Contrasts in the Control of Schistosomiasis

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As control of schistosomiasis slowly progresses, some of the contrasts within this concept are becoming more sharply focussed and distinct. New lessons are being learned from current experience, yet the past cannot be ignored nor forgotten (Paraense, 1987). The last WHO Expert Committee on Control of Schistosomiasis (WHO, 1985) endorsed a global strategy of reduction of morbidity due to schistosomiasis. Achievement of this goal is generally accepted to be feasible with the available tools. On the other hand, the tendency in some quarters to misinterpret the availability of appropriate technology and safe effective antischistosomal drugs for control as magic bullets ignores the realities of the health care delivery systems of the endemic countries. What are these contrasts? How do they influence our current assessment of the global situation?

Past vs. Present.

In 1972 (Wright) schistosomiasis was recognized to be endemic in 71 countries although neither India or Mauritius were included among these. Before that time transmission of schistosomiasis had ceased in Cyprus and Portugal. Since that time no new or old infections were declared in St. Martin and Israel and are no longer included. Since 1972, additional countries reporting schistosomiasis are Equatorial Guinea, India, Jordan, Malaysia, Mauritius, Montserrat, Oman, and Sao Tome and Principe . No new infections have been reported in Japan since 1977.

As of 1989 schistosomiasis is endemic in 76 countries. In three countries where only S. haematobium had been previously reported, S. mansoni is now endemic: Niger, Oman and Somalia. The spread as due to agricultural development in the former two countries and due to displaced populations in the latter. S. intercalatum is now being confirmed in areas where it has long been suspected to be endemic: Sao Tome and Principe and Equatorial Guinea. Case reports of S. intercalatum infection from Mali and other west African countries are being followed up now.

This increase has probably been accompanied by a quantitative decrease in the total number on persons infected. While the global figures remain to be 200 million infected and 600 million exposed, these are the high range of the current estimates which are in the process of being revised.

The inadequate reporting of public health data remains the major obstacle to accurate estimates. As recently as 1966 more cases of schistosomiasis were officially reported from New York City than from Brazil. In 1963 schistosomiasis was reportable in 39 countries of which 11 were not endemic. Iarotski and Davis (1981) found that notification was required in 22 of 59 endemic countries replying to a WHO questionnaire.

The lack of information is further aggravated by the absence of reporting schistosomiasis as a cause of morbidity. While it is generally accepted that it contributes little to the overall mortality rates, hospital based data continues to be underutilized to evaluate its impact on health services. The WHO Expert Committee (WHO, 1985) recommended increased use of the International Classification of Diseases (WHO, 1977) with particular attention of the underlying infection in hospital records to improve reporting on schistosomiasis.

Egg counts vs. morbidity.

Morbidity control is far from a new concept. It is the means to achieve this objective which are new. It has brought new significance to diagnostic techniques and drug treatment in the public health context.

For diagnosis of schistosomiasis and other helminthic infections, the utilization of the Kato/Katz technique is increasing. Its limited sensitivity is well known. When assessed in the clinical context of diagnosis of the individual patient, it is arguably not the technique of choice. It is as important to understand its limitations as it is to taut its advantages. Some of these limitations are:

1. the quantity of stool is small. The various templates may measure 10-50 mg of stool. This contrasts to the laboratory stool concentration techniques such as the modified Ritchie or the Bell techniques which use a minimum of 1000mg, or 20-100 times the amount examined on a single Kato slide.

2. trained microscopists are required. It is increasingly difficult to train and maintain microscopists in public health programmes. On the other hand it is short sighted to believe that peripheral laboratory do not require the capacity to undertake microscopic examinations for diagnosis of parasitic and infectious diseases. There are no options. Long term commitment to promote this capacity can be initiated within current control programmes.

3. equipment is necessary. While the Kato technique has been described as simple, and it is, if one has the proper materials. Since it is simple, creative adaptation is possible. Banana leaves as stool containers, locally available metal screen, brass templates, even wrapping cellophane have all been used as substitutes for the 250 micron mesh nylon screen, plastic templates or the wettable cellophane.

For the past three years the WHO Parasitic Diseases Programme has been working with the German Gesellschaft fur Technische Zusammenarbeit (GTZ) through its Project Administration Service in Nairobi to establish a practical, low cost reimbursement scheme to provide supplies and equipment for diagnosis of parasitic diseases in Africa and the Eastern Mediterranean region. GTZ and the Cooperation Francaise have contributed the basic commodities and this programme is now underway. Until Kato technique materials are readily available and affordable its application in public health programmes will be limited.

There are many features in favor of the Kato technique for public health programmes:

1. It is a concentration technique. The extent of the concentration has been speculated rather than calculated. The concentration has been suggested to be up to 38% (Sleigh et al. 1982).

2. The distribution of eggs in the stool is random. If the eggs were aggregated then the representativeness of a single sample or the tractability of the results to statistical analysis could be questioned (Barreto et al. 1978).

3. Egg output over time is stable in the short term. This fact enhances the reproducibility of the results.

4. It is a standard reproducible technique. The Kato-Katz modification of this technique is the basis of this reliability which permits comparison of data over time as well within and between different programmes.

5. It is amenable to quality control procedures. Since the slides can easily be saved for later reexamination or shipped for some distance, the technique can contribute to the reliability of the data (El Malatawy et al. 1989).

6. Diagnosis of other intestinal helminths is possible. This aspect of the Kato technique promotes the integration of control of intestinal helminths and schistosomiasis. This feasible objective can be included in long range health planning.

The acceptability of the sensitivity of reagent strips for urinary blood to identify persons infected with S. haematobium has been confirmed in most endemic areas (Tanner, 1989). The limitation of the use of proteinuria as an indicator of infection due to the lower specificity has also been recognized.

The urine filtration technique with various types of filters (Nuclepore, Nytrel, filter paper) using a single random 10 ml. sample of urine probably detects about 90% of those who are infected during five or six consecutive examinations with the same technique. Classification of intensity of infection for research purposes based on a single sample of either urine or faeces is inadequate. In a number of programmes the sensitivity of current techniques is currently being studied.

While quantitative techniques are endorsed and used increasingly within control programmes the data generated cannot be seen as an end in itself. Public health administrators and planning officials do not understand egg counts. Morbidity assessment is an essential measurement for evaluation of control. The range of morbidity due to schistosomiasis was emphasized by the WHO Expert Committee (WHO, 1985) and has been the subject of recent reviews (Chen and Mott 1988a,1988b,1989; Gryseels, 1989). As morbidity due to schistosomiasis is more consistently reported it will be possible to assess trends in control.

One of the exciting areas of our understanding of the effect on morbidity is a mechanism for the inhibition of egg maturation and destruction of the granuloma proposed by Garcia and Mitchell in 1982, which has now been confirmed (Garcia et al. 1989). They have observed that anti-embryonation immunity is associated with S. japonicum infection. On the other hand, Matsuda et al. (1983) showed that praziquantel had a destructive effect on the complete embyronation of the miracidia and provoked hatching in situ, thus reducing granuloma development. These observations provide a basis for understanding the long term effect of treatment on disease caused by S. mansoni observed here in Brazil (Bina and Prata, 1983, Sleigh et al. 1986). There is now a general consensus on the beneficial effect of treatment to reduce morbidity due to Schistosoma infection. The onset of this effect appears 12-18 months after treatment.

As large scale control programmes generate data, there are fundamental epidemiological concepts which are being reemphasized.

a. Presence vs. absence. Negative epidemiological data has a definite role in schistosomiasis control. Absence of schistosomiasis is usually ascribed to areas where hospital laboratories have not reported its presence. Rarely is current negative data available from surveys designed to determine the absence of schistosomiasis. To the contrary,

research institutions undertake field research and public health programmes focus in "known" areas where high prevalence, high egg counts and high morbidity rates are most probable. Areas without schistosomiasis are attractive sites for water resources development and this information should be at the disposal of the planners of these projects.

b. Uniform vs. clustered. Clustering or aggregation in the epidemiology of schistosomiasis is the rule rather than the exception. The aggregation is present from global to family levels. In Zimbabwe the heterogeneity of the epidemiology of schistosomiasis has been observed (Chandiwana 1988a). The extrapolation of data from one endemic area to another within an endemic country is limited by our ability to acquire basic ecological data which influences water contact and transmission patterns. Moreover, the lack of data from areas and localities where schistosomiasis is not endemic is also a major constraint.

The aggregation is not limited to prevalence, it includes all other epidemiological variables related to schistosomiasis: intensity of infection, incidence, and morbidity patterns. Heavy worm burdens, as reflected in the faecal or urinary egg counts, are found in a few persons, within a few families or within a few localities. This aggregation has recently been observed in small communities, particularly after intervention (Kloetzel and Vergetti, 1988). They remind us that at one level this concept was articulated by Pessoa and Amorim in 1957 as 'peridomiciliary foci'. Similar observations can no doubt be made in most endemic areas. In control programmes which are based on sound epidemiological principles this characteristic of schistosomiasis means that surveillance in the maintenance phase must be based on appropriate criteria. While clustering may not be evident immediately, they can feasibly be identified by adequate surveillance through the health care system.

c. Stable vs. unstable. There is a tendency to underestimate the dynamics of population movements in endemic areas. In any longitudinal field research project, the assumed annual drop out rate is about 20-30 %. In national control programmes this factor is not included in the interpretation of most data.

Movements of displaced person due to conflict, drought and famine are currently playing an important role in the changing epidemiology of schistosomiasis in these countries:

1. Laos/Cambodia/Thailand
2. Ethiopia/Somalia/Sudan
3. Mozambique/Zambia/Malawi
4. Angola/Zaire

S. mansoni transmission is now established in some refugee camps in northern Somalia. In Ethiopia new foci of S. haematobium have been identified with population displacements (Ethete & Assefa, 1989)

d. Rural vs. urban. Most broad generalizations about schistosomiasis state, firstly, that it is a rural disease and, secondly, that it effects the poor populations. The changing global demography requires that the first assumption be reconsidered.

Between 1950 and 1980, the world's urban population nearly tripled from 701 million to 1,983 million; in other words, from one quarter of the total population to 41% of the total population. While this growth certainly was focussed on smaller cities, the number of metropolis over 5 million inhabitants rose from 7 to 26 in the same period. The change in distribution of cities with over 10 million inhabitants is more impressive; in 1950 London and New York were the only cities of this size; in 1975 there were 7, including Sao Paulo, Shanghai and Mexico City; by 2000 it is projected that only one addition city of this size will be in a developed country (Osaka) and 17 more cities of this size will be in developing countries.

In developing countries the urban population quadrupled from 286 million in 1950 to 1,140 million in 1985. While urban growth rates of 3-4% have not been uncommon, cities like Salvador, Bahia reached 9% growth rate at their peak. Projections in the future are no less startling; by 2000, the developing countries will have twice as many urban dwellers as developed countries and by 2025 the ratio will be 4:1.

Urban schistosomiasis is a reality rather than a potential threat. In Brazil the study of the Lago da Pampulha in Belo Horizonte by Carvalho et al. (1985) is an excellent example as to how ecological changes and transmission of schistosomiasis have evolved. In the periurban areas of almost every capital city in sub-Saharan Africa, transmission of schistosomiasis occurs. Urban schistosomiasis is the cumulative outcome of local transmission and migration. It usually begins with migration of infected persons from the rural endemic areas and may culminate in permanent transmission. Both aspects of urban schistosomiasis are burdens on urban health services. Case detection by microscopic examination and treatment may not be available. Control of transmission requires coordination of multiple municipal services from city planning to public works. Once established transmission control requires enormous resources which are not available in the health sector.

e. Hospital vs. the community. Now that morbidity control has been endorsed as a feasible objective for national programmes, the next question is how will this data be collected. Although opinion may not be unanimous, the generally positive association between the execution of the Brazilian national control programme (PECE) and reduction in morbidity is accepted. The impact was more pronounced than expected so that little provision had been made for either morbidity measurements within the programme itself or for improving hospital reporting. In a retrospective review, Andrade and Bina (1985) pointed out that autopsy records in the teaching hospitals of the northeast of Brazil have confirmed the reduction of disease due to schistosomiasis as a cause of death.

During a 27-year period between 1951 to 1978 in a rural general hospital in Uganda the case fatality rate due to schistosomiasis was 6% (104 deaths/2543 patients with admission diagnosis of schistosomiasis). As expected this was one of the lowest of all case fatality rates, however of the total of 1960 deaths during this period, 104 or 5.3% were due to schistosomiasis. Interestingly from the same data base it was possible to identify certain areas near the Nile with higher case fatality rates than others.

This is an isolated example of the potential for evaluation of the impact of control. Both important epidemiological data indicating areas of high morbidity and data on the importance of schistosomiasis to the health care system were obtained. Hospital data, with its inherent limitations of population bias, cannot be ignored in the evaluation process of control of parasitic diseases.

Species vs. strain. The new diagnostic techniques and effective safe chemotherapy have focussed our attention on the parasite as it effects man, in contrast to laboratory animals. The basic taxonomy of human Schistosoma is not in question. It is functional and serves the scientists and public health workers alike. However, there has always been a healthy level of scientific inquiry which has kept the question of strain variation under scrutiny. Morphology alone does not appear to be tell the whole story. Immune blotting techniques and DNA probes offer new potential to characterize the parasite.

From the point of view of control, the question of differences in morbidity patterns of S. haematobium transmitted by Bulinus globosus vs. Bulinus truncatus has probably been satisfactorily answered in large scale control activities with treatment. On the other hand oxamniquine has served as an unwitting probe to define S.mansoni of varying sensitivity. Even the recommended current dosage schedules of 15-20mg/kg in Brazil vs. 40 mg/ kg or higher on the African continent need to be monitored constantly.

The question of interaction of different species of Schistosoma and its potential influence on the outcome of treatment cannot be forgotten. Although praziquantel given at 40 mg/kg as recommended gives similar egg negative rates in populations with either S. haematobium or S. mansoni, in persons with mixed infections the subsequent egg negative rates of S. haematobium were higher than the egg negative rates of S. mansoni infections at 12 months post treatment (Kardaman et al. 1985) . Robert et al. (1989) have identified a village in the Cameroon where S. haematobium egg counts were observed to be higher in persons with mixed S. mansoni and S. haematobium infections than in persons with S. haematobium infections alone.

In West Africa, hybridization between S. haematobium and S. intercalatum is well documented. In Sao Tome and Principe it appears that both these parasites are endemic so hybridization, as yet unproved, is a definite possibility. No comparative data on the effect of praziquantel against the hybrid strains is available.

Furthermore, large populations in S. intercalatum endemic areas such as Equatorial Guinea have not been treated. Schistosoma intercalatum was described and the name proposed by Fischer (1934) in a classic paper which is recommended reading. Aside from thorough comparative morphological descriptions of the adult parasites and the eggs, the snail intermediate hosts, the epidemiological distribution and clinical manifestations, he noted that the intensity of infection decreases sharply in the older age groups. In two villages, no infected persons were detected over 30 and 35 years of age respectively. At the same time in a village with lower overall prevalence and intensity of infection and a lower assumed level of transmission, intensity of infection did not vary with age. He suggested that there was a significant difference between the immune status of individuals in areas with high prevalence and intensity as compared with low prevalence and intensity. He subsequently demonstrated that three of six fisherman between 35 and 45 years of age were resistant to experimental infection with S. intercalatum. In the coming years S. intercalatum will be more widely recognized in West and Central Africa in the course of control activities.

Given the history of older antischistosomal drugs and the large numbers of persons who have been and will be treated with the current drugs, constant monitoring is a necessary watchword. Praziquantel is one of the most thoroughly evaluated drugs used in treatment of a parasitic disease. Its lack of toxicity and few side effects have been well documented.

In monitoring the post-treatment state the concept of reinfection has been a battered term within the epidemiology of schistosomiasis. The precise use of terms such as; incidence, egg negativity and cure or failure rates has not

reached a general consensus. The functional use of these terms is limited by the sensitivity of the diagnostic technique and the epidemiology of the situation where they are applied. Chandiawana (1988b) has usefully pointed out significant differences in comparative incidence data between cohorts of egg negative individuals who have been previously treated and egg negative individuals who have never been treated. His qualitative data suggests that incidence of new infections is higher among treated individuals than egg negative individuals in an endemic area where transmission has not been altered by intervention. In studies from endemic areas where the initial prevalence is high, this result may be anticipated since those who are initially infected have a higher frequency of water contact both before and after treatment. On the other hand there was no evidence that treatment of individuals with heavy S. mansoni infection with praziquantel or oxamniquine predisposed them to high egg counts on reinfection (Gryseels and Nkulikyinka, 1989).

At the same time that increased rates of reinfection among treated individuals as compared with untreated egg negative individuals may occur, a more important concern is the possibility of increased morbidity after reinfection among treated individuals. There is no evidence to support this hypothesis.

Susceptibility vs.resistance to antischistosomal drugs. As yet resistance to praziquantel and to metrifonate has not been reported. Resistance to oxamniquine has been well documented in the laboratory and under field conditions (Dias et al., 1982). However it has not modified either treatment schedules in large scale programmes. The potential for resistance to appear remains a challenge in all future control programmes. Systematic isolation of the parasite from alleged "treatment failures" and laboratory evaluation of the sensitivity of the parasite can only be encouraged.

Information vs. education. Of the components of a combined approach to control, i.e. water supply, sanitation, environmental management and snail control, the WHO Expert Committee identified health education as the first priority in a control programme (WHO, 1985). A health education poster which has been widely distributed by WHO has emphasized the role of man rather than the details of the biological cycle (WHO, 1984). The tendency in the past has been to assume that behavioral change would be promoted through a rational understanding of the biological life cycle. It is now apparent for many quarters (Schall 1987; Ekeh and Adeniyi 1988) that behavioral change is a long term objective and must be initiated at more than one entry point in the life and culture of the individuals and communities of endemic countries. Health education is part of the general development process. Accurate information and attractive health education approaches cannot overcome the realities of daily life, if no adequate water supplies, sanitation nor opportunities to achieve one's aspirations are available.

There are no simple or simplistic answers to these challenges which are an integral part of the achievement of control.

Large vs. small scale operational research.

In the past 7 years WHO has collaborated closely with three control programmes with similar objectives:

1. to assess optimal use of selective population chemotherapy with current antischistosomal drugs.

2. to determine optimal integration of control into health services.

3. to determine the conditions necessary to sustain control with national resources.

In each of these countries , the parasite was different and the health services were not similar. Each area was selected because of particular characteristics which weighed against a successful outcome:

Botswana: The low population density and vast areas reduced the probability of adequate population coverage.

Pemba: The prevalence of S. haematobium is the among the highest in the world. Transmission is year around with one high peak in the summer months. Health services infrastructure is rudimentary.

Egypt: The prevalence of both S. haematobium and S. mansoni is high in a area with a vast irrigation system. No snail control, or sanitation or water supply programme was possible. Only school children were treated due to limited resources.

S. mansoni endemic area.

In Ngamiland, Botswana, the site of the unique Okavango Delta, a schistosomiasis control programme integrated into the existing primary health care system was initiated in 1985 (Ali et al. 1989). The programme, supported by the Edna McConnell Clark Foundation is guided by a national plan of action prepared by a national task force. The target population of the district is 75,000 persons with a population density of less than 1 person per km^2. Two mobile teams comprised of six persons each undertake diagnosis (Kato-Katz technique) and treatment (single dose of praziquantel 40mg/kg) of about 17,000 school children at 12-18 month intervals. Within two years the objectives of 75% reduction in prevalence and 90 % reduction of infections of greater than 100 eggs per gram of faeces were achieved.

These changes occurred simultaneously with an active water supply and sanitation programme in the district. Health education and community participation have been integral components of health services in Botswana and their

mobilization has promoted the schistosomiasis control activities. In three villages a longitudinal pre- and post-water supply assessment of impact on schistosomiasis is ongoing.

Villages where the prevalence among school children was 10% or less at the second survey were considered to be in the maintenance phase. At that point diagnosis and treatment was to be available in the health unit of the village. Implementation of maintenance has been slower than anticipated. Training of staff has not been possible until the job descriptions have been revised and the information flow for surveillance has been instituted. Nevertheless the programme is financed with national resources and is expanding its activities into other parts of the country.

At this point it is possible to consider snail control in specific water contact sites where prevalence is the highest. However the water contact sites are diverse and many at some distance from habitation so that special studies will be required before molluscicide can be done.

S. haematobium endemic area

The island of Pemba and its population of about 300,000 persons has been known to be one of the most highly endemic areas of urinary schistosomiasis in the world. In 1986 a programme to eliminate morbidity due to S. haematobium was begun by utilizing the primary health care approach (Savioli et al. 1989). This programme is supported by the Ministry of Foreign Affairs, Direzione Generale per la Cooperazione allo Sviluppo and the German Pharma Health Fund.

After the indirect techniques of visual observation of blood in the urine and using chemical reagent strips were compared with a urine filtration technique and confirmed to be over 80% sensitive and 90% specific, school surveys were begun in November 1986 at 6 month intervals by trained local health workers assisted by interested teachers. The prevalence of haematuria has been reduced among the 5-14 year age group in schools from 53.7% to 10.3% after 4 selective population treatment surveys using praziquantel at 40 mg/kg. Most importantly, gross haematuria has been reduced from 15.9% to 0.3% or a reduction of 98.3% in this same period. The main objective of this programme is to strengthen the primary health care system of 36 dispensaries. Microscopes are being set up in the dispensaries and microscopists are being trained to do the urine filtration. Once the maintenance of diagnosis and treatment is established, control of intestinal helminths will begin.

S. haematobium and S.mansoni endemic area

The Nile Delta is generally recognized as the most important endemic area of both these types of schistosomiasis.

Transmission is seasonal, being low or absent in the winter months between November and February, with a peak in July-August annually. In this area water contact is a part of every daily life centered around the vast irrigation system.

This project began in 1983 under UNICEF in Abu El Matameer district of the Beheira governorate with an estimated population of 160,000 (El Malatawy et al. 1989). The objective of this project was to test appropriate operational methodology for intervention and to assess the impact of a single dose of praziquantel 40 mg/kg in infected school children. More than 400 staff were trained and school surveys were undertaken by mobile teams using the Kato-Katz technique (S. mansoni) and urine filtration (S. haematobium).

Among 29,365 children examined at the first survey, 22,130 (75.4%) were infected and were treated. One year later, of 31,084 children examined, 12,720 (40.9%) were infected or an overall reduction in prevalence of 45.8%. The reduction in prevalence of single S. haematobium infections was greater than that of single S. mansoni infections. Furthermore the prevalence of double infections was reduced from 12.6% to 1.1%, a reduction of 91.3%.

In 1984, the same approach was extended to Abo Homos district with an estimated population of 218,000. Among 40,241 school children examined, 32,411 (80.5%) were found to be infected. One year later, 47,183 children were examined and 14,514 (30.8%) were infected. Similar results were achieved in this district.

These results have been carefully assessed. Within the project itself there was rigorous quality control of reexamination of every 10th slide. In 1988, three years after the last treatment a selected sample of schools were reexamined the accuracy of the examinations was assessed independently (Dr. H. Spencer, personal communication, 1989) Concordance between examinations by the mobile teams and a reference laboratory was similar. Most striking however was the persistent reduction in prevalence and, particularly. heavy infections 3 years after the last treatment.

Schistosomiasis present vs. future.

There have been large scale successes in schistosomiasis control in the past 20 years. In Tunisia a balanced programme of selective population chemotherapy and snail control has achieved a sustained reduction of transmission.(Rey et. al 1982) Ten years after the main intervention phase, surveillance is still maintained. Though not widely recognized one of the most effective schistosomiasis control programmes is already in the maintenance phase, integrated into the primary health care system in Saudi Arabia (Ashi et al. 1989). Prevalence has been reduced from 11% in a population at risk of 2,000,000 persons in 1983 to 1.9% in 1987 through a balanced programme of selective population

chemotherapy and snail control. Surveillance is now focussed on the large expatriate population to avoid spread or return of transmission.

While there are many reasons for optimism for the future of control of schistosomiasis, good short-term results should be blur one's ability to critically assess potential future problems. The positive effect of chemotherapy on reduction of disease present at the time of treatment and prevention of development of morbidity among small groups is uncontested. In the long term the possible risks must be assessed.

Population-based chemotherapy in endemic areas is undertaken assuming that transmission will remain unchanged. In most endemic areas there is a common sense knowledge, if not research based knowledge, of the probable transmission cycle. If exact data is lacking, operational programmes assume that in areas with a single annual peak of transmission, treatment should be given at the end of the transmission season. In areas with two annual peaks of transmission, treatment is given after the most intense period of transmission. In areas where transmission is assumed to occur year around without great fluctuation in intensity, treatment is given to optimize operational efficiency, i.e. access to the population at risk, school schedules, distances between villages, etc. Furthermore in these areas retreatment must be anticipated at shorter intervals and directed to specific target groups. This has been confirmed by two contrasting experiences in Pemba and Zanzibar. In Zanzibar (WHO unpublished data) metrifonate given at 7.5 mg/kg in three doses two weeks apart on an annual basis reduced prevalence less than 40% over two years. In Pemba praziquantel was used at 40mg/kg in a single dose at 6 month intervals and prevalence was reduced over 75% and heavy infections were reduced by over 90% in 18 months. While different drugs were used it is appears that the different treatment intervals may have influenced the results. As yet there is no large scale experience comparing two different treatment intervals for the same antischistosomal drug.

The lack of precise data on transmission patterns strengthens the necessity of monitoring treated populations. Reliable longitudinal data from control programme will enable appropriate modification of the time of treatment as well as the interval between treatments. In Brazil the initial annual treatment cycle has now been extended up to two or three years. The diversity of the epidemiology of schistosomiasis is such that one should not anticipate that the same time or interval of retreatment would be applicable for all localities. On the other hand careful post treatment monitoring can identify the localities which are the exceptions to the rule.

One of the most remarkable lessons in the wake of the euphoria of large scale chemotherapy is the need to have an operational health care delivery system to maintain the

reduction in prevalence achieved by the short term interventions. "Long term commitment" is terminology reserved for marriage, politics, religion and schistosomiasis control. The planning for maintenance of control begins before the specific interventions are underway. Endemic countries like Brazil, Egypt, Morocco and China have a health delivery infrastructure into which schistosomiasis control is being maintained. The costs of control are becoming more and more difficult for the endemic countries to bear. Concerted intervention for short initial periods is possible with adequate human resources and financial support. Even these types of field activities will require combining two or more disease control operations to reduce overall costs. Thus, in the long term success of schistosomiasis control will not only be measured by the reduction in morbidity but also by the full integration of maintenance within the health care infrastructure.

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