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Cost and effectiveness of different approaches to schistosomiasis control in Africa

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Summary

In order to analyze the cost-effectiveness of selected mass-chemotherapy, a model is used to compare the treatment of urinary schistosomiasis with metrifonate (3 dose regimen, fortnightly intervals) and praziquantel (one dose regimen). The model was applied to two situations. Setting I, based on experiences in the Peoples Republic of the Congo, assumes that the average distance between the project base and the area of intervention is 80 km, the other, setting II, based on the situation in Mali, assumes an average distance of 250 km. The aim of the project is defined as the reduction of a prevalence of 50 % to less than 5 % in the absence of reinfection. Using metrifonate, the cost per person rendered negative is calculated at DM 12.57 for the Congo and at DM 32.52 for Mali. Prevalence will be 4.2 % after intervention. Using praziquantel, the costs are DM 8.36 and 11.47, respectively, and the prevalence reached at the end of the intervention will be 1.1 %. The cost difference is mainly due to the high operational cost incurred by the 3 dose regimen. Once low prevalence levels are reached, operational cost further outweigh drug expenses.

Introduction

For the fast growing world population, increasing amounts of water are needed to raise food production. The simultaneous lack of energy has led to the construction of hydroelectric dams alongside the development of extensive irrigation schemes throughout the African continent and many other parts of the world. However, in those parts of the tropics where climatic conditions favour the transmission of schistosomiasis, the implementation of irrigation has caused the spread of the locally existing species of the parasite. The Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), GmbH, has been involved in a number of programmes aimed at improving agricultural gains through irrigation. Conscious, that this would increase the risk of schistosomiasis infection, parallel schemes to control schistosomiasis were created in Mali, the People's Republic of the Congo, in Malawi and Madagascar.

Since the course of the disease is chronic, the economic importance of the disease is generally underestimated. Even though results from the first, and by now classic study on St. Lucia island did not show any measurable impact (Weisbrod et al. 1973), several other investigations clearly demonstrated quite significant losses in terms of production as a result of prevalent *Schistosoma mansoni* infections (Barbosa and Pereira da Costa 1981, Collins et al. 1976, Fenwick and Figenschou 1972). Although such proof is not available until this date for populations affected with *S. haematobium,* the chronicity of the disease, resulting in disability and the risk to develop cancer of the bladder, are reasons enough for specific interventions.

Schistosomiasis control can only be undertaken within the context of the development of primary health care services in a given country. Its priority ranking with regard to other health problems has to be assessed carefully. In view of the general scarcity of resources in the health sector, specialized programmes can only be justified, if they are planned carefully and if the accompanying evaluation demonstrates their cost-effectiveness.

In most parts of Africa south of the Sahara, *S. haematobium* is by far the most prevalent of the existing schistosome species pathogenic to man. Two drugs are currently available for the treatment of *S. haematobium* infection: Metrifonate and praziquantel. Metrifonate is much cheaper than praziquantel but three doses at intervals of approximately two weeks are necessary, while praziquantel can be administered effectively in a single dose. Since the cost of mass chemotherapy is not only determined by the cost of the drugs, but also and to a considerable extent by expenses incurred through the execution of the programme, i.e. transport, personnel and materials, the analysis of cost-effectiveness must go beyond drug expenditure. Operational costs for different actions are markedly influenced by the overall size of a programme. A realistic comparison of the operational cost in the use of the two treatments could thus only be made in a large-scale control programme. The model developed and first used by Kielmann (1982) during his evaluation of the National Schistosomiasis Control Programme in the People's Republic of the Congo is presented here with modifications based on experience from other projects.

Methods

Main factors that influence overall cost and effectiveness (of a schistosomiasis control programme) are: Cost of medication, of transport, of personnel, the number of cases to be treated, cooperation of the population to be examined and to be treated, the efficiency of the drug (used to eliminate the parasite). Given that the baseline prevalence, the distance to the population and the size and composition of the mobile team are the same, the cost to cure one person from *S. haematobium* infection can then be used as an index to compare the cost effectiveness of metrifonate and

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praziquantel. In order to facilitate and standardize calculations, a number of assumptions were made. The currency unit employed is Deutsche Mark.

Assumptions

1 Prevalence is 50% in a population of 1000, i.e. there are 500 cases. It is the aim of the project to reduce the prevalence to 5%.

2 The mean weight of an infected person is assumed to be 40 kg.

3 Each of the three treatments with metrifonate consists of 10 mg/kg bodyweight. Metrifonate costs DM 0.06 per 100 mg or DM 0.24 per treatment per person.

3.1 The cure rate of metrifonate is 20% after one single dose, 45% after two doses and 60% after the complete treatment of three doses (Davis and Bailey 1969).

3.2 100% of the infected persons will receive at least one dose of metrifonate, 75% will attend the second treatment only 50% will take all three doses.

3.3 Reinfection is disregarded

4 single treatment with praziquantel consists of 40 mg/k bodyweight. Praziquantel costs DM 0.29 per 100 mg or DM 4.64 per person.

4.1 The cure rate of praziquantel is 85% (Mott, 1982).

4.2 All cases will take the treatment.

4.3 Reinfection is disregarded.

5 The cost of one examination is DM 0.35. This includes materials and personnel but not transport. After each treatment with metrifonate, surveys including the total population will alternative with examinations of treated cases only. After each treatment with praziquantel the whole population will be examined.

6 Transport costs are DM 1.00/km for the vehicle (investment and depreciation), plus DM 0.24/km for fuel (at 20 litres/100 km and DM 1.20 per litre), plus DM 1.00/km for personnel (per diems and salaries). Total cost per km is DM 2.24.

Results

Based on the above assumption, the cost for one person cured, using metrifonate or praziquantel has been calculated for two different settings. In setting I, approximating the Congo situation, the average distance to reach the population was set at 80 km. In setting II, based on the Mali experience, the average distance to reach the population was set at 250 km.

Tables 1 and 2 contain an itimized list of costs following the two settings and using either metrifonate or praziquantel. Figure 1 compares the cost components for mass treatments with the two drugs.

The analysis shows that for metrifonate the cost per person cured came to DM 12.57 in setting I and DM 32.52 in setting II. At the end of the intervention a prevalence of 4.2% was reached. If praziquantel had been employed, the cost per person cured would have been DM 8.36 in setting I and DM 11.47 in setting II. Prevalence at the end of the intervention would be 1.1%.

Discussion

This simplified cost-calculation demonstrates that praziquantel, despite its higher cost, is more economical in its use. In a country like the Congo (setting I) with shorter routes to cover between the logistic centre and the area of intervention, a compaign using praziquantel would cost only two thirds of one using metrifonate. At the same time,

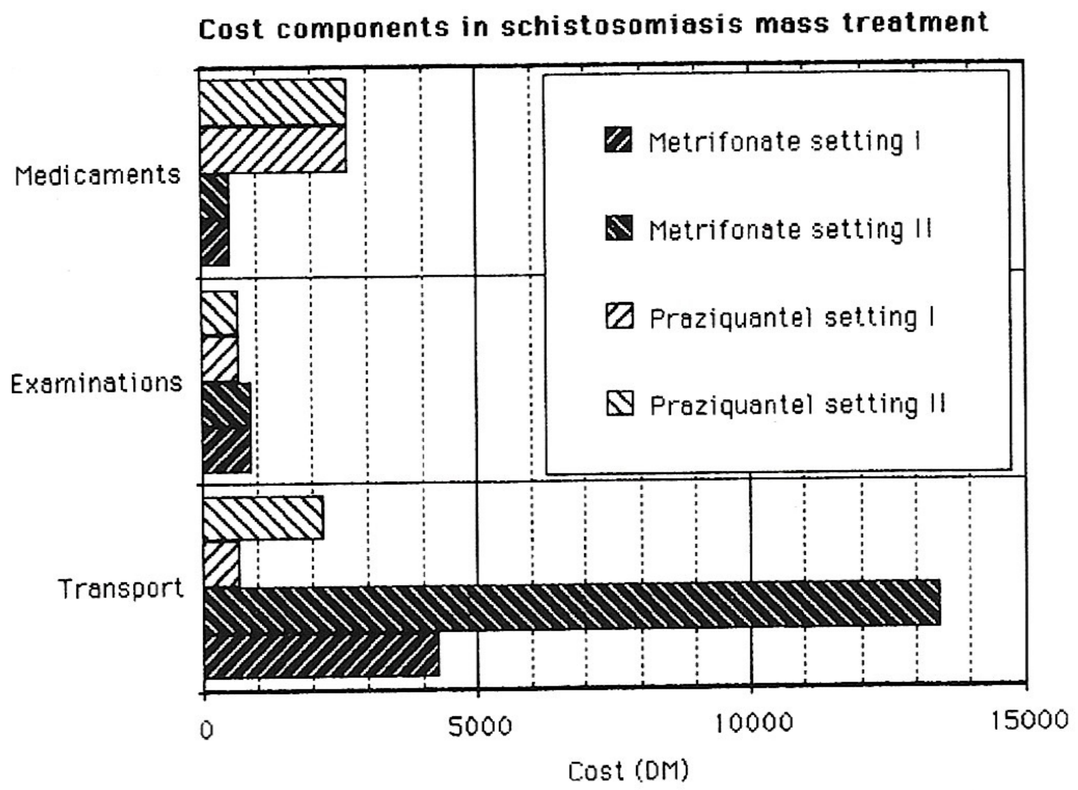

Fig. 1 Comparison of cost components in schistosomiasis mansoni treatment campaigns using metrifonate or praziquantel in two different geographic settings

significantly lower levels of prevalence (1.1% versus 4.2%) are reached. In a country like Mali (setting II) with a lower population density and generally longer transport routes, the differences in cost using praziquantel or metrifonate are even more pronounced. If praziquantel is used, intervention costs are reduced by 67.7%. The importance of transport as a cost factor is clearly shown in Fig. 1.

The calculation demonstrates that operational costs are by far more important than the cost of drugs. The necessity to treat three times using metrifonate is largely responsible for the higher operational costs. Unavoidable case attrition between treatments reduces overall efficiency of the metrifonate treatment and further increases operational costs. The fact, that praziquantel can be given in a single dose represents a clear advantage of this drug especialiy when one considers that in many areas of Africa *S. haematobium* coexists with *S. mansoni* infections.

The importance of operational costs in the execution of a schistosomiasis control programme underlines the necessity to limit vertical actions to a minimum. Although, it still remains to be shown at which level cost effectiveness is higher if schistosomiasis control is fully integrated into primary health care services, it appears logical to integrate at least all maintenance activities after the prevalence has dropped below 10%. Operational research to this effect is presently conducted in Mali and in the Congo.

The present calculation ignored possible effects to reinfection. This important factor is still very difficult to determine. Only follow-up studies on large numbers of individuals permit its determination in human populations. The situation regarding the cost assessment of vector transmission is even worse, as no suitable index exists, that could be employed in large scale control programmes. This means that the assessment of the cost effectiveness of environmen-

Table 1 Cost of mass treatments using metrifonate (Currency unit Deutsche Mark)

Item	Persons	Unit	Unit cost	Setting I (2*80 km)	Setting II (2*250 km)	Persons cured	Prevalence %
Baseline							
Transport		km	2.24	358.40	1120.00		
Examinations	1000	Persons	0.35	350.00	350.00		
1st dose	500	Persons	0.24	120.00	120.00	25	47.5
2nd dose	375	Persons	0.24	90.00	90.00	56	41.9
3rd dose	250	Persons	0.24	60.00	60.00	150	26.9
Transport 2nd d.		km	2.24	358.40	1120.00		
Transport 3rd d.		km	2.24	358.40	1120.00		
Subtotal				1695.20	3980.00	231	26.9
2nd mass treatment							
Transport		km	2.24	358.40	1120.00		
Examinations	500	Persons	0.35	175.00	175.00		
1st dose	269	Persons	0.24	64.50	64.50	13	25.5
2nd dose	202	Persons	0.24	48.38	48.39	30	22.5
3rd dose	134	Persons	0.24	32.25	32.25	81	14.4
Transport 2nd d		km	2.24	358.40	1120.00		
Transport 3rd d.		km	2.24	358.40	1120.00		
Subtotal				1395.33	3680.13	124	14.4
3rd mass treatment							
Transport		km	2.24	358.40	1120.00		
Examinations	1000	Persons	0.35	350.00	175.00		
1st dose	144	Persons	0.24	34.67	34.67	7	13.7
2nd dose	108	Persons	0.24	26.00	26.00	16	12.1
3rd dose	72	Persons	0.24	17.33	17.33	43	7.8
Transport 2nd d.		km	2.24	358.40	1120.00		
Transport 3rd d.		km	2.24	358.40	1120.00		
Subtotal				1503.20	3788.00	66	7.8
4th mass treatment							
Transport		km	2.24	358.40	1120.00		
Examinations	144	Persons	0.35	50.56	50.56		
1st dose	78	Persons	0.24	18.63	18.63	4	7.4
2nd dose	58	Persons	0.24	13.98	13.98	9	6.5
3rd dose	39	Persons	0.24	9.32	9.32	23	4.2
Transport 2nd d.		km	2.24	358.40	1120.00		
Transport 3rd d.		km	2.24	358.40	1120.00		
Subtotal				1167.69	3452.49	36	4.2
Grand total				5761.42	14900.62	458	4.2
Cost per person cured				12.57	32.52		

Table 2 Cost of mass treatments using praziquantel (Currency unit Deutsche Mark)

Item	Persons	Unit	Unit cost	Setting I (2*80 km)	Setting II (2*250 km)	Persons cured	Prevalence %
Baseline							
Transport		km	2.24	358.40	1120.00		
Examinations	1000	Persons	0.35	350.00	350.00		
Treatment	500	Persons	4.64	2320.00	2320.00	425	7.5
Subtotal				3028.40	3790.00	425	7.5
2nd mass treatment							
Transport	km	km	2.24	358.40	1120.00		
Examinations	1000	Persons	0.35	350.00	350.00		
Treatment	75	Persons	1.16	348.00	348.00	64	1.1
Subtotal				1056.40	1818.00	64	1.1
Grand total				4084.80	5608.00	489	1.1
Cost per person cured				8.36	11.47		

tal strategies can at best be estimated only roughly at present.

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