Transactions of the Royal Society of Tropical Medicine and Hygiene (2006) **100**, 208—215

www.elsevierhealth.com/journals/trst

SOCIETY MEETING PAPER

Progress towards countrywide control of schistosomiasis and soil-transmitted helminthiasis in Uganda☆

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Received 19 October 2004; received in revised form 22 December 2004; accepted 9 March 2005

KEYWORDS
Schistosomiasis;
Schistosoma mansoni;
Soil-transmitted helminthiasis;
Praziquantel;
Albendazole;
Uganda

Summary Schistosomiasis caused by infection with *Schistosoma mansoni* is a serious public health burden in 38 of the 56 districts of Uganda. This article reviews the initial experience of the national control programme. Launched in 2003, this started with a pilot phase with the main aim of utilizing the experience to formulate feasible and appropriate methods of drug delivery. Overall, 432 746 people were treated and coverage was 91.4% in schools and 64.7% in communities. The issues raised by independent evaluators included that most communities did not participate in the selection of community drug distributors (CDD) and that teachers and CDDs needed refresher training mainly on health education and the management of side effects. As a way forward, it is suggested that the Ministry of Health should integrate deworming into the existing health infrastructure so that every time a child is reached for any health service, the child is also dewormed.

☆ Based on a presentation to the Royal Society of Tropical Medicine and Hygiene Meeting on 15 January 2004, entitled 'Fresh from the Field: Schistosomiasis in Uganda'.

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doi:10.1016/j.trstmh.2005.03.015

1. Introduction

The situation of schistosomiasis in Uganda has previously been reviewed up to 1984 (Doumenge et al., 1987). Recent countrywide surveys undertaken by the Vector Control Division (VCD), Ministry of Health, demonstrate the presence of *Schistosoma mansoni* in 38 of 56 districts and *S. haematobium* in only two districts (Kabatereine et al., 2004). Nationally, it is estimated that up to 4 million people are infected and altogether 16.7 million are estimated to be at risk of infection. In heavily infected areas, many people are infected at an early age; some suffer early severe disease and may die, others experience chronic disease for up to 20 years, resulting in severe complications in both young and older adults. If caught early enough the disease may be reversible with appropriate treatment.

Intensity of infection, as indirectly estimated using quantitative faecal egg counts, is related to morbidity, and the highest intensities are found in populations in regular contact with the Nile River and Uganda's Lakes, generally associated with fishing. Many of the fishing communities in Uganda have prevalences of 60—100% (Kabatereine et al., 2004), with a mean intensity of infection >1000 eggs per gram of stool (which is considered extremely high). Further away from the large water bodies, *S. mansoni* may also be found, but usually focally related to small streams (Odongo-Aginya et al., 1994), irrigation canals (Bukenya et al., 1994), swamps and valley dams (VCD, unpublished data).

1.1. Morbidity of schistosomiasis in Uganda

Schistosoma mansoni was first shown to cause serious morbidity in residents along the shores of Lake Albert and the Albert Nile almost 50 years ago (Nelson, 1958). Since then numerous surveys report significant morbidity (Frenzel et al., 1999; Ongom and Bradley, 1972; Ongom et al., 1972), with portal hypertension common, especially in males, from middle age onwards. Hospital records over a 30-year period showed this condition to be the leading cause of hospital deaths and the second cause of hospital admissions in adults (Williams et al., 1986). More recently, surveys in communities along Lake Albert found that of 48 deaths in a 1-year period, 14 (29%) could be attributed to haematemesis or ascites, likely to be due to infection with *S. mansoni* (Kabatereine, 2000).

It is now known that most of this morbidity, and associated mortality, can be prevented or reversed through repeated and regular treatment with praziquantel. A recent study in Arua and Nebbi districts found that 83% of individuals suffered morbidity and, of these, 20% had severe periportal fibrosis (Frenzel et al., 1999). Following treatment, the severe morbidity resolved within 2—3 years, and since the resolution was more marked in younger age groups, early treatment in school-aged children is warranted.

1.2. Soil-transmitted helminthiasis (STH)

In Uganda, a recent nationwide survey found that the prevalence of STH among schoolchildren exceeded 60% in 35 of 38 districts (Kabatereine et al., 2001, 2005). Hookworm was homogeneously distributed throughout the country, exceeding 60% in 85% of the schools surveyed, but *Ascaris lumbricoides* and *Trichuris trichiura* were most prevalent in southwest Uganda. Thus, every child in Uganda is likely to be infected with STH (especially hookworm) or at risk of being infected. In such situations the WHO (2002) recommends mass treatment of all school-aged children at least once but preferably twice a year, using albendazole (preferably for hookworm) or mebendazole. These broad spectrum drugs are effective, cheap and safe, and easy to administer in single-dose tablets as part of a mass deworming campaign, even to children as young as 6 months (Allen et al., 2002).

1.3. Prospects for control

Having approved the recent WHO resolution setting a target of reaching 75% of all school-aged children with regular treatment by 2010, the government needed to place this resolution into its own health agenda in order to request external funding to implement the programme. While this was being done, the Schistosomiasis Control Initiative (SCI), established in Imperial College London with funding from the Bill and Melinda Gates Foundation, agreed to provide much of the needed initial support to launch a control programme. Since March 2003, the Ugandan national control programme (NCP) has targeted communities at high risk in schistosomiasis-endemic areas in the 18 most affected districts, and will reach some 4 million people, providing health education and annual treatment for the next 5 years.

2. Implementation of control

The implementation began with a pilot phase from April to October 2003 reaching more than 400 000

people. One subcounty was selected for treatment in each of the 18 most affected districts, and the main objective was to use the experience gained to formulate feasible and appropriate methods of drug delivery. The specific objectives were to (i) develop and deliver appropriate health education messages, (ii) maximize deworming coverage and reach all persons residing in the selected subcounties, (iii) determine the capacity of primary school teachers and community drug distributors (CDD) to distribute drugs and keep correct records, (iv) identify critical issues that might hinder or enhance deworming, and (v) develop a course of action for sustained mass deworming. The proportion of non-enrolled school-aged children to the total population was also determined to devise a way of reaching this group in future school-based deworming programmes.

A national team based at the Vector Control Division, Kampala, trained trainers of trainers (ToTs) who included two people from each of the district health and education offices, one from the district community development office and nine local health workers based in the concerned subcounty.

In order to solicit support and create programme ownership, the ToTs then informed local political, religious leaders and decision makers about the benefits of the programme and carried out advocacy meetings at the district headquarters targeting top district officials. They trained drug distributors (at least two teachers per school and two CDDs per community). The teachers and CDDs were taught about the essential elements of disease transmission, health impact and control. They were also taught how to manage drug administration, registration of children and community members, management of minor side effects, and how to use posters and pamphlets. Finally they were convinced of the benefits of treatment.

To help them counteract misconceptions such as 'schistosomiasis disease is caused by witchcraft' and that 'traditional medicine can cure bilharzia' the drug distributors were trained and provided with a question and answer booklet designed for this purpose. The trainees were supplied with registers to record details of each person including age, gender, height and number of tablets successfully administered. If a person was not treated, a space was provided to fill in reasons for non-treatment. A practical session was arranged during the training to make sure the trainees understood how to fill the registers.

Health education in schools and communities was carried out by the trained drug distributors before they subsequently registered the target population and delivered the treatment. Furthermore, a team of independent evaluators was sent to each district to assess the impact of the programme. Their terms of reference included visiting each district and subcounty and interviewing leaders, schoolchildren, teachers, CDDs and any other relevant person. They were asked to find out if leaders and communities were aware of the programme, if they were satisfied with advocacy and if the training of ToTs and drug distributors was satisfactory. They were to check on compliance, and attend to complaints (if any) and they were also empowered to make suggestions for the way forward.

3. Results

3.1. Coverage as reported by district directors of health services (DDHS)

According to reports from DDHS, a total of 432 746 people were treated during the pilot phase including 270 219 in schools (mainly schoolchildren) and 162 527 in communities. The breakdown by district, and the numbers treated in schools and communities are shown in Table 1.

The coverage in schools was 91.4% compared to 64.7% in communities; overall coverage was 79.2%. A randomly selected sample of the treatment registers was collected from 147 schools from 17/18 districts and 265 communities from 14/18 districts in order to check for errors and to calculate the treatment coverage. The capacity of drug distributors to deliver treatment was judged by their ability to meet the set objectives as shown by results from the analysed data.

3.2. Coverage according to treatment registers

Treatment records in the registers were available on 170 707 individuals including 80 469 in schools and 90 238 in communities. In agreement with the reports from the DDHS, the overall mean coverage according to the registers was high (81.6%); coverage was higher in schools than in communities (89.0% vs. 80.1%).

These registers recorded the age of treated individuals. If school-aged children are defined as those between 5 and 14 years, the overall school-aged population coverage was 50.8%. The proportion of children enrolled and non-enrolled are shown in Table 2. Overall, 22.1% of the community population was school aged (non-enrolled); 9.5% were below 5 years; and 68.4% above 14 years. Thus, of all the school-aged children, 30.7% (19 063) were not enrolled.

Table 1 Treatment coverage in schools and communities by district

District	Schoolchildren targeted	Schoolchildren treated	Coverage in schools (%)	Community members targeted	Community members treated	Coverage in communities (%)	Total targeted	Total treated	Total coverage (%)
Adjumani	64 989	70 189	108.0[a]				64 989	70 189	108.0
Apac	8 956	7 564	84.5	15 331	11 000	71.8	24 287	18 564	76.4
Arua	49 693	40 156	80.8	59 955	29 243	48.8	109 648	69 399	63.3
Bugiri	8 150	7 123	87.4	20 402	17 236	84.5	28 552	24 359	85.3
Bundibugyo	1 569	1 524	97.1				1 569	1 524	97.1
Busia	7 963	7 440	93.4	13 490	9 808	72.7	21 453	17 248	80.4
Hoima	32 319	29 005	89.7				32 319	29 005	89.7
Jinja	5 858	5 083	86.8	7 037	5 671	80.6	12 895	10 754	83.4
Kayunga	4 924	3 817	77.5	7 560	5 292	70.0	12 484	9 109	73.0
Kibaale	11 026	7 310	66.3	30 176	15 292	50.7	41 202	22 602	54.9
Lira	8 220	7 783	94.7	14 733	8 424	57.2	22 953	16 207	70.6
Masindi	8 405	6 798	80.9	14 610	11 810	80.8	23 015	18 608	80.9
Mayuge	8 889	7 661	86.2	16 180	13 287	82.1	25 069	20 948	83.6
Moyo	38 820	36 235	93.3				38 820	36 235	93.3
Mukono	8 105	7 330	90.4	14 548	10 227	70.3	22 653	17 557	77.5
Nakasongola	7 168	5 724	79.9	6 310	4 520	71.6	13 478	10 244	76.0
Nebbi	12 468	12 485	100.1[a]	30 148	20 149	66.8	42 616	32 634	76.6
Wakiso	8 104	6 992	86.3	624	568	91.0	8 728	7 560	86.6
Total	295 626	270 219	91.4	251 104	162 527	64.7	546 730	432 746	79.2

[a] This figure is greater than 100% because some of the schools treated non-enrolled children.

Table 2 Proportion of enrolled and non-enrolled children from the sampled registers

Age group	No. (%) in school	No. (%) in communities	Total (%)
0—5 and >15 year olds	11 677 (15.8)	67 067 (77.9%)	78 744 (49.2)
School-aged (5—15 year olds)	62 089 (84.2)	19 063 (22.1%)	81 152 (50.8)
Total	73 766	86 130	159 896 (100)

The difference in coverage calculated from the treatment registers to that reported by the DDHS was due to the inclusion of non-enrolled and non-registered individuals by the DDHS. According to the coverage from registers, in schools, 25% achieved 100% coverage and 87.8% achieved over 75% coverage. In communities, 22.4% achieved 100% coverage and 69.2% achieved over 75% coverage. In a few communities, coverage was less than 25% (5.4% of total), but this was determined to be due to a lack of adequate number of tablets, with perceived side effects also contributing to the low compliance in some areas.

To assess the efficiency of teachers versus CDDs in record keeping, registers from 87 schools and 232 communities were checked for mistakes. Results showed that 67.8% (59/87) of schools and 61.2% (142/232) of communities entered data correctly illustrating that CDDs were as efficient as teachers in record keeping.

3.3. Observations by the independent evaluators

A report from the independent evaluators showed that district officials were aware of the programme and supportive mainly in terms of deployment of staff and budgeting for praziquantel for passive treatment of cases in health facilities (the report is available upon request from the authors). School teachers and CDDs were knowledgeable on dose determination of praziquantel using height. Their knowledge of the life cycle of schistosomiasis was satisfactory. However, knowledge on record keeping and management of side effects was inadequate. They noted that although treatment was given in all targeted schools and communities, there was often a shortage of drugs to treat all communities. Shortages were usually because of treatment being given to unregistered individuals, particularly in Nebbi, Kibaale and Mayuge districts. Registration was by serial numbers which made it difficult to identify which households the defaulters came from.

Some of the common issues raised were that 92% of the communities did not participate in the selection of drug distributors; in some cases village leaders selected themselves or their relatives or friends. Side effects were not recorded in nearly all schools and communities and it was concluded that the error emanated from inadequate training. Health education and informing community members prior to commencement of treatment was done in only 43% of the communities visited. Furthermore, posters were seen in only 59% of schools and 37% of the communities visited and the number was always inadequate.

Overall, the independent evaluators were satisfied that within a short period, the project had reached 100% of its targeted communities. They suggested that drug distributors needed more training especially in record keeping and management of side effects. Inaccurate (low) registration in communities led to a tremendous shortage of drugs compromising coverage. As for side effects, people perceived that the treatment had induced excessive salivation, vomiting and abdominal pain, but that treatment had improved appetite. Community members needed to be better informed to alleviate fear of side effects. Health education messages should have given more emphasis to the long-term benefits of treatment despite the temporary side effects. They perceived that treatment coverage might be lower in future if intensive health education was not done. Thus, they recommended that more health education materials and posters must be developed, preferably in local languages which people can read and understand, and that drug distributors must be trained on the management of side effects.

3.4. Side effects of treatment

To assess the side effects associated with treatment a community-based pre- and post-treatment survey was undertaken among 344 individuals aged 3—75 years in Bugoigo, Masindi district. Overall, 76% of individuals reported at least one side effect within 3 days after receiving treatment. The specific signs and symptoms are reported in Table 3. No relationship was observed between frequency of side effects and intensity of infection prior to treatment (data not shown).

Table 3 Frequency of self-reported side effects among 344 community members in Bugoigo, Masindi district

Side effect	Frequency (%)
Dizziness	21.8
Diarrhoea	18.9
Abdominal pain	13.7
Rash	12.5
Headache	10.8
Nausea	9.9
Vomiting	9.3
Fatigue	5.8
Drowsiness	4.1
Body pain	3.2
Fever	2.6
Heart palpation	2.3
Body swelling	2.0
Cough	1.2
Haematemesis	0.9
Bloody stool	0.9
Body weakness	0.3

3.5. Programme costs: an example in Arua district

To estimate the cost of treatment in Uganda, estimates were obtained for three subcounties around Rhinocamp in Arua district. The cost analysis is based on the development of a detailed cost menu of the drug intervention. Only financial (transaction) costs are estimated. The costs are divided into four main cost centres: drugs; delivery; health education; and training. All local costs are converted into equivalent US$ (Ugandan Shillings 1735 = US$1). A total of 40 156 schoolchildren and 29 243 community members received treatment; 69 399 individuals in total. The total number of praziquantel tablets delivered was 196 150, and the total of albendazole tablets was 69 399.

The financial costs of the programme in the three subcounties at 2004 prices are summarized in Table 4, which shows that the total cost was US$23 684. The purchase of praziquantel and albendazole were the largest elements of the programme at 88.7%. No other major cost centre exceeded 8.4% of the total cost of the programme. The estimated financial cost per person treated using both drugs is US$0.34. This cost does not include the opportunity cost of unpaid labour days of teachers, CDDs, district officials and NCP staff. Future work will estimate both the full economic (financial and opportunity) cost of the programme.

Table 4 Cost profile of the control programme in Rhinocamp, Arua district by major cost centres

Major cost centre	US$ (%)
Drug	21 003 (88.7)
Delivery	1 989 (8.4)
Health education materials	187 (0.8)
Training	505 (2.1)
Total financial cost	23 684 (100)

4. Discussion

Experience from the pilot phase has shown that drug distribution in schools is excellent and community-directed treatment is a feasible health approach for mass drug distribution in poor remote communities. Low coverage (below 50%) was noted in some communities and in a few schools. If adequate supervision had been available during the drug distribution period, timely identification and correction of poor performing communities and schools would have been possible. However, it must be noted that supervision can be very costly and it might jeopardize sustainability if dependent on central or district staff who must travel long distances, sometimes in four-wheel drive cars. In view of this consideration, it is recommended that supervision of drug distribution should be done by local health workers as part of their normal outreach services. Thus as many as possible local health workers should be trained to handle this role adequately to further minimize the costs undertaken within routine supervision at the local level.

According to observations from the independent evaluators, most low coverage was due to a fear of praziquantel side effects, inadequate community mobilization and/or lack of appropriate health education. Other less credible reasons given included rumours that anthelminthics were intended to kill HIV/AIDS patients and/or to reduce their fertility. Many local health workers had limited knowledge of bilharzia and could not convince the communities to take the drugs and this must be improved through thorough retraining of ToTs and drug distributors.

Another important constraint to the programme has been the expectation of incentives to community-based workers (drug distributors), which are not forthcoming in this programme. For issues of sustainability, the NCP will not make such payments. However, in some communities this can cause low morale in the drug distributors leading to poor performance in the short term. They do not understand why the deworming programme does not give remuneration while some other health programmes (polio eradication) did so in the past. In order to overcome this problem, a large number

of distributors will be trained to maintain an adequate pool of willing distributors. If the served communities really feel there is a need to reward their distributors, the programme will encourage them to do so without involving the Ministry of Health.

One of the main objectives of the deworming programme is to create demand for regular deworming. Results from the pilot phase showed that people appreciated the treatment in that they reported that they felt better. This implies that those people who now believe that treatment is important will demand more treatment.

Most of the negative impact of STH and bilharzia is known to be suffered by school-aged children (Albonico et al., 1999) and, in the longer term, mass treatment exercises will be limited to this age group while older age groups will be advised to seek treatment from health facilities. Due to universal free primary education in Uganda, it had been hoped that more than 75% of this age group would be in school and thus easy to reach. However, results from this study have shown that in the remote bilharzia-infected communities, up to 30% of children are not enrolled in school. Thus, in the future, school-based deworming activities must include a means of reaching as many as possible of the non-enrolled children. Since controlling worms is not a short-term undertaking, every opportunity must be taken to ensure that it is embedded in the country's health infrastructure for sustainability.

As a way forward, the Ministry of Health is currently integrating deworming into all existing opportunities, such as '*The National Child Health Days*' held in May and November each year which are used mainly for immunizing children aged less than 5 years and to distribute vitamin A. For example, during the National Mass Measles Immunization Campaign for children aged less than 15 years, which was held in October 2003, about 9 million children were also dewormed. Uganda has also introduced regular deworming in all mother and child health clinics. The overall objective of this integration is to ensure that every time a child is reached for any health service, the child is also dewormed.

To facilitate this approach, albendazole and praziquantel have been included on the essential drug list and are obtainable on credit by the districts from the National Medical Stores. This implies that districts can now access deworming medicines through the normal arrangement for moving other essential drugs to the peripheral health units. During the next phase, efforts will be made to test the efficiency of this approach. At present, all dewormers are provided free by the SCI and even the cost of delivering them from the National Medical Stores to the community is borne by the SCI.

Although the Ministry of Health has now started purchasing substantial amounts of praziquantel and albendazole especially for health facilities and mass deworming of children under 5 years, a single player (Ministry of Health) will find it difficult to sustain regular mass deworming due to the high cost of delivering treatment. Therefore, external support will continue to be sought to enable maximum coverage and a long-term sustainable programme. The Ministry of Health has therefore embarked on a campaign to recruit more alliances from the WHO, UNICEF, World Bank, non-governmental organizations and other donors to support the programme in the long term.

As the next step, the Ministry of Health is promoting synergy between vertical disease programmes as a way forward. The rationale for integration is that many diseases overlap in distribution, utilize the same personnel at district and community levels, share strategies for control such as mass treatment and sometimes deliver the same drugs such as the deworming and LF programmes that deliver albendazole and the LF and onchocerciasis programmes both of which deliver ivermectin. The Ministry of Health is in the process of identifying cross-cutting activities such as training, community mobilization, health education, drug delivery, surveillance and community registration which programmes can integrate to save resources.

5. Conclusion

This pilot phase has provided clear evidence that, with financial support, the Ugandan NCP can regularly deworm school-aged children across the country. In order to achieve maximum treatment coverage, the support of teachers, communities, health workers and leaders is vital. The experience has demonstrated that teachers are quite efficient in delivering treatment to schoolchildren but that two teachers per school are too few to handle the job efficiently without demanding incentives. As many drug distributors as possible should be trained in future campaigns to strengthen drug delivery. This move must be backed by increased funding for training and for production of educational materials. Although Uganda offers a free universal primary education, the study has shown that a large number of children are not at school and to achieve the WHO's antiparasitic target of 75% by 2010, greater effort must be made to reach non-enrolled children. Integrating deworming into already

existing and successful disease control campaigns is a sure way of sustaining the programme.

Conflicts of interest statement
The authors have no conflicts of interest concerning the work reported in this paper.

Acknowledgement

The Schistosomiasis Control Initiative is generously supported by a grant from the Bill and Melinda Gates Foundation. S.B. is supported by a Wellcome Trust Advanced Training Fellowship (73656) and J.P.W. is supported by a Royal Society University Award. The authors would like to thank the teachers, CDDs, ToTS, DDHS and the staff of the Vector Control Division for their commitment. We are indebted to Dr R. Ndyomugyenyi and Dr A.W. Onapa who evaluated the programme.

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