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Cost-effectiveness analysis of Mectizan treatment Programmes for Onchocerciasis Control: Operational Experiences in two districts of Southwestern Nigeria

K. O. OSUNGBADE, [1]E. A. A. OLUMIDE, [2]A. O. LAWANSON AND [1]M. C. ASUZU
[1]Department of [1]Community Medicine, College of Medicine and
[2]Economics, Faculty of Social Sciences, University of Ibadan, Ibadan, Nigeria.

Correspondence to:
K. O. Osungbade
Department of Community Medicine,
College of Medicine, University College Hospital,
University of Ibadan, Ibadan, Nigeria.
koosungbade@yahoo.com
Tel: +234-8034781208

SUMMARY

Objectives: This study analyzed the operational costs of two Mectizan treatment strategies in relation to their effectiveness.

Methods: The study was conducted in 24 communities located in Irewole and Egbeda districts of Osun and Oyo State, Nigeria respectively. Cost-effectiveness analysis included retrospective analysis of cost of treatment, review of records of distributors, estimation of overall cost-effectiveness ratios of treatment and distribution, calculation of mean cost-effectiveness ratios and statistical comparison of the mean cost-effectiveness ratios.

Results: Overall cost of treatment per person through mobile distribution was N27.39 (USD1.16) while the corresponding overall cost through community-directed distribution was N14.35 (USD0.61). Overall cost of distribution per tablet through mobile distribution was N20.97 (USD0.89) while the corresponding overall cost through community-directed distribution was N8.39 (USD0.36). The difference between the mean cost-effectiveness ratios for treatments through mobile distribution, 56.79, and community-directed distribution, 32.53, was not statistically significant (p=0.120265). Similarly, the difference between the mean cost-effectiveness ratios for distribution of tablets through mobile distribution, 40.83, and community-directed distribution, 19.17, was not statistically significant (p=0.167249). Treatment coverages were 59% and 80%, and 2,376 and 4,148 tablets were respectively distributed,

Conclusion: Distribution of Mectizan tablets by community-directed distributors was more cost-effective than by mobile health staff, but the differences in cost were not statistically significant. However, this could ensure self-reliance and sustainability of treatment programmes, which are prerequisites for decision making on treatment strategies.

KEY WORDS: onchocerciasis, cost-effectiveness, mectizan, treatment, distribution

INTRODUCTION

In most developed countries, cost-effectiveness analysis is usually assumed as one of the most important criteria for proving new medical technologies and introducing new health programmes. In a world of insufficient resources for health care, consideration of the effectiveness of any intervention in relation to its cost must be paramount to health policy makers. Inefficient allocation of health care resources is inevitable when explicit cost considera'ion is neglected, with the consequence of reduction in the overall health benefits for the citizens. The scarcity of resources to

take care of myriads of diseases that plague developing countries makes cost-effectiveness analysis of intervention programmes imperative. Therefore there has been in recent times an increasing global movement towards the use of cost-effectiveness analysis in taking or forming health care decision. In this type of analysis, costs and effectiveness of all possible interventions are compared in order to select the mix that maximizes health for a given set of resource constraints(1).

Onchocerciasis infection remains an important public health problem, particularly in African countries(2–6). Mass treatment programmes with Mectizan tablets for about 12–15 years in affected communities have proven to be the main strategy of controlling the disease. However, delivery of drugs to needing populations living and working in these communities poses enormous challenges, including operational costs and sustainability. Various methods have been used to deliver Mectizan tablets to affected populations, each having its own implications in terms of human resource requirements, operational costs and effectiveness. Groups of community members were trained and used at different times for Mectizan distribution in order to achieve high effciency and effectiveness. These include indigenous residents primary health care staff, high school graduates, teachers, etc who are located within the communities where distribution is taking place (7–9).

There are about 106 on-going Mectrizan treatment programmes in Africa and 28% are located in Nigeria, but few have operational cost research incorporated (10). This may be partly due to limited training for researchers in the relevant field and antipathy toward economic analysis, as observed in relation to other sectors (11). In a cost-conscious environment, cost-effectiveness analysis is the bedrock of national health care decision-making. Few previous studies have focused on operational cost of treatment programmes and prospects of their community financing options, but little attention have been paid to relating cost and effectiveness of the programmes (12–14). Thus, there is paucity of information on economic evaluation of treatment programmes, particularly cost-effectiveness of methods used to carry out the treatment programmes in endemic communities. Future coverage decisions and sustainability of the Mectizan treatment programmes will depend on information about the cost-effectiveness of the programme.

In view of the upsurge of non-communicable diseases such as HIV/AIDS, malaria and tuberculosis, the resource demands due to the HIV/AIDS epidemic and the limited budgets for health sector especially in African countries, such operational cost research is highly desirable. It is hoped that such treatment programmes could be self-sustainable of operational cost minimal and community ownership is encouraged. Furthermore, development partners are increasingly demanding for cost-effectiveness analysis not only as a basis for assessing the value of health intervention programmes to the community, but also about their future coverage and sustainability. In view of the foregoing, this study assessed mass treatment programmes with Mectizan tablets in two onchocerciasis-affected districts of southwestern Nigeria and analysed their operational costs in relation to effectiveness. The findings were found useful for decision-making by stakeholders involved in similar Mectizan treatment programmes in onchocerciasis-affected areas of Africa.

MATERIALS AND METHODS

The study was conducted in two neighbouring onchocerciasis affected districts of Irewole and Egbeda, which are respectively located in Osun and Oyo States, Nigeria. Twenty-four comparable communities, 12 in each district, where Mectrizan treatment programmes were already established and on going for at least two years were used. The cost-effectiveness implication of the engagement of (i) primary health care staff as mobile drug distributors in Irewole district and (ii) indigenous community residents as community-directed distributors in Egbeda district was the focus of this study.

A retrospective cost analysis of the following drug distribution methods was reviewed:

i. Mobile drug distribution in Irewole district: A pool of 45 primary health care staff was trained on distribution of Mectizan drugs. Two teams, each consisting of three members, were formed on a day-to-day basis and visited previously scheduled affected communities during which community residents were treated. A project vehicle was used for field activities on three days per week, which conveyed members of the two teams from the district headquarters to the communities and back to the headquarters.

ii. Community-directed drug distribution in Egbeda district: Twelve indigenous community residents were trained and used to distribute Mectizan. They all resided in the communities and provided drug treatments to community membrs, within and outside their respective communities on demand at any time of the day.

For both distribution methods, dispensing dosage of Mectizan tablets for onchocerciasis was used on the height of individual receiving treatment (15). A long slender stick was calibrated in centimetres with the aid of a tape measure and a permanent marker. In taking measurement, each individual was requested to remove foot wears, stand and back the calibrated stick with heels and occiput touching the lower and upper parts of the stick respectively. Height measurement for an individual was taken as the crown-

heel length as extended on the stick. Individuals whose heights ranged from 90 centimeters to 119 centimeters were treated with one tablet, while those whose heights ranged from 120 centrimetres to 140 centrimetres received two tablets. For persons whose heights ranged from 141 centrimetres to 158 centrimetres, three tablets were given whereas those with heights of 159 centrimetres and above received four tablets. Eligibility for Mectizan treatment covered the entire community members, whether affected by onchocerciasis or not. Exclusion criteria included less than five years old or less than 90 centrimetres tall, women with one-week old baby (after one week they become eligible) and seriously sick community members (15.)

Sources of Data

We re-analyzed the records of the activities of the health staff and community-directed distributors, who were involved in the distribution of Mectizan drugs in Irewole and Egbeda districts, respectively during the year 200. Records of the number of people who were treated as well as the quantity of tablets, which were used for drug treatments were retrieved from their records. In addition, the records of quantity of tablets received and returned by each team or individual drug distributors were obtained. We estimated the economic costs of the personnel and processes involved in the two distribution methods such as cost of participation and training, and transportation.

Data Analysis

We considered the cost-effectiveness analysis of the approaches adopted to distribute Mectizan tablets in five man steps: (1) Retrospective analysis of cost of drug treatment (2) Review of records of drug distributors with respect to the number of people treated, the quantity of drugs administered and the quantity of drugs remaining (3) Estimation of overall cost-effectiveness ratios of treatment (C/E^{i}) and drug distribution (C/E^{ii}) in each of the two districts (4) Calculation of mean cost-effectiveness ratios (mC/E^{i} and mC/E^{ii}) in each of the two districts and (5) Statistical comparison of the mean of the mean cost-effectiveness ratios (mC/E^{i} and mC/E^{ii}) between the two districts.

Steps:

1. Retrospective analysis of cost of drug treatment: Since the drug was being supplied, free of charge by the manufacturers, and there was a standing promise to continue to supply it free as long as it was requested for, the cost of procuring the drug was excluded from our cost analysis. Furthermore, this cost component was similar in the two districts. Therefore, cost analysis focused on direct and indirect costs for each method of Mectizan distribution under review. Costs were estimated using prevailing market prices of goods and services.

Treatment costs included the direct cost of training health staff and community-directed distributors such as venue of training, writing materials, audio-visuals, refreshment and transportation. Other direct costs included field allowances paid to local health, supervisory and supportive staff, incentive payments to community-direct distributors, and transportation cost incurred during the period of durg distribution and supervision. Indirect costs of participation in terms of opportunity cost of the time lost from regular jobs by supervisory and local health staff as well as community-directed distributors were estimated.

Cost analysis was made in local currency Naira (N). The current national average basic salary of N5,500.00 (US$233.15) per month (i.e. N35 (US$1.48 per hour) was used to assign value in Naira to costs measured as time loss(16). For the purpose of comparison, purchasing power parity (PPP) exchange rate of N23.59 per dollar for health goods and services sub-heading in Nigeria(17) was used to provide the equivalent values of costs in United States Dollar (US$) in this study.

The mobile local health staff, on the average, covered four scheduled communities per day and never returned to these communities during any given distribution year. Hence, the cost consideration was limited to three days required to cover 12 communities under consideration. On the other hand, the community-directed distributors (one per village) had the drugs in their custody for at most one month and treated all their community members within the one-month period. After the one month, they retired the remaining drugs and submitted their records to the local health at the district headquarters. Hence, the estimation of the opportunity costs for their participation covered only one month.

In this way, the estimates of the cost of distribution by the two groups of drug distributors were based on how much time each had contact with their respective communities during the process of drug distribution. Furthermore, considering the possibility of non-availability of official vehicle for mobile distribution of the Mectizan drugs, we cost the rental alternative, as another cost estimate associated with mobile distribution by local health staff.

2. Review of records of drug distributors: Registers of drug distribution by the local health staff and community-directed distributors in each community were reviewed. The quantity of tablets administered and number of persons treated were obtained. In addition, the quantity of tablets returned to the headquaters was documented. The proportion of the population treated in each district was used to measure coverage.

3. Estimation of overall cost-effectiveness ratios of treatment (C/E^{i}) and drug distribution (C/E^{ii}) in each district: C/E^{i} was calculated as the ratio of the estimated operational cost to the number of persons treated in a district while C/E^{ii} was the ratio of estimated operational cost to the number of Mectizan tablets administered in a district.

4. Calculation of mean cost-effectiveness ratios: First, operational cost per community was obtained as the average of total operational cost in 12 communities. Then, C/E^{i} and C/E^{ii} were calculated for each of the communities in a district. Lastly, arithmetic means (mC/E^{i} and mC/E^{ii}) were derived for each set of C/E^{i} and C/E^{ii} in a district

5. Comparison of the mean cost-effectiveness ratios: F-statistics was used to compare the mean cost-effectiveness ratios, mC/E^{i} and mC/E^{ii}, between the two districts and level of significance was set at $p<0.05$.

Limitations

The study relied mainly on the records of both the project administrator and community-directed distributors, the completeness of which could not be totally guaranteed. This resulted in the inability to deduce operational cost at individual community levels.

RESULTS

(1) Retrospective analysis of cost of drug treatment: The total operational cost in 12 communities of Irewole district where a project vehicle was used by mobile teams to distribute drugs over a three-day period was N49,846 (USD 2,113.01). In the alternative, if in the absence of project vehicle, the team has resulted to hiring of one, the total operational cost was estimated at N57,260 (USD 2,427.30). In Egbeda district, where community-directed distributors were used to distribute drugs, the total operational cost in 12 communities was estimated at 34,800 (USD 1,475.21) (Table I).

(2) Review of records of drug distributors: The records of the drug distributors in 12 communities of Irewole district showed that a total of 1,820 treatments were given while 2,376 Mectizan tablets were distributed. Similarly, in 12 communities of Egbeda district, a total of 2,425 treatments were given while 4,148 Mectizan tablets were distributed (Table I).

(3) Estimation of overall cost-effectiveness ratios of treatment (C/E^{i}) and drug distribution (C/E^{ii}) in the two districts: The overall cost-effectiveness ratio of treating one person (C/E^{i}) in Irewole distribt was N27.39 (USD 1.16) while the corresponding cost-effectiveness ratio in Egbeda district was N14.35 (USD 0.61). This gave a differential cost-effectiveness ratio of N13.04 (USD 0.55) between the two districts. The overall cost-effectiveness ratio of treating one person by mobile health staff with a hired vehicle was N31.46 (USD 1.33). This resulted in a higher differential cost-effectiveness ratio of N17.11 (USD 0.72) than when a project vehicle was used (Table i).

The overall cost-effectiveness ratio of distribution of one tablet of Mectizan in Irewole district was N20.97 (USD 0.89) while the corresponding cost-effectiveness ratio in Egbeda district was N8.39 (USD 0.36) This gave a differential cost-effectiveness ratio of N12.58 (USD 0.53) between the two districts. The corresponding cost-effectiveness ratio by mobile health staff with a hired vehicle was N24.09 (USD 1.02), which resulted in a higher differential cost-effectiveness ratio of N15.70 (USD 0.66) than when a project was used (Table I)

(4) Mean cost-effectiveness ratios (mC/E^{i} and $m/C/E^{ii}$): Two cost-effectiveness ratios (C/E^{i} and C/E^{ii}) were obtained for each community in the two districts as shown in tables II and III. The

Table I: Operational Costs of Treatment and Mectizan Distribution in Irewole and Egbeda Districts

Operational costs	Mobile Distribution Method (Project vehicle)	Mobile Distribution Method (vehicle hire)	Community-Directed Distribution
Total costs	N49,846 ($398.77)	N57,260 ($458.08)	N34,800 ($278.40)
Total population	3,108	3,108	3,033
Population treated	1,820	1,820	2,425
Coverage	59%	59%	80%
Total number of Mectizan tablets distributed	2,376.5	2,376.5	4,148
Overall cost of treatment of one person (C/E^{i})	N27.39 ($0.22)	N31.46 ($0.25)	N14.35 ($0.12)
Overall cost of distribution of 1 tablet of Mectizan (C/E^{ii})	N20.97 ($0.17)	N24.09 ($0.19)	N8.39 ($0.07)

means of all costs per treatment of one person (mC/E^{i}) were 56.79 and 32.53 in Irewole and Egbeda districts respectively. The means of all costs per distribution of one tablet of Mectizan (mC/E^{ii}) were 40.83 and 19.17 in Irewole and Egbeda districts respectively (Tables ii and iii).

(5) Comparison of the mean cost-effectiveness ratios (mC/E^{i} and mC/E^{ii}): There were no statistical differences between the corresponding means of (i) cost per treatment of one persons (mC/E^{i}) {F=2.58; p=0.120265} and (ii) costs per distribution of one tablet of Mectizan (mC/E^{ii}) {F=2.11; p=0.167249} in the two districts (Table iv).

Table II: Cost-effectiveness ratios obtained for 12 villages in Irewole District

Villages	Amount incurred per villages (C) in Naira	Numberof people treated (E^{i})	C/E^{i}	Number of tablets distributed (E^{ii})	C/E^{ii}
Oosa	4,153.86	158	26.29	183	22.70
Ayepe	4,153.86	375	11.08	431.5	9.63
Ologun	4,153.86	36	115.39	54.5	76.23
Aba Tisa	4,153.86	283	14.68	336.5	12.34
Faru Alapomu	4,153.86	106	39.19	153	27.15
Ratibi	4,153.86	28	148.35	38.5	107.89
Ope	4,153.86	83	50.05	136.5	30.43
Arikoko	4,153.86	53	78.38	57	2.88
Ayegunle	4,153.86	70	59.34	98.5	42.17
Moro	4,153.86	40	103.85	63.5	65.42
Wasinmi	4,153.86	422	9.84	558.5	7.44
Balogun	4,153.86	166	25.02	265.5	5.65
			mC/E^{i} = 56.79		mC/E^{ii} = 40.83

C/E^{i} = Cost of treatment per person in each village
C/E^{ii} = Cost of distribution of 1 tablet of Mectizan in each village
mC/E^{i} = mean cost of treatment per person in each village
mC/E^{ii} = mean cost of distribution of 1 tablet of Mectizan in each village
N4,153.86 = USD176.08

Table III: Cost-effectiveness ratios obtained for 12 villages in Egbeda District

Villages	Amount incurred per villages (C) in Naira	Numberof people treated (E^{i})	C/E^{i}	Number of tablets distributed (E^{ii})	C/E^{ii}
Olukolo	2,9000	102	28.43	184	15.76
Alabuke-owo	2,9000	258	11.24	474.5	6.11
Alfa	2,9000	168	17.26	308	9.42
Ibiti-Egan	2,9000	39	74.36	77	37.66
Olukeye	2,9000	594	4.88	1,011	2.87
Koloko	2,9000	67	43.28	102	28.43
Alugbo	2,9000	322	9.01	481.5	6.02
Ilero	2,9000	48	60.42	75	38.67
Owobale	2,9000	548	5.29	1,000	2.90
Onilemo	2,9000	52	55.77	81	35.80
Alaja-Adeniji	2,9000	45	64.44	81	35.80
Oyinda-ola	2,9000	182	15.93	273	10.62
			mC/E^{i} = 32.53		mC/E^{ii} = 19.17

C/E^{i} = Cost of treatment per person in each village
C/E^{ii} = Cost of distribution of 1 tablet of Mectizan in each village
mC/E^{i} = mean cost of treatment per person in each village
mC/E^{ii} = mean cost of distribution of 1 tablet of Mectizan in each village
N2,900.00 = USD122.93

Table IV: Comparison of mean cost-effectiveness ratios of mobile (in Irewole district) and community-directed distribution (in Egbeda district) methods

cost-effectiveness ratios	Mobile distribution method (by project vehicle)		Community-directed distribution method		F-Statistics	p-value
	Mean	Variance	mean	Variance		
(not significant)mC/E'	56.79	2078.70	32.53	658.19	2.58	0.120265 (not significant)
mC/E"	40.83	1049.26	19.17	219.52	2.11	0.167249 (not significant)

DISCUSSION

The discovery of Mectizan tablets as an effective microfilaricide with no or minimal side-effects and the ease if its administration has, no doubt, changed the direction of control effort. Though, the supply of Mectizan tablets to affected communities is guaranteed by its manufacturers, free of charge, for as long as they are required, and national ministries of health continuously make effort to get the drugs to the community level. Yet treating affected populations poses enormous challenges such as operational cost. In this study, N27.39 (USD 1.16) and N20.97 ($0.89) were spent as treatment cost per person and distribution cost per Mectizan tablet respectively by the mobile health staff. These costs were high when compared to treatment cost per person and distribution cost per Mectizan tablet of N14.35 (USD $0.6 I) and N8.39 (USD 0.36) respectively by the community-directed distributors.

A previous study in Achi area of Anambra State, Nigeria on comparison of costs of three distribution methods reported N44.40 (USD 1.88), N69.60 (USD 2.95) and N110.40 (USD 4.68) for central, clinic-based and door-to-door systems respectively [12]. These costs were much higher than those obtained in this study. It is noteworthy however that these high costs were reported at a period during which Mectizan treatment programmes had just been newly introduced in onchocerciasis-affected communities in Africa and different methods were been explored for distribution of Mectizan. During this time, emphasis was placed on achieving high treatment coverage as a measure of success while little or no consideration was given to operational costs.

Another study, which was carried out in three onchocerciasis-affected communities In Nigeria reported that the residents volunteered to contribute between N33.60 (USD 1.42) and N45.60 (USD 1.93) for treatment of one person [13]. In another study. between N7.20 (USD 0.31) and N150 (USD 6.36) were reported [14]. The treatment cost per person and distribution cost per Mectizan tablet by community-directed distributors obtained in this study were both cheaper than the above reported costs in the previous studies. In addition. they were found to be cheaper than N24 (USD 1) as cost per treated person, which was recommended by African Programme for Onchocerciasis Control (APOC) partners as a maximum contribution from the community [13]. The low operational costs obtained through the use of community-directed distributors in this study therefore make the strategy important to be explored in mass treatment programmes. This will promote cost-sharing and community ownership, which are both essential for sustainable drug delivery systems [18].

Though this study showed that Mectizan distribution by the community-directed distributors was cheaper than through the mobile health staff, the differences were not statistically significant. However, differential cost-effectiveness ratios of N13.04 (USD 0.55) and N12.58 (USD 0.53) per person treated and per Mectizan tablet distributed respectively incurred by mobile health staff over community-directed distributors was an additional cost to the community, and this might constitute a burden for them to bear. This will invariably have a negative effect on their willingness to share cost in supporting treatment programmes and hence the sustainability.

Apart from the low cost derived from Mectizan distribution by the community-directed distributors, a higher coverage of 80% was achieved than that of distribution by the mobile health staff, which recorded 59%. In addition, the number of Mectizan tablets distributed through community-directed distributors was more than the number distributed by health staff (4.148 versus 2,376). This finding could be explained by the fact that the community-directed distributors normally resided in the community and therefore were able to provide drug treatment on demand at any time of the day. Furthermore, they gave treatments to residents living In nearby communities which are smaller than where they lived and worked.

Another reason for the high coverage might be the opportunity for reporting adverse reactions and prompt attention given to them by the community-directed distributors. This is in contrast to what was obtained in the mobile distribution method where treatment was made possible only to the residents who were met at home at the time of visit of the team to the respective communities. Hence, the low coverage achieved through mobile distribution method might be partly due to the absence of most community members, who had left their homes for farms, markets and other destinations considered as important to them

before the arrival of the health staff. This situation could be worsened on occasions when the health staff had a delay in embarking on a scheduled visit for some reasons, such as a faulty vehicle. It is worthy to note that such a low coverage rate would not produce the expected interruption in transmission of infection before the next distribution period, and this could result in slow progress of disease control.

Furthermore, drug distribution by the mobile health staff had to be scheduled so that it does not coincide with a particular climatic, cultural or religious season, such as the raining season, Muslim Ramadan fast, etc. Drug distribution is usually disrupted during these seasons as they make the communities and their populations inaccessible due to either poor road networks or refusal to take Mectizan tablets at a time before the break of Ramadan fast in the evening. Another setback of the distribution by the health staff was that it did not provide opportunity for reporting and prompt attention to adverse reactions of drug treatment, which was an important component of mass treatment programmes. This is because the health staff would have been scheduled to visit and treat other neighbouring communities on the subsequent days.

However, some difficulties were also encountered with Mectizan distribution by the community-directed distributors. Some of these include poor record keeping by and high dropout rate among community-directed distributors. Often, the number of tablets recorded to have been dispensed and left at hand did not tally with the total number of tablets given to them at the beginning of distribution; while some returned less number of bottles or packets of Mectizan tablets at the end of distribution and could not account for them. High drop-out rate was commonly experienced among the community-directed distributors. This resulted mainly from their non-remuneration and lack of motivational support received from their communities. These problems could hinder community ownership, self-reliance and programme sustainability which the method is expected to promote. Furthermore, it would result in too frequent recruitment and training of new community-directed distributors with consequent high cost of operations.

CONCLUSION

The use of both the health staff and community-directed distributors in Mectizan treatment programmes seemed to be good, simple and convenient. Both groups were readily available in the community, easy to train and could be rapidly put to use during drug distribution period. Their uses however have different cost and logistic implications. From this study, the use of mobile health staff would be difficult to sustain because of its high cost. low effectiveness and the associated operational problems.

The use of community-directed distributors seemed not too cumbersome; its low cost and high effectiveness were advantageous over the mobile method. We recommend targeted trainings and re-trainings for community-directed distributors in order to improve their record keeping practices. In addition, repeated advocacies and mobilization should be intensified in onchocerciasis-affected communities in order to enlist motivational support for community-directed distributors and hence promote community ownership and sustainability.

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