Helminth control in school-age children
A guide for managers of control programmes

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World Health Organization
Geneva
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Helminth control in school-age children

A guide for managers of control programmes

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Preface

This book is a guide for planners and programme managers in the health and education sectors who are responsible for implementing community-based programmes for control of soil-transmitted helminth (STH) and schistosome infections in school-age populations.

The book describes a common and cost-effective approach whereby periodic parasitological surveys in a sample of the school population are used to select the appropriate control strategy for the whole community. An alternative approach, which relies on individual diagnosis and treatment, has been used with success in the rapidly evolving economies of Japan and the Republic of Korea, but is not discussed here.

Key elements of guidelines previously published by WHO—Guidelines for the evaluation of soil-transmitted helminthiasis and schistosomiasis at community level (WHO, 1998) and Monitoring helminth control programmes (WHO, 1999c)—are brought together in this book, with a third component on planning and budgeting.

The book is intended to help managers to plan, implement, and monitor worm control programmes using methods based on the best current experience. It covers the following topics:

— programme design
— delivery of drugs to schools and treatment of children
— collection of data for programme evaluation
— obtaining the needed materials.

Users should note that the book is intended for guidance only; regional and national factors will influence actual control strategies. The illustrative examples in the book are provided as a means of sharing practical and specific experience: they will need to be adapted to local circumstances.

It is also important to understand that the helminths considered here are those that give rise to the greatest burden of disease, and for which there are field diagnostic techniques and control measures of proven cost-effectiveness (e.g. drugs that are inexpensive and efficacious and can be given as single doses). Consequently, control measures for organisms such as Strongyloides stercoralis and Enterobius vermicularis and for cestode infections are not discussed here. Strategies for controlling onchocerciasis and filariasis are also excluded since the extent of continuing worldwide elimination efforts ensure that these topics are adequately covered elsewhere. However, the integration of STH/schistosomiasis control with onchocerciasis/filariasis elimination programmes should be encouraged whenever possible.
Schistosomiasis and STH infections are diseases of poverty. Control of these diseases consolidates advances made by child survival programmes, helps to build the working capacity of adolescents and adults, and enhances opportunities for economic development. Adequate sustained control and, ultimately, interruption of transmission will depend on the success of intersectoral collaboration in improving hygiene and living conditions.
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Background

1.1 Magnitude of the problem

The burden of disease caused by soil-transmitted helminth (STH) and schistosome infections is enormous. More than 2000 million people are affected worldwide, of whom more than 300 million suffer from associated severe morbidity; 155,000 deaths are reported annually (Crompton, 1999). Global estimates of prevalence, mortality and morbidity are summarized in Table 1.1, and Figures 1.1 and 1.2 show the geographical distribution of STH and schistosome infections. These infections account for more than 40% of the global burden of all tropical diseases, excluding malaria (WHO, 1999a). STH infections are widely distributed in tropical and sub-tropical areas, especially in poor populations (for example, most populations in sub-Saharan Africa, indigenous populations in the rural areas of the Americas, and periurban slum populations). By contrast, schistosome infections occur much more focally, depending on local environmental conditions and on the distribution of suitable vectors.

Schistosomiasis and STH infections are diseases of poverty. These infections give rise to much suffering and death; in addition, they contribute to the perpetuation of poverty by impairing the cognitive performance and growth of children, and reducing the work capacity and productivity of adults.

In terms of the disease burden in school-age populations in developing countries, intestinal helminth infections rank first among the causes of all communicable and noncommunicable diseases (see Table 1.2).

Table 1.1  Estimates of global morbidity and mortality caused by soil-transmitted helminths and schistosomes

<table>
<thead>
<tr>
<th>Parawater</th>
<th>Prevalence of infection (millions)</th>
<th>Morbidity (cases, millions)</th>
<th>Mortality (deaths, thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil-transmitted helminths:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascaris lumbricoides</td>
<td>1450</td>
<td>350</td>
<td>60</td>
</tr>
<tr>
<td>Hookworms</td>
<td>1300</td>
<td>150</td>
<td>65</td>
</tr>
<tr>
<td>Trichuris trichiura</td>
<td>1050</td>
<td>220</td>
<td>10</td>
</tr>
<tr>
<td>Schistosomes</td>
<td>200</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

*Adapted from Crompton (1999).
Helminth control in school-age children

Figure 1.1 Global distribution of soil-transmitted helminth infections

Areas where STH are a public health problem
Areas where STH are transmitted
Figure 1.2 Global distribution of schistosomiasis
1.2 Disease and transmission

1.2.1 Disease

Soil-transmitted helminth and schistosome infections cause morbidity, and sometimes death, by:

— affecting nutritional status
— affecting cognitive processes
— causing complications that need surgical intervention
— inducing reactions in the tissues (notably granuloma).

Table 1.3 summarizes the effects of STH and schistosome infections on human health.

1.2.2 Transmission

STH and schistosomes are transmitted by eggs excreted in human faeces or urine, which contaminate the soil or water sources in areas that lack adequate sanitation. Humans are infected through:

— ingestion of infective eggs or larvae on contaminated food or hands (*Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale*)
— penetration of the skin by infective larvae that contaminate the soil (hookworms) or fresh water (schistosomes).

Unlike viruses, bacteria, fungi, and protozoa, these parasites do not multiply in the human host. Reinfection can therefore occur only as a result of new contact with the contaminated environment (see Figures 1.3 and 1.4).

1.3 Treatment and prevention

1.3.1 Drugs used in helminth control programmes

The drugs used to treat the most common STH and schistosome infections are effective and inexpensive. They have also been through extensive safety testing and have been used in millions of individuals with few, and minor, side-effects. Recommended treatments for use in public health interventions are summarized in Table 1.4.

---

One treatment for soil-transmitted helminth infections (1 tablet per child) costs less than 3 US cents.

One treatment for schistosomiasis (on average 2½ tablets per child) costs less than 20 US cents.

---

1.3.2 Prevention

Three components of a control programme, represented schematically in Figure 1.5, can interfere with the transmission cycle of STH and schistosome infections:

• **Drug treatment**—aimed at reducing *morbidity* by decreasing the worm burden. This will result in an immediate improvement in child
Background

Table 1.2  
DALYs lost and ranking of main causes of disease burden in children 5–14 years of age in developing economies

<table>
<thead>
<tr>
<th>Disease</th>
<th>Rank</th>
<th>DALYs lost (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intestinal helminth infections</td>
<td>1</td>
<td>16.7 (11.3%)</td>
</tr>
<tr>
<td>Childhood cluster (pertussis–poliomyelitis–measles–tetanus)</td>
<td>2</td>
<td>11.8 (8.3%)</td>
</tr>
<tr>
<td>Respiratory infections</td>
<td>3</td>
<td>10.4 (7.3%)</td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>4</td>
<td>8.7 (6.1%)</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>6.9 (4.8%)</td>
</tr>
<tr>
<td>Malaria</td>
<td>6</td>
<td>6.4 (3.2%)</td>
</tr>
<tr>
<td>All causes (communicable and noncommunicable)</td>
<td></td>
<td>142.0 (100%)</td>
</tr>
</tbody>
</table>


Table 1.3  
Effects of soil-transmitted helminth and schistosome infections in humans

<table>
<thead>
<tr>
<th>Effect</th>
<th>Sign of morbidity</th>
<th>Parrotide</th>
<th>Reference (example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutritional impact</td>
<td>Intestinal bleeding, anaemia</td>
<td>Hookworms</td>
<td>Stoltzfus et al., 1996</td>
</tr>
<tr>
<td></td>
<td>Urinary tract bleeding, anaemia</td>
<td>Schistosoma mansoni</td>
<td>Lambertucci, 1993</td>
</tr>
<tr>
<td></td>
<td>Malabsorption of nutrients</td>
<td>S. haematobium</td>
<td>Farid, 1993</td>
</tr>
<tr>
<td></td>
<td>Competition for micronutrients</td>
<td>Ascaris lumbricoides</td>
<td>Solomons, 1993</td>
</tr>
<tr>
<td></td>
<td>Impaired growth</td>
<td>A. lumbricoides</td>
<td>Curtale et al., 1995</td>
</tr>
<tr>
<td></td>
<td>Loss of appetite, reduction of food intake</td>
<td>Trichuris trichiura</td>
<td>Taren et al., 1987</td>
</tr>
<tr>
<td></td>
<td>Diarrhoea or dysentery</td>
<td></td>
<td>Stephenson et al., 1993</td>
</tr>
<tr>
<td>Impaired cognitive processes</td>
<td>Reduction in fluency and memory</td>
<td>T. trichiura</td>
<td>Callender et al., 1998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STH</td>
<td>Kvalsvig et al., 1991</td>
</tr>
<tr>
<td>Conditions requiring surgical intervention</td>
<td>Intestinal obstruction</td>
<td>A. lumbricoides</td>
<td>de Silva, 1997</td>
</tr>
<tr>
<td></td>
<td>Rectal prolapse</td>
<td>T. trichiura</td>
<td>WHO, 1981</td>
</tr>
<tr>
<td>Tissue reactions</td>
<td>Granuloma (reactions to eggs) in mucosa of urogenital system, intestine, and liver; obstructive uropathy; calcified bladder; cancer of bladder</td>
<td>Schistosomes</td>
<td>Farid, 1993</td>
</tr>
<tr>
<td></td>
<td>Fibrosis of portal tracts, hepatomegaly, ascites</td>
<td>Schistosomes</td>
<td>Lambertucci, 1993</td>
</tr>
</tbody>
</table>

health and development and, in the case of schistosomiasis, prevent the development of irreversible consequences in adulthood.

- **Improved sanitation**—aimed at controlling transmission by reducing soil and/or water contamination.
- **Health education**—aimed at reducing transmission and reinfection by encouraging healthy behaviours.
**Figure 1.3  Life cycle of intestinal helminths**

- Infected individual contaminates soil with faeces containing helminth eggs. Eggs develop in the soil.
- In infected individual, eggs or larvae develop into adult worms, which produce eggs.
- Other individuals are infected by eggs ingested through food or dirty hands, or by larvae penetrating the skin.

**Figure 1.4  Life cycle of schistosomes**

- Infected individuals contaminate fresh water with urine or faeces containing schistosome eggs.
- Cercariae contaminate individuals in contact with fresh water.
- In water the miracidia hatch from eggs and contaminate snails (intermediate host). Snails later release large numbers of cercariae.
Table 1.4  
**Drugs recommended for public health interventions against soil-transmitted helminth and schistosome infections**

<table>
<thead>
<tr>
<th>Infection</th>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil-transmitted helminths</td>
<td>Albendazole* or</td>
<td>400mg</td>
</tr>
<tr>
<td></td>
<td>Levamisole or</td>
<td>80mg*</td>
</tr>
<tr>
<td></td>
<td>Mebendazole* or</td>
<td>500mg</td>
</tr>
<tr>
<td></td>
<td>Pyrantel pamoate</td>
<td>10mg/kg</td>
</tr>
<tr>
<td>Schistosomes</td>
<td>Praziquantel</td>
<td>40–60mg/kg</td>
</tr>
<tr>
<td></td>
<td>Oxamniquine (for S. mansoni only)</td>
<td>15–30mg/kg</td>
</tr>
</tbody>
</table>

*aThe single-tablet formulation of these drugs makes them particularly attractive for use in school-based control programmes because there is no need for scales to weigh the children.

*bFor use in school-age children, two tablets of 40mg each are given in a single dose.

Figure 1.5  
**Programme for the control of soil-transmitted helminth and schistosome infections**

One or all of these components can be applied in a community, depending on the epidemiological situation and on the resources and support available. When the intensity of infection is high, drug treatment should be considered as a first-line rapid control measure. Improvements in sanitation and behavioural modification through health education are long-term measures, which should be considered for inclusion in a comprehensive community strategy. Increasing people’s awareness of the problem and extending community involvement are important aims of any helminth control programme. Families are especially important resources for supporting school health education activities and for improving sanitation and waste management in the home.
1.4 Epidemiological basis for control

Soil-transmitted helminths and schistosomes do not multiply in the human host (see section 1.2.2). Treatment will not always kill 100% of the infecting worms, but the few remaining worms do not multiply and pose only a minimal threat to health. Control efforts should therefore aim to produce a drastic reduction in the worm burden.

In endemic populations, STH and schistosomes are aggregated: most infected individuals in a community will have infections of a light or moderate intensity, while a few will be heavily infected. Heavily infected individuals suffer most of the clinical consequences of the infections and are the major source of infection for the rest of the community.

Prevalence is a measure only of the number of infected people in a community; intensity of infection is a measure of the number of worms infecting an individual. Thus, in monitoring the impact of a deworming programme, both prevalence and intensity should be assessed. Intensity of infection can be measured directly from a worm count following expulsion treatment, or indirectly—and much more conveniently—by egg count. Thresholds for the classification of “light”, “moderate”, and “heavy” infections are provided in Table 2.3. Each community can then be classified according to a combined prevalence/intensity rating in order to determine the appropriate treatment regimen (WHO, 1998).

Both prevalence and intensity of infection should be estimated to monitor the control activities.

Until environmental and/or behavioural conditions have changed, the prevalence of infection will tend to return to original pretreatment levels. Reinfection occurs because the infective forms of the organisms will continue to contaminate the environment. Unchanged prevalence of infection after repeated drug administration does not indicate failure of a control programme; certain important benefits are always achieved by drug treatment:

- reduction in the number of heavily infected people
- reduction in environmental contamination
- reduction in micronutrient loss (e.g. iron loss through intestinal bleeding in hookworm infection)
- improved nutritional status of the community.

The aim of control programmes is to reduce worm burden and keep it low. Children will become reinfected, but repeated treatment will ensure that they have fewer worms, for shorter periods. This will in turn help to give them the best chance of growing and learning.
Morbidity is directly related to worm burden. The greater the number of worms in the infected person, the greater will be the morbidity. For hookworms, this relationship is illustrated in Figure 1.6. The amount of blood lost in the faeces (an indicator of morbidity) increases as the worm burden (measured in terms of eggs per gram of faeces) increases.

Heavy-intensity infections are the major source of morbidity.

1.5 School-age children

School-age children are an important high-risk group for STH and schistosome infections because they are:

— in a period of intense physical growth and rapid metabolism resulting in increased nutritional needs; when these needs are not adequately met, individuals are more susceptible to infection;
— in a period of intense learning; helminth infections have been shown to have a negative impact on cognitive tasks;
— continuously exposed to contaminated soil and water but probably lack awareness of the need for good personal hygiene.

Reducing the intensity of infection significantly reduces both the morbidity attributable to these infections and the occurrence of severe complications such as those that are characteristic of the later stages of schistosomiasis. Periodic treatment of school-age children through schools has been identified as an effective preventive measure. Making use of the well-established school infrastructure reduces the costs of distributing treatment and provides an excellent opportunity to reach both enrolled and non-enrolled school-age children (see section 3.5.5).
1.6 Elements of a helminth control programme in schools

Using a schematic timeline, Figure 1.7 illustrates the major elements to be considered when planning a helminth control programme in the school-age population. In addition, consideration should be given to integrating the control programme with other health interventions and to regularly communicating with the community about the data and results obtained.
1.7 Sustainability

Among a number of factors that help to sustain helminth control programmes in schools, the most important is the support of the children’s parents and families, and of the community in general. With the backing of other advocates (e.g. ministries of health and education, nongovernmental organizations (NGOs)), substantial support for these programmes will emerge. Families can also have a voice in deciding how a programme will be financed, contribute to programme costs, or provide practical assistance (such as helping with transport or in the organization of drug administration days).

Government involvement is also crucial, particularly in developing and adopting a national policy on helminth control. Partnerships, for example with other governments, international organizations, nongovernmental organizations, and donor agencies, can be explored as a means of supporting helminth control programmes. Initiatives such as the School Health Insurance Scheme (WHO, 1999b) can be promoted, and it may be possible to secure financial assistance from sectors such as industry and agriculture, especially when the programme can be seen to offer them direct and indirect benefits. Programme directors thus have a responsibility to ensure that the impact of these programmes is made known to different government sectors. Health ministries can take advantage of the opportunities provided by schools in furthering their goals of promoting health; ministries of education, in turn, should be aware that helminth control programmes will increase the learning potential and achievement of school-age children.

A third factor is the involvement of the international community. Neither developed nor developing countries should overlook the contribution of helminth control programmes to the economic development of populations living in endemic areas.

1.8 Targets

Experience from several countries has demonstrated that periodic treatment of school-age children with anthelminthics effectively and substantially reduces morbidity in the short term and significantly lowers the risk of complications developing in adulthood. In developing countries, more than 480 million children attend primary schools each year, with enrolment varying between 68% and 98% of eligible children (Bundy & Guyatt, 1995). Schools provide an ideal setting in which to implement helminth control at low cost for an important high-risk group. Moreover, the benefits of a school-based control programme can be extended to other high-risk groups such as preschool children and pregnant women—even to the entire community.

WHO has set a target of delivering regular anthelminthic treatment to at least 75% of school-age children in endemic countries by the year 2010.
2 Planning

2.1 Collaboration between Ministry of Health and Ministry of Education

The successful implementation of any school health programme depends on effective collaboration between the Ministry of Health (MoH) and the Ministry of Education (MoE). A “School Health Office” under the administrative jurisdiction of either ministry allows personnel from both ministries to collaborate in the control activities. Countries that do not have such an office are encouraged to establish one before initiating a school health programme. The purpose of this collaboration is to ensure that each ministry has a clear picture of what the other is already doing, or can do, and of what the other’s capacities are, plus an in-depth knowledge of the local resources and infrastructure. As a first step, the school health office should collect and review available data on local occurrence of helminth infections and nutritional deficiencies; this will help to define the context for exploratory meetings with decision-makers, communities and potential donors.

2.2 Situation analysis

A situation analysis should be undertaken to guide the design and evaluation of school-based helminth control programmes. This can be detailed and comprehensive if resources are available, but the most appropriate initial approach is usually rapid data collection that can be achieved at relatively low cost. A list of suggested information to be collected for the situation analysis is presented in Table 2.1.

2.3 Budget

School-based helminth control programmes are among the most cost-effective public health interventions for reasons that include the following:

- They use existing educational infrastructure.
- They depend on inexpensive, safe, and effective drugs.
- They have a maximal effect in reducing the morbidity and transmission of STH and schistosome infections.
- They strengthen health awareness and provide the opportunity for wider health education.

Preparation of a realistic budget for the control programme is an essential part of the planning process, and will determine whether local funds will be adequate or whether external funding is required. The preliminary budget also serves as an advocacy tool both within the district, region, or country concerned and with external donor agencies.
The budget shown in Table 2.2 is provided as a checklist; it indicates the items to be considered during the first year of implementation of a helminth control programme in a hypothetical endemic region. All costs are given in United States dollars (US$).

Mebendazole and praziquantel are indicated as anthelminthic drugs in this example but individual health authorities should base their choice on their own experience and on the cost and local availability of the drugs.

In the example, the cost of treating each child is 46 US cents (US$ 0.46) during the first year of intervention. This includes baseline data collection, laboratory materials, and anthelminthic drugs. Per capita programme costs may be expected to decrease over time.

This budget is based on the cost analysis of a programme conducted in the Tanga Region of the United Republic of Tanzania in 1996, details of which have been published by The Partnership for Child Development (1996). The costs have been adjusted to year 2000, and estimates for the additional expenses of a survey, outreach to non-enrolled children, and training materials have been added (Table 2.2).

The hypothetical region is made up of four districts and has a population of 450000 individuals, including 100000 school-age children. The peripheral health structure is composed of 80 dispensaries/health centres, and there are 350 schools in the area. The area is considered endemic for schistosomiasis and STH. (In areas with no schistosomiasis, the budget could be significantly reduced—the cost of the questionnaire survey and of praziquantel tablets would not be included.)

<table>
<thead>
<tr>
<th>Data to be collected</th>
<th>Source</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local occurrence of helminth infections</td>
<td>MoH files/reports; academic publications; theses; hospital records</td>
<td>Identification of areas where helminth control is indicated</td>
</tr>
<tr>
<td>Size of school-age population and degree of school participation</td>
<td>Census data; population estimates; MoE files</td>
<td>Determination of the size of the control programme and the extent of non-enrolment</td>
</tr>
<tr>
<td>Costs of drugs, equipment, and other needed materials (see section 2.3)</td>
<td>MoH drug procurement body</td>
<td>Itemized budget estimates</td>
</tr>
<tr>
<td>Baseline information on helminth prevalence and intensity in the school-age population</td>
<td>Baseline questionnaire; parasitological (and nutritional) survey</td>
<td>Selection of appropriate control measures</td>
</tr>
<tr>
<td>Health sector and community perceptions of the disease, programme needs, and solutions</td>
<td>Focused discussions; KAP surveys; meetings with key informants</td>
<td>Obtaining optimal community involvement</td>
</tr>
<tr>
<td>Information on training and health education material available or in use in schools, dispensaries, etc.</td>
<td>MoH, MoE files</td>
<td>Maximizing use of available health education material</td>
</tr>
<tr>
<td>Information on NGOs conducting or interested in conducting school health programmes in specific areas</td>
<td>MoH, MoE, NGO files</td>
<td>Maximizing use of available resources</td>
</tr>
</tbody>
</table>

Table 2.1 Principal data to be collected for a situation analysis
In programmes involving over 100 000 children, the direct cost per child is estimated as 20–37 US cents each year.

The baseline data collection budget covers:

— adaptation/duplication/distribution of the schistosomiasis questionnaire to 350 schools
— parasitological data collection on 1000 school-age children (a team of 4 people, collecting data on 50 children/day, over 4 weeks; allowance US$ 10 per person–day)
— laboratory material, including the purchase of 2 microscopes (see Annex 1 for list of materials)
— drugs administered during the survey to the 1000 children plus all other children in the schools included in the sample (total 4000 children)
— fuel and maintenance charges for 1 vehicle (a vehicle is assumed to be available for 4 weeks at no charge).

Laboratory technicians are assumed to be adequately trained, and the cost of data entry and analysis is not included.

The teacher/health worker training budget covers:
— 3–4 workshops per district (25–30 participants in each workshop)
— training materials for teaching and for distribution to participants
— participation of 2 regional trainers in each workshop
— participation1 of 1 teacher per school (total 350 teachers)
— participation1 of 1 health worker per dispensary (total 80 health workers)
— adaptation/duplication/distribution of training materials.

The health education materials budget covers:
— adaptation/translation/production of materials for children in school
— development of specific material to reach non-enrolled children.

Examples of health education materials developed or recommended by WHO would be provided free of charge upon request (see List of useful addresses provided with this book).

The drug administration budget covers:
— mebendazole (3 US cents per tablet2), twice a year to all school-age children (total 200,000 tablets)
— praziquantel (10 US cents per tablet2 yearly to 50% of the schools (average 2⅓ tablets per child—total 125,000 tablets)3
— insurance costs and freight charges
— drug clearance, storage, and repackaging
— periodic quality control of drugs
— 175 scales (bathroom type) for determining dosage of praziquantel (but see section 3.5.2 for alternative methods of estimating dosage, which would reduce this cost).

Supervision by health personnel of the drug administration on treatment days is considered to be part of their regular activities and thus represents no additional direct cost. In some countries, however, an allowance may be considered to cover transport expenditures.

1 Participation costs include transport (US$ 5 per participant). Per diem allowances are budgeted at US$ 5 per participant (but these costs must be appropriately adapted in each country according to local standards).
2 See List of useful addresses provided with this book.
3 Drug quantities have been calculated for the entire school-age population, including non-enrolled school-age children.
**Outreach activities** for non-enrolled school-age children and information sessions for community groups are normally organized by the schools, and the budget covers:

— US$ 10 per school per drug administration round.

**Monitoring activities** are an integral part of the programme from the outset and are budgeted for:

— duplication of forms.

**Distribution and collection of forms** should be organized to coincide with other programme activities and should incur no cost.

### 2.4 Collection of baseline parasitological data

Baseline information is essential:

— to select the appropriate control measures to be used in the control programme;
— to provide a set of comparison data for monitoring the impact of the programme.

Generally speaking, STH infections are widely distributed, both geographically and demographically, and a parasitological stool survey in a sample of schools is normally sufficient to evaluate their public health importance in a community. Schistosomiasis, on the other hand, tends to be much more focally transmitted, because it depends on the presence of both the appropriate snail vector and suitable environmental conditions (e.g. freshwater ponds, irrigation ditches, and canals). One of the symptoms of urinary schistosomiasis is visible blood in urine. Since this is normally well recognized by children, the assessment of urinary schistosomiasis can be undertaken rapidly and accurately by using a simple questionnaire distributed to all schools in a delimited administrative or geographical area. The method has proved effective for ranking schools according to the level of transmission of urinary schistosomiasis (WHO, 1995).

In areas where the control programme needs to consider STH infections and both intestinal and urinary schistosomiasis, the following steps are suggested for the collection of baseline information:

1. Conduct the questionnaire survey in all schools to assess the occurrence of urinary schistosomiasis.
2. In areas likely to be endemic for urinary or intestinal schistosomiasis (on the basis of questionnaire results or other information collected during the situation analysis), conduct a stool and urine survey in a random sample of schools to assess the prevalence and intensity of STH and both intestinal and urinary schistosomiasis.

Localized pockets of urinary schistosomiasis infection can be identified in this way, and the magnitude of STH and intestinal schistosomiasis in the area can be assessed. For assessment of *S. haematobium* infection, it is then possible to compare the questionnaire results from all schools with the more accurate laboratory examination of urine in a random sample of schools: this allows a better understanding of the relationship between reported and actual occurrence of urinary schistosomiasis in the area.
Although baseline estimates of the prevalence and intensity of STH infections and schistosomiasis derive from information provided only by children attending schools, they are considered to provide a valid estimate of levels in the entire population of school-age children. It is crucial for outreach activities that target non-enrolled school-age children to be included as an integral component of any planned control programme.

In areas where urinary schistosomiasis does not occur, a stool survey should be conducted in a random sample of schools to assess the prevalence and intensity of STH and intestinal schistosomiasis. This will provide sufficient information for planning control activities.

2.4.1 Questionnaire survey for urinary schistosomiasis

The questionnaire is a rapid means of identifying heavily infected schools that should be treated first in urinary schistosomiasis control. It should be sent to all schools in the area concerned, which can be done at a relatively low cost, and should be administered by the teachers to children in three classes in each school (1st, 3rd, and 5th year). The questionnaire is short and simple and asks the children whether they have seen blood in their urine at any time during the past month (or a shorter period). The validity of this method with respect to intestinal schistosomiasis and blood in the stool is still under investigation.

Visible haematuria (blood in the urine) is an indicator of a heavy infection. The absence of visible haematuria, however, does not prove absence of infection because low-grade infection would not typically result in red urine. Nonetheless, the questionnaire survey does provide indirect evidence of the extent of schistosomiasis in a community.

Detailed procedures for using the questionnaire approach are discussed in *The schistosomiasis manual* (WHO, 1995). The brief outline shows how the questionnaire survey can be used to collect baseline data in a given area.

**Preparation of questionnaire survey**
- Identify the areas to be surveyed.
- Prepare a questionnaire in the local language (see Annex 2 for the model questionnaire used in Kilosa District, United Republic of Tanzania).
- Pretest the questionnaire and modify as necessary.

**Dissemination of questionnaire**
- Contact the relevant regional and district education and health authorities in the areas to be surveyed and brief them on the purpose and methodology of the survey.
- In consultation with the relevant authorities, identify individuals who will be responsible for coordinating survey activities at district level.
- Obtain information on the number of schools in the district and discuss the method of distribution and collection of questionnaires.
- Set mutually agreed target dates for distribution, completion, and return of questionnaires.
- Produce sufficient copies of the questionnaire and instructions for its use.
- Forward these to district authorities for distribution to head teachers.
- Keep in touch with the responsible person in the district during the survey.
• Collect completed questionnaires from district or regional authorities.
  Experience shows that 2 months is generally sufficient to obtain replies from over 90% of the schools involved.

2.4.2 Stool and urine survey for assessing STH and schistosomiasis

A stool and urine survey provides information on the prevalence and intensity of STH infections and schistosomiasis. The survey is conducted in only a random sample of schools in the area. The Kato–Katz method (WHO, 1991, 1994) is used for detecting STH and schistosome eggs in stools, and a filtration technique (or testing by reagent strip) for *S. haematobium* eggs (or blood) in urine. Any decision on the need for intervention should be based on results from both the questionnaire survey and the stool and urine survey. It is important to ensure that appropriately trained laboratory staff are available for collecting data.

Survey organization

School-based surveys are normally organized by a school health office with support, if necessary, from different levels of ministries of health or education, nongovernmental organizations, or universities. Following analysis of the survey results, potential interventions (anthelminthic treatment, micronutrient and other nutritional supplementation, sanitation measures, and information, education, and communication (IEC) strategies) are considered for inclusion in the control programme.

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Following the principle of “no survey without service”, all survey teams should be equipped with drugs to treat schistosomiasis and STH infections.

Children found to be suffering from other diseases should be referred to the nearest health centre.

The following sections provide detailed descriptions of the different components of the baseline parasitological stool survey.

*The field team*

A field team composed of 1 team leader, 2 laboratory technicians, and 1 auxiliary worker is usually sufficient to collect survey data on both STH and schistosome infections from at least 50 children per day. Some assistance in data recording and in the regulation of the flow of children through the various data-collecting stations should be arranged with the principal and teachers in each school.

*Tasks and responsibilities of team members*

The *team leader* is responsible for:

— training the team and explaining the survey objective to the community leaders and to the local health and school personnel
— organizing the practical procedures for data collection
— periodically checking how the forms are filled in
— quality control of the work performed by the laboratory technicians
— preparing reports for health authorities and the community involved
— organizing and delivering treatment in the schools being investigated.
The laboratory technicians are responsible for:

— collecting the samples
— labelling the stool/urine containers
— preparing and examining the stool and urine samples
— recording the results.

The auxiliary worker (who can usually be recruited from the local health centre or dispensary) is responsible for:

— measuring and recording children’s height and weight
— ensuring a clean working environment
— ensuring the continuous availability of clean containers, clean slides, and other material for the Kato–Katz and filtration techniques
— cleaning and safe disposal of contaminated material.

Meeting with people involved in the baseline survey
Health and education authorities—at central, regional, district, and village levels—and community leaders should be contacted, both for permission to visit the schools and to obtain their support and collaboration in the planning and implementation of helminth control programme activities in their area. There should be regular meetings with those involved to explain the purpose of the programme and of the survey, the expected benefits for the community, and the relevance of the diseases to be investigated, and to discuss possible strategies to be considered. Periodically, there should be meetings to inform all involved about the progress of the programme.

Parents must be informed that they can withdraw their children from the survey at any time without disadvantage for their children or themselves.

Sample size
The following factors should be taken into account in determining the size of the survey:

— available resources (time, funds, and personnel)
— objective of the data collection
— the sampling methodology.

To assess the need for control measures, a sample of 200–250 children in each ecologically homogeneous area is considered to be adequate for evaluation of the prevalence and intensity of the different helminth infections (Lwanga & Lemeshow, 1991). For example, in an area that is homogeneous in terms of climate, humidity, ecology, and soil type, a sample of 5 classes of 50 children (from 5 randomly selected schools) should provide sufficient data. To obtain comparable data from different control programmes it is suggested that third-year primary school classes be surveyed wherever possible: in an existing control programme, the infection status of third-year classes will reflect the impact of several drug administration rounds.

Sampling methods
The following steps in sample selection are given as an example for a national programme. If the programme covers only a region or a district, the sampling method should be adapted accordingly.
1. On the basis of available information (including the results of questionnaires, data on climate, humidity and vegetation, and reports of health units on S. mansoni), divide the country into a few homogeneous areas and select districts from each such area.
2. Select schools randomly from the list of all schools in each selected district.
3. Select one third-year class in each selected school and examine all the children present (up to a total of at least 50 children).

Selecting districts. The principle is to ensure, to the greatest extent possible on the basis of the information available, that the different areas are adequately sampled. The following example illustrates how to ensure that the data collected reflect the actual situation in the selected area. In each area, districts could be selected using lottery methods (i.e. putting the name of each district on separate pieces of paper in a container and drawing one out of the container).

Example

- The country consists of four ecologically different areas (a coastal area, a high-altitude area, a dry area, and a forested area).
- A questionnaire survey is conducted in all schools of the country.
- The questionnaire survey identifies self-reported haematuria only in coastal and forested areas.
- A stool and urine survey is conducted in five schools in the coastal area and five schools in the forested areas:
  - one or two districts are selected from all districts in the coastal area
  - one or two districts are selected from all districts in the forested area.
- A stool survey is conducted in five schools in the high altitude area and in five schools in the dry area:
  - one or two districts are selected from all districts in the high-altitude area
  - one or two districts are selected from all districts in the dry area.

Selecting schools. The selection of five schools from among those in each homogeneous area can also be done using lottery methods. It is important to include in the sampling frame all schools in the area, including private, religious, and other special schools.

Selecting classes. A letter of introduction explaining the details of the survey should be sent to the selected school before the day of the survey. The team leader should make an appointment to arrive at the school in the morning; he or she should introduce the team to the school staff and explain the aim of the survey. A lottery method should be used to select one class with at least 50 children from among the third-year classes. Where there is only one class in the third year, that class should be selected. If the number of children present in the selected class is less...
than 50, another class of an older age group should be selected and all children in both classes examined, to give a total of at least 50 children.

**Practical collection of biological samples**

General information on the school (see Annex 3) should be collected to facilitate interpretation of the results. Each child in the selected class should receive a container for a stool sample plus a second container for urine if *S. haematobium* infection is to be investigated.

When stool containers are distributed, it is important to indicate the amount of stool needed and to demonstrate how to introduce it into the container using a wooden stick. The containers should be distributed to the schoolchildren either on the day of collection or during the previous day. Generally speaking, the number of samples returned is independent of the timing of container distribution, but the first option simplifies the work by requiring only one visit to each school. The cultural appropriateness of this approach must be checked before the start of the survey. Urine containers should be distributed on the day of the survey.

The simplest way to collect both data and specimens is to organize a flow of children through stations where specific data are collected. It is useful to provide every child with a form (see Annex 4 for an example) to carry through all the data-collection stations (Figure 2.1). The individual responsible for each station will fill in the appropriate section of the form and return it to the child, and all forms will be collected at the final station. The team leader is responsible for checking, during the day and again at the end of the day, that the forms are correctly filled in.

There should be four data-collection stations, as follows:

1. “Registration/stool station”—name, class, age, and sex are registered on the form and the stool containers are collected and marked with the identity of the child.
2. “Urine station”—urine samples are collected and observed for visible haematuria and/or either tested with a reagent strip for the presence of blood or tested using the filtration method.
3. “Weighing station”—each child is weighed and his or her weight is marked on the form; height can also be measured here.
4. “Treatment station”—forms are collected and checked for errors, and appropriate anthelminthic treatment is administered to the children; treatment for STH is normally given presumptively to all the children in the school.

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**Planning**

It is important to allocate an identity number to each child and to mark it on his/her sample containers and form. This allows identification of the child in the event that any special therapy is needed.
Microscopic examination of stool samples can be performed at the school (usually in the afternoon) or the stool samples can be transported for examination in a laboratory.

Laboratory examinations
Parasitological diagnosis of STH and schistosome infections is made by examining stool and/or urine samples for the presence of helminth eggs.

**Stool examination.** The Kato–Katz technique (WHO, 1991, 1994) involves microscopic examination of a fixed amount of faecal material to detect and count helminth eggs. Egg counts give an essential indirect measure of the worm burden: the higher the egg count, the greater the number of worms infecting the individual concerned. Ideally, all samples should be collected in the morning and processed and examined in the afternoon of the same day. This simplifies the daily routine and reduces the number of containers and slides needed since they can be cleaned at the end of each day and reused. It is important that eggs are counted within 1 hour of the preparation of slides: hookworm eggs tend to become transparent over time and may be overlooked.

**Urine examination.** There are two options for the diagnosis of *S. haematobium*—detection of eggs or detection of haematuria (an important sign of urinary schistosomiasis in endemic areas). Visible haematuria may be detected by direct observation of the urine sample, which appears reddish in colour; it is an important sign of heavy infection with *S. haematobium* (Savioli et al., 1990). Detection of microhaematuria requires the use of a reagent strip.
The filtration technique (WHO, 1991) involves the microscopic examination of a filter used to collect the eggs of *S. haematobium* from 10 ml of urine. The urinary excretion of these eggs follows a daily rhythm, with a peak around noon. Urine specimens for filtration are therefore best collected between 10:00 and 14:00 (10 am and 2 pm).

Indirect diagnosis, using a reagent strip for haematuria, can be carried out quickly and easily; the method is highly sensitive and specific in endemic areas (Savioli et al., 1990) and can be considered a valid alternative to filtration. The reagent strip is dipped into the urine sample and then, after about 1 minute, compared with a colour scale supplied with the strips. Intensity of infection can be estimated according to the quantity of blood detected by the strip. Since haematuria tends to be more consistent than excretion of eggs, the strips can be used at any time of the day.

Use of the Kato–Katz and filtration techniques and of reagent strips offers several advantages in field situations:

- No special equipment is needed, other than a light microscope, the Kato–Katz kit, and the urine filters or strips.
- Most material for the Kato–Katz (templates, slides) and urine filtration (filter holders) may be reused after thorough washing.
- Urine filtration and reagent strips allow immediate diagnosis, while the child is still present, so that any necessary treatment can be given immediately.
- With Kato–Katz kits, slide preparation can be started in the field, immediately after stool collection.

**The appearance and diagnostic features of all common intestinal helminths known to infect humans are illustrated in *Bench aids for the diagnosis of intestinal parasites* (WHO, 1994). The bench aids can be used as a reference by laboratory technicians during training activities and in laboratory diagnosis.**

**Safety procedure**

Team members are recommended to wear latex gloves during the collection and microscopic examination of faecal and urinary specimens. Any material contaminated with stool or urine should be soaked in a suitable disinfectant, such as sodium hypochlorite solution, before disposal or cleaning for reuse.

**Quality control**

The consistency of microscopic results during the survey should be verified by quality control; this is particularly important for the Kato–Katz technique. Before the survey is undertaken, a day should be spent evaluating the consistency of egg counting among laboratory technicians. Each day during the survey, the team leader should read 10% of the slides handled by each microscopist without prior knowledge of the results. In the case of a discrepancy larger than 10%, the slide should be
discussed by the two readers and further slides should be examined to avoid repeated errors.

2.5 Analysis of the data collected

2.5.1 Questionnaire results

The questionnaire will provide information about the percentage of children in each school reporting symptoms of severe disease in the previous month. During the analysis, it would be possible to rank all the schools investigated according to the percentage of positive answers to the question concerning blood in the urine.

Responses about blood in the urine are very informative. High proportions of positive responses identify schools where morbidity is high and children are more in need of treatment.

Other valuable information can be obtained by comparing the results of the questionnaire with the parasitological survey in schools where both have been used. A correlation between prevalence and intensity of parasitological infection and the percentage of positive replies on the questionnaire can contribute to decisions on treatment. While decisions on how many schools are to receive praziquantel treatment should be based on human and financial resources, treatment of all school-age children in schools where there is more than 10% visible haematuria is strongly recommended.

2.5.2 Parasitological survey results

Individual results

The laboratory examination during the survey will classify each individual as infected or uninfected for each helminth species. Further, the individual can also be classified according to intensity of infection, measured in terms of eggs per gram (epg) of faeces and eggs per 10 ml of urine. When reagent strips are used, however, the intensity can only be estimated. With the Kato–Katz technique, the epg value is obtained by multiplying the number of eggs counted on the slide by a multiplication factor that varies according to the size of the template used. WHO recommends the use of a template holding 41.7 mg of faeces, which corresponds to a multiplication factor of 24. The classes of intensity proposed for the classification of individual infection, based on three WHO reports (1987, 1993; the third report is in preparation), are presented in Table 2.3.

According to the thresholds presented in Table 2.3, each individual can be classified as having no infection or as having light, moderate, or heavy infection; however these classifications may need to be adapted to specific local epidemiological situations.

School population results

The information relevant to the decision-making process for the control of soil-transmitted helminthiasis and schistosomiasis is:
The prevalence of infections (the percentage of infected individuals) in a population
— proportion of heavily infected individuals in a population.

The following formula is used to calculate prevalence of infection:

\[
\text{Prevalence} = \frac{\text{no. of subjects testing positive}}{\text{no. of subjects investigated}} \times 100
\]

It is important to calculate:

— the prevalence of infection with each helminth species—which allows treatment strategies and drugs to be selected accordingly
— the cumulative prevalence of soil-transmitted helminth infections (the prevalence of infection with at least one STH)—which is a useful indicator when deciding whether or not to implement targeted treatment.

When the Kato–Katz method is used, some light infections may be missed with the result that the estimated prevalence may be somewhat lower than the “real” prevalence in the community. This fact must be taken into consideration in evaluating the survey results.

Intensity of infection at community level can be expressed in different ways (arithmetic mean epg, geometric mean epg), but the most comprehensive and operational manner to present the intensity of infection is by classes of intensity by parasite.

For example, prevalence of heavy hookworm infection

\[
= \frac{\text{no. of subjects with heavy hookworm infection}}{\text{no. of individuals investigated}} \times 100
\]

and cumulative prevalence of heavy STH infection

\[
= \frac{\text{no. of subjects heavily infected with any STH}}{\text{no. of individuals investigated}} \times 100
\]

### Table 2.3  

<table>
<thead>
<tr>
<th>Helminth</th>
<th>Intensity threshold</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Light</td>
</tr>
<tr>
<td><em>A. lumbricoides</em></td>
<td>1–4999epg</td>
</tr>
<tr>
<td><em>T. trichiura</em></td>
<td>1–999epg</td>
</tr>
<tr>
<td>Hookworms</td>
<td>1–1999epg</td>
</tr>
<tr>
<td><em>S. mansoni</em></td>
<td>1–99epg</td>
</tr>
<tr>
<td><em>S. haematobium</em></td>
<td>1–50 eggs/10ml urine</td>
</tr>
<tr>
<td><em>S. japonicum</em></td>
<td>Any intensity of infection is considered to be high</td>
</tr>
</tbody>
</table>

Planning
Since the first objective of any control programme is the reduction in the proportion of highly infected individuals, this indicator is extremely important both for the selection of control measures and for monitoring the progress of the programme.

2.5.3 Frequency of drug administration and other control measures

The results of the survey can be used to determine the frequency of drug administration in the school-age population and the urgency of other measures such as health education activities and sanitation.

Soil-transmitted helminth infections

The results of a stool survey can be used to classify the school community into three large categories:

I. High prevalence and/or high intensity
The cumulative prevalence exceeds 70% of the sample and/or the cumulative percentage of moderately/heavily infected individuals exceeds 10% of the sample.
- Treatment 2–3 times a year targeted to all school-age children.
- The higher the cumulative percentage the more important it is to intensify the intervention.

In this category, standards of sanitation are usually extremely low. Reducing transmission through interventions based on IEC strategies, and improving sanitation, water supply, and appropriate waste management will be long-term aims; frequent and repeated treatment will significantly reduce the number of heavy infections and control the morbidity caused by STH infections.

II. Moderate prevalence and low intensity
The cumulative prevalence of STH is over 50% but less than 70%; the cumulative percentage of moderately/heavily infected individuals is less than 10%.
- Treatment targeted to all school-age children at least once a year.
- The higher the cumulative prevalence the more important it is to intensify the intervention.

Communities in this category usually have inadequate standards of sanitation. Reduction of transmission may be enhanced by implementing IEC strategies and supporting improvements in sanitation and waste management, in addition to drug treatment.

III. Low prevalence and low intensity
The cumulative prevalence of STH infections is below 50%; the cumulative percentage of moderately/heavily infected individuals is less than 10%.
IEC strategies, improvements in sanitation, water supply, and appropriate waste management have the potential to reduce the transmission of STH infections and should be extensively implemented.
Schistosomiasis
A similar classification can be used for schistosomiasis-endemic areas, but the threshold for implementation of targeted treatment for school-age children is lower.

I. High prevalence
The prevalence of schistosomiasis is over 50% or visible haematuria is over 30%.
• Yearly treatment targeted to all school-age children should be accompanied by IEC strategies and sanitation improvements.

II. Moderate prevalence
The prevalence of schistosomiasis is over 10% but less than 50%.
• Treatment once every 2 years, targeted to all school-age children, should be planned, accompanied by IEC strategies and sanitation improvements.

III. Low prevalence
The prevalence of schistosomiasis is under 10%.
• Targeted treatment of all school-age children twice during primary schooling (at entry and on leaving).
IEC strategies and sanitation and water-supply improvements should be extensively implemented at community level. The health system (dispensaries and health centres) must be provided with sufficient resources to treat symptomatic cases.

2.5.4 Feedback to the communities

Draft report
Survey findings should be reported to the local authorities as soon as data are available. The report may be a simple summary about the number of persons examined, the number of positive cases, the intensity of infections, and the number of persons treated during the survey. Individuals who participated in the data collection should be acknowledged and thanked. Consideration should also be given to presenting the findings orally, at a special meeting.

Final report
A more detailed final report of the survey must be sent to the local health and school authorities as soon as the data have been analysed. This report should communicate the results in a simple, clear, and concise way for non-experts. It should contain a simple analysis and evaluation of the data collected, and should advise on the preventive and control measures to be adopted.

2.6 Participation of the community in the planning process
Community participation provides additional practical information (for example, on the existence of unofficial schools in the area), and assists in planning activities (for example, by identifying better ways to reach non-enrolled school-age children). Community members will be directly involved in implementation activities (providing class supervision during a monitoring exercise, for instance). Once the community is convinced of the importance of the helminth control activity, the long-term sustain-
Helminth control in school-age children

ability of the programme becomes a realistic prospect. Where resources are available, the organization of a knowledge, attitudes, and practice (KAP) survey may provide an important opportunity to learn about community needs and involve the community in the health activities.

Example: KAP survey in Nepal

A KAP survey was organized by the Japanese International Cooperation Agency (JICA) in 1998 to assist in planning an appropriate health education component of a helminth control programme for primary-school children in Nepal.

Objectives. The objectives of the survey were to:
— identify community perceptions of STH infection
— evaluate community knowledge about STH and its prevention
— evaluate personal hygiene practices
— identify care-seeking behaviours in the community
— investigate community willingness to participate in the programme.

Methodology. Information was collected through focus group discussions (FGD) among schoolchildren and 28 communities of different social, ethnic, and religious backgrounds. The staff responsible for moderating and recording data from the FGD were trained in the methods to be used, and guidelines were prepared.

Fieldwork. Three teams, each composed of a moderator and two recorders, organized the FGD and reported the information collected during the discussion.

Results. Information was collected on hand-washing practices, use of shoes, defecation practices, perceptions of the relevance of the infection by children and adults, and preventive and curative measures taken. Health education was then targeted to specific behaviours (use of shoes, and the washing of hands and food) and to the importance of modifying “bad health” practices (small children defecating in house yards).

More than 50% of the 28 communities were found to be ready to provide financial support for the helminth control programme—an indication that such a programme would be sustainable over the long term.
3.1 Community involvement

The participation of the community from the start of planning is a key factor in the success of a control programme. Since improvement in children’s health is the objective of the programme, communities are normally supportive, which in turn ensures the necessary logistic support, provides additional practical information, and underpins the long-term sustainability of the programme. Representatives from schools (teachers), from the community (parents, community leaders), and from government (health and education authorities) should be informed as early as possible about:

— the objective of the intervention
— the health risk posed by the infections and the likely benefits of the control programme
— the results of parasitological or nutritional surveys.

The committee should be involved in any decision-making and approve the interventions to be implemented.

It is important to present information to the community in a simple and clear style: prevalences must be presented in practical terms that are easy to understand and preferably in the local language(s). It is advisable to discuss financial aspects (e.g. self-financing, government subsidies, co-payments, loans, insurance—see section 1.7) at this stage, as well as the short- and long-term objectives of the programme and the milestones to be reached.

3.2 Pilot phase—expansion phase

A phasing-in of control activities is recommended to ensure that the large-scale programme runs smoothly and efficiently. All organizational components of the programme can be tested in a pilot phase so that appropriate modifications can be made as the programme is expanded. Testing is important; staff of the school health office will benefit from the experience of working together to organize the different control activities and teams, and working with the local health and school personnel who will be participating in the control programme. Moreover, the validity of forms, questionnaires, and educational material can be assessed during the pilot phase, which will provide insight into the time and cost requirements of the different programme components. Problems dealt with on a small scale will yield solutions that can be developed for more widespread use. The accuracy of estimates (e.g. of numbers of non-enrolled children) can also be evaluated.
Once the pilot phase has been completed, the phasing-in period may need to include several further expansions—possibly over a period of years—for the control programme to achieve countrywide coverage.

### 3.3 Drug procurement and storage

The timely availability of drugs is essential for the effectiveness of the whole programme, and drug procurement is therefore a key phase in the implementation of control activities. In the case of large or national programmes, drugs must be ordered well in advance because of the quantity needed: procurement can be a lengthy process and drug companies may not be able to produce very large amounts of a drug in a short time.

Purchasing large quantities of drugs is a complex undertaking involving many steps, ministries, and manufacturers. The document *Operational principles for good pharmaceutical procurement* (WHO/UNICEF/UNFPA/World Bank, 1999) provides a set of principles that can be adapted by individual governments and public or private organizations in developing their own internal procurement procedures.

Whenever possible, specially trained personnel, probably from the essential drugs unit or similar department of the Ministry of Health, should be responsible for drug procurement.

Where there are difficulties in purchasing large amounts of drugs, programme managers may contact WHO Headquarters through their WHO Country Representative (WR) or through the WHO regional office. The Procurement Service of WHO can then make the necessary arrangements (see List of useful addresses provided with this book).

#### 3.3.1 Storage at central level

Drugs must be stored in a secure, cool, dry place. It is probable that the essential drugs unit (or equivalent department) in the MoH has a suitable facility. Space requirements for drug storage can be easily estimated. As an example, the space required to store the 200000 mebendazole tablets and 100000 praziquantel tablets mentioned in section 2.3 for one year’s treatment of 100 000 school-age children would be 0.5m³ (half a cubic metre). The drugs are normally packed in containers of 500 or 1000 tablets. Containers should not be opened at the central level, but kept intact until received at district level. Drug transfer into and out of the central storage facility should be carefully registered using appropriate forms. At regional and district levels, registration of drug transfer can be done using forms already in existence.

#### 3.3.2 Distribution to regions, districts, and schools

Before each round of drug administration can take place in the schools, adequate quantities of drug(s) have to be delivered. Different countries
have different distribution systems, so the specifics of distribution will need to be determined locally. The most important issues to consider are:

— making as much use as possible of existing structures in the MoH
— providing sufficient advance notice to storage and distribution facilities in the MoH for appropriate arrangements to be made.

Example: Use of education infrastructure for drug distribution in Tanga District, United Republic of Tanzania

In the United Republic of Tanzania, Ward Education Officers (senior teachers responsible for visiting schools regularly to provide advice and training, and deliver school supplies) each supervise several schools (typically 3–7). These individuals have played a key role in school health programmes that deliver anthelminthics. The steps followed in the programmes are:

• Each school completes a form showing how many children are enrolled in each class. This form can be issued to teachers when they collect their pay and returned a month later.
• Drugs are repackaged for each school by the District Medical Stores in the presence of a senior representative of the MoE. A simple electronic balance calibrated to count tablets is used to speed up this process and reduce handling. Praziquantel is provided on the basis of 2.5 600-mg tablets per child. Additional tablets (an extra 1–2%) to treat STH are provided to allow for extra children or the children of teachers to be treated. Tablets for each school are heat-sealed in a clear plastic bag with a slip of paper, signed by staff of the MoH and MoE, showing the number of tablets within. The packages are formally received by the MoE, which then becomes accountable.
• The school adviser collects and signs for the packets of tablets from the District Education Office and delivers one to each head teacher who signs for it. An allowance is provided to cover travel costs to and from the District Office.
• As most schools have neither suitable storage facilities nor night guards, the head teacher usually keeps the tablets safely in his or her house.
• The school adviser trains the teachers in the correct administration of drugs. Training in health education may also be provided.
• All children in the District are treated on the same day and are given some food before treatment, especially if praziquantel is to be given. They can bring the food to school themselves or it can be arranged by the school committee or teachers.
• Health personnel are given advance notice of the treatment day so that they are ready to provide support to schools. Schools should be able to claim expenses if children need to be transported to a medical facility.
• Random checks are later made in a sample of schools to ensure that children were actually treated. Teachers are informed that the spot checks will take place.
• Any remaining tablets and forms are collected soon after treatment by the school adviser and returned via the District Education Office to the District Health Office.

Experience has shown that wastage is less than 1% using this process because there is full accountability at each step.
Another efficient way of distributing drugs from the district level to schools is to combine the distribution with training activities (see section 3.4.3 for example). If at least one teacher from each school participates in training activities, that same teacher can transport the drugs back to the school.

At the district level, the drug consignment is opened and the drugs are divided into separate labelled containers according to needs of each school (which are based on the school's enrolment figures and an estimate of the numbers of non-enrolled school-age children). Suitable containers and labels have to be provided by the programme since they may not be available at district level.

3.3.3 Storage at peripheral level

The drugs will remain in the school for only a short period of time before being administered. The storage space (e.g. cupboard in the school or in the local dispensary) should:

— be dry, to prevent moisture from affecting the appearance or potency of the drug
— have secure doors to prevent break-ins
— be protected against insects and other pests and from direct sunlight.

Drugs should not be stored in the same place as poisonous or toxic substances or chemicals such as kerosene and petrol. As far as possible all drugs should be accounted for, although this may be difficult in the case of praziquantel—the need for 1/2-tablet and 1/4-tablet doses results in a number of broken tablets. A decision should also be made on what to do with drugs left over in schools after administration; possibly the head teacher could collect them and give them to the local dispensary for use in treating other infected individuals.

3.3.4 Quality of the drugs

All public drug supply systems should have access to quality control laboratories for testing drug products. If drugs are not purchased directly from a pharmaceutical company, which must guarantee their quality, managers should take action to confirm that drug quality has been assured by independent analysis. WHO has identified several laboratories that can undertake this type of testing and should be contacted for referral to a testing laboratory and in any instance where drug quality cannot be ascertained or is suspect. Testing alone cannot guarantee the quality of a drug—appropriate storage conditions are equally important.
3.4 Training

3.4.1 Managers

Training of managers can be a complex issue, but the personal experience of individuals who have already managed school-based helminth control programmes is invaluable. WHO is promoting exchange visits by managers from different countries in order to share their experience of situations that may require different problem-solving approaches.

For managers with limited experience of this type of helminth control programme, the best approach is “on the job” training. This is the rationale behind the suggestion that each programme start with a pilot phase; managers can test different approaches in a limited area in order to gain the necessary confidence to scale up to a regional or national programme. WHO can be contacted by programme managers for technical support, guidelines, technical documentation, and other materials (see List of useful addresses provided with this book). When warranted, a visit by WHO personnel during specific phases of the control activities can also be arranged.

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Drug quality control

To test the quality of a drug, the laboratory needs at least 100 tablets, preferably in the original sealed package (that is, if the package contains 500 tablets, it is preferable to send the full package).

Information to be provided to the laboratory testing the drug quality should include the following:

- For tablets that are in the original package
  - date and place of collection
  - conditions and duration of storage
  - reason for quality control (e.g. routine, new producer, reported problems of drug efficacy)
  - the producer’s certificate of analysis (if available)
  - the quantity of tablets produced in the lot (if available)
  - all additional information provided on the label.

- For tablets that are not in the original package
  - lot number and number of tablets in the production lot
  - production date
  - date of expiry
  - description of the original package
  - name of the producer and the distributor.
3.4.2 Health personnel

The major skills to be acquired by health personnel during training are:

— organization of drug administration in schools
— supervision and support of teachers

Health personnel responsible for health units and village health workers from the same areas as the teachers should be invited to participate in the training activities. Training sessions provide an ideal opportunity to inform these individuals about the purpose and practical implementation of the school-based activities. Health personnel can support the activities of the teachers or, where their numbers are sufficient, undertake the drug administration themselves.

The drugs used in school health programmes are extremely effective and not contraindicated for school-age children. Experience of use in millions of children in several countries shows that these drugs have only rare, mild, and transient side-effects.

Side-effects of anthelminthic treatment

• Side-effects are rare and are generally a reaction to degeneration of the worms that have been killed.

• The only drug side-effect that needs intervention is allergic skin reaction, which can be treated with a histamine antagonist.

• Mild abdominal pain is the most frequently reported side-effect, usually associated with praziquantel. It does not need treatment.

3.4.3 Teachers

The major skills to be acquired by teachers during training are:

— organization of drug administration in schools
— dissemination of health education messages
— reaching non-enrolled school-age children
— completing the forms for reporting (see model forms in Annexes 3, 4 and 5).

Experience from several helminth control programmes in endemic countries has demonstrated several advantages of using trained teachers in the implementation of these programmes:

• Teachers are familiar with the children and know how to deal with them.
• Teachers are respected by the children and their families.
• Teachers are frequently motivated and interested in health issues, particularly improving the health status of children.
Trained teachers can easily administer drugs and disseminate health education messages to the school-age population.

One training session of a few hours is normally sufficient to train a group of 30–40 teachers. Each teacher should subsequently be able to organize the drug administration in his or her school.

The example in the box below shows the timetable and content of a training course conducted in Guinea in 1997: during the course each teacher was provided with the quantity of drugs and the health education material needed for his or her school. Training was organized in a large school to enable each participating teacher to practise drug administration in at least one class.

Example: Teacher/health personnel training session—School Control Programme in Guinea

In 1997 the Programme covered 36,500 children from six sous-préfectures. In 1998 it was extended to six préfectures, covering 350,000 children, and in 2000 the Programme was scaled up to the whole country.

Objective of the training activities—to enable teachers to organize an efficient drug administration, to give simple health education messages and to fill in the forms correctly.

Timetable

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:00–09:30</td>
<td>Introduce aims of the school health programme</td>
</tr>
<tr>
<td>09:30–09:45</td>
<td>Discuss epidemiological results in the area</td>
</tr>
<tr>
<td>09:45–10:00</td>
<td>Discuss drug safety, process of referral, drug storage conditions</td>
</tr>
<tr>
<td>10:00–10:30</td>
<td>Questions and clarification</td>
</tr>
<tr>
<td>10:30–11:00</td>
<td>Coffee/tea break</td>
</tr>
<tr>
<td>11:00–11:30</td>
<td>Additional questions and clarification (including discussion of outreach activities)</td>
</tr>
<tr>
<td>11:30–12:30</td>
<td>Practical exercise: Drug administration</td>
</tr>
<tr>
<td></td>
<td>Drugs administered to one demonstration class by the trainer.</td>
</tr>
<tr>
<td></td>
<td>Teachers in groups of 3 or 4 administer drugs to the rest of the school</td>
</tr>
<tr>
<td>12:30–13:00</td>
<td>Practical exercise: Health education</td>
</tr>
<tr>
<td></td>
<td>Health education is provided to one demonstration class by the trainer.</td>
</tr>
<tr>
<td></td>
<td>Teachers in groups of 3 or 4 provide health education to the rest of the school</td>
</tr>
<tr>
<td>13:00</td>
<td>Distribution to each teacher of adequate quantities of drug for his or her school</td>
</tr>
</tbody>
</table>

1 “Sous-préfecture” and “préfecture” are administrative units similar to district and region.
A “cascade” type of training ensures efficiency and standardization while allowing for local input (e.g. to guide appropriate outreach activities). The first step is organization of a central training team—a core group of personnel will then be responsible for the organization of training activities at the regional level. Trained individuals at the regional level then train those at the district level.

The number of training sessions needed in each district will depend on the number of schools and the distances involved. It is suggested that sessions be organized for a maximum of 40 teachers at a time from nearby schools.

3.5 Delivery of the intervention in schools

3.5.1 Treatment day

The administration of a single dose of albendazole (400mg), mebendazole (500mg), or levamisole (80mg) is straightforward: each child receives one tablet (two in the case of levamisole). The teacher should ensure that children either swallow the tablets whole (levamisole) or chew them before swallowing (albendazole and mebendazole). In addition to these three anthelmintics, WHO also lists pyrantel (10 mg/kg) as an appropriate drug for deworming programmes. Clean drinking water should be available at the school on treatment day.

If praziquantel is to be given in addition to one of the drugs mentioned above, each child must be given the correct number of tablets according to body weight (40–60 mg/kg—see Table 3.1) or height (see 3.5.2) and should stay in school for 2 hours after the administration. If side-effects occur, the teacher should refer the child to health personnel.

Children who are ill on the treatment day should not receive drugs. This is not because of any danger of side-effects, but to prevent the potential misperception that the drug(s) caused the illness. These children can be given the anthelmintic drug(s) later, when they are well again.

<table>
<thead>
<tr>
<th>Body weight range (kg)</th>
<th>No. of 600-mg praziquantel tablets</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–14.9</td>
<td>1</td>
</tr>
<tr>
<td>15–22.4</td>
<td>1½</td>
</tr>
<tr>
<td>22.5–29.9</td>
<td>2</td>
</tr>
<tr>
<td>30–37.4</td>
<td>2½</td>
</tr>
<tr>
<td>37.5–44.9</td>
<td>3</td>
</tr>
<tr>
<td>45–59.9</td>
<td>4</td>
</tr>
<tr>
<td>60–75</td>
<td>5</td>
</tr>
</tbody>
</table>

3.5.2 Use of the “tablet pole”

Weighing scales may not always be available in schools. A method of determining dosages of praziquantel that relies only on height (which can be more readily measured) has therefore been developed: height and weight are usually highly correlated in children.
The “tablet pole” is a long piece of wood marked with the number of tablets of praziquantel needed to treat school-age children for schistosomiasis. A child simply stands upright against the pole and the number of tablets corresponding to his or her height can be read from the pole. Use of a tablet pole to determine dosage has several advantages over weighing children:

- It is cheaper than a weighing scale and has no moving parts that can break.
- It is simple and quick to use and requires no calculations.
- It is accurate and safe to use; an analysis has shown that the doses of praziquantel given to 80–90% of children measured with a tablet pole are in the same range as doses that would have been determined by weighing (Hall et al., 1999). The remaining 10–20% of children receive a dose within an acceptable range for treatment of schistosomiasis.

The height thresholds of the pole as tested in African children are shown in Annex 6.

### 3.5.3 Health education/health promotion activities

The purpose of health education is to influence health-related behaviours and conditions by stimulating pupils’ interest in, and guiding their efforts to improve, their own health and that of their families and community. Health education should therefore stress practical and basic information that will enable pupils to reduce the chances of exposure to infection. Close collaboration between education and health staff is necessary to identify behaviours that must be addressed in any particular community. Good standards of hygiene can be reinforced by having clean and functional latrines in the schools.

#### Common behaviours related to the transmission of helminth infections (WHO, 1996)

- Unhygienic habits that allow helminth eggs to enter the mouth:
  - not washing hands with clean water and soap before eating
  - not washing raw vegetables and fruits with clean water.
- Behaviours that allow hookworms or schistosomes to penetrate the skin:
  - walking barefoot
  - contact with fresh water.
- Behaviours that allow eggs or larvae to contaminate the environment:
  - defecating anywhere other than a latrine
  - urinating in fresh water.
- Behaviours that may result in continued transmission of infection:
  - failing to comply with treatment
  - failing to improve sanitation facilities and management of human waste (faeces).

Where endemic conditions warrant it, other parasitic diseases, not described in this book, can easily be addressed during health education sessions and activities. For example, eating raw and undercooked fish, shellfish, and meat can result in infection with flukes and tapeworms, and drinking untreated or unfiltered water can result in infection with guinea worm and protozoan parasites.
People must be taught what specific behaviours are likely to result in helminth infections so that such behaviours can be avoided. However, other information is also needed to encourage and enable students to adopt healthy practices. Information about values, beliefs, and attitudes that may influence behaviours and conditions associated with helminth infections can be obtained from pupils and from parents by undertaking a special type of study (KAP survey, focus group discussion).

Knowledge, attitudes, and practices related to reducing transmission of helminth infections (WHO, 1996)

Knowledge. Pupils and others will learn that:
• People can become infected by swallowing tiny worm eggs, invisible to the naked eye, which can be present on hands or food that have been contaminated with human faeces. They can also become infected by some worm larvae that can penetrate the skin.
• Worm infections can be prevented by avoiding some very specific behaviours.
• Poor hygiene and poor waste management lead to transmission of worms.
• Worm infections can easily be treated at a reasonably low cost.

Attitudes. Pupils and others can demonstrate:
• responsibility for personal, family and community health
• compliance with screening and treatment activities in the school/community
• confidence to change unhealthy habits
• willingness to share information about preventing worm infections in the school, in the family, and in the community.

Practices. Pupils and others will be able to:
• avoid behaviours that are likely to increase exposure to infection
• communicate messages about worm infection to their peers, their families and members of the community
• encourage peers, siblings, and families to take part in “deworming” activities
• follow the guidelines on maintaining a healthy school environment.

The availability of educational tools—documentation and other material—is important to help teachers promote health education among pupils. These tools should be designed to increase knowledge, build positive attitudes and values, dispel myths, and encourage each child's capacity to practise healthy behaviours. Teachers could also be trained in health education/health promotion activities that address other important health issues such as healthy nutrition, the dangers of smoking, the prevention of violence, and prevention of HIV/AIDS and other sexually transmitted infections (and the discrimination related to these infections).

Documentation on health education/health promotion activities may be requested from the organizations included in the List of useful addresses provided with this book.
Table 3.2 Additional health measures that can be integrated into the helminth control programme targeted to school-age children

<table>
<thead>
<tr>
<th>Health measures</th>
<th>Indication</th>
<th>Intervention</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron supplementation</td>
<td>In countries/communities where iron deficiency anaemia is considered to be an important public health problem</td>
<td>Ferrous sulfate, 200mg (65 mg iron), once weekly*</td>
<td>Tee et al., 1999</td>
</tr>
<tr>
<td>Iodine supplementation</td>
<td>In target areas of severe iodine deficiency and inadequate use of iodized salt</td>
<td>Iodized oil capsules, 400 mg, orally, every 1-2 years</td>
<td>Peterson et al., 1999</td>
</tr>
<tr>
<td>Lymphatic filariasis, global elimination programme</td>
<td>In countries/communities endemic for filariasis†</td>
<td>In Africa: once yearly ivermectin, 150 μg/kg albendazole, 400 mg In Asia and the Americas: once yearly diethylcarbamazine, 6 mg/kg albendazole, 400 mg</td>
<td>Ismail et al., 1998</td>
</tr>
<tr>
<td>Active trachoma prevention</td>
<td>In countries/communities where trachoma is endemic</td>
<td>Tetracycline, 1%, eye ointment</td>
<td>Schachter et al., 1999</td>
</tr>
<tr>
<td>Food supplementation programmes</td>
<td>These programmes have been the commonest ways of using food aid for education by the World Food Programme and other food aid donors. Deworming strengthens the educational and nutritional benefits of school feeding</td>
<td>Food supplementation</td>
<td>WFP, 1999</td>
</tr>
</tbody>
</table>

*Research is in progress to determine the most cost-effective dosing regimen. The efficacy of once or twice weekly supplementation appears promising and likely to be effective and sustainable in schools.
†The combination of ivermectin + albendazole will also treat STH, scabies, and strongyloidiasis. Additional administration of anthelmintics may be necessary in areas of high prevalence/high intensity of infection.

3.5.4 Other possible activities

Table 3.2 summarizes other activities that could be considered for integration into the school helminth control programme, depending on the local situation. (For relevant WHO contacts, see List of useful addresses provided with this book.)

3.5.5 Outreach to non-enrolled school-age children

One of the most important limitations of school health programmes is the fact that a significant proportion of school-age children in many developing countries do not attend school. These children have been shown to be more heavily infected than those who do go to school (Husein et al., 1996).
Reaching non-enrolled school-age children is a challenge for any control programme. The best means of reaching this population group need to be identified in each community, usually on the basis of information supplied by local groups, women’s organizations, religious leaders, community committees, family representatives, and teachers. School-children can bring their non-enrolled siblings and friends to school on “treatment day”, a “town crier” can announce treatment dates and times, music, theatre, radio, etc. can be used to inform and invite non-enrolled school-age children to obtain treatment and to participate in health education activities. The extent of non-enrolment can be estimated by comparing census information with school enrolment records. School enrolment figures can also be obtained from reports by international organizations such as United Nations Children’s Fund (UNICEF), United Nations Educational, Scientific and Cultural Organization (UNESCO), and United Nations Development Programme (UNDP).

Example: Outreach to non-enrolled school-age children—
the School Health Programme in Zanzibar


Objective of the outreach activities. To reach school-age children not enrolled in school in order to give them anthelminthic treatment and micronutrient supplements.

Strategy. During district-level teacher meetings, organized to train teachers in drug administration and health education activities, there was discussion of how to reach the large number of non-enrolled school-age children. Each group of teachers identified ways of informing families about the availability of anthelminthic treatment at the school on special “treatment” days. A small sum of money (US$ 20) was given to each school to buy the necessary materials for outreach activities. Possible outreach approaches identified were:

(a) posters, handmade by pupils
(b) traditional music group performing in the school on the treatment day
(c) messages distributed via megaphones and radio, and by religious leaders, to inform the village about the treatment day
(d) child-to-child communication (enrolled children letting non-enrolled siblings and friends know about treatment days).

A combination of approaches (c) and (d) resulted in more than 60% of non-enrolled school-age children being treated.
4.1 Objective of the monitoring process

WHO views monitoring as an integral component of any control programme, essential to the effective and efficient operation of the programme and to ensuring maximal benefit for infected individuals, their families, and their communities. An appropriate monitoring system allows documentation of the programme's impact, informs current practice, and guides future applications. It is important to disseminate the results of monitoring activities to communities and to relevant government ministries, and to provide feedback to donor agencies.

4.2 Cost of the monitoring process

Monitoring is an important part of the managerial process and it should be carried out with a minimum of expense, so as not to divert resources away from intervention activities. At the planning stage, it is recommended that approximately 5% of the programme budget be reserved for monitoring activities.

4.3 Suggested indicators

The indicators discussed in this section are considered important for monitoring the results of a school health programme involving drug treatment for STH infections and schistosomiasis and health education. They have been grouped into three categories, presented in Table 4.1. In order to provide maximal information, each indicator should be collected at the appropriate time and in the appropriate population group.

Baseline indicators are essential both for planning the type of intervention that will be included in the control programme and to serve as a reference against which later years will be compared. It is thus essential that the same method is always used to collect data in different years. Data on the impact of the intervention require the monitoring of a group of children who are likely to have received at least 2 years of intervention; grade 3 is therefore the optimal group for monitoring purposes.

Improvements in grade 1 children are not normally due to the repeated treatment but to a change in the community's epidemiological situation, which may have come about as a result of environmental and behavioural modifications.

Specific indicators in each category are listed in Tables 4.2, 4.3, and 4.4. Not all the indicators listed need to be collected—in fact, only a few are considered essential (shaded areas in the tables). Collection of additional
indicators should be based on a clear rationale for their use and on the resources available.

**Table 4.1** Categories of indicators, their use, and frequency of collection

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Use</th>
<th>Frequency of collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>Monitoring the organizational aspects of the programme</td>
<td>At every drug administration round</td>
</tr>
<tr>
<td>Parasitological</td>
<td>Selection of appropriate control measures; monitoring the impact of</td>
<td>Before start of treatment and every 2–3 years thereafter</td>
</tr>
<tr>
<td></td>
<td>the programme on occurrence of helminth infections</td>
<td></td>
</tr>
<tr>
<td>Morbidity</td>
<td>Monitoring the impact of the programme on selected outcomes closely</td>
<td>Before start of treatment and every 2–3 years thereafter</td>
</tr>
<tr>
<td></td>
<td>associated with parasite infections</td>
<td></td>
</tr>
</tbody>
</table>

• A control programme organized with *limited local resources* can be adequately monitored using only *process indicators*.

• A programme with *more resources* should consider *parasitological monitoring* every 2–3 years in addition to the collection of process indicators.

• A national control programme, implemented jointly by the Ministry of Health and the Ministry of Education and with *important financial resources*, should also consider monitoring *morbidity indicators* in addition to process and parasitological indicators.

Data collection is normally undertaken using forms. Examples of forms are given in Annexes 3, 4, and 5, but it is suggested that programme managers adapt these forms to each specific control programme. Forms should be pre-tested before a control programme is initiated.

**4.4 Process indicators**

Once the control programme has been initiated, the first monitoring activity involves calculating the number of participating schools and the number of teachers trained, and evaluating the distribution and quantity of drugs administered, and the number and type of health education activities carried out. These data are normally derived from forms completed during training activities, during distribution of drugs to schools, and after each school treatment day. The most important indicator is the estimate of *drug coverage* (i.e. the proportion of the school-age population, both enrolled and non-enrolled, that received the drugs). Additional aspects may also be evaluated when it is deemed useful, such as the content of health education activities, drug storage conditions (e.g. expiry dates), and the condition of latrines and water supplies in schools.

Process indicators, such as teachers’ attendance at training sessions, and drug administration coverage, are normally more accurate if collected
Monitoring immediately after the relevant event. They provide a measure of the efficiency of the programme in reaching the target population and allow problem areas to be identified.

Table 4.2 presents, at a glance, the process indicators, their calculation and use, and expectations or goals.

Example: Monitoring the process—the school control programme in Nepal

**Background.** The World Food Programme (WFP) has conducted a school feeding programme (SFP) in Nepal since 1996 with the objective of encouraging school enrolment. A parasitological survey of 780 primary-school children indicated a very high prevalence and intensity of STH infections and identified helminth control activities as important in strengthening the benefits of the SFP to the children’s nutritional status and school performance. The following control measures were implemented:

- twice-yearly anthelminthic administration to schoolchildren involved in SFP
- health education activities focusing on the STH infections
- improvement of sanitation in the schools (long-term objective).

**Target and objectives.** The deworming programme targeted 250,000 schoolchildren in approximately 2000 public primary schools in 12 districts. Its objective was to cover more than 75% of the school population.

**Procurement of drugs.** Albendazole (400mg) was procured from a local manufacturer after evaluation of the drug quality and competitiveness of the price.

**Training and preparation of training materials.** In 1998 MoH officials and WFP staff from Kathmandu, supported by WHO, organized Trainers’ Training Workshops in four districts. District health officials and Ministry of Education staff from each of the 10 project districts participated in the first-level training and then, in turn, provided second-level training to schoolteachers and parents.

**Printing and distribution of posters.** 3200 posters illustrating how worms develop in the human body, how they can damage people’s health, and ways of preventing worm infection, and 3000 “flash cards” depicting sanitation scenarios were printed for training and for distribution to schools.

**Administration of drugs.** Tablets were distributed to the primary schools through the WFP channel together with foods. In each school, trained teachers administered albendazole tablets to schoolchildren (>90% coverage in the target districts).

**Monitoring.** Forms have been developed to be filled in by teachers and district health officials for reporting on training activities and drug administration.

**Results.** Analysis of the data collected revealed extremely successful results in 1999:

- 100% of the schools had at least one teacher trained
- 90% of the enrolled schoolchildren received treatment.
Table 4.2  Process indicators, their calculation and use, and expectations or goals

<table>
<thead>
<tr>
<th>Process indicator</th>
<th>Calculation</th>
<th>Use</th>
<th>Expectations or goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) No. of schools participating in the programme</td>
<td>From programme forms</td>
<td>Evaluating the extent of the programme in the school system</td>
<td>&gt;90% of schools in the area have participated</td>
</tr>
</tbody>
</table>
| b) Percentage of schools participating in the programme | Numerator: no. of schools participating  
Denominator: total no of schools in the area of intervention | Determining whether training activities were adequate (for review and revision of training content, as appropriate) | At least one teacher in each school trained in health education activities, drug administration, and form-filling |
| c) No. of teacher training sessions | From programme forms | Estimating the amount of drugs needed and the efficiency of the drug-distribution system in the different areas | Each school received sufficient drugs to treat all school-age children (including non-enrolled children) |
| d) No. of schools with a trained teacher | From programme forms | For accountability | |
| e) No. of tablets administered | From programme forms | | |
| f) No. of tablets returned by teachers | From programme forms | | |
| g) Coverage† | Numerator: no. of school-age children receiving the intervention  
Denominator: no. of school-age children in the area of intervention | Determining the proportion of children receiving treatment | ≥75% of school-age children have been treated |
| h) Percentage of classes participating in at least one health education activity | Numerator: no. of classes that participated in at least one health education activity  
Denominator: total no. of classes in the area of intervention | Determining whether sufficient health education activities were undertaken | >90% of classes have participated in at least one health education activity |

†This indicator is one of the most important: reaching 75% of the school-age population has been identified by WHO as a minimal coverage target for endemic countries.

*Note that “school-age children” includes both enrolled and non-enrolled children. This denominator is normally available at country level or can be derived from census data. School-age children form approximately 25% of the total population in developing countries. If census data are not available or not up to date, the denominator could be estimated from the number of children enrolled and from the enrolment proportion (obtainable from the annual UNICEF publication The state of the world’s children and similar reports).
4.5 Parasitological indicators

Parasitological monitoring is based on assessment of the impact of the control programme on the intensity of helminth infections. Details of parasitological assessment, including quality control, are given in section 2.4.

At least two years of repeated intervention are normally necessary before improvements in the health of school-age children can be measured with parasitological indicators. Parasitological data are therefore collected 2–3 years after the collection of baseline data.

Parasitological monitoring is carried out just before a drug administration round (see Figure 1.7, p. 10). The timing is critical: monitoring at this point will provide the most information on reinfection occurring since the previous treatment, allowing the impact of the previous cycle(s) to be assessed. A representative sample of regions (and districts within regions and schools within districts) should be selected for monitoring purposes. New representative regions, districts, and schools should be selected for each monitoring event to avoid singling out any in particular. Because of the more focal nature of schistosomiasis, a sampling frame (or list) should be drawn up of schools, districts, and regions in areas that have been identified, from the questionnaire, as endemic for schistosomiasis (see section 2.4.1, p. 17).

The principal objective of a control programme is to reduce morbidity.

This is done by reducing the proportion of heavily infected individuals in the population.

Calculation of parasitological indicators provides a direct measurement of the effects of the control programme on the occurrence of helminth infections, and an indirect measurement of the effectiveness of the programme in improving health status. In particular, these indicators show whether the proportion of infected children, and especially those with heavy-intensity infection, is declining.
Example: Parasitological monitoring—the school helminth control programme in the Seychelles

A strategy to reduce morbidity and, in the long term, transmission of intestinal parasites, was implemented in the Seychelles in 1993. The programme involved 20,000 children and was integrated into the primary health care system, with control activities being undertaken through existing health facilities. The strategy was based on deworming three times a year, health education, and improvements in sanitation and water supply.

Objective. The programme aimed to reduce STH infection to a level at which morbidity would no longer be a public health problem (<1% of heavy-intensity infections). Programme coverage was 99.4%; parasitological monitoring yielded the following results:

<table>
<thead>
<tr>
<th>STH</th>
<th>Prevalence (%)</th>
<th>% heavy infection</th>
<th>Prevalence (%)</th>
<th>% heavy infection</th>
<th>Prevalence (%)</th>
<th>% heavy infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. lumbricoides</td>
<td>17.7</td>
<td>1.0</td>
<td>9.8</td>
<td>0.7</td>
<td>4.4</td>
<td>0.1</td>
</tr>
<tr>
<td>T. trichiura</td>
<td>53.3</td>
<td>1.1</td>
<td>36.1</td>
<td>1.3</td>
<td>27.3</td>
<td>0.7</td>
</tr>
<tr>
<td>Hookworms</td>
<td>6.3</td>
<td>0.6</td>
<td>8.6</td>
<td>0.2</td>
<td>4.2</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Cumulative</strong></td>
<td><strong>60.5</strong></td>
<td><strong>2.7%</strong></td>
<td><strong>44.4</strong></td>
<td><strong>2.2%</strong></td>
<td><strong>33.8</strong></td>
<td><strong>0.9%</strong></td>
</tr>
</tbody>
</table>

After three interventions the number of infected children was reduced by more than 44% and, more importantly, the proportion of heavily infected children was reduced to less than 1%. These results were probably a consequence of the concomitant and rapid socioeconomic development of the country, legislation to enforce implementation of sanitation in the whole country, and the high level of school attendance which significantly facilitated the programme.

Table 4.3 summarizes the parasitological indicators and specifies the numerator to be used in the calculation of each; the denominator is always the total number of children examined for the parasite(s) of interest.

4.6 Morbidity indicators

Morbidity monitoring will measure the direct effects of programme activities on improving health status; however, improvements in morbidity indicators are likely to be seen only where a control programme has been in effect for a relatively long time. A complete list of the possible signs of morbidity in STH and schistosome infections is given in Table 1.3 (p. 5). Some nutritional indicators (such as anaemia) and certain measures of overt morbidity (such as hepatosplenomegaly, cancer, or hospitalizations) are easier to collect and analyse. Prevalence of anaemia should be considered as a basic indicator of nutritional status, especially where there is hookworm infection. When warranted, and if adequate resources are available, other indicators, such as height and weight, mid-upper arm circumference, and erythrocyte volume fraction (haematocrit), can also be considered.
<table>
<thead>
<tr>
<th>Parasitological indicator</th>
<th>Calculation&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Use</th>
<th>Expectations or goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall prevalence of any soil-transmitted helminth infection</td>
<td>Numerator: no. of children positive for any of the three soil-transmitted helminths</td>
<td>Choosing appropriate control measures at baseline</td>
<td>Reduction of prevalence over time, especially where drug interventions are combined with behavioural and environmental improvements that reduce opportunities for exposure to infection (achieved over the long term through sustained health education activities)</td>
</tr>
<tr>
<td>Prevalence of each soil-transmitted helminth infection (A. lumbricoides, T. trichiura, and hookworm)</td>
<td>Numerator: no. of children with each soil-transmitted helminth infection</td>
<td>Measuring the effectiveness of the control measures in reducing prevalence</td>
<td></td>
</tr>
<tr>
<td>Prevalence of intestinal schistosome infections</td>
<td>Numerator: no. of children with intestinal schistosome infections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevalence of any haematuria or parasite eggs in urine</td>
<td>Numerator: no. of children with any haematuria or parasite eggs in urine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall proportion of “heavy-intensity” infection with any soil-transmitted helminth&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Numerator: no. of children moderately/heavily infected with any of the three soil-transmitted helminths</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of “heavy-intensity” infections with each of the soil-transmitted helminths&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Numerator: no. of children moderately/heavily infected with each of the soil-transmitted helminths</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of “heavy-intensity” intestinal schistosome infections&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Numerator: no. of children heavily infected with intestinal schistosomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of children with visible haematuria or “heavy-intensity” urinary infection&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Numerator: no. of children with visible haematuria or heavily infected with urinary schistosomes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>For all the indicators, the denominator is the total number of children investigated.

<sup>b</sup>For thresholds of heavy-intensity infection, see Table 2.3.
Measurement of morbidity indicators can be carried out at the same time as parasitological monitoring (see child form in Annex 4) or at other times. The collection of morbidity indicators requires experienced personnel and accurate instruments (e.g. ultrasound equipment, digital haemoglobinometer, stadiometer). If programme resources do not permit the purchase of such specialized equipment to be used by trained personnel, it is wiser not to measure these indicators than to measure them without the necessary precision. Details on methods of making nutritional measurements may be found in the manual Measuring change in nutritional status (WHO, 1983).

Table 4.4 summarizes morbidity indicators, their calculation and use, and related expectations or goals.

<table>
<thead>
<tr>
<th>Morbidity indicator</th>
<th>Calculation</th>
<th>Use</th>
<th>Expectations or goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of children with clinical signs or symptomsa</td>
<td>Numerator: no. of children with specified clinical sign or symptom examined for that sign or symptom Denominator: total no. of children investigated for that sign or symptom</td>
<td>Determining the effects of the control programme on health status</td>
<td>Reduction of the proportion of children with morbidity resulting from STH and/or schistosome infection to less than 1%</td>
</tr>
<tr>
<td>Percentage of children with anaemia</td>
<td>Numerator: no. of anaemic children (haemoglobin &lt;11 g/dl) Denominator: total no. of children investigated for haemoglobin status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of children with severe anaemia</td>
<td>Numerator: no. of children with severe anaemia (haemoglobin &lt;7 g/dl) Denominator: total no. of children investigated for haemoglobin status</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*aAppropriate clinical signs or symptoms to be investigated can be selected. These can be determined from various sources; for example, in the sample of children investigated parasitologically or from those involved in a specific survey (such as an ultrasound survey for schistosomiasis), or from records in hospitals, health centres, and dispensaries.

4.7 Additional indicators

In certain circumstances additional indicators may be warranted. These can be formulated at the national, regional, or district level at the outset if financial resources are sufficient, or later if additional funding becomes available from outside the control programme budget. The following four indicators serve as examples only; others can be formulated to reflect special needs or concerns.

- **Knowledge–Attitudes–Practice.** As an integral part of situation analysis, an assessment of changes in knowledge, attitudes, and practice (KAP) as a result of control activities can be valuable for the development of appropriate health education messages (see section 2.6). Changes are assessed by comparing results at two or more points in time.

- **Assessment of drug efficacy.** Anthelminthics are extremely effective in the treatment of worm infections. WHO should be consulted if programme managers suspect a reduction in drug efficacy: drug resistance may have developed, but expert investigation is essential. The topic is dealt with in a recent WHO report—Report of the WHO
Example: Morbidity monitoring—the control programme in Cambodia

Schistosomiasis due to *Schistosoma mekongi* is a priority health problem in certain areas along the Mekong River and several of its tributaries in Cambodia. Surveys and pilot studies conducted since 1993 have provided the fundamental data necessary for the establishment of a control programme. The intermediate host preferences are such that the rocky river banks provide the ecological conditions necessary for transmission of the infection, and a rapid appraisal method was used to identify priority risk areas. The questionnaire that was used also underlined the importance of two morbidity indicators—bloody stool and “big belly” (hepatosplenomegaly). Results of the questionnaire were validated by parasitological surveys. A total of 226 villages in two endemic provinces were surveyed over a 2-month period. An estimated 60,000 people were at risk of infection, and the related morbidity extremely severe.

The control programme included three main strategies:
- periodic mass drug administration (a single dose of praziquantel)
- strengthening the health facilities to prevent and treat the disease
- health education and information campaigns.

In STH-endemic areas, praziquantel administration was combined with a single dose of mebendazole. The impact of the programme was monitored using both morbidity and parasitological indicators. Baseline data and follow-up surveys in endemic villages included investigation of ascites, hepatosplenomegaly, and other signs of portal hypertension.

<table>
<thead>
<tr>
<th>Village</th>
<th>Liver morbidity indicators (%)</th>
<th>Spleen morbidity indicators (%)</th>
<th>S. japonicum prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achen</td>
<td>81.8</td>
<td>47.5</td>
<td>23.4</td>
</tr>
<tr>
<td>Chatanol</td>
<td>78.0</td>
<td>47.5</td>
<td>25.2</td>
</tr>
<tr>
<td>Sambok</td>
<td>82.7</td>
<td>51.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Sre Khoeun</td>
<td>83.9</td>
<td>54.0</td>
<td>38.1</td>
</tr>
<tr>
<td><strong>Mean prevalence</strong></td>
<td><strong>81.6</strong></td>
<td><strong>50.0</strong></td>
<td><strong>26.6</strong></td>
</tr>
</tbody>
</table>

These strategies dramatically reduced schistosomiasis prevalence in four sentinel villages (from 70.6% in 1995 to less than 5% in 1999); excellent control of morbidity was also noted (liver pathology, monitored with ultrasound, decreased from 81.6% to 26.6% by 1999).
Informal Consultation on Monitoring of Drug Efficacy in the Control of Schistosomiasis and Intestinal Helminths (WHO, 1999d).

- **Safe water and adequate sanitation.** Where the construction, repair, and maintenance of a water supply or latrines have been a component of the control programme, it may be appropriate to include a specific assessment of their impact. Additional process indicators should be formulated to reflect the specific nature of any sanitation interventions.

- **School effects.** Indicators under this heading include school attendance, absenteeism, retention, and achievement. The success of school-based activities in achieving outreach to other risk groups, or even to the community as a whole, can also be ascertained.
An increasing number of large-scale helminth control programmes are being planned to address the considerable burden of soil-transmitted helminthiasis and schistosomiasis in school-age populations in developing countries. New partnerships are being created to support these programmes, both financially andlogistically. Increased experience in programme implementation will benefit future programmes by increasing effectiveness and efficiency. Monitoring and evaluation results using standard outcome measures will allow the development of comparative data to assess impact and will contribute to the sustainability of these programmes.


The definitions provided here refer to the use of terms in this book, and are not necessarily valid in other contexts.

**ascites**  
See hepatosplenomegaly.

**cercaria**  
See life cycle of STH and schistosomes.

**coverage**  
The proportion of the target population reached by an intervention (e.g. percentage of school-age children treated during a treatment day).

**cumulative prevalence**  
See prevalence of infection.

**DALY**  
Disability-adjusted life year. “DALYs lost” indicate the number of years of healthy life lost because of a disease (or group of diseases) and provide an indicator of the public health relevance of the disease(s).

**disease burden**  
The mortality, morbidity, and disability caused by disease.

**dysentery**  
Frequent discharge of watery stools containing blood and mucus.

**epg**  
See intensity of infection.

**fibrosis (of portal tract)**  
The formation of fibrous tissue as a reparative or reactive process. Fibrosis of the portal tract is frequent in *Schistosoma mansoni* and *S. japonicum* infections.

**granuloma**  
Focal lesion resulting from an inflammatory reaction caused, in the case of schistosomiasis, by the eggs of schistosomes.

**haematuria**  
Presence of red blood cells in the urine. **Visible haematuria** is blood present in sufficient quantity to be detectable by direct visual examination of the urine sample (the colour of the urine is red-brown). **Microhaematuria** is blood present in insufficient quantity to be visible to the naked eye but detectable using a reagent strip.

**helminths**  
A group of parasites commonly referred to as worms. The group includes trematodes, cestodes, and nematodes. Schistosomes are trematodes; the species that most commonly infect humans are: *Schistosoma haematobium*, *S. intercalatum*, *S. japonicum*, *S. mansoni*, and *S. mekongi*. Cestodes include the beef and pork tapeworms, the largest of the helminths, and nematodes include the roundworm *Ascaris lumbricoides*, the whipworm *Trichuris trichiura*, and the hookworms *Necator americanus* and *Ancylostoma duodenale*; these nematodes are collectively referred to as “soil-transmitted helminths” (STH).
hepatosplenomegaly
Enlargement of the liver and the spleen due, in the case of intestinal schistosomiasis, to the host’s reaction to parasite eggs. The condition interferes with blood circulation in the two organs and causes portal hypertension (high blood pressure in the venous system entering the liver) and ascites (accumulation of serous fluid in the abdominal cavity). Hepatosplenomegaly and ascites can result in a considerable enlargement of the abdomen (“big belly”).

IEC
Information–education–communication—a health education strategy that aims to encourage people to adopt and maintain healthy life practices.

intensity of infection
The number of helminths infecting an individual. In the case of soil-transmitted helminths it can be measured directly by counting expelled worms after drug treatment, or indirectly by counting helminth eggs excreted in faeces (expressed as eggs per gram, epg). For schistosomes, only indirect measurement is possible and involves counting eggs per 10ml of urine. Indirect methods are more convenient and more commonly used.

intestinal obstruction
Blockage of the lumen of the intestine. This is a severe complication of ascariasis that occurs in infants and requires surgical intervention.

JICA

KAP survey
An assessment of the knowledge, attitudes, and practices of a community or group of individuals at one point in time, usually with respect to a health or health-related topic.

larva
See life cycle of soil-transmitted helminths and schistosomes.

life cycle of soil-transmitted helminths and schistosomes
Soil-transmitted helminth eggs hatch, as infective larvae, in soil (hookworms) or in the intestinal tract after ingestion of the egg (A. lumbricoides, T. trichiura). To develop into the adult form of the parasite, the larvae may then migrate in the human body (after penetration of the skin or of the digestive mucosa) and re-enter the intestine (A. lumbricoides, hookworms) or remain in the intestinal tract (T. trichiura).

For schistosomes, miracidia hatch from eggs excreted in fresh water. The miracidia are mobile in water and infect snails (intermediate host). Infected snails release great quantities of free-swimming larvae ( cercariae), which can penetrate the skin of humans (definitive host). The cercariae then migrate in the body and transform progressively into adult schistosomes.

lottery method
Method of sampling in which all the units are equally likely to be selected; for example, the name of each district is written on an individual piece of paper, all papers are placed in a container, and one is drawn out at random.

microhaematuria
See Haematuria.

micronutrients
Essential nutrients that are required by the human body only in small amounts (e.g. iron, iodine, vitamins).

miracidia
See life cycle of soil-transmitted helminths and schistosomes.
Helminth control in school-age children

morbidity Clinical consequences of infections and diseases that affect an individual’s well-being.

outreach activities Activities designed to provide populations not normally covered by a prevention or control programme (such as non-enrolled school-age children in areas where control programmes are targeted to school-age children) with the same health benefits as those who are covered.

portal hypertension See Hepatosplenomegaly.

prevalence of infection The percentage of individuals in a population infected with a particular parasite; for example, one population could have an ascariasis prevalence of 20%, a trichuriasis prevalence of 50%, and a prevalence of hookworm infection of 30%. The cumulative prevalence is the percentage of individuals in a population infected with at least one parasite. Using the above example, the cumulative prevalence could be between 50% and 100%, depending on the number of double and triple infections.

random sample The selection of a subset of a population, where the process of selection is by chance (e.g. lottery method).

sanitation Facilities for the safe disposal of human excreta and for the provision of safe drinking-water.

schistosomes See helminths.

school age Usually refers to children between 6 and 15 years of age, who may or may not be enrolled in school.

snail See life cycle of soil-transmitted helminths and schistosomes.

soil-transmitted helminths See helminths.

soil-transmitted helminthiasis Parasitic diseases caused by the soil-transmitted helminths: Ascaris lumbricoides, Trichuris trichiura, and the hookworms (Ancylostoma duodenale and Necator americanus).

visible haematuria See haematuria.

uropathy Disorder involving the urinary tract.
List of material for the survey

<table>
<thead>
<tr>
<th>Material</th>
<th>No. or quantity required</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For collecting stool and urine samples:</strong></td>
<td></td>
</tr>
<tr>
<td>Plastic containers (100 ml) for stool samples</td>
<td>250</td>
</tr>
<tr>
<td>Plastic containers (250 ml) for urine samples</td>
<td>250</td>
</tr>
<tr>
<td>Permanent-ink marker pens</td>
<td>5</td>
</tr>
<tr>
<td><strong>For analysing specimens:</strong></td>
<td></td>
</tr>
<tr>
<td>Microscopes (eyepiece x10, objectives x10)</td>
<td>2</td>
</tr>
<tr>
<td>Microscope slides</td>
<td>250</td>
</tr>
<tr>
<td>Forceps</td>
<td>2</td>
</tr>
<tr>
<td>Scissors</td>
<td>1</td>
</tr>
<tr>
<td>Disposable gloves (non-sterile)</td>
<td>1 pack of 100</td>
</tr>
<tr>
<td>Kit for 500 Kato–Katz</td>
<td>1</td>
</tr>
<tr>
<td>Glycerine</td>
<td>200 ml</td>
</tr>
<tr>
<td>Green malachite powder (optional)</td>
<td>5 g</td>
</tr>
<tr>
<td>Urine reagent strips (blood)</td>
<td>250</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Polycarbonate filters, diameter 13 mm, pore size 12–20 μm</td>
<td>250</td>
</tr>
<tr>
<td>and</td>
<td></td>
</tr>
<tr>
<td>Filter-holders for filtration</td>
<td>50</td>
</tr>
<tr>
<td><strong>For cleaning recyclable material:</strong></td>
<td></td>
</tr>
<tr>
<td>Brushes</td>
<td>3</td>
</tr>
<tr>
<td>Heavy-duty rubber gloves</td>
<td>3 pairs</td>
</tr>
<tr>
<td>Bucket</td>
<td>2</td>
</tr>
<tr>
<td>Powdered soap</td>
<td>250 g</td>
</tr>
<tr>
<td>Sodium hypochlorite (bleach)</td>
<td>3 litres</td>
</tr>
<tr>
<td><strong>For data registration:</strong></td>
<td></td>
</tr>
<tr>
<td>Pencils</td>
<td>10</td>
</tr>
<tr>
<td>Forms (see Annexes 3, 4, 5)</td>
<td>300</td>
</tr>
<tr>
<td><strong>For treatment:</strong></td>
<td></td>
</tr>
<tr>
<td>Mebendazole, 500 mg</td>
<td>Sufficient to treat the entire school</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Albendazole, 400 mg</td>
<td></td>
</tr>
<tr>
<td>Praziquantel, 600 mg</td>
<td></td>
</tr>
<tr>
<td>Scales (bathroom type)</td>
<td>1</td>
</tr>
</tbody>
</table>

*Stool containers should be made of plastic to allow recycling and should be large enough to allow a child to introduce a small quantity of faeces (about 10 g) using a wooden stick.

*If the filtration technique is used, the urine container should be large enough to allow a child to collect all the urine, since the eggs of *S. haematobium* tend to be found in the last few drops.
ANNEX 2

Schistosomiasis questionnaire used in primary schools of Kilosa District, United Republic of Tanzania
Put a ✓ for “yes” or a ○ for “no” and a dash — if the child does not remember or cannot answer. You must answer the following questions. Each column is for one child only. If there are not enough boxes on one page, use the back. Return this to the head teacher. Thank you.

**Name of school ______________________ Class __________________** (Use only for classes I, III, and V)

| Pupils | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 |
|--------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|

**Question 1** Which of the following symptoms did you experience during the last month? Put a ✓ or a ○ or — in the box for each symptom.

**Coughing**

**Itching**

**Headache**

**Fever**

**Abdominal pain**

**Blood in urine**

**Blood in stool**

**Diarrhoea**

**Question 2** Which of the following diseases did you experience during the last month? Put a ✓ or a ○ or — in the box for each disease.

**Malaria**

**Diarrhoea**

**Skin diseases**

**Eye diseases**

**Schistosomiasis**

**Respiratory inf.**

**Worms**

**Abdominal problems**

This questionnaire can be adapted and simplified. Only the shaded questions are relevant for investigating the importance of schistosomiasis in the school.
## School Form

### School Survey

**SOIL-TRANSMITTED HELMINTHIASIS AND SCHISTOSOMIASIS**

**SCHOOL FORM**

*to be completed by the survey team*

<table>
<thead>
<tr>
<th>School ____________________________</th>
<th>Date <strong>/</strong>/____</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region ____________________________</td>
<td>District ___________________</td>
</tr>
</tbody>
</table>

### Composition

<table>
<thead>
<tr>
<th>Total number of schoolchildren _______</th>
<th>Number of girls* _______</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of classes ___________</td>
<td>Number of teachers _______</td>
</tr>
</tbody>
</table>

### Water

<table>
<thead>
<tr>
<th>Is there a water source in the school? Yes ☐ No ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of water source ___________________________</td>
</tr>
<tr>
<td>Are there water sources close to the school? Yes ☐ No ☐</td>
</tr>
<tr>
<td>Type(s) of water source ___________________________</td>
</tr>
</tbody>
</table>

### Sanitation

<table>
<thead>
<tr>
<th>Are there latrines in the school? Yes ☐ No ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition of latrines ___________________________</td>
</tr>
</tbody>
</table>

### Health

<table>
<thead>
<tr>
<th>Nearest health facility ___________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type ___________________________________________</td>
</tr>
</tbody>
</table>

### Treatment

<table>
<thead>
<tr>
<th>Number of children treated for soil-transmitted helminthiasis:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrolled _______</td>
</tr>
<tr>
<td>Number of children treated for schistosomiasis:</td>
</tr>
<tr>
<td>Enrolled _______</td>
</tr>
</tbody>
</table>
SOIL-TRANSMITTED HELMINTHIASIS AND SCHISTOSOMIASIS
SCHOOL SURVEY

CHILD FORM
PARASITOLOGICAL/NUTRITIONAL DATA
to be completed by the survey team

<table>
<thead>
<tr>
<th>Personal data</th>
<th>Date <strong>/</strong>/____</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID Number ___________________</td>
<td>School (or village) _________________________</td>
</tr>
<tr>
<td>Name _______________________</td>
<td>Age _____ years________</td>
</tr>
</tbody>
</table>

| Nutritional data |  |  |
|------------------|-----------------|
| Weight _____ kg | Height _____ cm | Hb _____ g/dl |
| Anaemia (Hb < 11 g/dl) Yes ☐ No ☐ | Severe anaemia (Hb < 7 g/dl) Yes ☐ No ☐ |

<table>
<thead>
<tr>
<th>Parasitological data</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Stool examination</td>
<td>eggs/slide</td>
<td>eggs/gram (epg)</td>
<td>Moderate/heavy-intensity threshold</td>
</tr>
<tr>
<td>Ascaris lumbricoides</td>
<td></td>
<td></td>
<td>≥5000 epg</td>
</tr>
<tr>
<td>Trichuris trichiura</td>
<td></td>
<td></td>
<td>≥1000 epg</td>
</tr>
<tr>
<td>Hookworms</td>
<td></td>
<td></td>
<td>≥2000 epg</td>
</tr>
<tr>
<td>Schistosoma mansoni</td>
<td></td>
<td></td>
<td>≥100 epg</td>
</tr>
<tr>
<td>S. japonicum</td>
<td>See note</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other parasites identified</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| (b) Urine, visual examination |  |  |
| Visible haematuria |  |  |
| Microhaematuria (using reagent strips) |  |  |
| (c) Urine, examination by microscope |  |  |
| Schistosoma haematobium (filtration) |  |  |

<table>
<thead>
<tr>
<th></th>
<th>eggs/10 ml of urine</th>
<th>Heavy-intensity threshold</th>
<th>Heavy-intensity infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For S. japonicum, any intensity of infection is considered to be heavy.
SOIL-TRANSMITTED HELMINTHIASIS AND SCHISTOSOMIASIS
SCHOOL SURVEY

DRUG DISTRIBUTION FORM FOR ENROLLED SCHOOL-AGE CHILDREN

to be completed by the teacher during each treatment day

<table>
<thead>
<tr>
<th>School name</th>
<th>Location</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
<td>Region</td>
<td>District</td>
</tr>
</tbody>
</table>

Health education activities performed? Yes ☐ No ☐

Describe health education activities on the reverse side of this form →

<table>
<thead>
<tr>
<th>Names of enrolled children, from class roster</th>
<th>Sex</th>
<th>Drug administered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PZQ*</td>
<td>ALB</td>
</tr>
</tbody>
</table>

1
2
3
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24
25

Number of children enrolled

Number of children treated

Total quantity of drug used

*For praziquantel (PZQ), indicate the number of tablets given to each child.
### SOIL-TRANSMITTED HELMINTHIASIS AND SCHISTOSOMIASIS

### SCHOOL SURVEY

**DRUG DISTRIBUTION FORM FOR NON-ENROLLED SCHOOL-AGE CHILDREN**

to be completed by the teacher during each treatment day

<table>
<thead>
<tr>
<th>Name of child receiving treatment</th>
<th>Sex</th>
<th>Age</th>
<th>Drug administered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>PZQ*</td>
</tr>
<tr>
<td></td>
<td>ALB</td>
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<tr>
<td>25</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Number of children treated**

**Total quantity of drug used**

*For praziquantel (PZQ), indicate the number of tablets given to each child.*
Tablet pole for dosing praziquantel, as used in sub-Saharan Africa

The tablet pole with the height thresholds shown in the diagram below has been tested on 25,688 individuals in 10 sub-Saharan African countries. In more than 98% of cases, a dose of between 30 and 60 mg/kg was indicated by this method, which is within the dose range that is both effective and safe.

---

List of useful addresses

Note: This list is subject to regular updating. For the latest version, please consult the web site: http://www.who.int/infectious-disease-news/helminth-control-addresses.

Obtaining assistance with drugs and other material procurements

- WHO Procurement Service (PRS)
  Department of Informatics and Infrastructure Services (IIS)
  Cluster of General Management (GMG)
  World Health Organization
  1211 Geneva 27
  Switzerland
  Fax: +41 22 791 4196/4166

Current conditions related to drug procurement through PRS/WHO are as follows:

1. PRS guarantees best prevailing prices and quality.
2. For orders over US$ 70,000, PRS writes out an international tender.
3. For orders below US$ 70,000, PRS uses a simplified competitive bidding procedure.
4. PRS charges 3% overhead costs.
5. Prepayment is requested and can be made through the WHO country Representative.
6. Payment in local currency can be discussed with the WHO Representative.

Where to obtain WHO material

- Parasitic Diseases and Vector Control (PVC)
  Endemic Diseases Control, Prevention and Eradication (CPE)
  World Health Organization
  1211 Geneva 27
  Switzerland
  Tel: +41 22 791 4729 (PVC secretary)
  Fax: +41 22 791 4869
  Email: saviolil@who.int

Additional contacts in WHO/HQ

- Nutrition for Health and Development (NHD)
  Dr B. De Benoist
  Email: debenoist@who.int

- School Health and Youth Health Promotion (SHP)
  Mr J. Jones
  Email: jonesj@who.int
• Strategy Development and Monitoring for Eradication and Elimination (CEE)
  Email: filariasis@who.int

• Blindness and Deafness (PBD)
  Email: PBD@who.int

• Food Aid for Development (FAD)
  Dr M. Mokbel
  Email: mokbelm@who.int

Focal points for helminth control in WHO regional offices

• WHO Regional Office for Africa (AFRO)
  (Dr A. Kaboré, Dr J.-B. Roungou)
  Tel: +1 321 733 9336
  Fax: +1 321 735 9009
  Email: ddc@whoafr.org

• WHO Regional Office for the Americas/Pan American Health Organization (AMRO/PAHO)
  Division of Disease Prevention and Control
  (Dr J.P. Ehrenberg)
  Tel: +1 202 974 3894/3381
  Fax: +1 202 974 3632
  Email: ehrenbej@paho.org

• WHO Regional Office for the Eastern Mediterranean (EMRO)
  Tel: +20 2 670 2535
  Fax: +20 2 670 2492/2494

• WHO Regional Office for South East Asia (SEARO)
  Division of Communicable Diseases
  (Dr Padmasiri)
  Tel: +91 11 331 7804
  Fax: +91 11 332 7972 or +91 11 331 8412
  Email: padmasiri@whosea.org

• WHO Regional Office for the Western Pacific (WPRO)
  Dr K. Palmer (all countries)  Dr C. Urbani
  (Cambodia, China, Lao PDR, Viet Nam)
  Tel: +63 2 528 9725  Tel: +84 4 845 7901
  Fax: +63 2 521 1036/526 0279  Fax: +84 4 823 3301
  Email: palmerk@wpro.who.int  Email: urbanic@vtwpro.who.int

Additional contacts

• Glasgow University
  WHO Collaborating Centre for Soil-transmitted Helminthiases
  Institute of Biomedical and Life Sciences
  Graham Kerr Building
  Glasgow G12 8QQ
  Scotland
List of useful addresses

• The Hashimoto Initiative
c/o Department of Tropical Medicine and Parasitology
School of Medicine
Keio University
Japan

• The World Bank
Health Nutrition and Population
1818 H Street NW
Washington
DC 20433
USA

• United Nations Children’s Fund
Health Section
3 United Nations Plaza
New York
NY 10017
USA

• McGill University
Faculty of Medicine
Division of Clinical Epidemiology
Montreal General Hospital
1650 Cedar Avenue
Montreal
Quebec H3G 1A4
Canada

• Danish Bilharziasis Laboratory
WHO Collaborating Centre for Applied Medical Malacology
and Schistosomiasis Control
Jaegersborg Allé 1D
2920 Charlottenlund
Denmark

Companies producing/distributing useful materials

Note: The organizations listed are the suppliers known to WHO. Readers who are aware of other organizations supplying these materials are kindly requested to contact WHO with the information.

• International Dispensary Association
P.O. Box 37098
1030 AB Amsterdam
Netherlands
Tel: +31 20 403 3051
Fax: +31 20 403 1854
Email: info@ida.nl
Web site: www.ida.nl
Helminth control in school-age children

• Millipore Intertech (for filter-holders)
  Ashby Road
  P.O. Box 255
  Bedford
  MA 01730
  USA
  Tel: +1 800 645 5476, ext. 8895
  Fax: +1 781 533 8630
  Web site: www.millipore.com

• Pesquisa e Desenvolvimento Ltd (for Kato–Katz kits)
  Av. Getulio Vargas 1810 7 andar
  30112-021 Bel Horizonte
  Minas Gerais
  Brazil
  Tel: +55 31 281 7300
  Fax: +55 31 281 4447

• Sefar-Flytis (for filters)
  Rue Louis Minjard
  42360 Panissières
  France
  Tel/fax: +33 477 274485
  Web site: www.sefar.com

• United Nations Children's Fund Supply Division
  Procurement and Assembly Centre
  UNICEF Plads—Freeport
  2100 Copenhagen
  Denmark
  Tel: +45 35 273527
  Fax: +45 35 269421
  Email: supply@unicef.dk
  Web site: www.supply.unicef.dk

• Vestergaard Frandsen Group (for filters, filter-holders, Kato–Katz kits)
  Akseltorv 4B
  6000 Kolding
  Denmark
  Tel: +45 75 503055
  Fax: +45 75 503044
  Email: sales@vestergaard-frandsen.dk
  Web site: www.vestergaard-frandsen.dk
Schistosomiasis questionnaire

Put a ✔ for “yes” or a ☐ for “no” and a dash — if the child does not remember or cannot answer. You must answer the following questions. Each column is for one child only. If there are not enough boxes on one page, use the back. Return this to the head teacher. Thank you.

Name of school ______________________ Class ________________ (Use only for classes I, III, and V)

| Pupils | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 |
|--------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Age    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Sex    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

**Question 1** Which of the following symptoms did you experience during the last month? Put a ✔ or a ☐ or — in the box for each symptom.

- Coughing
- Itching
- Headache
- Fever
- Abdominal pain
- Blood in urine
- Blood in stool
- Diarrhoea

**Question 2** Which of the following diseases did you experience during the last month? Put a ✔ or a ☐ or — in the box for each disease.

- Malaria
- Diarrhoea
- Skin diseases
- Eye diseases
- Schistosomiasis
- Respiratory inf.
- Worms
- Abdominal problems

This questionnaire can be adapted and simplified.
### Personal data

<table>
<thead>
<tr>
<th>Date</th>
<th>ID Number</th>
<th>School (or village)</th>
<th>Name</th>
<th>Age</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Nutritional data

<table>
<thead>
<tr>
<th>Weight</th>
<th>Height</th>
<th>Hb</th>
<th>Anaemia (Hb &lt; 11 g/dl)</th>
<th>Severe anaemia (Hb &lt; 7 g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Yes □ No □

### Parasitological data

#### (a) Stool examination

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Eggs/slide</th>
<th>Eggs/gram (epg)</th>
<th>Moderate/heavy-intensity threshold</th>
<th>Moderate/heavy-intensity infection</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascaris lumbricoides</td>
<td></td>
<td>≥5000 epg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trichuris trichiura</td>
<td></td>
<td>≥1000 epg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hookworms</td>
<td></td>
<td>≥2000 epg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schistosoma mansoni</td>
<td></td>
<td>≥100 epg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. japonicum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other parasites identified:

#### (b) Urine, visual examination

<table>
<thead>
<tr>
<th>Visible haematuria</th>
<th>Present</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes □ No □</td>
</tr>
</tbody>
</table>

Microhaematuria (using reagent strips)

#### (c) Urine, examination by microscope

<table>
<thead>
<tr>
<th>Schistosoma haematobium (filtration)</th>
<th>Eggs/10 ml of urine</th>
<th>Heavy-intensity threshold</th>
<th>Heavy-intensity infection</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥250</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: For S. japonicum, any intensity of infection is considered to be heavy.*
### SOIL-TRANSMITTED HELMINTHIASIS AND SCHISTOSOMIASIS

#### SCHOOL SURVEY

**SCHOOL FORM**

to be completed by the survey team

<table>
<thead>
<tr>
<th>School ____________________________</th>
<th>Date <strong>/</strong>/____</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region ____________________________</td>
<td>District __________________</td>
</tr>
</tbody>
</table>

**Composition**

<table>
<thead>
<tr>
<th>Total number of schoolchildren _______</th>
<th>Number of girls* _______</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of classes _______</td>
<td>Number of teachers _______</td>
</tr>
</tbody>
</table>

**Water**

- Is there a water source in the school? **Yes** □ **No** □
- Type of water source _______________________________________________________
- Are there water sources close to the school? **Yes** □ **No** □
- Type(s) of water source _______________________________________________________

**Sanitation**

- Are there latrines in the school? **Yes** □ **No** □
- Condition of latrines _______________________________________________________

**Health**

- Nearest health facility _______________________________________________________
- Type ___________________________ Distance ______km

**Treatment**

- Number of children treated for soil-transmitted helminthiasis:
  - Enrolled _______ Non-enrolled _______
- Number of children treated for schistosomiasis:
  - Enrolled _______ Non-enrolled _______
SOIL-TRANSMITTED HELMINTHIASIS AND SCHISTOSOMIASIS
SCHOOL SURVEY

DRUG DISTRIBUTION FORM FOR ENROLLED SCHOOL-AGE CHILDREN
(to be completed by the teacher during each treatment day)

<table>
<thead>
<tr>
<th>School name</th>
<th>Location</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
<td>Region</td>
<td>District</td>
</tr>
</tbody>
</table>

Health education activities performed? Yes □ No □

Describe health education activities on the reverse side of this form →

<table>
<thead>
<tr>
<th>Names of enrolled children, from class roster</th>
<th>Sex</th>
<th>Drug administered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
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<td>1</td>
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</table>

Number of children enrolled
Number of children treated
Total quantity of drug used

*For praziquantel (PZQ), indicate the number of tablets given to each child.
**SOIL-TRANSMITTED HELMINTHIASIS AND SCHISTOSOMIASIS**
**SCHOOL SURVEY**

**DRUG DISTRIBUTION FORM FOR NON-ENROLLED SCHOOL-AGE CHILDREN**
to be completed by the teacher during each treatment day

<table>
<thead>
<tr>
<th>School name</th>
<th>Location</th>
<th>Date <strong>/</strong>/_______</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
<td>Region</td>
<td>District</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of child receiving treatment</th>
<th>Sex</th>
<th>Age</th>
<th>Drug administered</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>PZQ*</td>
</tr>
<tr>
<td></td>
<td>ALB</td>
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</tbody>
</table>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |

Number of children treated

Total quantity of drug used

*For praziquantel (PZQ), indicate the number of tablets given to each child.