4 Monitoring

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

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

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

indicators should be based on a clear rationale for their use and on the resources available.

- **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

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 (400 mg) 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*

Note: Core indicators are shown in bold type in shaded areas.

Process indicator	Calculation	Use	Expectations or goals
a) No. of schools participating in the programme	From programme forms		
b) Percentage of schools participating in the programme	*Numerator:* no. of schools participating *Denominator:* total no of schools in the area of intervention	Evaluating the extent of the programme in the school system	>90% of schools in the area have participated
c) No. of teacher training sessions	From programme forms	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
d) No. of schools with a trained teacher	From programme forms		
e) No. of tablets administered	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)
f) No. of tablets returned by teachers	From programme forms	For accountability	
g) Coverage[a]	*Numerator:* no. of school-age children receiving the intervention *Denominator:* no. of school-age children in the area of intervention[b]	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

[a]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.

[b]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:

	Survey 1—May 93		**Survey 2**—Sep. 94		**Survey 3**—Feb. 96	
STH	Prevalence (%)	% heavy infection	Prevalence (%)	% heavy infection	Prevalence (%)	% heavy infection
A. lumbricoides	17.7	1.0	9.8	0.7	4.4	0.1
T. trichiura	53.3	1.1	36.1	1.3	27.3	0.7
Hookworms	6.3	0.6	8.6	0.2	4.2	0.1
Cumulative infection	***60.5***	***2.7%***	***44.4***	***2.2%***	***33.8***	***0.9%***

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 4.3 *Parasitological indicators, their calculation and use, and expectations or goals*

Note: Core indicators are shown in bold type in shaded areas.

Parasitological indicator	Calculation[a]	Use	Expectations or goals
Overall prevalence of any soil-transmitted helminth infection	*Numerator:* no. of children positive for any of the three soil-transmitted helminths	Selecting appropriate control measures at baseline Measuring the effectiveness of the control measures in reducing prevalence	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 activies)
Prevalence of each soil-transmitted helminth infection (*A. lumbricoides*, *T. trichiura*, and hookworm)	*Numerator:* no. of children with each soil-transmitted helminth infection		
Prevalence of intestinal schistosome infections	*Numerator:* no. of children with intestinal schistosome infections		
Prevalence of any haematuria or parasite eggs in urine	*Numerator:* no. of children with any haematuria or parasite eggs in urine		
Overall proportion of "heavy-intensity" infection with any soil-transmitted helminth[b]	*Numerator:* no. of children moderately/heavily infected with any of the three soil-transmitted helminths	Selecting appropriate control measures at baseline Measuring the effectiveness of the control measures in reducing heavy-intensity infections	Reduction of the proportion of heavily infected children to 0%
Proportion of "heavy-intensity" infections with each of the soil-transmitted helminths[b]	*Numerator:* no. of children moderately/heavily infected with each of the soil-transmitted helminths		
Proportion of "heavy-intensity" intestinal schistosome infections[b]	*Numerator:* no. of children heavily infected with intestinal schistosomes		
Proportion of children with visible haematuria or "heavy-intensity" urinary infection[b]	*Numerator:* no. of children with visible haematuria or heavily infected with urinary schistosomes		

[a]For all the indicators, the denominator is the total number of children inuestigated.
[b]For thresholds of heavy-intensity infection, see Table 2.3.

Table 4.4 *Morbidity indicators, their calculation and use, and expectations or goals*

Morbidity indicator	Calculation	Use	Expectations or goals
Proportion of children with clinical signs or symptoms[a]	*Numerator:* no. of children with specified clinical sign or symptom *Denominator:* total no. of children examined for that sign or symptom	Determining the effects of the control programme on health status	Reduction of the proportion of children with morbidity resulting from STH and/or schistosome infection to less than 1%
Percentage of children with anaemia	*Numerator:* no. of anaemic children (haemoglobin <11 g/dl) *Denominator:* total no. of children investigated for haemoglobin status		
Percentage of children with severe anaemia	*Numerator:* no. of children with severe anaemia (haemoglobin <7 g/dl) *Denominator:* total no. of children investigated for haemoglobin status		

[a]Appropriate 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.

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.

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.

	Liver morbidity indicators (%)			Spleen morbidity indicators (%)			*S. japonicum* prevalence (%)		
Village	1995	1997	1999	1995	1997	1999	1995	1997	1999
Achen	81.8	47.5	23.4	66.0	62.4	17.1	68.6	23.6	4.9
Chatanol	78.0	47.5	25.2	14.3	8.7	0.8	70.3	3.7	7.2
Sambok	82.7	51.0	20.0	59.4	22.0	2.5	70.7	15.1	1.5
Sre Khoeun	83.9	54.0	38.1	22.9	13.3	6.4	72.9	18.7	2.4
Mean prevalence	***81.6***	***50.0***	***26.6***	***40.6***	***26.6***	***6.7***	***70.6***	***15.2***	***4.0***

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.