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A Cost-Effectiveness Analysis of Community Health Workers in Mozambique

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Abstract

Introduction: Community health worker (CHW) programs are a key strategy for reducing mortality and morbidity. Despite this, there is a gap in the literature on the cost and cost-effectiveness of CHW programs, especially in developing countries. **Methods:** This study assessed the costs of a CHW program in Mozambique over the period 2010-2012. Incremental cost-effectiveness ratios, comparing the change in costs to the change in 3 output measures, as well as gains in efficiency were calculated over the periods 2010-2011 and 2010-2012. The results were reported both excluding and including salaries for CHWs. **Results:** The results of the study showed total costs of the CHW program increased from US$1.34 million in 2010 to US$1.67 million in 2012. The highest incremental cost-effectiveness ratio was for the cost per beneficiary covered including CHW salaries, estimated at US$47.12 for 2010-2011. The smallest incremental cost-effectiveness ratio was for the cost per household visit not including CHW salaries, estimated at US$0.09 for 2010-2012. Adding CHW salaries would not only have increased total program costs by 362% in 2012 but also led to the largest efficiency gains in program implementation; a 56% gain in cost per output in the long run as compared with the short run after including CHW salaries. **Conclusions:** Our findings can be used to inform future CHW program policy both in Mozambique and in other countries, as well as provide a set of incremental cost per output measures to be used in benchmarking to other CHW costing analyses.

Keywords

cost-effectiveness, community health, efficiency, primary care, access to care

Introduction

Community health workers (CHWs) have played an integral role in improving health care delivery in countries around the world for a number of years.[1-4] Community health workers, defined as "any health worker carrying out functions related to health care delivery; trained in some way in the context of the intervention; and having no formal professional or paraprofessional certificated or degreed tertiary education,"[1] have been promoted in alignment with an effective primary healthcare system as outlined in the Alma Ata declaration in 1978.[5] Following a period of diminished interest in their use in the 1980s,[1] there has been renewed global interest in CHW programs, most recently as a key strategy to achieving the Millennium Development Goals, universal health coverage, and chronic diseases.[3,6-8]

There is clear evidence documenting the importance of CHW programs in general in reducing mortality and morbidity.[8-11] A Cochrane systematic review of 82 randomized studies of the effectiveness of lay health workers in primary and community health care in both low- and high-income countries showed improved uptake of immunization, improved outcomes for the treatment of malaria and acute respiratory infections, and reduction of child morbidity and mortality when compared to usual care.[9] In addition, a recent review by Christopher et al[10] of 7 evaluations of CHW programs in West Africa found a 63% reduction in mortality when CHWs delivered insecticide treated nets and a 36% reduction in mortality when CHWs delivered antimalarial chemoprophylaxis. CHW programs have also been successful in achieving specific outcomes.[12] For example, CHWs

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have been used in campaigns to treat childhood illness,[13,14] decrease child morbidity and mortality,[15] provide prompt and effective malaria case management,[16] and improve maternal and newborn health.[17]

This evidence for the effectiveness of CHWs has increased investments in CHW programs. Despite this increased investment and use, costing analyses of CHW programs are not routinely conducted.[1,18-20] This gap in the literature is especially evident for CHW programs in developing countries.[1,21] This is partly because of the intrinsic difficulty in measuring CHW costs and lack of consistency in output measures among studies.[20] Not only are there a limited number of costing and cost-effectiveness studies of CHW programs in developing countries, but a number of these studies use different output measures making the analyses difficult to compare. While not directly comparable to this study, a study in South Africa found that using community-based Directly Observed Therapy–Short-Course (DOTS) was more cost-effective than hospitalization or sanatorium care on a cost per patient cured basis.[22] A study of CHW-led women's groups in Nepal found a substantial reduction in both neonatal and maternal mortality and an incremental cost-effectiveness of $211 per life year gained among neonates.[23] An analysis of a CHW program for basic health care and preventive practices in the Western province of Kenya showed a benefit-cost ratio of about 9, indicating that the program was a good investment.[24]

As countries begin to plan their health and development programs post–2015 Millennium Development Goals and to focus on universal health coverage, more countries may incorporate the planning and implementation of CHW programs into their health system strengthening plans. Policymakers need detailed costing information and incremental cost-effectiveness data for effective CHW programs. This study adds to the literature on costing of CHW programs through examining the incremental cost-effectiveness for 3 specific output measures for a CHW program in Nampula Province, Mozambique over the period 2010-2012.

Setting

Mozambique offered a unique setting to add to the limited evidence base on the cost-effectiveness of CHW programs. Mozambique has been using CHWs since the late 1970s, when the government of Mozambique first began implementing the "Agente Polivalente Elementar" (APE) approach. In addition to the government APE program, nongovernmental organizations in Mozambique have a history of working with CHWs (agentes comunitários de saúde) on a range of health issues. For example, several large donor-funded health programs in Mozambique have worked with CHWs as a key strategy for community-level service delivery. The USAID-funded Strengthening Communities Through Integrated Programming (SCIP) project implemented by Pathfinder International in Nampula province, one of the largest projects working with CHWs, began training CHWs in 2010 to provide integrated health care services. The SCIP project implemented CHW trainings in a phased approach by training an initial group of CHWs in 2010 and then scaling up to a full complement of CHWs in 2011 and 2012 to fully cover the target population in project districts.

The SCIP project implements different CHW intervention packages in selected districts of Nampula province. The SCIP CHW program analyzed below implemented a "specialized," targeted package of health interventions based on World Relief's Care Group Volunteer model with additional content, such as family planning, incorporated into the training. Using this model, community health workers received training every 15 days from their direct supervisors called Animadores. Animadores were in turn managed by Community Supervisors, who were selected by their communities to manage and train their respective Animadores. The topics covered included family planning/reproductive health, maternal health, malaria, diarrhea, pneumonia, tuberculosis, HIV, orphans and vulnerable children, malnutrition, and newborn care. All topics were covered over the course of a 1-year period, varying from one to four training sessions per topic. Each CHW was assigned approximately 10 households, and visited each household once every 2 weeks to talk with adult household members about the different health topics using an integrated approach. World Relief did not have a CHW program in these five districts before the SCIP project began in 2010.

Methods

A retrospective costing analysis of the SCIP Specialized CHW package was conducted to estimate the cost of providing CHW services for the years 2010, 2011, and 2012 with respect to the following three key program output measures: households in coverage area, household visits, women of reproductive age who receive benefits. These 3 output measures were chosen because they were monitored over all 3 years of the analysis and reflected the key activities (household visits to women of reproductive age) that CHWs were expected to conduct. In addition, many CHW programs track and monitor similar output measures, making the results and the analysis replicable and comparable to other CHW programs

Budgetary and expenditure data from the World Relief project files were used to calculate personnel, recurrent and capital costs for all CHW program–related activities for the period 2010-2012. Budgetary figures were used as a proxy for expenditure figures based on communications with project personnel who reported minimal discrepancy between budgetary and expenditure figures for most items included in the costing analysis. In the absence of a control group or similar communities without a CHW program, we used 2010 as the baseline year of the analysis and a proxy control.

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Table 1. Community Supervisors, Animadores, and Community Health Workers, 2010-2012.

	2010	2011	2012
Community supervisor	45	47	47
Animador	407	407	409
Community health worker	10 532	29 574	28 422

Personnel costs captured the remuneration costs for all workers involved in the CHW project. The personnel categories were divided into costs associated with the program personnel working in Nampula City and in the communities. Annual salaries and fixed benefits were extracted from the budgetary data for each cadre of workers for years 2010, 2011, and 2012. The level of effort devoted to CHW activities was estimated for each cadre of workers based on interviews with program staff. Personnel working in Nampula City were estimated to devote between 10% and 62% of their time to CHW activities. Most of the cadres working directly in the communities worked 100% of their time on the CHW program, except the Orphans and Vulnerable Children (OVC)/HIV AIDS Facilitators and Home-based Care (HBC) Facilitators reported working only 67% of their time on CHW activities. The community health workers themselves were volunteers and did not receive a salary. The two other cadres that worked in the community, Community Supervisors and Animadores, were financially compensated for their level of effort and these amounts were included in the costing analysis. As described below, we conducted two costing analyses, one assuming no contribution to personnel costs for CHWs and a second estimation that included their potential contribution to personnel costs.

Recurrent costs included monthly and yearly costs associated with maintenance and repair of vehicles and motorcycles, gasoline, office supplies, insurance, utilities (energy, telephone, and water), travel costs, printing, waste collection services, and training allowances. Capital costs estimated the amortized capital cost of buildings, motor vehicles, motor bikes and bicycles, and office equipment, including computers and software. All recurrent and capital costs were inflated in years 2011 and 2012 by 10% according to the official inflation rate for Mozambique estimated by the World Bank.

The number of workers in each personnel category/cadre was extracted from project files. Table 1 summarizes the number of Community Supervisors, Animadores, and CHWs for the years 2010, 2011, and 2012 in order to show the organization and magnitude of the program.

Data on the following program outputs were estimated annually using data from the project database and reports: number of households covered, number of household visits and number of female beneficiaries of reproductive age (15 to 49 year olds) served. For the first output, number of households covered per year, data were extracted from the reported number of households covered by the program per month from program reports. For the second output, number of household visits, we multiplied the number of households covered by the number of households visited per month by each CHW as reported by the program (2 household visits per month). For the final output, number of beneficiaries, we used the number of households covered per district and the mean number of women of reproductive age per household in each district from the year 2010. The mean number of women of reproductive age per household in each district was calculated using the district-level unweighted ratios of women of reproductive age per household from the SCIP Project baseline survey conducted in 2010, which included a full listing of household members for sampled households. According to this survey, the mean number of women of reproductive age per household in each district was 0.926.

The total costs and outputs were reported and used to calculate the change in costs for 2 periods, 2010-2011 (short run) and 2010-2012 (long run). We used the change in total cost and change in total outputs to calculate incremental cost-effectiveness ratios for each output over 2 periods, 2010-2011 (short run) and 2010-2012 (long run). We conducted 2 types of costing analyses. The first analysis assumed CHWs were volunteers and did not receive any monetary compensation. The second analysis, a sensitivity analysis, included an estimated amount for CHW salaries, using the minimum wage for the districts around Nampula City of $45/month. This amount was the same amount that was proposed as a monthly subsidy for CHWs under the National Community Health Worker Program of Mozambique.[25] For the sensitivity analysis, we also estimated that CHW devote 39% of their time to CHW project activities. This 39% level of effort was based on interviews with key project informants who reported that the CHWs must be available for 2 home visits per week and for 3 days per month to participate in community mobilization sessions. The CHW effort measure was based on 365 days per year as they make some of their home visits on weekends.

Using the changes in costs and program outputs over the years of the CHW program, we calculated the incremental cost-effectiveness ratio (ICER) for the periods of 2010-2011 (short run) and 2010-2012 (long run). The ICER was defined as the ratio of the change in costs divided by the change in program outputs over a specified time period. Efficiency of program implementation was calculated by examining the percentage reduction in ICER over the first year of the program compared with the second year of the program, and captured the increase in the 2 program outputs compared with the change in cost inputs.

Results

Table 2 reports estimates of the total CHW program costs for the SCIP CHW program in Mozambique for the years

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Table 2. Total Community Health Worker (CHW) Program Costs (in US$), Without and With CHW Salaries, 2010-2012.

	2010	2011	2012	Total	Change 2010-2011 (%)	Change 2011-2012 (%)
Without CHW salaries	1 336 844	1 582 960	1 671 801	4 591 605	18.4	5.6
With CHW salaries	3 580 593	7 883 438	7 726 855	19 190 886	54.6	−2.0

Table 3. Program Outputs, 2010-2012.

	2010	2011	2012	Change 2010-2011 (%)	Change 2011-2012 (%)
Households in coverage area	69 218	169 425	220 152	145	30
Households visits	1 661 256	4 066 200	5 283 648	145	30
Beneficiaries: women of reproductive age	62 643	153 956	195 503	146	27

Table 4. Incremental Cost-Effectiveness Calculation by Program Output, Short Run and Long Run.

	ICER Calculation Without CHW Salary		ICER Calculation With CHW Salary	
Total Change in Costs and Outputs	2010-2011	2010-2012	2010-2011	2010-2012
Costs	246 117	334 956	4 302 845	4 146 262
Households covered	100 206	150 933	100 206	150 933
Household visits	2 404 944	3 622 392	2 404 944	3 622 392
Beneficiaries	91 312	133 859	91 312	133 859
Incremental cost-effectiveness ratio				
Cost per household covered	2.46	2.22	42.94	27.47
Cost per household visit	0.10	0.09	1.79	1.14
Cost per beneficiary	2.70	2.50	47.12	30.97
Efficiency gain, 2010-2012, %				
Households covered	11		56	
Household visits	11		56	
Beneficiaries	7		52	

Abbreviations: CHW, community health worker; ICER, incremental cost-effectiveness ratio.

2010, 2011, and 2012, both without and with estimated salaries for CHWs. As shown in Table 2, without CHW salaries included, total costs increased each year from US$1.34 million in 2010 to US$1.58 million in 2011 to US$1.67 million in 2013. The percentage increase in program costs was larger from 2010 to 2011 (18.4%) than from 2011 to 2012 (5.6%). The second row reports results from the sensitivity analysis of total program costs if CHWs were paid for their services, using $45/month as an estimate for their monthly wage and a 39% level of effort for CHW activities. The analysis including CHW salaries shows that program costs increased by 54.6% in the first year and then stabilized and showed a slight reduction over the second year (−2.0%). In 2012, the total CHW program cost with CHW salaries would have been US$7 726 855, compared with the program cost of US$1 671 801 without CHW remuneration.

Table 3 reports on the three program outputs included in the analysis. The percentage increase in program outputs was larger from 2010 to 2011 than from 2011 to 2012 for all outputs, reflecting the large increase in service provision during the first year and then stabilization in program implementation.

Table 4 shows ICER calculations for each of the 3 program outputs (households covered, household visits, and beneficiaries), for two time periods (2010-2011, short run and 2010-2012, long run), using total program costs with and without CHW salaries. The highest ICER are for the cost per beneficiary covered including CHW salaries, estimated at US$47.12 in the short run and US$30.97 in the long run. The smallest ICER are for the cost per household visit not including CHW salaries, estimated at US$0.10 in the short run and US$0.09 in the long run. The largest efficiency gains are for households covered and household visits both showing a 56% gain in cost per output over the short-run compared with the long run, suggesting the highest efficiency gains when community health worker salaries are included in program costs. The efficiency gains capture the additional outputs achieved by those community health

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workers who remain in the program; as they become more efficient at reaching more houses, making more household visits and meeting with more women of reproductive age.

Discussion

The costing analysis of the SCIP Specialized CHW package found that the total program costs increased from US$1.34 million in 2010 to US$1.67 million in 2012 as the project achieved full deployment of trained CHWs. Including an estimate of CHW salaries based on minimum wage in the region and level of effort increased total program costs by 362% in the year 2012. In terms of incremental costs per output, the highest ICERs were for the cost per beneficiary covered when including CHW salaries and the smallest ICERs were for the cost per household visit not including CHW salaries. The largest efficiency gains were demonstrated using CHW salaries as the project moved from short run to long run.

Because costing analyses of CHW programs are not routinely conducted in low-income settings, there were only a few studies with findings comparable to the results presented above. For example, an economic analysis of CHW programs in the Cape Town province of South Africa found the average cost per home visit ranged from R26 to R65, which was equivalent to approximately US$8 to US$21 (in 2012 US$).[26] These results are most comparable to the incremental costs measured above for cost per household covered which ranged from US$2.22 to US$27.47, with and without CHW salaries included. While not directly comparable, the incremental costs per household covered in 2010-2011 (US$42.94) and beneficiary covered (US$47.12) measured above are lower than some of the more expensive community based and family based DOTS programs, which have been found to be in the range of US$76.2 and US$84.1 per patient.[27] The methods and results from this study will provide a venue for additional comparable results.

The theoretical cost analysis including a minimum wage for CHWs of $45/month highlighted the significant contribution to the health system that CHWs are currently providing on a volunteer basis. Despite these increases in costs when including CHW salaries, the final results showed a large gain in efficiency when CHW salaries are included. This is because of the fact that the program and the CHWs become more efficient in their tasks as the program is implemented, leading to increased outputs as costs stabilize. These efficiency gains should be even higher if CHWs are actually paid as the literature has shown that motivation and compliance improves if CHW receive a salary and other incentives versus not having any of these financial and non-financial incentives in place.[28-31]

The results of the costing analysis show that using CHWs to deliver services can be less costly than other community-based programs in relation to specific program outputs. These results are important as many countries currently rely on CHWs or are beginning to incorporate CHW programs into their health systems. We have also defined 3 key CHW output measures that can be used as benchmarks, on a cost per output basis, for comparison with CHW programs in other areas of the world. Since the three outputs chosen for analysis in this study are intermediate outputs to health improvement, additional studies are needed to measure the effectiveness of CHW programs in improving health outcomes (ie, cost per couple-years of protection provided or unwanted pregnancy averted), which were not addressed in this study. The results highlight the significant contribution that CHWs are currently providing to the health system of Mozambique on a volunteer basis, paying them a minimum wage in 2012 would have increased the total program costs nearly 5-fold. Despite the substantial contribution CHW salaries make to overall program costs, efficiency gains were greatest in the scenario including CHW salaries. The results of this analysis are important for countries as they plan, implement, and monitor CHW programs, as well as for countries considering sustainable remuneration of CHWs.

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Declaration of Conflicting Interests

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