Cost-effectiveness of an intervention to improve integration of maternal and child HIV services in Ruvuma Region, Tanzania

Summary

The USAID Applying Science to Strengthen and Improve Systems (ASSIST) Project collaborated with the Ministry of Health, Community Development, Gender, Elderly, and Children (MOHCDGEC) and implementing partners to improve HIV/AIDS service quality in Tanzania. In the Ruvuma Region, ASSIST supported the Regional and Council Health Management Teams and an implementing partner to integrate prevention of mother-to-child HIV transmission (MTCT) and maternal, neonatal, and child health (MNCH) services using quality improvement methods from February 2015 to March 2016. This short report presents the evaluation of the intervention's effectiveness and cost-effectiveness. One group of facilities began participating in the intervention in February 2015, and the second group began in March 2016, with the second group acting as the control group in the first period.

The intervention formed facility improvement teams, identified performance gaps, analyzed root causes of dysfunction, set objectives, and tested changes using "Plan-Do-Study-Act" cycles. Facility improvement teams conducted follow-up technical meetings to monitor impact of tested changes and adapt them as needed. Facility teams were coached and mentored by ASSIST staff. Control sites provided ART and family planning services according to Tanzanian national HIV policy with no improvement activities.

Data on performance indicators were collected from clinic registers and patient charts. Costs from the USAID ASSIST Project perspective were taken from project accounting records. Difference-in-differences analysis determined improvements in key indicators. Cost-effectiveness analysis used a decision tree to compare intervention to control sites.

The outcome variables were additive, meaning that one single cost was incurred for several different outcomes with those outcomes having different efficiencies. This is explained further in the results section.

There were improvements of 13-60% in the indicators used for the cost-effectiveness analysis. Total cost of the intervention was US$43,000 (US$11 per patient). For every $10,000 spent on the intervention, there were 20 additional pregnant or lactating women newly initiated on ART to reduce MTCT of HIV risk, an additional 31 HIV exposed children who received their second HIV test, 3,496 more children tested for HIV at OPD services, 580 more children tested for HIV at pediatric wards, 749 more children tested at RCH clinics, 9 more children >15 enrolled in ART, 22 more HIV+ children prescribed IPT, 177 more women receiving family planning services, and 802 more HIV+ women receiving their family planning method of choice.

Based on the apparent efficiency of the program, we recommend implementation, in Tanzania more widely, of QI interventions like the one described here to improve HIV service performance.

OCTOBER 2017

This short report was prepared by University Research Co., LLC (URC) for review by the United States Agency for International Development (USAID) and authored by Edward Broughton, Yohane Mkiramweni, and Stella Kasindi-Mwita of URC under the USAID Applying Science to Strengthen and Improve Systems (ASSIST) Project. USAID ASSIST is managed by URC under the terms of Cooperative Agreement Number AID-OAA-A-12-00101. URC's global partners for USAID ASSIST include: EnCompass LLC; FHI 360; Institute for Healthcare Improvement; Johns Hopkins Center for Communication Programs; and WI-HER, LLC. The contents of this report are the sole responsibility of URC and do not necessarily reflect the views of USAID or the United States Government. For more information on the work of the USAID ASSIST Project, please visit www.usaidassist.org or write assist-info@urc-chs.com.

Introduction

USAID is supporting provision of services to people with HIV or those at substantive risk of acquiring it in Tanzania through the PEPFAR program (1). To succeed in addressing the UNAIDS goal of having 90% of people with HIV knowing their status, 90% of HIV-positive on ART, and 90% of those on ART with viral suppression, HIV services need to be delivered effectively and efficiently (2). The USAID Applying Science to Strengthen and Improve Systems (ASSIST) collaborated with the Ministry of Health, Health Community Development Gender Elderly and Children (MOHCDGEC) and other implementing partners to improve HIV/AIDS service quality in Tanzania. In the Ruvuma Region, the USAID ASSIST Project supported the Regional Health Management Team (RHMT), Council Health Management Teams (CHMTs) and the implementing partner, Henry Jackson Foundation Medical Research International – Walter Reed Program (HJFMRI-WRP) to integrate services for prevention of mother-to-child HIV transmission (MTCT) and maternal, neonatal, and child health (MNCH) services using quality improvement methods. Work in Ruvuma began in March 2015 and as of March 2016 was going through its third phase of harvesting best practices after the preparation and implementation phases. This short report presents the evaluation of the effectiveness and cost-effectiveness of the intervention. We compared changes seen in the intervention sites to a control group of sites that did not apply an improvement intervention. This was to account for any secular changes in the improvement indicators that may have occurred and thereby strengthen the case for attribution of the changes to the ASSIST-supported intervention. The evaluation focused on uptake of family planning methods among HIV-positive clients and HIV testing of women attending family planning clinics.

Study Design

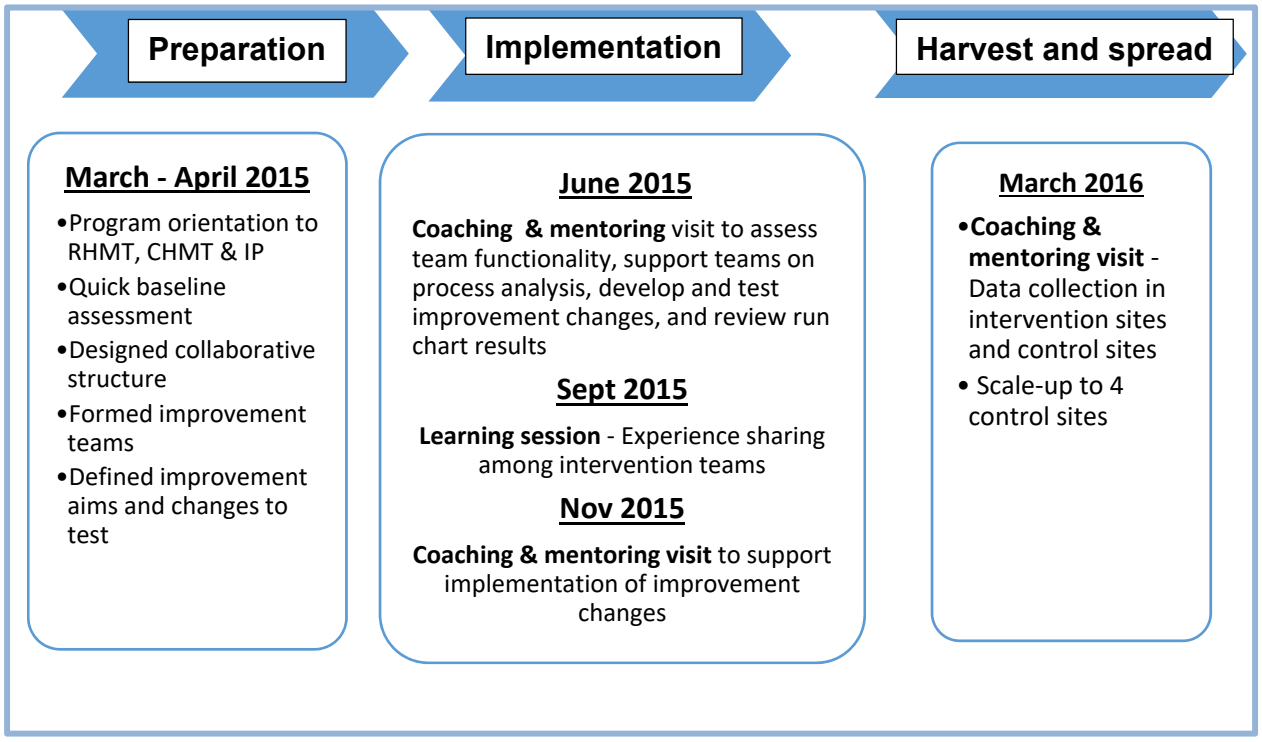
Implementation of the improvement intervention in Ruvuma occur in two phases, wherein one group of facilities began participating in the intervention in February 2015 and the second group of facilities began in February 2016. Facilities in the second group acted as the control group while the intervention was conducted in facilities in the first phase.

The four facilities in the two councils of Songea Municipal and Mbinga District with a workload of at least 100 people coming for HIV care per month were selected for intervention and were separated into two groups. In the first group, the two facilities participated in the improvement intervention to improve uptake of family planning methods among people with HIV and HIV testing for women attending family planning services. For the other two facilities in the second group, no improvement activities were implemented in the first period. The improvement intervention was applied in the second group of facilities in the second phase. Data for the two indicators were collected at baseline before intervention in both groups (January 2015) and 13 months later at February 2016 for comparison.

The improvement intervention involved forming facility improvement teams, identifying performance gaps, analyzing root causes of dysfunction through a detailed process analysis of the client flow pattern, setting improvement objectives, and testing improvement changes and measuring results using “Plan-Do-Study-Act” (PDSA) cycles. Facility improvement teams conducted follow-up technical meetings to monitor the impact of the tested changes and adapt changes according to what worked or not to improve performance in the two measured indicators. Teams of health care providers at the facilities received periodic coaching and mentoring support from improvement experts from the USAID ASSIST Project and also participated in a learning session – a gatherings of teams from the intervention facilities to share learning about successful and unsuccessful changes they tested (see **Figure 1**).

Control sites provided ART and family planning services according to Tanzanian national HIV policy and were involved in ongoing national family planning and HIV testing campaigns. However, they had no specific local improvement activities to ensure they were actually following these policies.

Figure 1: Implementation timeframe



Data Collection

Intervention sites used a standard evaluation system tool commonly known as the "SES Journal" to record the changes they tested and plot their results as a time series chart. Data from intervention sites were available in the facility quality improvement (QI) file. Data from intervention sites were verified by the USAID ASSIST Project coaches using the registers and individual client's cards, and corrections were made when errors were detected. Data from comparison facilities were obtained directly from registers and individual client cards. Data were collected by a team of two USAID ASSIST staff, one regional HIV/AIDS coordinator and one Council HIV/AIDS coordinator from each council. Data collectors discussed the modality and agreed on the simple excel tool for data collection. Data were collected from all facility register entries and therefore represents the population of patients receiving services in the clinic.

Cost Data

Cost data for the implementation of the improvement activities were from the perspective of the USAID ASSIST Project and taken from the accounting records of the University Research Co., LLC Tanzania office, which implemented the project. They included the direct costs for providing the technical assistance, including transportation costs and meals and incidentals for overnight trips for improvement expert staff. They did not include a proportion of the headquarter costs for managing the project because we were considering only incremental costs of this activity. The cost data also did not include additional cost to the Henry Jackson Foundation which was the implementing partner for this activity, since these were thought to be minor. The cost data did not include the costs of health care providers' time which was borne by the MOHCDGEC.

Data Analysis

We used difference-in-differences analysis to determine if there was evidence that the improvement intervention caused a change in the indicators beyond that seen as a secular trend in the control sites where there was no intervention [3]. We used logistic regression comparing the differences between the first two months of the baseline periods to the two months close to the end of the intervention period (months 10 and 11 of the 12-month intervention period). We reported the difference-in-differences as a percentage and the p-value for the difference in the change in odds of being compliant with the indicator.

Cost-effectiveness analysis was conducted using a decision tree comparing the intervention sites to the control sites for the two sets of indicators of interest. Probabilities of different results for the indicators were determined from difference-in-differences calculations. We used the actual proportions of those compliant with the specific indicators from the study to determine the probability distribution for each indicator under investigation. We did not vary the cost inputs because there was an acceptable degree of certainty in their accuracy. For each model for the different outcome indicator, we conducted 10,000 iterations in Monte Carlo Simulations to arrive at confidence intervals for each.

The outcome variables are additive, meaning that one single cost was incurred for several different outcomes with those outcomes having different efficiencies. This is explained further in the results section.

Ethical Considerations

This evaluation was conducted as a routine part of the assistance provided to the facilities through this bilateral donor-funded program. The data collected were anonymous and did not constitute any additional data to the routine data collection required for patient and facility management. Therefore, it was considered exempt from full review by the Institutional Review Board of URC.

Results

For the HIV testing indicator, one intervention site was a health center located in urban setting. This facility has 21 clinicians, 41 nurses, 40 medical attendants, nine laboratory technologists, and one data clerk. The facility served a catchment population of 31,868 people, of which 7,776 were women of reproductive age (15-49 years). The other intervention site was a dispensary located in an urban setting with two clinicians, five nurses, two assistant laboratory technologists, and one data clerk. The facility served a catchment population of 26,451, of which 1,058 were women of reproductive age. One control site was a dispensary located in an urban setting with two clinicians, seven nurses, one laboratory technologist, and one data clerk. The facility served a population of 15,994 people, of which 3,903 were women of reproductive age. The other control site was a dispensary located in a rural setting run by two nurses who served a population of 7,876 people, of which 1,890 were women of reproductive age.

For the family planning uptake indicator, one intervention site was a district hospital in a rural setting with 17 clinicians, 41 nurses, nine laboratory technologists, and one data clerk. The facility served a catchment population of 130,000, of which 10,740 were women of reproductive age. The other intervention facility was a health center located in an urban setting. It had 21 clinicians, 41 nurses and attendants, nine laboratory technologists, and one data clerk. The facility served a catchment population of 31,868 people, of which 7,776 were women of reproductive age. One control site was a dispensary located in urban setting with two clinicians, two nurses, three medical attendants, two assistant laboratory technologists, and one data clerk with a catchment population of 23,542, of which 942 were women of reproductive age. The other control site was a dispensary located in a rural setting with one clinician, three nurses, and one data clerk with a catchment population of 5,200, of which 1042 were women of reproductive age. HIV prevalence in the region is 7%.

Table 1 shows the total number of women of reproductive age (15-49) seen in 2015 in each of the intervention and control sites relative to each indicator.

Table 1: Patient volume in intervention and control facilities

HIV testing and counselling indicator

		Total women 15-49 years seen in 2015
Intervention	Health Center	3312
	Dispensary	367
Control	Dispensary	531
	Dispensary	441

Family planning indicator

		Total women 15-49 year seen in 2015
Intervention	District Hospital	10523
	Health Center	5248
Control	Dispensary	2288
	Dispensary	3203

In the two months before the intervention, about 10% of HIV-positive women of reproductive age (15-49 years) were receiving their family planning (FP) method of choice. After the intervention, the proportion receiving their family planning method of choice in the intervention group had increased markedly but decreased slightly in the control group (**Figure 1**). The difference in the change between the intervention and control groups was 66% (p<0.001).

In the different intervention and control groups for the HIV counseling and testing indicator, the level of compliance was at or close to 0%. The additional improvement in the intervention group compared to the control group was 44% (p<0.001) (see **Figure 2**).

Figure 1: Increased FP uptake among HIV+ women attending HIV care in intervention sites compared to comparison sites in Ruvuma region, Jan 2015 – Feb 2016

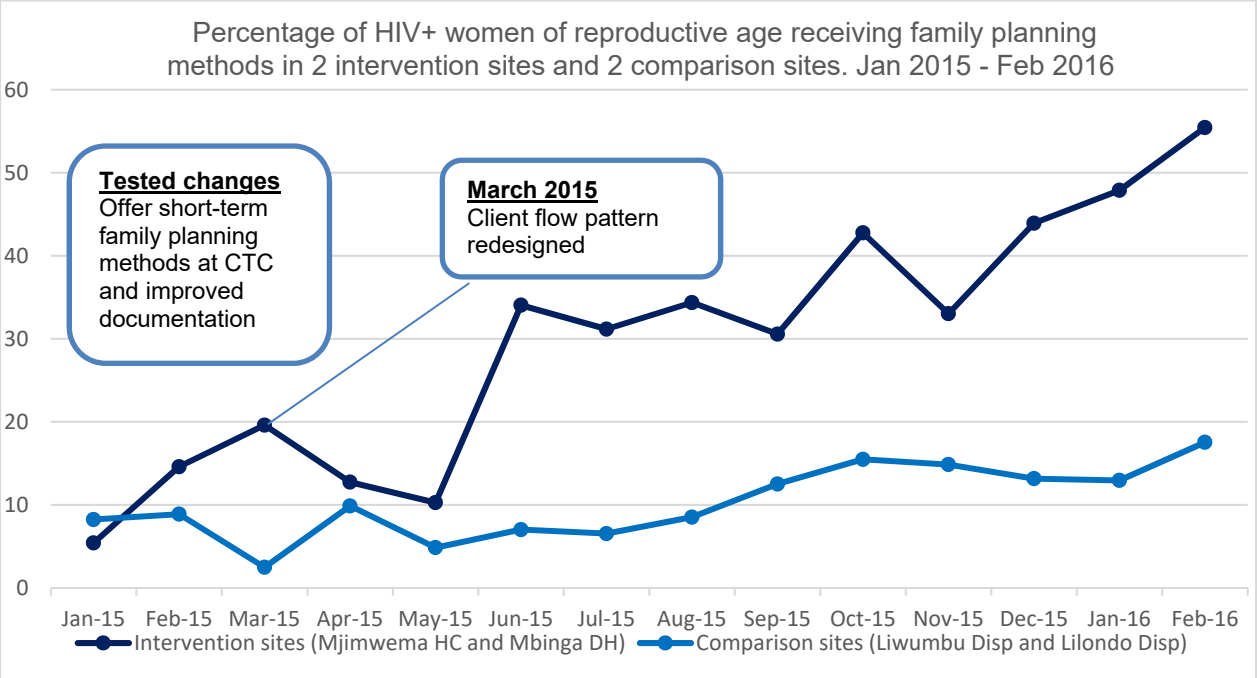
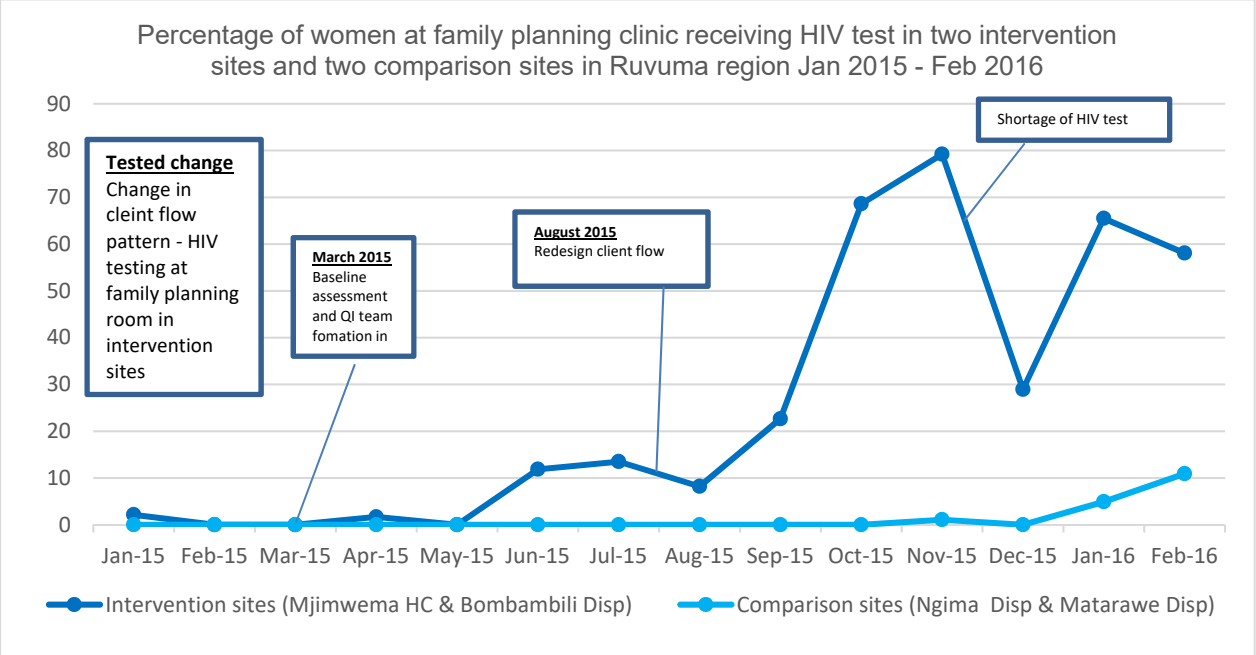


Figure 2: Increased access to HIV testing in family planning clinics in intervention sites compared to control sites, Ruvuma region



Cost

The total cost of the intervention was US$ 43,000 based on an US$ to Tanzanian Shilling exchange rate of 1:2190 (see **Table 2**). The greatest proportion of the costs were for the salaries of the project staff. The number of patients receiving service at the clinics participating in the intervention was 3,945 people. This gives an approximate cost per patient of US$11 for the intervention.

Cost-effectiveness

There were improvements of 13-60% in the indicators used for the cost-effectiveness analysis (**Table 3**). The baseline and end line probabilities of compliance from which the improvement quantities were derived were entered into the models for each of the indicators. The results in terms of the cost per percent improvement in the indicator are seen in the intervention group compared to its comparison in the "CEA results" column. This means, for example, that for every one percent increase in HIV-positive pregnant or lactating women who are newly initiated on ART to reduce MTCT risk, the cost is US$ 36.50 (95% CI: $28.10 - $51.70). However, all expenditures of the improvement activity resulted in the improvements is all of the listed indicators. Therefore, for a more complete accounting of the efficiency of the positive effects of the intervention, the rightmost column presents the number of additional patients in the participating clinics who received services to compliance with the quality indicators. The column should be read as, "for every $10,000 spent on the intervention, there were 20 additional pregnant or lactating women who were newly initiated on ART to reduce the risk of MTCT of HIV and there were an additional 31 HIV-exposed children who received their second HIV test after cessation of breast milk and 3,496 children tested for HIV at outpatient department (OPD) services", and so on for the entire list. That is, the effects listed in this column are additive effects for the one expenditure.

Table 2: Costs of the improvement intervention

Activity	ASSIST Advisor	ASSIST Salaries		M&IE and accommodation		Participant M&IE and travel		Transport cost		Conference package		Stationary		Total
	N	US$	%	US$	%	US$	%	US$	%	US$	%	US$	%	US$
Preparation	3	3914	40	2904	30	2497	26	385	4.0					9700
Learning sessions	2	621	6	621	6	5888	55	3368	31.5	1151	11	183	1.7	10681
Coaching & mentoring	2 - 3	7183	32	7183	32	2127	9	6112	27.0					22605

Table 3: Cost-effectiveness results

Indicator (per month)	End line denominator	Improvement (observed)	P-value	CEA results $/% improvement	Conf. interval Low	Conf. interval Upper	Additional recipients of compliant services/ $10,000
% of HIV+ pregnant/lactating women who newly initiated ART to reduce MTCT	73	27.5%	>0.001	36.5	28.1	51.7	**20**
% of HIV-exposed children receiving second HIV test after cessation of breast milk	91	33.7%	>0.001	31.9	22.3	56.0	**31**
% of children tested for HIV at OPD services (OPD, TB and Care & Treatment clinics)	5794	60.3%	>0.001	18.1	17.6	18.5	**3496**
% of children tested for HIV at pediatric in-patient wards	1690	34.3%	>0.001	58.3	55.3	61.6	**580**
% of children tested for HIV at child clinics	4927	15.2%	>0.001	78.7	73.7	84.5	**749**
% of HIV+ infants / children <15 yrs enrolled in HIV care	28	32.3%	0.001	31.0	20.7	62.0	**9**
% of HIV+ children screened TB -ve prescribed IPT per national guideline	70	31.4%	>0.001	36.9	26.4	59.3	**22**
% of new family planning women receiving HIV testing and counselling	617	28.6%	>.001	40.5	32.8	52.7	**177**
% of eligible HIV+ women of reproductive age receiving family planning methods	6211	12.9%	>.001	40.4	27.0	52.1	**802**

Discussion

This report presents the evaluation of a quality improvement intervention conducted at three sites in Ruvuma, Tanzania from January 2015 to January 2016. It shows improvements in several important indicators of quality of HIV testing, care and treatment were achieved over the period. This is important accomplishment that contributes to reaching the 90-90-90 for control of the HIV epidemic.

Two intervention sites (Mjimwema and Bombambili Health Centers) were given full support to improve their HIV testing services. The sites had QI teams which received periodic coaching and mentoring from ASSIST staff. The team attended learning sessions to share experiences with other teams. With these efforts, the team managed to increase the proportion of women at the family planning clinic who received HIV testing from 2% in Jan 2015 to 58% in February 2016. The two control sites did not receive any intervention and increased performance by only 11% from Jan 2015 to Feb 2016. Improvement changes in the intervention sites included testing for HIV at family planning clinic instead of referring women to the laboratory in another building for HIV testing.

The proportion of HIV-positive women of reproductive age receiving family planning methods in two intervention sites (Mjimwema Health Center and Mbinga District Hospital) increased from 5% in Jan 2015 to 55% in Feb 2016. The two control sites which had no QI intervention only improved from 8% in Jan 2015 to 18% in Feb 2016. Changes in client flow patterns to accommodate provision of short-term family planning methods at the HIV clinic contributed significantly to the improvement in sites which had the improvement intervention.

The cost of the intervention from the perspective of the project was about US$43,000 or US$11 per patient seen at the participating health facilities. This represents 0.0047% of the Tanzanian Government's total health spending and 22% of per capita spending for the patients receiving services in the participating facilities (3). It is difficult to compare the cost-effectiveness of this program to other health programs because this intervention had multiple outcomes for the given level of expenditure. One program to improve services in Tanzania that included implementation of an electronic clinical decision support system for improving quality of antenatal and childbirth care in rural areas cost a total USD$167,000 or US$43 per patient receiving service at participating facilities (4). Another study of isoniazid prevention therapy among HIV patients screened positive for latent tuberculosis cost US$ 170,000 or $406 per case averted (5). A cost-effectiveness analysis for screening and treatment of cervical cancer in Dar es Salaam showed the cost per screening of US$1.45 and the cost of cryotherapy prophylaxis was US$ 29 (6). Other programs to improve the quality of HIV services in similar settings are the implementation of the chronic care model in Uganda conducted as part of the same USAID ASSIST Project (7) which showed a cost of US$1.67 per patient. Studies in East Africa on the cost of HIV testing found costs US$13 and US$32. This intervention compared favorably to costing study results found nationally and regionally, and the overall cost appears affordable in this context. Ideally, we would have been able to report the result here in terms of expenditure per disability-adjusted life year or HIV-related death averted. This would allow direct comparisons with other interventions to determine the relative efficiency of this program. However, this would involve tracking and following patients for longer than logistics allowed in this study.

Limitations and Ethical Considerations

One weakness with the approach taken for this evaluation is that we were unable, due to time constraints, to measure the intervention's impact over a longer term to determine if the improvements were maintained or if performance tended towards baseline levels once technical assistance from the improvement experts ceased. If the improvements seen here did last longer than this active period, then the overall result would look more efficient than it appears here. Also, if the improvements seen were to increase or to spread to other areas of clinical service independent of further intervention by ASSIST or other implementing partners with a similar goal, this would also be shown as an even more positive result.

This is one of the goals of the intervention – to facilitate development of a culture and practice of continual monitoring of service delivery performance and system changes with the goal of improving overall services. If the evaluation had been conducted over a time long enough to see if these goals were met, it may have been that more improvements could have been attributed to the intervention and therefore greater benefits resultant from the same expenditure. With this consideration, the results presented here should be considered as conservative measures of program efficiency.

The perspective taken for calculations of cost of the intervention were the program and therefore did not include the opportunity cost of participation of personnel of the MOHCDGEC. Although no additional actual expenditure was required by the MOHCDGEC, they lost the usual productivity of their clinicians for the duration of their involvement in the improvement activity. One the one hand, this could have made the program look more efficient than it actually was by not accounting for this time lost providing services to patients and other regular tasks. On the other hand, the consequence of some of the improvements implemented during the intervention may have been to increase the number of patients seen at the clinics by improving work flow, reducing redundancy, and increasing clinician efficiency. These factors were not measured either, but again, if they had been and if it was seen that these goals had been achieved, the cost-effectiveness of the program would have been greater that what is stated here. Conversely, it is possible that the changes led to a reduction in the number of patients seen for the same work time of clinicians, and the estimate of cost-effectiveness would have appeared more positive is this was the case. It could also be argued that the perspective taken for the determination for cost of the intervention should have been the societal perspective. If this was the case, it could be surmised that the time of patients taken by seeking services from a health facility being run more efficiently and effectively would be lower and therefore including these lower opportunity costs for patients would have given a more positive cost-effectiveness result for the QI intervention.

The total given for the number of patients receiving services at participating facilities was about 4,000. It is possible that some patients were double-counted because they attended the clinics more frequently that scheduled and were therefore registered mistakenly as additional patients rather than an unscheduled revisit. Increasing the number of patients attending for services would decrease the cost per patient of the services and therefore make the result more beneficial than it would otherwise be.

The intervention and comparison groups were not randomly assigned because of practical limitations (ASSIST was assigned the early and late intervention groups). We also had limited capacity to measure and control for confounding factors, and that may have influenced the relationship between the intervention and control facilities.

Conclusion and Recommendation

Comparing changes in the level of compliance to quality indicators from sites in which the QI intervention was conducted against those in which no QI activity was conducted, we can conclude that in the time of observation, the QI activity was associated with a service deliver performance improvement. Integration of prevention of MTCT/ART in an MNCH setting appears to have contributed to increasing ART services uptake. Availability of a comprehensive service package at one service point increases uptake of HIV services overall. Sites receiving the technical assistance to improve service quality increased the proportion of HIV-positive women receiving short-term family planning methods at care and treatment centers. Concurrently, the proportion of women who received HIV testing at family planning clinics also increased. Patients were more likely to miss some essential services if they were provided from service points dispersed throughout the health facility. Therefore, health facilities should embark on integrating essential health service packages to improve service uptake, reduce patient movement while in the facility, reduce queuing, and ultimately reduce the unproductive time patients spend at the facility.

Implementation of QI in health facilities helps create a culture and practice of data collection, analysis, and use. QI requires that each facility assess its performance, identify performance gaps, and develop changes to be implemented and evaluated to improve care. Intervention sites were reported to have

created the culture of conducting performance assessment, develop changes, and track performance on a monthly basis (from QI journals kept at facilities and from personal communication with practicing clinicians).

Based on the results seen here, we recommend implementation in Tanzania and more widely, of QI interventions like the one described here to improve HIV service performance. The provision of technical assistance to implement such a program appears to be acceptably efficient in this context.

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