chemotherapy activities, and the current situation and trends for historical data as reported to WHO.

The new monitoring and evaluation web site38 allows monitoring of the implementation of strategic activities for preventive chemotherapy and evaluating the extent to which the objectives are being reached.

The Global Health Observatory39 is an interactive WHO web site where departments and programmes can upload and present data, including those on schistosomiasis and other neglected tropical diseases.

Also under development is a pharmacovigilance system for severe adverse events, and draft guidelines that will be available later in 2011.

These programme monitoring activities are in response to the STAG [Strategic and Technical Advisory Group for Neglected Tropical Diseases] subgroup Working Group on Monitoring and Evaluation, and feedback from meetings of programme managers in 2010 and 2011, which ascertained that tools are needed to facilitate both effectiveness of programme management (through: macro-planning at national level; micro-planning at district level; stock management; advocacy; resource mobilization at country and regional levels; and capacity-building,

37 www.who.int/neglected_diseases/preventive_chemotherapy/databank/en/
38 www.who.int/neglected_diseases/preventive_chemotherapy/pct_database/en
39 www.who.int/gho/en/
especially at mid-level) and efficiency (through: improved coordination, including platforms and tools for information sharing; standardized evaluation protocol(s); and timeliness in data reporting (e.g. through use of mobile phones [mHealth]) and drug requests). Many of these tools are now developed or under development.

3.6 Access to praziquantel for neglected tropical disease control programmes

The major hurdle to scaling up schistosomiasis control has been the limited access to praziquantel for public health interventions. Until recently, the average amount of praziquantel available for preventive chemotherapy was about 50 million tablets per year. With successful advocacy to scale up control of neglected tropical diseases and pledges of additional resources, there has been a sudden increase in demand for praziquantel. In the past 3 years, demand has quadrupled, from 50 to 200 million tablets a year – despite the fact that several countries (e.g. Brazil, China and Egypt) have controlled schistosomiasis and consume less praziquantel than they did during the intensive phases of their programmes.

The projected need for praziquantel to bring schistosomiasis to scale in the next 5 years ranges from 467 million tablets for 2013, increasing up to 661 million tablets in 2017.

There are concerns that, with so few manufacturers of assured-quality active pharmaceutical ingredient and finished product, the demand increase may not be matched. Risks include interruption of supply, scale-up failure, substandard quality and higher prices. The three or four reliable producers all hint that the price will increase significantly. At current costs, production of 150 tonnes of active pharmaceutical ingredient would cost between US$ 80 and US$ 120 per kg, and the cost to scale up to an additional 150 tonnes would be between US$ 250 and US$ 400 per kg.

In joint planning between WHO, USAID and DfID, it was calculated that 152 million tablets were required in 2011; as of March 2011, 42 million tablets had been delivered to endemic countries. The forecast for 2012 is under planning, even though pledges by or through DFiD (through the Schistosomiasis Control Initiative), the World Bank and WHO are firm.

The shortage of praziquantel is thus real and acute. Several endemic countries have plans, capacity and support to expand coverage, while other countries (the Democratic Republic of the Congo, Ethiopia and Nigeria) have little or no access to praziquantel as yet. Coordination of its supply through the Working Group on Access to Assured-Quality Essential Medicines for Neglected Tropical Diseases would be useful, but may not solve the crisis. There is need therefore to advocate for expanded praziquantel donations, and to ensure that quality standards are harmonized.
4. Assessment of schistosomiasis programme impact

4.1 Monitoring impact in schistosomiasis control programmes

The control of schistosomiasis as a stand-alone preventive chemotherapy programme has an impact on health in several ways. It can reduce prevalence and intensity of infection of schistosomiasis, reduce or eliminate transmission, and significantly decrease associated morbidities, resulting in improved quality of life, nutritional status and cognitive ability. And control is cost-effective. The total economic cost per child treated for schistosomiasis in Uganda in 2007 was about US$ 0.54, compared with a cost-effectiveness of US$ 3.19 per case of anaemia averted.40

Impact can be measured in various ways. In the area of gender equity and maternal health, women’s nutritional status, haemaglobin (anaemia), birth outcomes and genital involvement can be measured. In the area of nutrition in children, Z scores, wasting, body mass index and growth spurts can be measured. In the area of morbidity and disability, nutritional status and haemoglobin counts, fitness (e.g. shuttle runs), reduction in morphological abnormalities on ultrasound, and reduction in other chronic disabilities and disfigurements can be measured. In the field of education, there may be changes in school attendance after treatment, and changes in school performance. And with regard to health systems strengthening, the use of health systems – and drug delivery through health systems – can be measured. In terms of economic status, a correlation with poverty reduction can perhaps be made, and with improved agricultural production, and net cost-benefits of integration can be measured.

The health consequences of schistosomiasis include gross haematuria (blood in urine); malnutrition and anaemia; growth retardation; cognitive impairment; increased susceptibility to other infections; chronic health problems (e.g. inflammation and fibrosis of the bladder wall, colon, liver, spleen, and lungs); and the life-threatening consequences of bladder cancer, portal hypertension, and haematemesis. ‘Objective’ morbidity (hepatosplenomegaly, haematuria, hydrocoele, blindness) is only the tip of the disease or disability iceberg – pain, diarrhoea, under-nutrition and anaemia are clearly associated with infection, are worse with heavier infection and are reversible, at least in part, with specific therapy.

Field examinations include measurement of height and weight, clinical examination (liver palpation), ultrasound examination (urinary and abdominal),

fingertip blood for haemoglobin (anaemia), stool examination (Kato–Katz), urine examination (visible blood, dipstick, filtration for egg counts) and a questionnaire for blood in urine.

4.2 Impact of schistosomiasis treatment: assessment of long-term follow-up

Until the 1990s, there was misunderstanding of ‘infection’ and ‘disease’, and schistosomiasis was thought simply to be people passing parasite eggs, with hepatosplenomegaly (S. mansoni) and hydronephrosis (S. haematobium). However, schistosomiasis is now known to be much more than this. Schistosome egg granuloma have both local and systemic impact and cause damage and scarring. Schistosomiasis is also anaemia, stunting, wasting, lack of fitness, cognitive impairment, infertility and genital disease. Light infections may occur 2–3 years before eggs are detected, and yet cause morbidity.

A summary of 13 randomized placebo-controlled trials for schistosomiasis showed that, after single treatment, fitness and skin-fold thickness improved within 1–2 months, cognition in children improved after 3 months, weight gain occurred after 3–12 months, pain ameliorated after 6 months and anaemia reduced after 4–8 months. However, the duration of follow-up of these trials may be too short to see regression of pathology, and rapid reinfection may blunt the benefit of treatment. Chronicity (or irreversibility) of disease may mean that it is too late to see improvement.

Prevalence increases, as does intensity, haematuria and proteinuria, when treatment is suspended. The advantage of annual therapy while there is continuing transmission is that the number of eggs is kept down. Also, with repeated treatment, there is progressive regression of affected children’s ultrasound abnormalities over time, and reduction in cumulative lifetime infectious burden (up to 35 years of age).41

There are few studies of very long-term outcomes of anti-schistosomal therapy. Some 10 to 18 years after treatment for S. haematobium, infection, bladder disease, moderate–severe haematuria and hydronephrosis are all minimal in people who received treatment. The total number of previous childhood treatments made a significant difference, independent of current infection status.42

With female genital schistosomiasis, childhood anti-schistosomal treatment was seen to prevent gynaecological contact bleeding and genital sandy patches.

Previous childhood treatment made a significant difference in contact bleeding from female genital schistosomiasis, independent of current infection status.\textsuperscript{43}

With multi-year treatment programmes, height and weight improve, and egg burden decreases up to age 17 (Kenya) Repeated school-age treatment is projected to have a height and weight impact\textsuperscript{44} – coverage and frequency make the difference.

Repeated annual population mass treatment for schistosomiasis improves morbidity outcomes beyond the impact of isolated treatments. Repeated treatment during childhood and adolescence has beneficial effects that persist into adulthood. By itself, repeated mass treatment does not prevent reinfection, but it can reduce the cumulative intensity of disease. For policy-making, the full benefits of regular large-scale anti-schistosomal treatment and of integrated treatments clearly need to be well studied, more clearly defined and documented.


\textsuperscript{44} Gurarie D et al. Modeling the effect of chronic schistosomiasis on childhood development and the potential for catch-up growth with different drug treatment strategies promoted for control of endemic schistosomiasis. \textit{American Journal of Tropical Medicine and Hygiene}, 2011, 84(5):773–781.
5. Integration of schistosomiasis with other neglected tropical disease control programmes

5.1 Planning for control: best practices
WHO has developed a rollout package as a start-up approach to integrating neglected tropical disease control programmes. For many of these diseases, the target Millennium Development Goals, target areas, target populations, interventions and even drugs to be used overlap across vertical programmes. Integration of interventions can save resources.

A situation analysis was conducted on how available resources can be used to maximum benefit. Integration of the vertical disease control programmes into one national neglected tropical disease control programme is becoming a necessity to increase cost-efficiency and accelerate scale-up. The best approach is for the Ministry of Health to lead the national neglected tropical disease control programme in setting national goals, identifying what actions to integrate, coordinating who is doing what and where, and identifying what the gaps are. The donors and partners can then support the Ministry of Health by filling the gaps.

The rollout package involves setting a national plan of action, carrying out a funding gap analysis, filling the gaps, and implementation. The national plan of action for the integrated neglected tropical disease control programme is developed by all the vertical programmes together, and the key information to be included is the result of the situation analysis, and the action plan with cost estimates for the next 5 years.

The situation analysis involves review of the epidemiological situation of all endemic neglected tropical diseases and ongoing control activities within the country. This provides information on the geographical overlap of these diseases by district or major implementation unit, and on the distribution of control activities implemented by different institutions and partners for the different diseases within the country. This information is key to identifying integration opportunities and gaps in technical and operational support.

Action planning is an exercise to define the activities that need to be carried out to achieve programme objectives. The important thing is to identify which activities can be integrated. For example, activities such as programme coordination, advocacy, social mobilization and training are conducted by all the disease programmes and can quite easily be integrated, whereby one training encompassing five preventive chemotherapy diseases can be done by a representative of the national neglected tropical disease control programme instead of each disease programme going to every district for disease-specific trainings.
Integration opportunities are not limited to vertical neglected tropical disease control programmes. Many activities can be also integrated with other programmes: for example, improvement of water supply and sanitation is an important component of control for schistosomiasis, soil-transmitted helminths, and trachoma. The neglected tropical disease control programme itself will not necessarily construct latrines or irrigation canals, but it is important that the national programme is represented and advocates for improved sanitation whenever a meeting or conference concerning water and sanitation is organized within the country. In this way, sanitation programmes in other sectors might prioritize the areas where the burden of neglected tropical diseases is high.

Once the national plan of action is developed, a funding gap analysis is conducted. This financial planning includes estimating the cost of achieving the programme’s objectives, defining the contributions of the government and donors or partners, and identifying the financial gap that needs to be filled. A funding gap analysis tool developed by RTI and USAID is being piloted in several countries prior to scale-up. An costing tool prepared by WHO’s Regional Office for Africa is also available, as well as a reference guide on how to develop the master plan for control of neglected tropical diseases in the region. The funding gap analysis exercise produces a cost estimate for integrated control of neglected tropical diseases by activity (planning, training, monitoring and evaluation, large-scale (mass) treatment, social mobilization, mapping, drug costs). The total cost of the integrated programme is significantly smaller than the sum of the individual vertical disease programmes.

Once the funding gap has been identified, filling the gap can often be done in the form of a stakeholder meeting where the national neglected tropical disease control programmes, Ministry of Health and partners discuss who is going to contribute to which part of the identified gap.

Next, implementation begins. At the end of the year, plans of action and the funding gap analysis tool can be updated.

WHO, in collaboration with donors and partners, has developed/is developing various tools to facilitate scale-up of the rollout package. These include: country profiles; guides to developing national plans of action for integrated control; global strategic plans – lymphatic filariasis (published), soil-transmitted helminths and schistosomiasis (in preparation); funding gap analysis tool; manuals for preventive chemotherapy, monitoring and evaluation, and deworming school-aged children; and a preventive chemotherapy information-sharing platform with restricted access (to WHO, donors and partners) for sharing information (e.g. forecasts of drug needs, draft budgets, national plans of action).

To date, plans of action are available from 35 schistosomiasis-endemic countries. The infrastructure to deliver praziquantel is present, and several of the countries
already have funding (for drug procurement, operations). The main factor delaying roll-out of the schistosomiasis control component of integrated control of neglected tropical diseases in many countries is the non-availability of praziquantel, both through donation and on the market.

5.2 Resources for control: large-scale support for implementation of preventive chemotherapy
Large-scale support for implementing preventive chemotherapy for neglected tropical diseases includes some bilateral funding and donations from the pharmaceutical sector.

Funding from the United States government for integrated control of neglected tropical diseases increased substantially between 2008 and 2010, from US$ 15 million to US$ 65 million, due to the remarkable results achieved by countries and their advocacy back to the USA. The goals of this support are to reduce the prevalence of seven of the most prevalent neglected tropical diseases (including schistosomiasis) by at least 50% among 70% of the world’s affected populations, and in doing so to contribute to the elimination of lymphatic filariasis by 2020, onchocerciasis in the Americas by 2015 and blinding trachoma by 2020.

To date, the USAID programme has completed roll-out and scale-up, and reached national scale. Some 14 countries are being supported to scale up an integrated package for neglected tropical disease control, with another three countries receiving support for specific disease control needs. Assessment of elimination and expansion to reach more people are ongoing or being planned.

Other large-scale support for implementation of preventive chemotherapy is provided by DfID (the UK Department for International Development). Its five-year programme (2010–2015) includes £9.5 million for drug delivery, country logistics, monitoring and evaluation; £15 million for procurement (£13.5 million for praziquantel); funding implemented through the Schistosomiasis Control Initiative and the Centre for Neglected Tropical Diseases, Liverpool. It focuses on Côte d’Ivoire, Liberia, Malawi, Mozambique, Niger, Uganda, the United Republic of Tanzania and Zambia. There is collaboration between DfID and USAID.

Using large-scale support, gains can be made in areas that were lagging behind; real gains are being made in closing the gap in mapping. Mapping for decision-making allows neglected tropical disease control programmes to qualify for drug donations: between 2007 and 2009, the number of treatments delivered annually tripled.

The significant contributions from the pharmaceutical sector for control of neglected tropical diseases have also increased rapidly, from a total value of donated drugs in 2007 of US$ 404 million, to US$ 686 million in 2010. But there is
a limited donation for praziquantel. It would make a significant difference if donors’ money did not need to be used for buying praziquantel, but for implementation.

Based on the international drug price indicator guide 2006 (MSH [Management Sciences for Health] and WHO), the total cost of medicines required for all neglected tropical diseases for 2011–2015 is US$ 1726 million. This includes, for schistosomiasis, US$ 155 million for a total of 1942 million praziquantel tablets.

The USAID praziquantel donation program for 2011 and 2012 is focused on rational use of resources – through coordination, rational allocation, avoidance of over- and under-supply, and avoidance of stockpiling. The challenge of limited funding for praziquantel is worsened by production and pricing issues as well as the limited donation from the pharmaceutical sector.

According to the roll-out package (see section 5.1), national plans of action and/or the results of funding gap analysis are presented at stakeholders’ meetings to seek funding. Among the objectives of the funding gap analysis are: estimating the cost of implementing integrated neglected tropical disease control programmes, quantifying existing resources, identifying funding gaps, encouraging rational allocation, and generating five-year projections of drug quantities and programme costs.

Among other things, monitoring and evaluation help in planning and implementing, monitoring of drug needs over time, evaluating the effects of integration decisions on costs, and monitoring the effects of achievements on programme costs.

Among the tools being developed is a comprehensive budgeting tool to track funding and assess the financial gap, by programme activity. This will allow countries to determine their funding priorities and resource allocations, track available donor funding, deploy resources more rationally and efficiently, achieve transparency with donors about spending, and accommodate donor requirements for resource deployment.

In an example from Uganda, improved efficiencies were gained by reducing the number of MDA [mass drug administration] treatment reports required at central level, reducing the number of days of training and the use of refresher training, reproducing rather than re-developing IEC [information, education, communication] materials, reusing rather than reproducing IEC materials, and decreasing the number of planning meetings.
5.3 Schistosomiasis within the control plan for the African Region

5.3.1 Regional strategy for control of schistosomiasis, 2001–2010
Of the 200 million people affected by schistosomiasis globally, 85% are in Africa. Of the 46 countries in WHO’s African Region, 42 are endemic for schistosomiasis. The Regional Strategy for Schistosomiasis (2001–2010) was based on staged implementation of control, on clear distinction between the goals for control of morbidity, infection, and transmission. While the objectives of these may overlap, they require different strategies, different expertise and research, and address different systems. Morbidity control should be the starting point towards transmission control and possibly elimination.

5.3.2 Status of schistosomiasis control in the region
The target was for all endemic Member Countries to have implemented national programmes by the end of 2010. Of the 42 schistosomiasis-endemic countries in the African Region, 23 have control programmes, mostly of limited scale. Only 4 or 5 countries have reached their entire at-risk populations, and prevalence rates are still 100% in some communities. In some high burden countries (e.g. the Democratic Republic of the Congo), the magnitude is still unknown.

Bottlenecks include the need for funding for programme coordination and technical support by WHO, and for country activities, and the poor availability or accessibility of praziquantel. In some countries that have drugs, the lack of knowledge about the real magnitude of the schistosomiasis burden causes difficulty in estimating resource needs and in implementation.

Challenges include sustaining the gains of chemotherapy for morbidity control, inadequate resources or political will to change direction to infection control, and inadequate resources to scale-up treatment to all known endemic communities. Countries often want to know for how long they need to implement preventive chemotherapy and how they should transition to infection control.

Opportunities have increased in the past 5 years. They include grants from the Bill & Melinda Gates Foundation for schistosomiasis control and research, praziquantel donations, increased funding for integrated control of neglected tropical diseases (currently mostly from USAID and DFID), funding from APOC (the African Programme for Onchocerciasis Control) for co-implementation, and general global momentum to overcome neglected tropical diseases. This has influenced commitment of the endemic countries themselves, who consider that sustainability will only be possible when health systems are involved.
5.4 Integrating schistosomiasis treatment into a neglected tropical disease control programme

The many reasons for integrating schistosomiasis into neglected tropical disease control programmes include the co-endemicity of the diseases and their similar intervention strategies, vectors and environmental concerns. Integration can enhance cost effectiveness and efficiency of programme activities, and combat donor fatigue.

To look at some of the benefits of integration, and to see if it would increase effectiveness, reduce costs and ease the strain on the public health system, integrated health interventions were put in place in two states in Nigeria (Plateau and Nasarawa). Coverage and impact of interventions against schistosomiasis, onchocerciasis, lymphatic filariasis, trachoma, malaria and vitamin A deficiency were measured. Integration began in 1999, with different diseases being introduced over the years; the latest roll-out was triple drug administration. Objectives were to assess the cost-effectiveness and sustainability of integrated interventions, and to position the project for national replication with support from the Government.

For management of integration, various teams comprised of formerly vertical Ministry of Health programme managers were formed at various levels, from the state Ministry of Health integrated health team, to the local government area health team, the community drug distributors and the community. Advocacy, mobilization, training, health education, treatment and supervision are done together, and data management and reporting of treatments are on one form. Monitoring and supervision are conducted in an integrated fashion. Health workers and village health workers no longer work in vertical programmes.

Challenges encountered during integration included people issues (e.g. resistance to change or perceived loss of power), delays in drug supply; sometimes non-payment of community drug distributors was an issue (those working in polio and malaria are paid). Organizational challenges included the number of different programmes and approaches used for data management, which is very complex to manage. Technical issues included the use of different mapping strategies, different evaluation strategies and different treatment schedules or targets. There is also pressure from non-eligible people to collect benefits (i.e. medicines, bednets). Government financial support remains unsatisfactory and threatens sustainability.
Schistosomiasis was integrated in 1999, and MDA of praziquantel was integrated with ivermectin and albendazole. Challenges included the need for separate rounds of treatment for praziquantel (due to restrictions of guidelines), management, mapping (village by village), and the cost of the medicine, which was not donated. After 2008–2010 however, more praziquantel was available and coverage of the population was 95%. Schistosomiasis treatments increased from 156 447 in 2007, to 991 080 in 2008 and to 1 057 337 in 2010. This was enabled by donation of praziquantel from Merck through WHO.

A pharmacokinetic study in 2005 clearly showed that the three drugs – albendazole, praziquantel and ivermectin – can be combined with a certain degree of safety. Three regimes were tried: oral praziquantel; oral ivermectin given concurrently with oral albendazole; and oral ivermectin given concurrently with oral albendazole and praziquantel. All regimens showed acceptable tolerability profile in healthy volunteers, although there was significantly less incidence of drug-related adverse events with the second regimen (without praziquantel). The triple drug administration programme was rolled out to see if it could be replicated in the field. This programme also has a complementary effect on hookworm, ascariasis, trichuriasis, taeniasis, other flukes, scabies, lice, etc.

In a cost study, eight local government areas conducted separate, stand-alone distribution rounds of the three drugs in 2008, and triple drug administration in 2009. There was 41% reduction in costs of triple drug administration compared with stand-alone distributions, from US$ 0.07 per treatment in 2008 to US$ 0.04 in 2009.

The study led to recommendations for management training in particular concerning people or conflict resolution, and for the replication of triple drug administration nationally and internationally (though this may be more complex in central Africa where there is co-endemicity with loiasis).

Compliance issues were not observed; rather, communities were excited and tended to support the programmes more as they could see there were many benefits.

drugs. However, there may be difficulties with children; it is difficult for them to swallow praziquantel tablets, so albendazole is given first as it has a good taste.

5.5 Monitoring needs for neglected tropical disease control programmes: lessons from lymphatic filariasis

In the life-cycle of a neglected tropical disease control programme, elimination is the ultimate end-point. In an integrated framework, it makes sense to integrate monitoring and evaluation. The framework needs to provide clear guidance for decision-making over the programme’s life-cycle, from mapping and planning to elimination and surveillance, and be based on agreed objectives and straightforward actions. Experience from lymphatic filariasis control programmes could guide implementation and monitoring of schistosomiasis control programmes.

For lymphatic filariasis, a 1% infection level triggered implementation of preventive chemotherapy. Mapping was facilitated by having the immunochromatographic test and an adequate supply of donated drug, and a flexible approach to definition of implementation units. Due to limited access to praziquantel, there are three threshold levels that define the frequency of preventive chemotherapy for schistosomiasis, and mapping has been confounded by the focal distribution of the infection.

Since 1998, the classification of countries endemic for lymphatic filariasis was based on the history of the disease or interventions after 1980, and the risk of lymphatic filariasis based on proximity to known endemic countries. In total, 83 countries were classified as endemic, of which 10 were later classified as not requiring MDA.

At a recent meeting, the evidence base used to define countries and implementation units as ‘LF-endemic’, ‘LF-endemic but not requiring MDA’ or ‘non-endemic in countries that are implementing MDA’ was reviewed, considering how to evaluate non-endemic implementation units as part of the process to verify the absence of transmission. Review criteria used included historical evidence, past interventions, surveys for microfilaraemia or antigen, current environmental risk (increases with climate, potential vectors), current social risk (increases with poverty and political instability), other ongoing interventions (e.g. vector control). Meeting conclusions were that 9 countries should be removed from the list of endemic countries, and that 72 countries were endemic for lymphatic filariasis. A similar algorithm could be used for the other diseases amenable to preventive chemotherapy.

It is likely that determination of countries no longer endemic for schistosomiasis will require a similar process for agreeing on criteria for elimination.
Guidelines on lymphatic filariasis recommend coverage surveys at least once over the programme life-cycle. The concept of sentinel sites was built into the lymphatic filariasis programme at the beginning, to establish a baseline for the programme. Sentinel sites are the platform for making decisions about stopping MDA.

Drug coverage surveys allow programme managers to know how many of the people in need of treatment actually received treatment, and when and where it was offered. Implementation units should verify reported coverage at least once by surveyed coverage. Definitions are based on the 2010 WHO manual Monitoring drug coverage for preventive chemotherapy.

To make the decision to stop large-scale treatment, ideally the absence of transmission should be documented. More practical though is to determine the absence of infection in a sentinel population. The development of guidelines for stopping MDA is an evolutionary process. The current ‘recommendations’ are based on judgment, experience and feedback from the field.

There are limitations of our current tools for surveillance of neglected tropical diseases. Despite the utility of current tests for making decisions about stopping MDA for lymphatic filariasis, they are not adequate for post-MDA surveillance – antigenaemia is a lagging indicator that takes months or years to become detectable following infection, while commercially available antibody tests are neither specific nor robust enough for programmatic use. As the programme evolves, there is greater and greater need for more sensitive diagnostic tools. A recent Informal Consultation examined some of the control needs. The development of new tests for surveillance is a cross-cutting issue and there is under-investment in the development and validation of field-friendly tools for surveillance. New antibody tests offer advantages for surveillance. Conceptually, in the context of Morocco, the absence of antibody in young children showed that transmission of schistosomiasis may have been interrupted.

So moving into this phase, a strategy is under planning to develop a multiplex platform for integrated surveillance. Built into this platform could be key antigens from targeted neglected tropical diseases (lymphatic filariasis, onchocerciasis, [schistosomiasis], soil-transmitted helminthiases, [trachoma]) and other infections where the impact of preventive chemotherapy drugs might be expected (Strongyloides, cysticercosis, scabies), plus antigens for the public health context (e.g. malaria, vaccine antigens and markers of waterborne disease). Biomarkers could also be included.

5.5.1 Evolution of guidelines
Guidelines are not cast in stone. The guidelines for stopping MDA of lymphatic filariasis were changed in 2005 and 2011 based on country experiences, and development and validation of new tools or survey methodology.

Guidelines for stopping MDA of lymphatic filariasis were reviewed by the WHO Monitoring and Evaluation Working Group and incorporated in new WHO monitoring and evaluation guidelines for lymphatic filariasis. They could be readily adapted to trachoma, onchocerciasis and schistosomiasis, if suitable.

Diagnostic needs and sampling requirements change as programmes evolve – from rapid test (mapping), to infection marker (MDA), to infection marker (stopping MDA), to transmission markers (surveillance).

5.6 Capacity-building for control
For capacity strengthening in preventive chemotherapy diseases, WHO is creating a template for developing national plans. An international training course for programme managers is under development. The first training activities were held in 2007 and 2008. The course includes an introduction to the five diseases targeted for preventive chemotherapy, strategic approach, management for integrated control of the five diseases, drug management, management of severe adverse events and crisis communication, morbidity management, monitoring and evaluation reporting. The training course is interactive, involving facilitators and participants. Participants use national data, and there is group work, fieldwork and final presentation based on real examples. A training manual is under development; a first draft should soon be ready.

Other activities for strengthening capacity include assessing human resource needs to implement control strategies; developing standardized training materials; creating in-service training for neglected tropical disease control programme managers and health workers involved in implementing control strategies (physicians, nurses, laboratory technicians, data managers, veterinary health workers, epidemiologists and mobile teams, etc.); collaborating with WHO regions and Member States to develop training materials for community health workers and non-formal care providers, and with training institutions to enhance their training capacity; and consolidating and developing new training-of-trainers networks to expand the knowledge, skills and number of health workers of all categories involved in control of neglected tropical diseases.
6. Points raised during the discussions

Focal nature of schistosomiasis

- Schistosomiasis is a highly focal disease and each epidemiological situation may be different. In some situations, the disease can be treated once and it never returns; in other situations, transmission continues. Among the species infecting humans, *S. haematobium* appears easiest to control and it is probable that elimination in many settings can be achieved for this species.

- Baseline prevalence probably reflects cumulative transmission over many years without treatment or other intervention. Schistosomiasis transmission rebounds, first to areas where there was originally high prevalence, so these hot-spots are where resources need to be focused and intervention efforts tailored.

- Schistosomiasis is a chronic inflammatory disease and most people eventually acquire infection in a highly endemic community. While it was once thought that many people are asymptomatic, and only those with heavy infections develop severe morbidity, it is now understood that low intensity infections cause “subtle morbidity” with severe health consequences. Thus, low transmission areas should also be addressed with the appropriate control measures.

Treatment

- The evidence from control programmes in four different epidemiological and political settings shows that when high treatment coverage is achieved and sustained, morbidity is significantly reduced. Treatment has an immediate impact on morbidity in schistosomiasis compared with other control measures such as access to water and sanitation.

- Currently there is not enough praziquantel even for areas where schistosomiasis is high; however, planning for control should assume that sufficient drug will become available. Where possible, treatment should be continued for many years, although to reserve resources, intervals between treatments can be lengthened, allowing resources to be targeted at the hot-spots of transmission. In the examples from Burkina Faso, China, Egypt and Uganda, extensive annual mass treatment in high transmission areas for 3–5 years had a significant impact on the prevalence and intensity of infection, as well as other indices of schistosomiasis morbidity, such that with careful monitoring and surveillance it was possible to reduce the thresholds for mass treatment while reducing the areas and populations targeted for treatment. Thus, significant scale-up of
Schistosomiasis treatment seen on adoption of a strategy for morbidity control was followed with more focused delivery of mass chemotherapy.

- High coverage with preventive chemotherapy will lead to a significant reduction in schistosomiasis morbidity. When this is achieved, the frequency of treatment can be reduced, but the intervention needs to be maintained. Managers need an indication of when to change the frequency of administration.

- The safety of praziquantel in large-scale population treatments has been proven over the past 30 years, with few severe adverse events attributable to the drug being reported and documented. However, perceptions of severity of side-effects due to the drug persist in some communities. The side-effects that do occur, including abdominal pain, allergic reactions, dizziness, vomiting and sweating, especially in heavily infected people, can be managed even at primary health-care level, but communities should be well briefed and prepared for large-scale preventive chemotherapy with praziquantel. Failure to do so may compromise efforts as side-effects can reduce compliance with interventions.

**Regular revision of strategy**

- The sequential, systematic way of scaling up preventive chemotherapy for schistosomiasis control, as seen in the country examples (section 1), is feasible and worked well. Regular revision of strategy, each time advancing one step further, allows tremendous progress to be made between each strategy change.

- Snail control should be an integral part of programmes and can have a marked impact on transmission in some foci.

- In areas where there are reservoir hosts (as in China), special measures, such as treatment of animals or their removal from watersheds, are required to reduce contamination of aquatic environments with parasite eggs.

- To change behaviour, religious and educational leaders can be effective in transmitting messages about avoiding water contact, etc.

**Policy dilemma**

- Political commitment at national level is required. For example, in Uganda, the goal of morbidity control was achieved and transmission reduced; however, implementation has to continue and this may cost more. To sustain the gains, surveillance surveys need to be conducted, and a policy and/or political decision would be required to proceed towards elimination.
**Surveillance**

- Once a move has been made from morbidity control to transmission control to elimination, and if the goals are to be achieved and maintained, a surveillance system is needed. This can help countries save drugs. Guidelines on surveillance are needed, and there needs to be an elimination research agenda.

- It was noted that in the Eastern Mediterranean Region, there is often strong political commitment, but monitoring is often absent. The system must be sustained and minimum data collected, sufficient to allow decision-making (rather than large-scale monitoring).

**Guidelines**

- The Schistosomiasis Expert Committee guidelines have changed over three iterations, based on evidence or on the right thing to do at the time. In 1980, schistosomiasis control was transmission control, but within 4 years there was evidence for morbidity control, so the strategy changed to this. The 1993 guidelines were based on the premise that heavy infections lead to morbidity. Since then, however, with the increasing evidence of subtle morbidity due to light to moderate infections, the threshold prevalence for moderate-risk areas was lowered from 20% to 10%. This meant that more people would have to be treated once every 2 years. While the guidelines for treatment for high- and low-transmission areas differ, with success in morbidity control, changing the goal to the interruption of transmission may logically follow. Whereas China had an elimination goal from the start, Egypt aims for the same goal, having succeeded in achieving morbidity control and having a few transmission hot-spots.

- Guidelines are a guide, not a bible. Different sets of guidelines are needed (e.g. guidelines towards elimination, guidelines for sustaining achievements, and operational research). In the examples given (section 1), while the countries did follow guidelines, and controlled morbidity, they are now developing their own policies on what to do next.

- Criteria for the process of certification of elimination are being developed. Member states of WHO’s Eastern Mediterranean Region resolved to eliminate *S. haematobium* by 2015. In 2009, PAHO’s Directing Council approved Resolution CD49.R19, urging Member States to eliminate or drastically reduce, by 2015, the burden of 12 neglected infectious diseases. For schistosomiasis, the goal is to reduce prevalence in high-transmission areas to less than 10% prevalence.

**Achieving and adjusting goals**

- The achievements in some countries are impressive and they have attained the goal of resolution WHA54:19 of reaching 75% of children with treatment by 2010. However, globally this goal has not been achieved – to date, 8.5% of children have been reached.
• Goal posts however, even if ambitious, provide something to aim for. They can be moved. Aiming for 75% was a heroic goal, but the price of praziquantel has been reduced considerably and 16 countries in Africa are implementing schistosomiasis control. So, while control is still to be gained in some places, in others, control is being maintained or sustained, and yet others need to move forward. Some countries have reached zero transmission, and there is need for a certification process.

• Goal posts are important to drug companies as well. The manufacturers of praziquantel should be provided with data on drug needs, in the context of the different phases. In Egypt, for example, where praziquantel tablets are produced, there is a commitment to provide tablets to cover mass chemotherapy campaigns in the few hot-spots of transmission remaining – about 3 million tablets a year.

Screening
• It is important to monitor the control programme. In 2009, the Egyptian programme screened more than 30 million urines and 18 million stool specimens for schistosomiasis infection through the primary health-care system. The specimens were from out-patients, a 10% sample of the population, and from school children. As the results for these population groups were similar, for both S. haematobium and S. mansoni, this is robust proof that screening of only school children alone may be sufficient for monitoring a control programme. With this screening process, it was possible to identify the hot-spots of transmission.

Multisectoral approach
• Two major programmes are transitioning towards the interruption of transmission. China and Egypt continue to use snail control judiciously, although this practice has not been part of the global schistosomiasis control strategy for the past 30 years. Snail control has also been integrated in Morocco, and in Brazil in some areas. Egypt uses mostly chemical snail control, while China uses mostly environmental control, using molluscicides to remove snails from limited foci. Chemical control can have deleterious environmental effects. China and Egypt have also built infrastructure, not only in the health system but also in the water, sanitation and communications sectors. A multisectoral approach is required for successful schistosomiasis control.

• Repeated large-scale chemotherapy with high population coverage has a significant impact on the prevalence and intensity of schistosomiasis infection, reduces morbidity and reverses pathology, and reduces transmission. To maintain and sustain the control gains from chemotherapy, other operational components for control, provision of
potable water, sanitation, snail control, health education and environmental management will be required.
7. **Recommendations for refining the control strategy**

Recommendations of the Informal Consultation about refining the current control strategy so that countries can move forwards are below.

### 7.1 Setting objectives and defining the problem: mapping and identifying communities at risk

#### Goal: elimination of schistosomiasis

Each programme setting could be classified into four (proposed) progressive stages towards elimination:

- morbidity control
- infection control (elimination as a public health problem)
- transmission control (interruption of transmission)
- elimination (post-transmission surveillance).

Each stage requires specific interventions (e.g. treatment, integrated approaches); diagnostics (from egg detection to antibodies); mapping, assessment and surveillance.

Conceptual framework of control programme:

- If prevalence ≥50% (high risk): through mapping using available data, conduct morbidity control, and set up sentinel site surveillance.
- If prevalence ≥10 but <50% (moderate risk): through more refined mapping, conduct morbidity control, and continue sentinel site surveillance.
- If prevalence ≥5% (to be defined) but <10% (low risk): through sentinel site assessment, conduct infection control, continue sentinel sites.
- If prevalence <1% (to be defined): through surveillance, conduct transmission control. Continue surveillance and aim at elimination.\(^52\)
- Elimination.

**Framework for morbidity control:**

1. **Situation analysis**
   - Collect available data for the country and conduct situation analysis as described in the WHO/AFRO Operational Guide.\(^53\)

---


2. Identify areas requiring interventions
   - Use predictive risk maps to define target areas
   - Collect baseline (parasitological) data
   - Implement interventions (e.g. treatment, frequency).

3. Intervention (implementation) unit
   - District
   - More refined mapping to identify high-risk areas (e.g. sub-district level, village)
   - Sample proportionate to geography.
   Output: defined areas or communities requiring interventions.

4. Prior to intervention
   - LQAS (small permanent or temporary freshwater bodies)
   - Transect sampling (e.g. lakes, irrigation schemes)
   - Parasitological data (prevalence and intensity), if possible supplemented with malacological data.

5. Trigger for intervention
   - Prevalence thresholds (>10%)
   - Collect baseline (parasitological and questionnaire) data
   - Implement interventions (e.g. treatment).

Transition from morbidity control to infection control – data showing progress are needed to make the switch:

Monitoring in sentinel sites:
   - Sentinel sites should cover different endemicity levels (high, moderate, low)
   - Sentinel sites should be selected for different endemicity areas (measuring progress)
   - Add non-fixed spot sites (reduce bias).

Frequency of monitoring surveys:
   - Proposal: first monitoring survey after 4 years (i.e. in high endemicity areas, after 4 (annual) treatment rounds; in moderate endemicity areas, after 2 (biennial) treatment rounds)
   - Reassessment of prevalence (through surveys at sentinel + additional sites).
Open issues, research needs:

- Working group: Americas – low-transmission areas – there is a need for an operational guide for schistosomiasis elimination (mapping, diagnosis, surveillance and certification of elimination).
- Mapping – Is a more detailed mapping approach (e.g. national survey) cost-effective?

### 7.2 Maintenance strategies decision after the attack phase

While many appropriate recommendations are already in the previous Technical Report (TRS 912), some were ‘soft’ at that time (2001) and are now strongly advocated. These should be included within the control agenda as programmes move forward from their initial 5–6 year ‘attack phase’ efforts.

The key, at this stage, is to refocus efforts according to the results observed, and to move beyond the concept of ‘maintenance’ as much as possible; that is, to get beyond a ‘sustaining control’ concept and move towards an ‘elimination as a public health problem’ classification for areas that have responded to initial control efforts.

- Efforts in this phase should focus on hot-spots of persisting transmission. This requires fine-scale (village level) mapping, and may be different from that done in the initial surveys for the baseline needs assessment or for the initial implementation of the attack phase. If part of an integrated neglected tropical disease control programme, the more frequent revisits for treatment against soil-transmitted helminthiases offers schistosomiasis control officers the opportunity to perform the needed community-level resurveys for *Schistosoma* infection.
- The new implementation strategies require micro-focal detail to achieve optimal results with a minimal amount of inputs. Although the mapping demands are greater, there are cost savings to be had from more focused implementation of control.
- In addition, the survey diagnostics need to be validated for their utility in low prevalence and very low prevalence areas.
- In choosing a sentinel group in this setting, 10–15-year-olds are still expected to have the highest prevalence of infection while there is ongoing transmission. It is recognized that where transmission interruption is the goal, then younger children (such as 7-year-olds entering the first year of
school\textsuperscript{54}) may be the appropriate sentinel population. However, the better performance of standard diagnostics for higher prevalence groups means that before switching from standard parasitology to more sensitive diagnostics, the group aged 10–15 years will probably remain the most useful sub-population to survey.

Four possible outcome scenarios for a community that has participated in a 5–6 year ‘attack’ phase schistosomiasis control programme are identified:

I. A poor response to assigned treatment, with persistently high levels of infection prevalence and high levels of morbidity. This scenario requires a careful assessment of the programme’s previous treatment-strategy assignments, as well as review of population drug delivery and coverage, drug quality, adherence to treatment and timing of treatment. Lacking evidence of programme dysfunction, new additional interventions are available. These include broadening coverage, increasing the frequency of treatment to every 6 months, and extra interventions such as snail control (by habitat modification or mollusciciding), extra water and sanitation intervention, and behaviour modification to reduce local contamination.

II. Reduction of morbidity, but persistent transmission with rapid reinfection. The group identified such areas as those with persistent prevalence over 10% among the sentinel 10–15-year-old age groups. (Where high-quality health centre data are available, these data, with different cut-offs, may be used as a proxy for decision-making). The current intervention should, at the least, be sustained at its present level to prevent re-emergence of advanced morbidities. Here also, a review of previous programme performance is recommended, to assure the best possible programme performance. At this juncture, infection transmission is likely to continue indefinitely without additional intervention efforts – strong consideration should be given to adding interventions for transmission interruption, even in this ‘sustaining control’ category.

III. Low intensity, low morbidity, low transmission, but with risk of re-emergence. In this scenario, sentinel group prevalence is typically between 1% and 10%. The transmission risk is assessed from experience during the attack phase of the programme – perhaps with episodic periods of high transmission. Elsewhere, the designation may be based on location (i.e. one that brings the population into periodic contact with high-risk water

bodies). For these kinds of communities, there is need to focus on identified hot-spots or periods of transmission. The general programme can scale back on the frequency of community or school-based drug treatments. Resources should be refocused on interventions for transmission interruption in identified hot-spots. The move to realign programme goals towards elimination may require a political decision by the national neglected tropical disease control programme; the team should develop sufficient data for advocacy in favour of the move towards elimination in such areas.

IV. Low intensity, low morbidity, no positive sentinel children by standard testing, with low risk of recurrence. In these areas, treatment campaigns may be stopped. However, surveillance for infection should be performed annually for at least 5 years, and treatment restarted if transmission (infection) recurs. The most sensitive diagnostic techniques should be used.

**General issues**

In the recommendations for frequency of treatment, the 'every other year' recommendation means that the programme should be treating half the eligible districts every year. Starting and stopping a programme every other year risks losing personnel, skills and functionality for the schistosomiasis programmes during the off times.

**Technical issues**

There will need to be a transition to mapping on a sufficiently fine scale to identify residual problem areas within each larger intervention area.

As prevalence decreases, there is need for increasingly accurate (sensitive or specific) diagnostics for *Schistosoma* infection. Certainly, haematuria detected with reagent sticks should replace visual haematuria as a criterion for *S. haematobium* infection. The potential benefits of replacing Kato–Katz with serology or point-of-care assays to diagnose *S. mansoni* should be evaluated at the time of planning each annual survey. Survey sample size will need to increase as prevalence drops, in order to accurately and more precisely assess local prevalence at levels <10%.

The performance of survey work should be carefully supervised and audited to assure that survey results are of the highest quality for decision-making about intervention.
The data flow to programme headquarters and national and international partners should be as accurate and up-to-date as possible to help foster the programme’s advocacy efforts.

Political issues
For advocacy, there is need to stress that the outcome indicators for programmes such as these should be disease averted, not doses delivered or population covered. That is the real success in morbidity control. The transition towards transmission interruption and elimination makes the programme more cost-effective in preventing the large number of expected cases of late disease (liver fibrosis, gastrointestinal bleeding, renal failure, bladder cancer, genital schistosomiasis, infertility) that would otherwise place expensive demands on the health system in future decades. This is because late forms of disease usually do not become apparent until the 20s or 30s, but are prevented by treatment in childhood.

The programme should definitely make the recommendation to move towards elimination in scenarios III and IV above, and even in scenario II wherever aggressive intersectoral transmission-interruption intervention can be performed. Managers should stress that the programme has very useful momentum and running efficiencies as communities come under control. Although the task list now changes, the programme should not stop working until infection can be eliminated.

Financial aspects
Transition of programme goals at this stage will probably not result in savings at this decision point. Although there will be decreased frequency of treatment in some areas, resources will need to be redirected into retraining and deployment of the teams for fine-scale mapping, supplemental snail control, and joint participation in mobilization, education and sanitation efforts.
### Maintenance strategies decision after attack phase

Baseline has informed the ATTACK PHASE – during this phase countries would have the surveillance data and would know where transmission occurs. **MAINTENANCE** = sustained control = after 5–6 years of annual treatment.

<table>
<thead>
<tr>
<th>Information</th>
<th>Maintenance phase categories*</th>
<th>Maintenance phase strategies</th>
<th>Decisions</th>
<th>Technical inputs</th>
<th>Political</th>
<th>Financial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process indicators -</td>
<td>Inadequate infection and morbidity control &gt;50% prevalence or morbidity is not being controlled</td>
<td>1. Review previous programme performance</td>
<td>Survey – where and who? = village-level surveys in 10–15-year-olds (alternative: health centre records)</td>
<td>Surveillance mapping (fine scale)</td>
<td>Change indicators of success to morbidity, not doses delivered or population coverage</td>
<td>Reduced frequency saves, but indicate that the resources need to go to new programme initiatives at this stage</td>
</tr>
<tr>
<td>assuming the</td>
<td></td>
<td>2. Increase intensity of intervention (increase coverage and/or frequency)</td>
<td>Changes in treatment coverage and frequency</td>
<td>Diagnostics</td>
<td>Stress that the new approaches show we are getting more ‘cost-effective’</td>
<td>Intensify inputs in elimination zones</td>
</tr>
<tr>
<td>benchmarks of</td>
<td></td>
<td>3. Add components of transmission control</td>
<td>Keep data inputs coming for advocacy</td>
<td></td>
<td></td>
<td>New mapping</td>
</tr>
<tr>
<td>coverage, drug</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Training in new strategies</td>
</tr>
<tr>
<td>quality, schedules</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>have been met</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Re-mapping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assess or validate</td>
<td>Continuing transmission or low morbidity &gt;10–50% prevalence</td>
<td>1. Review previous programme performance</td>
<td>Hard to do entry or exit treatment in schools – so use every 2–3 years protocol instead</td>
<td>Use reagent sticks for haematuria for <em>haematobium</em> – what about <em>mansoni</em>?</td>
<td>Stress that the ‘Programme never stops’ until transmission is interrupted</td>
<td>New mapping</td>
</tr>
<tr>
<td>coverage</td>
<td></td>
<td>2. Maintain treatment of school-aged children at previous level</td>
<td>The switch to elimination involves a programmatic and political change</td>
<td>Keep data inputs coming for advocacy</td>
<td>Advocate strongly they decide for elimination where possible</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Advocate transmission interruption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Move resources for ‘micro-focal’ intervention based</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

"*" Categories of maintenance phase strategies and decisions are influenced by technical inputs, political factors, and financial considerations.
### Low transmission where risk of re-emergence exists

[aka Infection control, but not transmission control]

- 1-10% prevalence, or location suggests rapid reintroduction possible

1. Can reduce treatment frequency
2. Advocate new focus on transmission interruption
3. Move resources for ‘micro-focal’ intervention based on new, fine-scale assessment

### Low transmission where low or no risk of re-emergence

0% prevalence by standard parasitology

Stop treatment, continue surveillance for >5 years

* These are the best % categories based on our current knowledge but may be changed according to location and progress as the programme continues.

** Where barriers to planned treatment occur (e.g. bottlenecks in praziquantel supply) the micro-focal treatment strategies / environmental modifications / behaviour change should be the focus of control efforts.

---

### Annex 1. Agenda

| Day 1  
30 March 2011 | Item                                                                 | Name                                                                 |
|----------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| 09:00–09:30    | ♦ Welcome address  
♦ Meeting objectives and introduction of participants               | ADG/HTM; Director, NTD  
Dirk Engels/Lester Chitsulo                                           |
<p>|                | <strong>Defining the Objectives of preventive chemotherapy for schistosomiasis in each type (generalized) of epidemiological setting</strong> |                                                                      |
| 09:30–10:00    | Morbidity control of schistosomiasis in China                         | Guo Jiagang/Zhou Xiaonong                                            |
| 10:00–10:30    | Adapting treatment strategies in a schistosomiasis control programme in Egypt | Ayat Haggag                                                          |
| 10:30–11:00    | <strong>Coffee break</strong>                                                     |                                                                      |
| 11:00-11:30    | Scaling up schistosomias control and impact on morbidity in Uganda   | Narcis Kabatereine                                                   |
| 11:30–12:00    | Scaling up schistosomias control in West Africa: Burkina Faso and Niger | Seydou Toure/Amadou Garba                                            |
| 12:30–13:00    | Discussion                                                           |                                                                      |
| 13:00–14:00    | <strong>Lunch</strong>                                                            |                                                                      |
|                | <strong>Programmatic Mapping</strong>                                             |                                                                      |
|                | a. Defining the implementation unit for preventive chemotherapy programmes targeting schistosomiasis |                                                                      |
|                | b. Strategy to identify levels of schistosomiasis prevalence that will determine the appropriate regimen for each unit |                                                                      |
| 14:00–14:30    | Mapping the distribution of schistosomiasis: historical data, risk mapping and rapid surveys | Simon Brooker                                                        |
| 14:30–15:30    | Validation of schistosomiasis distribution at country level          | Nana Biritwum                                                        |
| 15:30 – 16:00  | <strong>Coffee break</strong>                                                     |                                                                      |
| 16:00–16:30    | Considerations for targeting communities for treatment              | Julie Gutman                                                         |
| 16:30–17:00    | Targeting schistosomias treatment to sub-district levels             | Els Mathieu                                                          |
| 17:00–17:30    | Discussion                                                           |                                                                      |
| 18:00          | <strong>Reception</strong>                                                        |                                                                      |</p>
<table>
<thead>
<tr>
<th>Day 2</th>
<th>Item</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 March 2011</td>
<td><strong>Item</strong></td>
<td><strong>Name</strong></td>
</tr>
<tr>
<td>3.</td>
<td><strong>Identifying the preventive chemotherapy strategy to achieve the objective for each implementation unit</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Treatment regimen</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Monitoring of progress towards achieving the objective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Decision-making with respect to future treatment</td>
<td></td>
</tr>
<tr>
<td>09:00–9:30</td>
<td>The evolution of preventive chemotherapy for schistosomiasis</td>
<td>Lester Chitsulo</td>
</tr>
<tr>
<td>09:30–10:00</td>
<td>Community and school-based interventions for schistosomiasis control</td>
<td>Khalid Massa</td>
</tr>
<tr>
<td>10:00–10:30</td>
<td>Modifying strategies in the course of schistosomiasis control programmes</td>
<td>Frank O. Richards</td>
</tr>
<tr>
<td>10:30–11:00</td>
<td><strong>Coffee break</strong></td>
<td></td>
</tr>
<tr>
<td>11:00–11:30</td>
<td>Data requirements and reporting tools</td>
<td>Pamela Mbabazi</td>
</tr>
<tr>
<td>11:30–12:00</td>
<td>Access to praziquantel</td>
<td>Denis Daumerie</td>
</tr>
<tr>
<td>4.</td>
<td><strong>Assessment of schistosomiasis programme impact</strong></td>
<td></td>
</tr>
<tr>
<td>12:00–12:30</td>
<td>Monitoring impact in schistosomiasis control programmes</td>
<td>Alan Fenwick</td>
</tr>
<tr>
<td>12:30–13:00</td>
<td>Impact of schistosomiasis treatment: assessment of long-term follow-up</td>
<td>Charles King</td>
</tr>
<tr>
<td>13:00–14:00</td>
<td><strong>Lunch</strong></td>
<td></td>
</tr>
<tr>
<td>14:00–14:30</td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td><strong>Integration of schistosomiasis with other neglected tropical disease control programmes</strong></td>
<td></td>
</tr>
<tr>
<td>14:30–15:00</td>
<td>Planning for NTD control</td>
<td>Mary Linehan/Angela Weaver</td>
</tr>
<tr>
<td>15:00–15:30</td>
<td>Resources and budgeting for NTD control</td>
<td>Angela Weaver/Aya Yajima</td>
</tr>
<tr>
<td>15:30–16:00</td>
<td><strong>Coffee break</strong></td>
<td></td>
</tr>
<tr>
<td>16:00–16:30</td>
<td>Schistosomiasis within the NTD Control Plan for the African Region</td>
<td>Adiele Onyeze/Likezo Mubila</td>
</tr>
<tr>
<td>16:30–17:00</td>
<td>Integrating schistosomiasis treatment into an NTD control programme</td>
<td>Emmanuel Miri</td>
</tr>
<tr>
<td>Time</td>
<td>Topic</td>
<td>Speaker</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>17:00–17:30</td>
<td>Monitoring needs for NTD control programmes: lessons from lymphatic filariasis elimination programmes</td>
<td>Pat Lammie</td>
</tr>
<tr>
<td>17:30–18:00</td>
<td>Capacity building for NTD control</td>
<td>Francesco Rio</td>
</tr>
<tr>
<td>18:00–18:30</td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Item</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>09:00–09:30</td>
<td>Introduction to group work</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group I: Setting the objectives and defining the problem: mapping and identifying communities at risk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group II: Strategic approach to preventive chemotherapy for schistosomiasis: planning, treatment, monitoring and assessment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group III: Integration of schistosomiasis with other NTD Programmes</td>
<td></td>
</tr>
<tr>
<td>10:30–11:00</td>
<td>Coffee break</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group work (continued)</td>
<td></td>
</tr>
<tr>
<td>12:30–14:00</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>14:00–15:30</td>
<td>Recommendations for schistosomiasis control: reports of group work</td>
<td></td>
</tr>
<tr>
<td>15:30–16:00</td>
<td>Coffee break</td>
<td></td>
</tr>
<tr>
<td>16:00–17:30</td>
<td>Plenary discussion, conclusions and recommendations</td>
<td></td>
</tr>
<tr>
<td>17:30</td>
<td>Closure of meeting – Lorenzo Savioli</td>
<td></td>
</tr>
</tbody>
</table>
Annex 2. List of participants

TEMPORARY ADVISERS

BARAKAT, Professor Rashida
Emeritus Professor of Medical Parasitology, Department of Tropical Health, High Institute of Public Health, University of Alexandria, 165 El Horreya Street, Alexandria, Egypt
Tel: +203 542 7010; Mobile: +2010 542 7011; Email: Barakat@dataxprs.com.eg

BIRITWUM, Dr Nana Kwadwo
Programme Manager, Neglected Tropical Diseases Control Programme, Ghana Health Service, P.O. Box MB-190, Accra, Ghana
Tel: +233 302 935922/23; Email: nanakwadwo.biritwum@ghsmail.org

BROOKER, Dr Simon
Kenya Medical Research Institute (KEMRI), Wellcome Trust Research Programme, Nairobi, Kenya and Faculty of Infectious and Tropical Diseases, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT, United Kingdom
Tel: +44 207 927 2614; Fax: +44 207 9272918; Email: simon.brooker@lshtm.ac.uk

DEMBELE, Dr Robert
Coordinator, National Programme for Schistosomiasis/STH, Direction Nationale de la Santé, Bamako, Mali
Tel: +223 66 75 9561; Email: rdembele2000@yahoo.fr

GARBA, Dr Amadou
Riseal Niger, 333 Avenue des Zarmakoye, BP 13724, Niamey, Niger
Tel: +227 20 753180; Fax: +227 96 590453; Email: garbamadou@yahoo.fr

GUO, Dr Jiagang
National Institute of Parasitic Disease, China Center for Disease Control, 207 Rui Jin Er Road, Shanghai 200025, China
Tel: +86 21 6466 2182; Fax: +86 21 5465 0863; Email: guojg@sh163.net

GUTMAN, Dr Julie (unable to attend)
Assistant Professor, Emory University, Pediatric Infections Disease, Atlanta, USA
Email: gutmanjr@gmail.com

HAGGAG, Dr Ayat Atef
Schistosomiasis & Intestinal Parasites Control Department, 3 Magless El-Shaab Street, Ministry of Health and Population, Cairo, Egypt
Tel: +2 02 279 47199, Fax: +2 02 279 48187; Email: ayata@mohp.gov.eg
HERNANDEZ, Dr Leda *(unable to attend)*
Coordinator, National Lymphatic Filariasis Programme, Department of Health, National Center for Diseases Prevention & Control, San Lazaro Compound, Santa Cruz, Manila, Philippines
Tel: +63 2 711 6808; Email: dr_ledahm@yahoo.com; beth_d@doh.gov.ph

JEMU, Mr Samuel
National Schistosomiasis and STH Programme Manager, Ministry of Health, P.O. Box 30377, Lilongwe3, Malawi
Tel: +265 175 2434; Fax: +265 175 7205; Email: Samuel.Jemu@gmail.com

KABATEREINE, Dr Narcis
Vector Control Division, Ministry of Health, 15 Bombo Road, P.O. Box 1661, Kampala, Uganda
Tel: +256 414 251 927; Fax: +256 414 253 044; Email: vcdmoh@gmail.com

KING, Dr Jonathan
Program Epidemiologist, The Carter Center, 1149 Ponce de Leon Avenue, Atlanta, GA 30307, USA
Tel: +1 404 420 3838; Fax: +1 404 874 5515; Email: jdking@emory.edu

KPOTO, Dr Louise *(unable to attend)*
NTD/NCD Coordinator, Ministry of Health, Monrovia, Liberia
Email: lkpoto@gmail.com

LAMMIE, Dr Patrick
Division of Parasitic Diseases and Malaria, Centers for Disease Control and Prevention, Mail Stop D-65, 1600 Clifton Road, Atlanta, GA 30329, USA
Tel: +1 404 718 4135; Email: pjl1@cdc.gov

MASSA, Dr Khalid
Department of Preventive Services, Ministry of Health and Social Welfare, P. O. Box 9083, Dar es Salaam, United Republic of Tanzania
Tel: +255 713 413 699; Email: kmkmassa@yahoo.com

MATTOCK, Dr Nina
Medical writer/editor, Parasitologist, 6 Chemin du Jura, 1233 Bernex, Switzerland
Tel: +41 22 757 0431; Mobile: +41 22 79 375 0943; Email: ninamattock@sunrise.ch

MIRI, Dr Emmanuel
Country Representative, The Carter Center, Nigeria National Office, No. 1 Jeka Kadima Street, Off Tudun Wada Ring Road, Jos, Nigeria
Tel: +234 73 290 507; Mobile: +234 803 7009081; Email: emmamiri@yahoo.com
NEBE, Dr Obiageli Josephine  
Tel: +234 803 306 0036; Email: nebeoj@yahoo.com

NSAKASHALO-SENKWE, Dr Mutale (unable to attend)  
National NTD/NCD Coordinator, Ministry of Health, Ndeke House, P.O. Box 30205, Lusaka, Zambia  
Email: drnsakasenkwe@yahoo.co.uk

RIBEIRO SOARES, Dr Rosa Castália França  
National Health Foundation (Funasa), Ministry of Health, Rua Machado Neto no. 267, Edifício Villa das Palmeiras, Apto 601, Pituba, Salvador, Bahia, Brazil CEP 41830-510  
Tel: +55 71 3332 1072; Fax: +55 71 3332 1072; Email: castalia@uol.com.br

RICHARDS, Dr Frank  
Director, River Blindness, Lymphatic Filariasis, Schistosomiasis & Malaria Programs, The Carter Center, 453 Freedom Parkway, Atlanta, GA 30307, USA  
Tel: +1 404 420 3898; Fax: +1 404 420 3881; Email: frich01@emory.edu

TALLA, Dr Idrissa  
Manager, National Schistosomiasis & Soil Transmitted Helminths Control Programme, Ministry of Health and Prevention, Rue Aimé Césaire, B.P. 4024, Fann Résidence, Dakar, Senegal  
Tel: +221 33 869 4286; Mobile: +221 77 638 7908; Email: idrissatalla@yahoo.fr

TCHUEM TCHUENTE, Professor Louis-Albert  
Director, Centre for Schistosomiasis & Parasitology, P.O. Box 7244 Yaoundé, Cameroon and Coordinator, National Programme for the Control of Schistosomiasis and STH, Regional Adviser for Africa, Royal Society of Tropical Medicine & Hygiene, United Kingdom  
Tel: +237 2221 0183; Mobile: +237 7770 7436; Email: tchuentctchuente@schisto.com

TRAORE, Prof Mamadou Souncalo (unable to attend)  
Chef du DER, Département d’Enseignement et de Recherche (DER) en Santé Publique, Faculté de Médecine de Pharmacie et d’Odonto-Stomatologie (FMPOS), B.P. E810, Bamako, Mali  
Tel: +223 2022 3842; Mobile: +223 6675 9051; Email: traorem@afribonemali.net

TOURE, Dr Seydou  
Manager, NTD-Riseal Burkina Faso, 06 BP 9103, Ouagadougou 06, Burkina Faso  
Tel: +226 50 36 1515; Fax: +226 50 39 1700; Email: ntd-riseal-bf@mail-bf.com
UTZINGER, Dr Juerg
Department of Public Health and Epidemiology, Swiss Tropical and Public Health Institute, Socinstrasse 57, CH-4002 Basel, Switzerland
Tel: +41 61 284 8129; Fax +41 61 284 8105; Email: juerg.utzinger@unibas.ch

VAZ, Dr Igor
Director, Urology Department, Maputo Central Hospital, P.O. Box 1164, Maputo, Mozambique
Tel: +258 823 001 930; Email: igorvaz@hotmail.com

VOUNATSOU, Dr Penelope
Department of Public Health and Epidemiology, Swiss Tropical and Public Health Institute, Socinstrasse 57, 4002 Basel, Switzerland
Tel: +41 61 284 8109; Email: penelope.vounatsou@unibas.ch

ZHOU, Prof Xiao-Nong (unable to attend)
Professor & Director, National Institute of Parasitic Disease, Chinese Center for Disease Control, 207 Rui Jin Er Road, Shanghai 200025, China
Tel: +86 21 647 38058; Email: ipdzhouxn@sh163.net

PARTICIPANTS

AMIEL, Dr Olga Maria da Conceicao Nelson
National Coordinator NTD Program Manager for LF, Ministry of Health, 264 Av. Eduardo-Mondlane Au Salvador Allende, 1008 Maputo, Mozambique
Tel: +258 827 395 150; Fax: +258 21 326 164; Email: oamiel@misou.gov.org

BLAIR, Dr Lynsey
Senior Project Manager, Schistosomiasis Control Initiative (SCI), Department of Infectious Disease Epidemiology, Imperial College London, St Mary’s Campus, Norfolk Place, London W2 1PG, United Kingdom
Tel: +44 207 594 3267; Fax: +44 207 262 8140; Email: l.blair@imperial.ac.uk

COLLEY, Dr Daniel
Director, Center for Tropical & Emerging Global Diseases, Room 330B, University of Georgia, 500 D.W. Brooks Drive, Athens, GA 30602, USA
Tel: +1 706 542 4112; Fax: +1 706 542 3582; Email: dcolley@uga.edu

DEB, Ms Rinki
Centre for Neglected Tropical Diseases, Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, United Kingdom
Tel: +44 151 705 3131; Email: rinkideb@liv.ac.uk
FENWICK, Prof Alan
Executive Director, Department of Infectious Disease Epidemiology, Faculty of Medicine, SCI-Imperial College London, St Mary’s Campus, Norfolk Place, London W2 1PG, United Kingdom
Tel: +44 20 7594 3287; Fax: +44 20 7262 8140; Email: a.fenwick@imperial.ac.uk

FLEMING, Dr Fiona
Country Programme Manager, Schistosomiasis Control Initiative (SCI), Department of Infectious Disease Epidemiology, Imperial College London, St Mary’s Hospital, Norfolk Place, London W2 1PG, United Kingdom
Tel: +44 20 7594 3626; Fax: +44 20 7262 8140; Email: f.fleming@imperial.ac.uk

KABORE, Dr Achille
NTD Program, RTI International, 805 15th Street NW, Suite 601, Washington, DC 20005-3967, USA
Tel: +1 202 974 7826; Mobile: +1 202 340 8888; Email: akabore@rti.org

KING, Dr Charles
Professor of International Health, Center for Global Health & Diseases, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, Ohio 44106–7286, USA
Tel: +1 216 398 3667; Fax: +1 216 368 4825; Email: chk@cwru.edu

LINEHAN, Dr Mary
Deputy Director, NTD Control Program, RTI International, 701 13th Street NW, Suite 750 Washington, DC 20005–3967, USA
Tel: +1 202 728 1964; Fax: +1 202 974 78921; Email: melinehan@rti.org

MAGNUSSON, Dr Pascal
Specialist in Tropical Medicine and Infectious Diseases, DBL – Centre for Health Research and Development, Faculty of Life Sciences, University of Copenhagen, Thorvaldsensvej 57, 1871 Frederiksberg C, Denmark
Tel: +45 35331436; Fax: +45 35331433; Email: pma@life.ku.dk

MATHIEU, Dr Els
Medical Epidemiologist, Elimination and Control Activity, Division of Parasitic Diseases and Malaria, Center for Global Health, Centers for Disease Control and Prevention, Mail Stop F22, 4770 Buford Highway, NE, Atlanta, GA 30341–3724, USA
Tel: +1 770 488 3603; Fax: +1 770 488 4465; Email: emm7@cdc.gov

OTTESEN, Dr Eric
Director, Lymphatic Filariasis Support Center, The Task Force for Global Health, 325 Swanton Way, Decatur, GA 30030, USA
Tel: +1 404 687 5602; Fax: +1 404 371 1138; Email: EOttesen@taskforce.org
REINHARD-RUPP, Dr Jutta
Head, Scientific Innovation & Partnerships, Merck Serono S.A. Geneva, Chemin des Mines 9, 1202 Geneva, Switzerland
Tel: +41 22 414 4998; Email: jutta.reinhard-rupp@merckserono.net

ROLLINSON, Dr David
Individual Merit Research Scientist, Wolfson Wellcome Biomedical Laboratories, Department of Zoology, Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom
Tel: +44 20 7942 5181/5152; Email: D.Rollinson@nhm.ac.uk

SCHEER, Dr Alexander
Director, Informatics and Knowledge Management, R&D Operational Excellence, Merck Serono International S.A. Geneva, Chemin des Mines 9, 1202 Geneva, Switzerland
Tel: +41 22 414 9836; Email: alexander.scheer@merckserono.net

SIMON, Dr Gregory
Global Network for Neglected Tropical Diseases, 2000 Pennsylvania Avenue, N.W., Suite 7100, Washington, DC 20006, USA
Tel: +1 202 621 1685; Fax: +1 202 842 7689; Email: gregory.simon@sabin.org

WEAVER, Ms Angela
Senior Neglected Tropical Disease Advisor, U.S. Agency for International Development, Ronald Reagan Building, 3.07–27, 3rd floor, Washington, DC 20523, USA
Tel: +1 202 712 5603; Fax: +1 202 216 3702; Email: aweaver@usaid.gov

ZAADNOORDIJK, Dr Willemijn
Project Manager, Scientific Innovation & Partnerships, Merck Serono International S.A. Geneva, Chemin des Mines 9, 1202 Geneva, Switzerland
Tel: +41 22 414 4316; Email: willemijn.zaadnoordijk@merckserono.net

Zhang, Dr Yaobi
Regional Advisor, Neglected Tropical Diseases, Helen Keller International, Regional Office for Africa, P.O. Box 29.898, Dakar, Senegal
Tel: +221 33 869 1063; Fax: +221 33 820 7477; Email: yzhang@hki.org

WHO SECRETARIAT

WHO Regional Office for Africa
Dr Adiele Onyeze, (unable to attend), NTD Programme Manager, DPC/AFRO, Division of Prevention and Control of Communicable Diseases (DDC), WHO AFRO B.P. 6, Brazzaville, Republic of Congo
Tel: (+263) 4 788220 39; Email: OnyezeA@zw.afro.who.int
Dr Likezo Mubila, DDC/NPC, Programmes Dev. Officer/AFRO, LF, SCH, STH, CPC (NTD)-Focal Point, East & Southern Africa InterCountry Support Team, 86 Enterprise Road, Highlands, P.O. Box BE 773, Belvedere, Harare, Zimbabwe
Tel: (+263) 4 788220 39; Fax: +47 241 39 503; Email: mubilal@zw.afro.who.int

**African Programme for Onchocerciasis Control (unable to attend)**

**WHO Eastern Mediterranean Regional Office**

Dr Riadh Ben-Ismail, RA/CTD, Abdul Razzak Al Sanhouri Street, P.O. Box 7608, Nasr City, Cairo 11371, Egypt
Email: ismailr@emro.who.int

Dr Nasr El-din El Tantawy, EM/ACO/EGY, Abdul Razzak Al Sanhouri Street, P.O. Box 7608, Nasr City, Cairo 11371, EGYPT
Email: eltantawyna@egy.emro.who.int

**WHO Region of the Americas**

Dr Martha Saboya, Epidemiologist, HSD/CD/NTD, PAHO, 525 23rd Street, N.W., Washington, DC 20037, USA
Tel: +1 202 974 3875; Email: saboyama2@paho.org

**WHO headquarters**

Dr Lester Chitsulo, Team Leader, Preventive Chemotherapy and Transmission Control, NTD
Tel: +41 22 791 3862; Fax: +41 22 791 4869; Email: chitsulol@who.int

Dr Denis Daumerie, Project Manager, NTD
Tel: +41 22 791 3919; Fax: +41 22 791 4777; Email: daumeried@who.int

Dr Dirk Engels, Coordinator, Preventive Chemotherapy and Transmission Control, NTD
Tel: +41 22 791 3824; Fax: +41 22 791 4869; Email: engelsd@who.int

Dr Albis Gabrielli, (unable to attend), Preventive Chemotherapy and Transmission Control, NTD
Tel: +41 22 791 1876; Fax: +41 22 791 4869; Email: gabiellia@who.int

Dr Kazuyo Ichimori, Preventive Chemotherapy and Transmission Control, NTD
Tel: +41 22 791 2767; Fax: +41 22 791 4869; Email: ichimorik@who.int

Dr Pamela Mbabazi, Preventive Chemotherapy and Transmission Control, NTD
Tel: +41 22 791 4855; Fax: +41 22 791 4869; Email: mbabazip@who.int

Dr Antonio Montresor, Preventive Chemotherapy and Transmission Control, NTD
Tel: +41 22 791 3322; Fax: +41 22 791 4869; Email: montresora@who.int
**Dr Piero Olliaro**, Leader, Chemotherapy for Helminths and other NTDs, TDR  
Tel: +41 22 791 3734; Fax: +41 22 791 4383; Email: olliarop@who.int

**Dr Valerio Reggi**, Quality Assurance and Safety Medicines, EMP  
Tel: +41 22 791 3561; Email: reggiv@who.int

**Dr Francesco Rio**, Preventive Chemotherapy and Transmission Control, NTD  
Tel: +41 22 791 3833; Fax: +41 22 791 4869; Email: riof@who.int

**Dr Lorenzo Savioli**, Director, NTD  
Tel: +41 22 791 2664; Fax: +41 22 791 4869; Email: saviolil@who.int

**Dr Arve Lee Willingham**, Stewardship, TDR  
Tel. +41 22 791 3203; Email: willinghama@who.int

**Dr Aya Yajima**, Preventive Chemotherapy and Transmission Control, NTD  
Tel: +41 22 791 3554; Fax: +41 22 791 4869; Email: yajimaa@who.int
REPORT OF A INFORMAL
CONSULTATION ON
SCHISTOSOMIASIS
CONTROL

Geneva, Switzerland, 30 March – 1 April 2011

Preventive Chemotherapy and Transmission Control (PCT)
Department of Control of Neglected Tropical Diseases (NTD)
World Health Organization
20, Avenue Appia
1211 Geneva 27, Switzerland
http://www.who.int/neglected_diseases/en