Original article

Cost-effectiveness Analysis of Health Care Interventions in *Meskanena Mareko Wereda*, Ethiopia

Ababi Zergaw[1], Damen Haile Mariam[2], Ahmed Ali[2]

Abstract

Background: Decisions concerning the implementation of health programs are usually made on the basis of descriptive assessment. There are only few attempts to review whether returns from investment on these programs worth the effort.

Objectives: To analyze and evaluate the cost-effectiveness of health care interventions in terms of lessening disease burden and improving health status in a rural community.

Methods: The evaluation was conducted in health institutions in Meskana Mareko Wereda and in Shashemene Hospital that were purposively selected. Study subjects were people utilizing these facilities. Data on inputs of interventions were analyzed using the Disease Burden Modeling System and Disability Adjusted Life Years (DALYs) gained was used as a measure of effectiveness of interventions.

Results: Interventions at health stations level were most cost-effective compared to those at health center and the hospital. Generally, community and preventive interventions were found to be more cost-effective in lessening existing burden of disease (BOD) in the local community and in improving the general health status of the populations with cost of less than 5 Birr per DALY gained.

Conclusions: Implementing 22 health care interventions with cost of less than 100 Birr per DALY gained at the health stations level will avert 52% of the BOD in the area. On the other hand implementing 17 interventions at the hospital and 18 interventions at the health center level will avert only about 22 to 34% of the BOD. Given the availability of information pertaining to the local BOD and cost-effective intervention options, there appears to be a dire need to review local health priorities and intervention strategies. [*Ethiop.J.Health Dev.* 2002;16(3):267-276]

Introduction

Ethiopia is one of the low-income countries with poor health status and rapid population growth. In the country, poverty, low education, inadequate access to clean water and sanitation and limited access to health service facilities are root causes of the major health problems. In addition, the health service delivery system of the country is deficient in coverage, efficiency and effectiveness, as it is poorly organized. The distribution of health institutions is biased towards urban areas despite the fact that the overwhelming majority of the country's population is residing in rural areas. Only half of its population has got potential health services coverage. Services like expanded program on immunization (EPI) had coverage of 59.7 percent, while mother and child health (MCH) services had only 25.5 percent coverage (1-5).

As these basic services are low in coverage, the implication is that the country is suffering from high burden of disease. The burden is dominated by peri-natal and maternal conditions and by acute respiratory infections, followed by malaria, nutritional deficiency, diarrhoea, AIDS,

[1] P.O. Box 23385, 1000 Addis Ababa, Ethiopia;
[2] Department of Community Health, Faculty of Medicine, Addis Ababa University, Addis Ababa, Ethiopia

tuberculosis and measles. Health problems of mothers and children in combination constitute 56% of discounted life years (DLYs) (2).

After critically evaluating health conditions in the country, the government in its Health Sector Development Program focused on interventions with large public health impact for improvement of health status by reorganizing the six-tiered health care delivery system (health posts, health stations, health centers, rural hospitals, regional hospitals, and central referral hospitals) into a four-tiered consisting of the Primary Health Care Unit (PHCU), comprising a health center and 5 satellite health posts, district hospitals, zonal hospitals and specialized hospitals (2,5).

Given the scarcity of resources in the country, all health problems may not be given equal importance and may not be dealt with equally, indicating the dire need to seek alternative ways of approaching the problem. This again necessitates evaluating the present pattern of service provision. Such evaluation is important for better-informed decision-making as it could provide information on cost and effectiveness of the alternative strategies.

Decisions concerning individual health programs particularly in the Ethiopian health care context were hitherto usually made on the basis of assessment of the programs
themselves, which is largely of a descriptive approach. Reviewing attempts, whether returns from investment of time, money and personnel worth the effort were very few. Thus the purpose of this study was to evaluate the costeffectiveness of health care interventions in terms of reducing disease burden and improving health status of a rural community in
Ethiopia, by using Disability Adjusted Life Years (DALYs) gained as unit of effectiveness.

A cost is defined as the value of resources used to produce a good or service. However, the way these resources are measured can differ. There are two main alternatives with respect to measurement of these resources: financial and economic costing. Financial costs represent actual expenditure on goods and services purchased and they are described in terms of how much money has been paid for the resources used in the project or service. When costs are defined in terms of the alternative uses that have been forgone by using a resource in a particular way, they are called economic or opportunity costs. These costs recognize the cost of using resources, as these resources are then unavailable for productive use elsewhere. The basic idea behind using opportunity costs is that things have a *value* that might not be fully captured in their *price.* It is not difficult in many health programs to identify resource inputs for which little or no money is paid: volunteers working without payment; health messages broadcast without charge; vaccines or other supplies donated or provided at a large discount by organizations or individuals. Thus the *value* of these resources to society, regardless of who pays for them, is measured by opportunity cost (6).

Cost-effectiveness analysis is a tool that enables program managers to make informed decisions about resource allocation. By measuring and comparing the costs and consequences of various interventions, their relative efficiency can be assessed and future resource requirements estimated. The key feature of cost-effectiveness analysis is that it is used to examine alternatives that all work to meet the same objective. The results of the analysis are described in terms of the cost per unit of effectiveness for each alternative. The cost-effectiveness ratio is calculated for each alternative by dividing cost by the unit of effect (e.g. number of cases of a diseases averted). Then a comparison is made between these ratios. The alternative with the lowest cost per unit of effectiveness is the most cost-effective, and is generally to be preferred on grounds of economic efficiency. Costing and subsequent cost-effectiveness analysis can contribute to greater awareness in this area and facilitate decision-making about the best use of present and new resources. Cost-effectiveness data would help planners to assess which strategies, and what combination and volume of each, might provide the best value for money in the context of the objectives desired (6).

A DALY is an indicator of the year(s) lived with disability (YLD) and year(s) lost due to premature mortality (YLL) from any condition adjusted for the severity of disability. In case of mortality, the DALY measure reflects the expected gain in years of life associated with the intervention and in case of morbidity it reflects

the judgment of experts concerning the percentage of total incapacity that is restored by the intervention (7).

Methods

Study area: The study was conducted in Meskanena Mareko Wereda and Shashemene Hospital. The Wereda is 130 Km south of Addis Ababa. In the Wereda there are one health center, five health stations, eleven private clinics, eleven health posts and eight private drug vendors. A hospital was being constructed in the Wereda during the study period. Patients of surgical, obstetric and other emergencies were therefore, referred to rural hospitals situated some 100 to 140 kilometers away from Butajira town.

Study design: Cross-sectional evaluative survey was used to assess the cost-effectiveness of health care interventions for prevailing disease conditions. The prevailing disease conditions were defined based on a previous BOD study that was carried out in the current study area in 1998 (8). These conditions constituted 70% of the total BOD in the area at the time.

Study population: The Wereda population using health services of the area.

Sampling method: Purposive sampling was utilized to attain the stated objectives. Shashemene Hospital was selected to replace the hospital under construction of the Wereda based on the criteria defined for district hospitals in the Health Sector Development Program (HSDP) (2).

Data collection: Data were collected using semi structured pre-tested questionnaires. Separate instruments were developed for health workers serving in the health institutions and for the inventory of other resources (buildings, equipment, furniture, vehicles and recurrent budget). Questionnaires on cost of personnel for specific health care interventions were self-administered. Trained data collectors who completed grade 12 and who were residents of the study area conducted the inventory of the resources.

Data analysis: Data were entered and computer analyzed using EPI-INFO version 6.04b and statistical software for Disease Burden Modeling System. By assuming a steady state of burden of disease (incidence perspective) and using calculated DALYs from previous study (done in 1998 in the study area) and currently by estimating cost in the present study, cost-effectiveness of each intervention was determined. The unit cost of a DALY was used as a decision rule to rank order the relative cost-effectiveness of the interventions. The lower this number, the most cost-effective the intervention is.

Cost Estimation: The study employed financial (accounting) method of cost estimation to estimate cost of resources used in producing health care interventions and determine unit costs of interventions. Labor cost for each intervention was estimated by using time spent on specific interventions by the health personnel in all categories and calculating the their hourly wages (1,8). Information on the types of drugs and laboratory examinations prescribed for specific cases were collected and their current prices at each facility level were used for the cost estimation. For overhead cost estimation amortized value (initial capital cost changed to an equivalent annual cost) of buildings, equipment, furniture, vehicles, and other recurrent expenditures were included using the formula: C= Co/PWAF, for the capital costs,

Where C= equivalent annual cost

C_o= initial cost of the capital and

PWAF= present worth of annuity factor which is one unit of currency for n years at discount rate of r, that means,

Where a $DALY_i = YLL_i + YLD_i$ (7)

This approach of dividing the total cost to treat or prevent disease under consideration by DALYs will allow obtaining the unit (average) cost per DALY and determine relative cost effectiveness of the health care interventions in terms of cost per unit of disease burden averted among the health institutions.

Sensitivity analysis: As estimates of the amount of time that the health personnel devote to a particular health care intervention and other costs were approximate, it may not be wise or necessary

$$PWAF = \sum_{n=1}^{n} 1/(1+r)^n$$

and n= expected useful life years of the capital (0).

Other recurrent costs were taken directly from those institutions' financial (accounting) system. These include cost paid to administrative personnel other than health workers and other running or operational costs. Cost of capital items were annualized over their expected useful life years at a discount rate of 3%. For buildings a useful life years of 30 has been applied, and for equipment, furniture and vehicles a useful life years of 10 has been used (9 - 12). These shared costs were apportioned to specific interventions by dividing them to the volume of service (annual number of patients) at each health care facility at the time of the assessment (13,14). Finally cost-effectiveness of the interventions was determined by taking the ratio of the unit cost of specific intervention to DALYs lost due to disease under consideration, that means:

$$\frac{\text{Unit cost of intervention for disease i } \mathbf{X} \text{ incidence of disease condition i /100,000 population}}{\text{DALYs lost /100,000 population from disease condition i}}$$

Table 1: **Cost-effectiveness of health care interventions (cost/DALY gained) with range for sensitivity analysis at studied health institutions, Meskanena Mareko Wereda & Shashemene Hospital, Ethiopia, May 2000.**

to give a single or actual costeffectiveness figure (6,11,15 - 17). The use of a range of values for performing sensitivity analysis would avoid methodology introduced bias and would ensure validity of the results.

Therefore, ranges of cost-effectiveness estimates were calculated by arbitrarily varying (increasing twice and/or reducing by half) measured values of the variables.

Results

Generally, when the health institutions were compared in terms of their cost-effectiveness, health stations were found to be more costeffective than either the health center or the hospital. As shown in Table 1, preventive intervention for diarrhoeal diseases control at the hospital and health stations level was more cost-effective than other control measures, but at the health center level IEC was found to be most cost effective. In all the facilities, curative intervention using IV fluid and antibiotics was least cost effective. Furthermore, curative intervention with oral re-hydration salt (ORS) was found to be at the median of the interventions for dirrhoeal diseases control.

In the delivery of MCH care, community level intervention was most cost-effective followed by EPI and FP. Managing normal delivery was least cost-effective than other measures. In case of malaria control, chemo -prophylaxis with chloroquine had the least cost per DALY gained and therefore, this was the most cost-effective intervention followed by community level (IEC, altering and changing the environment) and case management interventions. The curative management at the hospital was 2 to 6 times less cost-effective than at the health center and health stations levels respectively.

At Butajira Health Center and the health stations under its administration, interventions against acute respiratory infection had decreasing order of cost-effectiveness by which community level interventions stood most costeffective followed by the preventive and curative strategies.

	Shashemene Hospital	Butajira Health center	Health stations
CDD (community)	60.96 (32.66-117.50)	38.64 (22.62-70.69)	28.20 (16.09-52.41)
CDD (Preventive)	53.26 (28.83-102.16)	44.79 (25.68-83.01)	24.52 (14.25-45.04)
CDD (cur c antibiotics)	170.75 (69.21-309.20)	111.39 (69.21-195.75)	50.04 (35.23-79.70)
CDD (cur c ORS)	155.56 (86.07-294.56)	94.24 (56.31-170.08)	50.67 (31.02-89.96)
CDD (cur c IV antibiotics)	290.45 (200.39-470.65)	157.72 (121.04-231.05)	115.02 (101.51-151.03)
MCH (community)	2.07 (1.13-3.97)	1.14 (0.68-2.04)	0.98 (0.56-1.81)
MCH (preventive-ANC)	8.07 (4.03-12.85)	4.53 (2.96-7.70)	2.00 (1.51-3.02)
MCH (preventive ND)	10.06 (5.12-19.95)	6.08 (3.17-11.90)	5.54 (2.84-10.92)
MCH (FP)	4.53 (3.20-7.16)	2.61 (1.81-4.23)	1.87 (1.27-3.08)
MCH (EPI)	2.89 (2.01-4.65)	3.60 (1.13-6.07)	1.86 (1.45-2.63)
Malaria ctrl (community)	130.96 (70.79-250.97)	123.37 (69.95-230.22)	94.95 (52.48-179.89)
Malaria ctrl (preventive)	108.97 (59.95-206.98)	41.72 (29.12-66.93)	47.59 (28.80-85.18)
Malaria ctrl (curative)	541.41 (322.57-889.03)	269.05 (169.72-467.73)	98.24 (73.20-170.33)
ARI ctrl (community)	52.29 (28.44-100.02)	40.41 (23.76-73.87)	27.08 (15.65-49.97)
ARI ctrl (preventive)	51.37 (28.00-103.97)	89.87 (48.42-172.81)	30.04 (17.11-55.88)
ARI ctrl (curative)	384.62 (303.43-546.98)	120.15 (79.54-202.12)	70.65 (54.59-102.83)
Measles ctrl (community)	6.18 (3.34-11.83)	4.09 (2.42-7.37)	3.06 (1.78-5.65)
Measles ctrl (preventive)	5.47 (3.01-10.44)	3.28 (2.04-5.76)	1.97 (1.24-3.44)
Measles ctrl (curative)	17.03 (9.41-32.22)	12.83 (7.80-22.86)	5.89 (4.14-9.41)
TB ctrl (community)	7.82 (4.20-15.03)	5.76 (3.35-10.60)	3.71 (2.13-6.86)
TB ctrl Preventive)	6.21 (3.41-11.82)	2.95 (1.94-4.99)	2.17 (1.35-3.77)
TB ctrl (cur-Short-term)	512.46(500.88-535.88)	293.00 (286.78-305.62)	199.21 (197.73-202.16)
TB ctrl (cur-Long-term)	662.42 (650.64-685.99)	377.29 (371.50-388.89)	204.60 (202.39-207.71)
HIV/AIDS ctrl (comm.)	0.78 (0.39-1.51)	1.06 (0.56-2.02)	0.37 (0.22-0.69)
HIV/AIDS ctrl (preven)	2.57 (1.33-5.08)	2.05 (1.08-4.00)	1.00 (0.52-1.94)
HIV/AIDS ctrl (c.op.in)	7.64 (6.59-9.73)	---	--

On the other hand, at Shashemene District Hospital it was the preventive strategy that was most cost-effective. Within the hospital curative management was 7 times less cost-effective than both community and preventive interventions. Also, case management of ARI at the hospital was 3 to 5 times less cost-effective than case treatment at the health center and health stations. Similarly, in treating an ARI case health stations were 1.5 to 3 times more cost-effective than the health center.

In lessening the burden of measles, the preventive strategy of giving measles vaccine was found to be more cost-effective than the other two modalities of interventions at the health care facilities. From interventions for the control of tuberculosis, prevention with BCG vaccination was most cost-effective. The least cost-effective was the curative management with long-term regimen using anti-tuberculosis drugs. Both courses of treatments (short and long-term) were 2 to 3 times less cost-effective at the hospital than health center and health stations, while at the health center these interventions were 1.5 to 1.8 times less costeffective than at the health stations. Unlike other results of cost-effectiveness of interventions presented above, there were great differences among the health institutions in conducting HIV/AIDS interventions. This was particularly due to availability of spot test and availability of drugs for opportunistic infections at Shashemene District Hospital. At the level of the health center and health stations, this cost was not included during cost-effectiveness analysis.

Table 2: **Relative rank order of cost-effectiveness of health care interventions (cost/DALYs gained) Shashemene Hospital, Ethiopia, May 2000**

Health care intervention	Cost/DALY gained (Sensitivity analysis)
HIV/AIDS ctrl (community)	0.78 (0.39-1,51)
MCH (community)	2.07 (1.13-3.97)
HIV/AIDS ctrl (preventive)	2.57 (1.33-5.08)
MCH (EPI)	2.89 (2.01-4.65)
MCH (FP)	4.53 (3.20-7.16)
Measles ctrl (preventive)	5.47 (3.01-10.44)
Measles ctrl (community)	6.18 (3.34-11.83)
TB ctrl (preventive)	6.21 (3.41-11.82)
HIV/AIDS ctrl (cur-op.inf.)	7.64 (6.59-9.73)
TB ctrl (community)	7.82 (4.20-15.03)
MCH (preventive – ANC)	8.07 (4.03-12.85)
MCH (preventive–normal delivery)	10.06 (5.12-19.95)
Measles ctrl (curative)	17.03 (9.41-32.22)
ARI ctrl (preventive)	51.37 (28.00-103.97)
ARI ctrl (community)	52.29 (28.44-100.02)
CDD (preventive)	53.26 (28.83-102.16)
CDD (community)	60.96 (32.66-117.50)
Malarial ctrl (preventive)	108.97 (59.95-206.98)
Malaria ctrl (community)	130.96 (70.79-250.97)
CDD (curative with ORS)	155.56 (86.07-294.56)
CDD (curative with antibiotics)	170.75 (69.21-309.20)
CDD (curative with IV antibiotics)	290.45 (200.39-470.65)
ARI ctrl (curative)	384.62 (303.43-546.98)
TB ctrl (curative – short-term)	512.46 (500.88-535.88)
Malaria ctrl (curative)	541.41 (322.57-889.03)
TB ctrl (curative-Long-term)	662.42 (650.64-685.99)

Table 3: **Relative rank order of costeffectiveness of care interventions (cost/DALY gained) ag Butajira Health Center, Meskanan Mareko Wereda & Shashemene Hospital – Ethiopia, May 2000.**

Health care intervention	Cost/DALY gained

	(sensitivity analysis)
HIV/AIDS ctrl (community)	1.06 (0.56-2.02)
MCH (community)	1.14 (0.68-2.04)
HIV/AIDS ctrl (preventive)	2.05 (1.08-4.00)
MCH (FP)	2.61 (1.81-4.23)
TB ctrl (preventive)	2.95 (1.94-4.99)
Measles ctrl (preventive)	3.28 (2.04-5.76)
MCH (EPI)	3.60 (1.13-6.07)
Measles ctrl (community)	4.09 (2.42-7.37)
MCH (preventive – ANC)	4.53 (2.96-7.70)
TB ctrl (community)	5.76 (3.35-10.60)
MCH (preventive – normal delivery)	6.08 (3.17-11.90)
Measles ctrl (curative)	12.83 (7.80-22.86)
CDD (community)	38.64 (22.62-70.69)
ARI ctrl (community)	40.41 (23.67-73.87)
Malarial ctrl (preventive)	41.72 (29.12-66.93)
CDD (preventive)	44.79 (25.68-83.01)
ARI ctrl (preventive)	89.87 (48.42-172.81)
CDD (curative with ORS)	94.24 (56.31-170.08)
CDD (curative with antibiotics)	111.39 (69.21-195.75)
ARI ctrl (curative)	120.15 (79.54-202.12)
Malaria ctrl (community)	123.37 (69.95-230.22)
CDD (curative with IV antibiotics)	157.72 (121.04-231.05)
Malaria ctrl (curative)	269.05 (169.72-467.73)
TB ctrl (curative – Short-term)	293.00(286.87-305.62)
TB ctrl (curative – Long-term)	377.29 (371.50-388.89)

The relative rank order of interventions in terms of their cost-effectiveness for each facility are given in tables 2, 3, and 4. In analyzing this relative rank order, if we take cost of 100 Birr per DALY gained in reference to health care expenditure per capita (12 USD) in low income countries as a cut off point for an attractive use of resources, then implementing 22 health care interventions in descending rank order which have cost of less than 100 Birr per DALY gained at the health stations level will avert 52% of the BOD in the area. Similarly, implementing 17 interventions at the hospital and 18 interventions at the health center level will avert only about 22 to 34% of the BOD of the area respectively.

Table 4: **Relative rank order of cost-effectiveness of health care interventions (cost/DALY gained) at Health Stations in Meskanena Mareko Wereda, Ethiopia, May 2000.**

Health care intervention	Cost/DALY gained (sensitivity analysis)
HIV/AIDS ctrl (community)	0.37 (0.22-0.69)
MCH (community)	0.98 (0.56-1.81)
HIV/AIDS ctrl (preventive)	1.00 (0.52-1.94)
MCH (EPI)	1.86 (1.45-2.63)
MCH (FP)	1.87 (1.27-3.08)
Measles ctrl (preventive)	1.97 (1.24-3.44)
MCH (preventive – ANC)	2.00 (1.51-3.02)
TB ctrl (preventive)	2.17 (1.35-3.77)
Measles ctrl (community)	3.06 (1.78 –5.65)
TB ctrl (community)	3.71 (2.13-6.86)
MCH (preventive – normal delivery)	5.54 (2.84-10.92)
Measles ctrl (curative)	5.89 (4.14-9.41)
CDD (preventive)	24.52 (14.25-45.04)
ARI ctrl (community)	27.08 (15.65-49.97)
CDD (community)	28.20 (16.09-52.41)
ARI ctrl (preventive)	30.04 (17.11-55.88)
Malarial ctrl (preventive)	47.59 (28.80-85.18)
CDD (curative with antibiotics)	50.04 (35.23-79.70)
CDD (curative with ORS)	50.67 (31.02-89.96)
ARI ctrl (curative)	70.65 (54.59-102.83)
Malaria ctrl (community)	94.95 (52.48-179.89)
Malaria ctrl (curative)	98.24 (73.20-170.33)
CDD (curative with IV antibiotics)	115.02 (101.51-151.03)
TB ctrl (curative – Short-term)	199.21 (197.73-202.16)
TB ctrl (curative – Long-term)	204.60 (202.39-207.71)

Discussion

The objective of this study was to assess costeffectiveness of health care interventions regarding improvement in general health status of the rural community, and DALYs gained was used as a common measure of effectiveness across the interventions. The main merit in choosing DALY as a measure of effectiveness was that all health benefits from health interventions are comparable regardless of their outcomes and the characteristics of the individuals affected by disease since all health losses (premature mortality, acute morbidity, permanent disability, pain or discomfort) can be aggregated into a time measure (7,10,18), and this was already done by the area's BOD study in 1998.

The present study was focussed on those interventions that yield the best return in health production for the money invested. Therefore, for the control of diarrhoeal diseases, preventive interventions (measles vaccination and growth monitoring) appeared to be most cost-effective compared to other forms of measures at the level of the hospital and health stations. However, at the health center, the community level interventions (IEC, promoting latrine construction and safe and adequate water supply) were the most cost-effective modalities of care. This was largely due

to low labor cost involved with the preventive interventions at the health stations and hospital levels, while at the health center the labor cost was higher than the two levels for the same intervention. On the other hand, for the community level intervention the labor cost was higher at the health stations and the hospital than at the health center.

In this study, the lowest cost for diarrhoeal diseases intervention was 24.52 Birr per DALYs gained which was at health stations level and the highest was 290.45 Birr per DALYs gained at the hospital. On the other hand, the finding of the study in costeffectiveness and program evaluation done in Ethiopia in 1996 for the interventions in diarrhoeal diseases control revealed cost of 18.72 to 174.16 USD (in 1996 USD) per life year saved (19). However, this great difference could be attributed to differences in methodology, besides the time difference in conducting the studies. Results of costeffectiveness studies could also differ because of many other factors. Differences in epidemiological factors (such as the length of transmission season in case of malaria), economic variables (such as local costs for staff and drugs) and the extent and quality of the existing health infrastructure (10,20,21,22) are among the many other factors. For this reason, it would be unfair to make comparisons with other studies done in other parts of the world.

Concerning MCH care, community level intervention (IEC) was the most cost-effective at all institutions. This was also mainly due to low labor cost associated with the intervention. In addition, other MCH interventions had other cost components like drug or laboratory services (except at the health stations) contributing to their less cost effectiveness compared to the IEC. The most important issue particularly concerning community (IEC) and preventive level interventions is how to make a mother or a client who does not actually seek them use such services. In addressing other major health problems, malaria chemo prophylaxis was found to be more costeffective with a cost of 41.72 to 108.97 Birr (5.09 to 13.29 USD) per DALY gained. This is a good return for money invested on it, although, this control measure may not be effective by itself.

In the control of acute respiratory infections, prevention (vaccination, growth monitoring) and community (IEC) level interventions appeared to be more cost-effective. At the hospital, ARI case management was less costeffective than the other two levels. This was due to high labor, drug and recurrent cost involved with the intervention. For instance the drug cost (59.99 Birr) at the hospital was 6 and
9 times higher than costs at health stations and health center. Further, it was observed that there was great discrepancy in drug management for cases of acute respiratory infections among the health institutions. Another major contributor to the BOD from childhood clusters was measles.
To reduce its burden, preventive strategy was found to be most cost-effective, with a cost of 1.97 to 5.47 Birr per DALYs gained. It is also evident that curative intervention was least cost-effective due to high labor cost incurred at all levels, particularly at the health center and the hospital.
In examining the cost-effectiveness of interventions for the control of tuberculosis, chemotherapy was found to be the least cost effective in all the studied facilities. Possible explanation for such least cost-effectiveness could be due to high drug, labor and recurrent costs of the intervention. Particularly the cost of drugs was very high for the short course. It ranged from 450 to 1115.20 Birr for the short term and from 462 to 1459.70 Birr for the longterm treatment regimen. With respect to HIV/AIDS control, IEC at the community level, condom promotion, counseling and treatment of sexually transmitted diseases as preventive measure, and case management to treat opportunistic infections were found to be cost-effective compared to most of the other interventions. These interventions are said to be cost-effective when targeted at relatively few people in the core groups (23). Nevertheless, the study did not take such an approach in evaluating the interventions to control the disease. Rather the study evaluated the interventions from the perspective of costeffectiveness in improving health in the general population. Making correct diagnosis is one of the determinant factors for the costeffectiveness of therapeutic interventions (20). Therefore, it would not be appropriate to talk about the cost-effectiveness of case management to treat opportunistic infections in HIV/AIDS at the levels of the health stations and health center

as these institutions do not have the diagnostic facility for HIV/AIDS. That is why it was left out.

Combining intervention strategies (preventive and curative) is said to be helpful to deal with most of the diseases, since a single strategy cannot protect everyone (21,23). Besides, there may not be adequate demand for some types of interventions (especially preventive) on the public side reducing the usefulness of the interventions and making them less feasible. In such situations, health care decision makers and health workers of the area must work at the forefront in raising awareness to improve the decisions of households on the use of health services provided that the decision makers and the health personnel are reoriented and retrained in terms of cost-effective interventions in reducing the existing disease burden of the local community. This is critical to the practicability of cost-effective interventions. Moreover, the strategy of combining interventions signify the importance of developing intervention packages which will have further benefits of reduced costs as a result of cost synergism. It is also a vehicle for orienting demand and improving referral (10).

Cost estimates in this study were assumed to affect the results of the analysis. Therefore, sensitivity analysis was performed in order to enhance the validity of the study results by deliberately varying the values of the variables included in the study. A sensitivity analysis indicated how the cost-effectiveness varied when cost values were changed. Economic analysts in health care programs advise to identify high and low estimates and calculate study results based on combinations of these estimates (12,16). There are also those who use cost variations ranging from 10% to 50% of the measured values and recompute results (24,25). Similarly in this study actually measured costs were considered as best estimates because it was difficult to find other best estimates from the few studies conducted in the Ethiopian context. The estimates of the sensitivity analysis are likely to widen the scope in evaluating the cost-effectiveness of the interventions. Even if such efforts were made in the analysis, one can question the validity of conducting such a study in the health institutions where there was no appropriate accounting method and where data documentation is not well practiced. However, this cost-effectiveness study has shown that it is worth using whatever available data and come up with estimates (with sensitivity analysis) than wait for everything to be perfect. Although, the study may lack some degree of precision, it has attempted to evaluate the costeffectiveness of interventions at health facilities in a rural setup.

The study, obviously, has its own limitations. As it was a cross sectional study, it did not account for repeated disease events. It has stated cost-effectiveness in providing the interventions only once for respective cases.
Besides, a steady state of diseases was assumed and in the sampling procedure, Shashemene District Hospital was selected to replace the newly built Butajira Hospital (not yet staffed and equipped). On the other hand, the case mix would not be the same at studied facilities.
Higher-level institutions would handle more severe and complex cases than lower level facilities. Since more severe cases would have more demand on resources, this would be reflected as low cost-effectiveness for higherlevel institutes. In any event, cost-effectiveness comparisons were made in the different level of facilities, however, it might not give adequate explanation of cost-effectiveness of the interventions particularly at the hospital level. The fact that average measures of resource requirements for a group of cases were not sorted and weighed according to type and severity of cases might result in the study's lack of some degree of precision.

Conclusion and Recommendations

The essence of this cost-effectiveness assessment was to exploe different ways of achieving the objective of reducing existing BOD in a rural setup. The analysis can help policy and decision makers compare alternative approaches to control those major health problems of the Wereda. As information about the burden of disease of the Wereda and costeffective interventions to reduce the burden is available, they need to review current health priorities and intervention strategies.

Overall community and preventive interventions were found largely cost-effective in lessening existing BOD in the local community. Therefore, considerable intensification of the health services

which encompass mix of these interventions, as delivery strategy of health care would lessen BOD in the study area. The policy implication in terms of improving general health status of the rural population is whether to invest on community and preventive or curative interventions. In this regard, this study has attempted to produce evidence relevant to this policy issue. Thus, priority should be given to the most cost-effective interventions. Further research is needed on a large scale to reveal more comprehensive and more representative data to determine cost-effectiveness of health care interventions.

Acknowledgements

We gratefully acknowledge the Department of Community Health, Addis Ababa University, for its financial assistance. We are also thankful to health and administrative workers of studied health institutions who have made the conduct and reporting of this a reality.

References

1. PHRDP (Policy & Human Resources Development Project), Ethiopia. Costeffectiveness and management of the public sector health care system. Ethiopian Social Sector Study Report, No. 8, 1998.
2. Ministry of Health, Ethiopia. Program action plan for the health sector development program, document of the Federal Democratic Republic of Ethiopia, 1998.
3. Peters DH, Elmendorf AE, Kandola K, Chellaraj G. Benchmarks for health expenditures, services and outcomes in Africa during the 1990s, Bulletin of the World Health Organization 2000;78(6): 761-769.
4. Population and Human Resource East Africa Department Africa Region. Health Policy in East Africa: A Structured Approach to Resource Allocation, Vol. 1, 1996.
5. Ministry of Health, Ethiopia. Health and health related indicators, Planning and Programming Department, 1999.
6. Green A. An introduction to health planning in developing countries. Oxford Medical Publications. Oxford, 1992.
7. Murray CJL, Lopez AD. The global burden of disease. Global burden of disease and injury series Vol. 1. Harvard University Press, 1996.
8. Abdulahi H, Haile Mariam D & Kebede D. “Burden of Disease Analysis in Rural Ethiopia”. Ethiopian Medical Journal; 2001;39(4):271-281.

9. Barnum H. Cost-effectiveness & Cost benefit analysis of programs to control diarrhoeal diseases. WHO, Geneva 1981.
10. Murray CJL, Lopez AD. Global Comparative Assessment in the Health Sector: disease burden, expenditures and intervention packages. WHO, Geneva 1994.
11. World Health Organization. Estimating cost for cost-effectiveness analysis. Guideline for managers of diarrhoeal disease control programs. Program for Control of Diarrheal Diseases. World Health Organization. Geneva 1988.
12. Creese A, Parker D. Cost Analysis in Primary Health Care. A training Manual for Program Managers. WHO, Geneva 1990.
13. Mills AJ, Kapalamula J, Chisimbi S. The cost of district hospital: a case study in Malawi. Bulletin of the World Health Organization 1993;71(314):329-339.
14. Murray CJL, Kreuser J, Whang W. Costeffectiveness analysis and policy choices: Investing in health systems. Bulletin of the World Health Organization 1994;72(4):663-674.
15. Drummond MF. Principles of Economic Appraisal in Health Care. Oxford University Press, Oxford, 1980.
16. Drummond MF Stoddart GL, Torrance GW. Methods for Economic Evaluation of Health Care Program. Oxford University Press, 1993.
17. Walsh JA, Warren KS. Strategies for Primary Health Care. Technologies appropriate to the control of disease in the developing world. The University of Chicago press, 1982.
18. Janovcky K. Health policy and system development: An agenda for research. World Health Organization, Geneva, 1996.
19. Panerai RB, Mohi JP. Health technology assessment methodologies for developing countries, PAHO, N.W. 1999.
20. Jamison DT, Mosley H. Disease Control Priorities in Developing Countries. Health Policy Responses to Epidemiological Change. World Bank Reprint Series: Number 460. Reprinted with permission from the American Journal of Public Health 1991;81(1):15-22.
21. Jamison DT. et. al. Disease Control Priorities in Developing Countries. Published for the World Bank. Oxford University Press, Oxford. 1993.
22. Bobadilla JL, Cowley P, Musgrove P, Saxenian H. Design, content and financing of essential national package of health services. Bulletin of the WHO 1994;72(4):653-662.
23. World Bank. Investing in Health. Oxford, 1993.
24. Zaman S. Cost analysis for hospital care. The case of Embada Hospital Cairo, Egypt, May 1993.
25. Roberts JA, Upton PA, Azene G. Escherichia coli 0157;H7 : an assessment of an outbreak. Journal of Public Health Medicine 2000;22(1):99-107.