

# Increasing HIV-Free Survival of Infants: Reorganizing Care Using Quality Improvement for the Optimal Health and Nutrition of HIV-Positive Women and Their Exposed Infants in Uganda

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## Abstract

Reorganizing service delivery to integrate nutrition and infant and young child feeding (IYCF) with prevention of mother-to-child transmission (PMTCT) is important for improving outcomes of HIV-positive mothers and HIV-exposed infants (HEIs). Quality improvement (QI) strategies were implemented at 22 health facilities. The percentage of HIV-positive pregnant women and lactating mothers who received IYCF counseling at each visit improved (45%-100%; mean = 93.1%, standard deviation [SD] = 15.5). Adherence to IYCF practices improved (70%-96%; mean = 92.4%, SD = 8.5). Mother-baby pairs receiving the standard care package improved (0%-100%; mean = 98.6%, SD = 22.6). The HEIs alive at 18 months and infected decreased (mean = 6.2%, SD = 4.8). Statistical significance of change was estimated using Fisher exact test and magnitude of change over time by calculating the odds ratio. For all indicators, improvement was rapid and significant ( $P < .001$ ), especially in the first 6 months of QI implementation. Using QI to integrate nutrition and ensure consistent and comprehensive PMTCT service delivery improved IYCF adherence and decreased transmission.

## Keywords

HIV prevention, PMTCT, nutrition, quality improvement, option B+

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## Introduction

Uganda has the third highest incidence of HIV globally, with an estimated 140 000 new HIV infections and mortality of 63 000 HIV-positive individuals annually. Women of reproductive age (15-49 years old) have a higher HIV prevalence than men (8.3% versus 6.1%, respectively), a factor that drives vertical HIV transmission from mothers to infants.<sup>1</sup> Uganda also has the fourth highest number of new infections among children out of the 22 United Nations Programme on HIV and AIDS (UNAIDS) priority countries.<sup>2</sup> Despite reducing new infections by half between 2009 and 2012, 56% of HIV-exposed infants (HEIs) were not tested and less than one-third of HIV-infected children (28%) receive treatment.<sup>3</sup>

The Partnership for HIV-Free Survival (PHFS) was implemented between 2012 and 2015 in 6 countries with a high HIV

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### What Do We Already Know about This Topic?

There is evidence that appropriate infant and young child feeding practices in the context of HIV increase HIV exposed infant survival, reduce mortality and morbidity rates in breastfed children. Despite this evidence, a ‘know-do’ gap exists amongst health workers during the provision of nutrition and PMTCT services to HIV positive mothers and their babies. Quality improvement provides an opportunity for the gap between what is known to improve care and what is done to improve care to be addressed.

### How Does Your Research Contribute to the Field?

This analysis demonstrates that using Quality improvement and the PMTCT platform to integrate nutrition services for HIV positive mothers and their infants significantly improves the outcomes of HIV exposed infants.

### What Are Your Research’s Implications toward Theory, Practice, or Policy?

The Quality improvement approach to close the gap between what is known and what is done to improve care and outcomes for HIV positive mothers and their infants should be incorporated into the Uganda Ministry of Health policy and guidelines.

burden: Kenya, Lesotho, Mozambique, South Africa, Tanzania, and Uganda. The country-led initiative was aimed at accelerating national implementation of the World Health Organization (WHO) 2010 guidelines on elimination of mother-to-child transmission (eMTCT) of HIV/AIDS, which included providing antiretroviral therapy (ART) for life to all HIV-positive pregnant women regardless of their CD4 count (Option B+). One of the key objectives of PHFS was to identify best practices from a small number of demonstration sites in each country that could then be documented and spread nationally.

The PHFS in Uganda was implemented by the Ministry of Health (MOH), The United States Agency for International Development (USAID) and The Centers for Disease Control through the President’s Emergency Plan for AIDS Relief, and USAID-supported implementing partners—University Research Co, LLC, through the Applying Science to Strengthen and Improve Systems Project (ASSIST), Family Health International 360 managing the Food and Nutrition Technical Assistance III Project (FANTA III), John Snow International’s (JSI) Strengthening Partnerships, Results, and Innovations in Nutrition Globally Project (SPRING), The AIDS Support

Organization (TASO), JSI’s Strengthening TB and HIV/AIDS Response in East Central Uganda (STAR-EC), and Elizabeth Glaser Pediatric AIDS Foundation’s Strengthening TB and HIV/AIDS Responses in the Southwest Region of Uganda (STAR-SW). The MOH took the lead in coordinating all the partners of the PHFS, developing implementation guidelines, and spreading promising practices that were identified during the implementation period; ASSIST guided and supported the quality improvement (QI) intervention; FANTA supported national coordination activities; SPRING, TASO, STAR-EC, and STAR-SW supported district and facility activities.

The PHFS initiative focused on improving survival of mothers and their infants. In Uganda, the MOH-led steering committee for PHFS agreed on the goals of reducing mother-to-child transmission from 15% to less than 1% of HIV-exposed children under 2 years and increasing adherence to recommended infant and young child feeding (IYCF) practices to 80% by 2015. Through PHFS, Uganda set out to increase the number of HIV-positive pregnant women and mother–baby pairs (MBPs) who returned to health facilities for their scheduled appointments; improve the uptake of critical services for all MBPs including ART adherence for the mother and nutrition assessment, counseling, and support (NACS) services for optimal maternal and infant nutrition; and encourage adoption of recommended IYCF practices, especially breastfeeding in the first hour and exclusive breastfeeding in the first 6 months for all mothers, particularly for HIV-positive mothers treated through Option B+. <sup>4,5</sup>

The initiative used the collaborative QI approach to improve the continuum of care for HIV-positive mothers and HEI at health facilities. The QI is a well-documented team- and data-driven intervention that combines content and process improvement to close gaps in performance. <sup>6</sup> Studies have suggested that QI can improve PMTCT processes and outcomes in resource-challenged health systems in sub-Saharan Africa. <sup>7-9</sup>

Improved IYCF has been associated with reduced mortality and reduced postnatal HIV transmission risk. <sup>10,11</sup> Adherence to IYCF guidelines is not easy to achieve in Uganda <sup>12</sup>; IYCF counseling is recommended as an evidence-based approach to ameliorate IYCF practices. <sup>13,14</sup> The QI has also been applied to malnutrition interventions and has been reported to improve screening, counseling, and adherence to nutrition plans in resource-rich settings. <sup>15,16</sup>

This article reports on Uganda’s PHFS experience, focusing on the use of the PHFS platform to roll out IYCF counseling, and the use of a standard care package to achieve adherence to national and international standards for postnatal care of mothers with HIV and their babies. Such use of evidence-based interventions packaged together has been shown to improve care. <sup>17,18</sup>

## Methods

### Selection of Demonstration Sites

The PHFS was implemented in 22 health facilities selected by the MOH in collaboration with USAID from 6 districts: Jinja,

Kisoro, Manafwa, Namutumba, Ntungamo, and Tororo (from 2013). These districts had a HIV prevalence higher than the national average of 6.5%, child stunting rates higher than the national average of 33%, and offered Option B+ services.

This intervention focused on the 22 high-volume health facilities, which are made up of 3 (14%) general hospitals with a delivery rate of over 200 infants monthly, 12 (55%) health center IVs that deliver between 50 and 100 infants monthly, and 7 (32%) health center IIIs with over 25 deliveries monthly. Health center IIIs provide outpatient, inpatient, Antenatal Care (ANC), immunization, infection/vector control, and outreach services, while health center IVs provide all those services and also surgery and blood transfusion services.

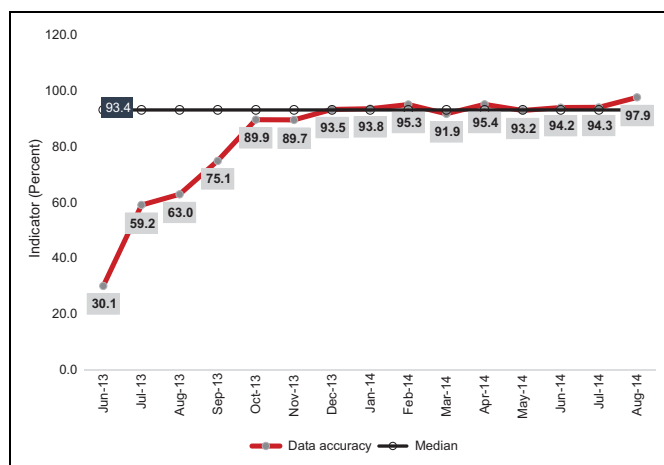
### Rapid Assessment of Facilities

Prior to the start of the QI process, a rapid assessment was carried out at all facilities to assess baseline performance of the selected indicators. The assessment was also necessary to ascertain the level of QI activity and experience present at each facility. There were only 4 sites with a functioning QI team at the time.

During the initial assessment, which took place over multiple visits to the facilities, the technical assistance team spoke to staff to ascertain the current status of PMTCT services and to identify overarching areas for improvement. The team found that health facilities did not currently have a way to identify which mothers and babies should be receiving HIV services or a way to ensure that these MBPs attended their appointments to receive all the required HIV services.

### The QI Intervention

**Identifying QI teams and developing QI skills.** Within each selected facility, QI teams were either formed or reconstituted based on their functionality; a QI team was considered functional if the team met frequently (at least once a month), with documented evidence of these meetings, and was currently working on an improvement activity. For sites that were actively engaged in other QI activities, the teams were trained to use QI in areas relevant to optimizing PMTCT service delivery by integrating IYCF and NACS services. The QI approach constituted identifying improvement aims, analyzing the root causes of the identified problem, and testing small changes to improve clinic processes. The impact of these changes was tracked using existing indicators—part of the Health Management Information System (HMIS)—or new indicators (developed for QI purposes) that corresponded to the various clinical processes that were being improved. The QI teams consisted of health facility staff who were integral to the process that was being improved; for example, when the goal was to improve retention of MBPs in care, the team ensured that midwives, laboratory technicians, and record-keeping assistants, as well as peer mothers, were represented in the core QI team.



**Figure 1.** Percentage of completely and accurately filled out HIV/ART care cards for HIV-positive women and Clinical charts for exposed infants across the 22 facilities (June 2013 to August 2014).

**Coaching and support to QI teams.** Coaches for QI teams were comprised of regional and district health staff, including PMTCT and QI focal points for the various districts. Regional coaches have more experience, may support more than one district, and are tasked with mentoring district-level staff. These coaches were trained and guided on their role as coaches by advisors from USAID ASSIST (the QI technical assistance partner). Coaches were assigned to health facilities to provide ongoing mentorship and work with the QI teams as they implemented improvement projects. Teams would record their progress through a given improvement project in a documentation journal, which is a tool that is used to guide and document the improvement process. At each monthly coaching visit, teams would review their data and talk through their results and any challenges that were experienced. The coaches also shared successful practices from other sites with their QI teams during these meetings.

**The QI process.** The first part of the QI process involved improving the completeness and accuracy of information in the clinic registers and patient cards, including the exposed infant clinical charts, the early infant diagnosis (EID) registers for HEI, and the HIV/ART care cards for HIV-positive women (Figure 1). Clinical charts for exposed infants and their mothers' HIV/ART care cards were kept together in one place to facilitate linkages between clinical information for each mother and her baby. This change idea was found to be highly effective for improving data quality; it helped health workers to know which HIV-positive mothers had infants in care and to measure retention in care by knowing which MBPs visited the facility monthly and received elements of care. When work started in June 2013, only 30.1% of records were completely and accurately filled out. After 5 months, the indicator improved to 89.9% out of a total of 798 records over the 22 facilities. A trend of over 90% data accuracy was recorded over 9 consecutive months, indicating that records were now being

completely and accurately filled out on a consistent basis. By August 2014, 97.95% accuracy out of 1033 total records had been achieved.

At the start of this intervention, the technical assistance team found a total absence of reporting for indicators on retesting, NACS, IYCF, and retention of MBPs. In all the sites, there was a lack of data on the number of HEIs who test positive/negative on their final HIV test at 18 months or 6 weeks after cessation of breastfeeding.

At the start of the intervention, the team found that services for MBPs were not being delivered consistently or comprehensively. The health facility teams were supported to reorganize care to ensure that MBPs were given a joint appointment and both received all their services at one location, the EID care point (later called the mother–baby care point). The collaborative decided that a standard care package and a checklist for essential services at routine visits might simplify the service delivery process for health-care workers. Nonroutine, but critical time-specific visits (age 6 weeks; 6 weeks postcessation of breastfeeding; and age 18 months) were tracked separately and were not part of the standard care package.

The standard care package focused on the key components of care to be provided to MBPs at each routine visit. To develop this package, content experts were consulted, available literature and MOH guidelines were reviewed, and consensus meetings with key stakeholders convened. The services in the package were:

- ART for the HIV-positive mother;
- nevirapine for the HEI (up to 6 weeks of age);
- cotrimoxazole for the HEI (after 6 weeks of age);
- nutrition assessment for the mother using mid upper arm circumference (MUAC) or body mass index,
- nutrition assessment for the baby using MUAC or weight-for-age z-score for the baby if under 6 months;
- IYCF counseling for the mother; and
- an appointment for the next visit explaining what services the mother and baby should expect to receive when they return.

In June 2013, the standard care package was disseminated to health facility teams at the first quarterly QI learning session. Health facilities redesigned the processes in their clinics by merging both ART and EID services to provide the package to all MBPs during the course of their joint appointment, in the same clinic, by the same team. To support monthly data monitoring, a tally sheet was developed and used to capture care parameters from the various data sources (ART register, EID register, clinical charts, and clinic appointment books). The tally sheet enabled health workers to know whether all the MBPs seen in the clinic each month had received all the components of the standard care package. The indicator on the provision of this standard care package was measured as an “all-or-nothing” indicator: an MIP had to have received all the components of the package at each visit for them to be reported as having received a standard care package.

Throughout the QI process, quarterly collaborative learning sessions were organized by the MOH and ASSIST for all 22 improvement teams. These sessions facilitated peer-to-peer learning and supported implementation of successful changes among QI teams. The learning sessions supported diffusion of innovations and the rapid spread of effective change ideas in the facilities. Sessions were structured to encourage teams to share their results using detailed run charts and dashboards showing monthly progress toward indicator targets, as well as exchange ideas about how to address challenges. The structure of the learning sessions evolved over time, with members of the site QI teams eventually taking the lead in facilitating group discussions and providing feedback to their peers.

Change ideas that resulted in improvement were documented at each learning session and compiled into “change packages” to facilitate efficient transfer and scale-up by other facilities.<sup>19–21</sup>

## Analysis

Four key indicators across the spectrum of the intervention were tracked over time from June 2013 to June 2015. They were: (1) Percentage of HIV-positive pregnant women and lactating mothers who received IYCF counseling at each visit (numerator: number of HIV-positive pregnant and lactating mothers who received IYCF counseling at each visit, denominator: total number of pregnant and lactating mothers attending the clinic monthly), (2) percentage of HEIs reported to be adhering to recommended IYCF practices (numerator: number of HEIs reported to be adhering to IYCF practices, denominator: total number of HEIs attending the clinic monthly), (3) percentage of MBPs receiving the standard care package (numerator: number of MBPs who received the standard care package, denominator: total number of MBPs seen in the clinic monthly); and (4) percentage of HEIs who are alive and infected at the age of 18 months (numerator: number of HEIs who are alive at 18 months and HIV positive at 1st and 2nd polymerase chain reaction, denominator: total number of HEIs who have been discharged from the EID care point). For indicators 1 to 3, the denominator reflects the MBPs returning to the clinic every month in increasing numbers, which was a result of health facility teams improving identification, tracking, and follow-up of MBPs to ensure regular attendance.

The QI coaches (district and regional), facilitated by the ASSIST Project, visited each facility monthly to coach teams and collect process data. These data were then compiled in an Excel database.

Data were aggregated across the 22 health facilities. The numerator, denominator, indicator, and the median of the indicator were charted monthly for all 4 indicators. The 25-month period of intervention was divided into 4 periods, where each period covered 6 months: June to December 2013, December 2013 to June 2014, June 2014 to December 2014, and December 2014 to June 2015. By comparing target patients who

**Table 1.** Characteristics of Selected Facilities.<sup>a</sup>

Characteristic	Number (%)
Type of facility	
General hospital	3 (14)
Health center IV	12 (55)
Health center III	7 (32)
Managing authority	
Private not for profit	1 (5)
Public/government	21 (95)
Geographic location	
Rural	9 (41)
Urban	9 (41)
Semi-urban	4 (18)
Districts	
Kisoro	4 (18)
Manafwa	4 (18)
Tororo	4 (18)
Jinja	3 (14)
Namutumba	3 (14)
Ntungamo	4 (14)
Total population served	642 550
Estimated HIV-positives among pregnant women	1480
Provider to population ratio	1:1280 <sup>b</sup>

<sup>a</sup>n = 22. Health center II: At parish level, headed by an enrolled nurse working with a midwife, 2 nursing assistants, and a health assistant. Operates an outpatient department (OPD) only and offers antenatal care. Health center III: At subcounty level, should have 18 staff, led by a senior clinical officer assisted by nurses. Operates an OPD, maternity ward, and antenatal and immunization services. It should also have a functioning laboratory. Health center IV: At county level, headed by a senior medical officer. Operates general OPD, inpatient care, and operating theatre for emergency operations or minor surgery (eg, circumcision). Regional referral hospital (RRH): Serves a region of 9 to 10 districts, has specialists. Operates general OPD, inpatient care, and operating theatre. Provides tertiary level referral services including life-saving medical, surgical, and emergency obstetric emergency care, such as blood transfusions and cesarean sections. National referral hospital: Serves the entire country and provides all services found at general and regional referral hospitals plus specialist services such as psychiatry, ear, nose, and throat (ENT), radiology, pathology, ophthalmology, and higher-level surgical and medical services, including teaching and research.

<sup>b</sup><http://www.finance.go.ug/dmdocuments/6-13%20Health%20Workers%20Shortage%20in%20Uganda%20May%202013.pdf>.

received services and those who did not at the start of each 6-month period, we estimated the statistical significance of change with the Fisher exact test,<sup>22</sup> which gives a better estimate as almost all patients receive care and the patients not receiving care can diminish to 0. Likewise, estimating the odds ratio (OR) for receiving services among the targeted patients further measures the magnitude of change from one period to the next.<sup>23</sup>

### Ethical Approval and Informed Consent

The data used for the analysis were collected as part of routine care service delivery. No personal identifying characteristics were collected as part of the QI process. The indicators used to assess improvement during the project cycle were calculated from aggregate data, and no

individual private health information was reported, thus ethical approval was not required.

## Results

### Facilities

The characteristics of the facilities are shown in Table 1. Three (14%) of the facilities were general hospitals in urban settings, 12 (55%) of the health facilities were health center IVs, and 7 (32%) were health center IIIs. Nine (41%) of the health facilities were in rural settings, 9 (41%) in an urban location, and 4 (18%) health facilities were semi-urban serving small towns. Twenty-one (95%) health facilities were government-owned and provide services to the public at no charge, while 1 (5%) was a private, nonprofit facility, which charged users a minor operational fee. Collectively, the 22 health facilities serve a population of 642 550 individuals, with an estimated 1480 of these being HIV-positive pregnant women.<sup>24</sup>

### Indicators

We report on selected indicators for delivery of eMTCT services and IYCF from the start of the QI intervention in June 2013 to June 2015 (25 months).

**Percentage of HIV-positive pregnant women and lactating mothers who receive IYCF counseling at each visit.** Each month across all reporting facilities, the mean number of HIV-positive pregnant women and lactating mothers seen was 1323 (SD = 415.9). Of these, 93.1% (SD = 15.5) received IYCF counseling at each visit (Table 2). Between June 2013 and September 2013, the IYCF counseling indicator increased rapidly from 45% to 95%, reaching 100% near the end of reporting period 3 and maintained through June 2015 (Figure 1A). There was significant improvement from June 2013 to December 2013 ( $P < .001$ ) and in period 2 ( $P = .042$ ). Early in period 3 (July 2014) to the end of period 4, all targeted mothers (100%) were receiving IYCF counseling (Table 3). Overall, increasing numbers of women were exposed to IYCF counseling every 6 months until July 2014 when IYCF counseling was offered to 100% of women in the target audience.

**Percentage of HEIs adhering to recommended IYCF practices.** The mean overall number of HEIs attending the EID care points monthly was 984 (SD = 232.2). Of these, an average of 92.4% (SD = 8.5) of mothers reported adherence to IYCF feeding practices (Table 2). As the number of HEIs at EID care points increased as a result of improving retention of MBPs in care, the facilities were able to consistently provide services to all of them. All HEIs were reported to be adhering to IYCF practices after an initial period of inconsistency. At baseline in June 2013, the indicator was relatively high at 70%. As early as November 2013, the indicator reached 90% and remained on the median (96%) or above from April 2014 until June 2015 (Figure 1B and Table 2). The improvement was highly

**Table 2.** Summary of QI Indicators, Uganda, June 2013 to June 2015.

Indicator	Definition	Mean	Median	SD	Minimum	Maximum
I	Percentage of HIV-positive pregnant women and lactating mothers who receive IYCF counseling at each visit	<b>93.1</b>	<b>99.7</b>	<b>15.5</b>	<b>44.5</b>	<b>100.0</b>
N	Number of HIV-positive pregnant women and lactating mothers given IYCF counseling at each visit	982.9	1090.0	316.0	126	1237
D	Number of HIV-positive pregnant women and lactating mothers attending in the given month	1322.8	1515.0	415.9	283	1667
	<i>Number of facilities reporting</i>	18	17	5	0	22
2	Percentage of HEIs reported to be adhering to recommended IYCF practices	<b>92.4</b>	<b>96.5</b>	<b>8.5</b>	<b>70.0</b>	<b>98.0</b>
N	Number of HEIs adhering to recommended IYCF practices	927.8	1042.0	268.0	292	1183
D	Number of exposed infants attending the EID care point in the given month	984.2	1073.0	232.2	417	1220
	<i>Number of facilities reporting</i>	22	22	0	21	22
3	Percentage of MBPs receiving the standard care package	<b>90.1</b>	<b>98.6</b>	<b>22.6</b>	<b>2.9</b>	<b>100.0</b>
N	Number of MBPs who received the standard care package	978.2	1090.0	333.9	9	1237
D	Total number of MBPs seen in the clinic in the given month	1034.4	1105.0	245.6	309	1250
	<i>Number of facilities reporting</i>	22	22	0	20	22
4	Percentage of HEIs who are alive and infected at 18 months of age	<b>6.2</b>	<b>5.0</b>	<b>4.8</b>	<b>0.0</b>	<b>21.7</b>
N	Number of HEIs who are alive at 18 months of age and HIV-positive at 1st and 2nd PCR	4.4	4.0	2.9	0	13
D	Total number of HEIs who have been discharged from EID care point	75.2	80.0	16.1	38	103
	<i>Number of facilities reporting</i>	18	17	3	12	22

Abbreviations: EID, early infant diagnosis of HIV; HEIs, HIV-exposed infants; IYCF, infant and young child feeding; MBPs, mother–baby pairs; PCR, polymerase chain reaction; SD, standard deviation; N, Numerator; D, Denominator.

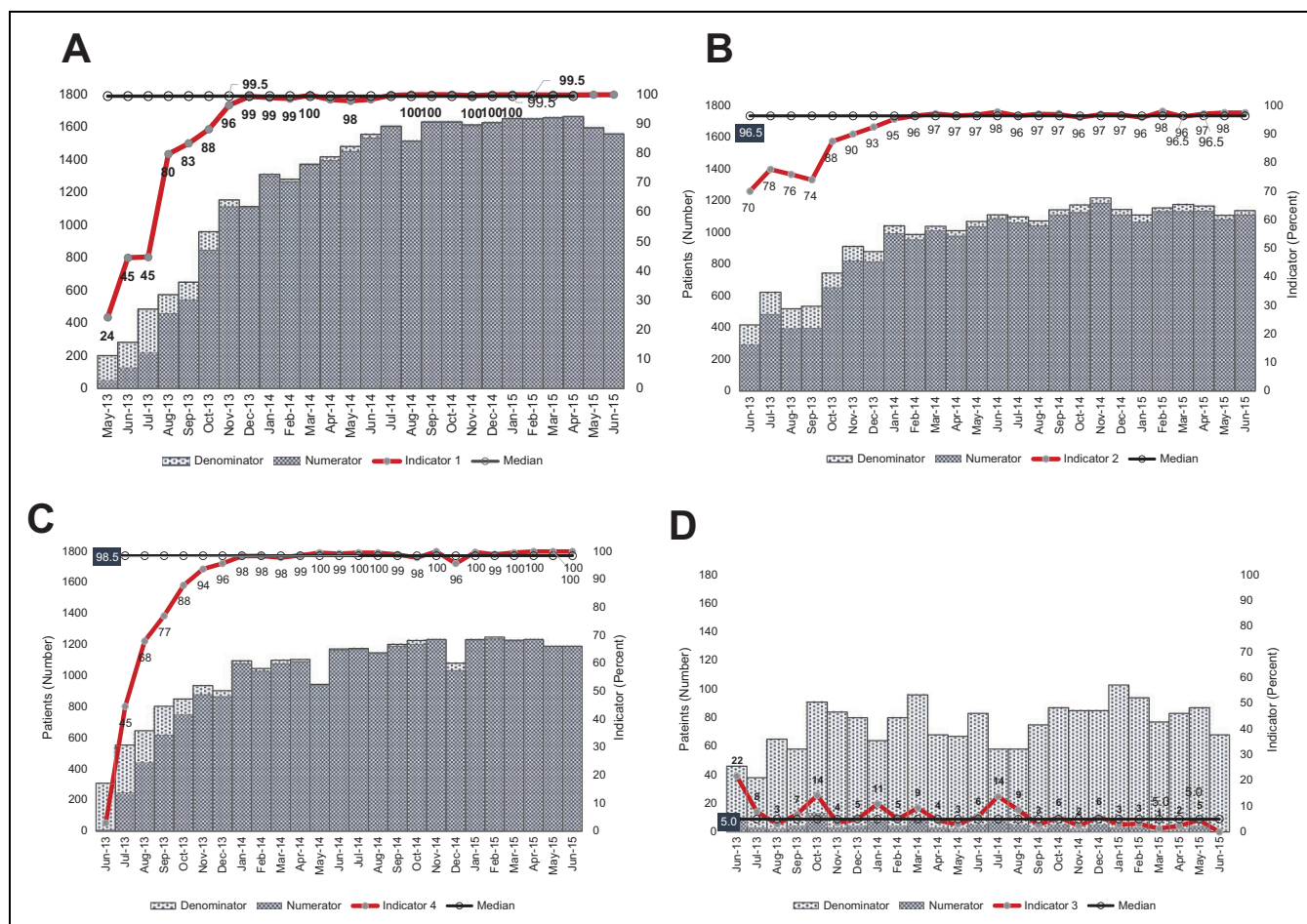
**Table 3.** Statistical Analysis of Indicators Over Time.

Interval	Period 1	Period 2	Period 3	Period 4
	June 2013 to December 2013	December 2013 to June 2014	June 2014 to December 2014	December 2014 to June 2015
1	Percentage of HIV-positive pregnant women and lactating mothers who receive IYCF counseling at each visit			
Odds ratio	0.0051	2.4781	-	-
95% CI	0.0024-0.0108)	1.0640-5.7716)	-	-
P value	<.0001	.0420	-	-
Significance			-	-
2	Percentage of HEIs adhering to recommended IYCF practices			
Odds ratio	0.1894	0.2721	1.4716	0.7764
95% CI	0.1366-0.2626)	0.1698-0.4379)	0.8749-2.4833)	0.4721-1.2811)
P value	<.0001	<.0001	.0504	.1441
Significance				
3	Percentage of MBPs receiving the standard care package			
Odds ratio	0.0014	0.1716	5.8737	-
95% CI	0.001-0.0028)	0.0830-0.3562)	2.8711-12.0437)	-
P value	<.0001	<.0001	<.0001	-
Significance				-
4	Percentage of HEIs who are alive at 18 months and HIV-positive			
Odds ratio	5.2778	0.8211	1.0256	-
95% CI	1.8336-17.9752)	0.3234-3.1742)	0.4045-3.824)	-
P value	<.0001	.7509	.9062	-
Significance				-

Abbreviations: HEIs, HIV-exposed infants; IYCF, infant and young child feeding; MBPs, mother–baby pairs.

significant in period 1 ( $P = .00$ ) and period 2 ( $P = .00$ ), with more HEIs reported adhering to IYCF consistently from period 1 (OR: 0.189, confidence interval [CI]: 0.137-0.263) to period 2 (OR: 0.272, CI: 0.170-0.438). The minimal change in periods 3 and 4 was not significant as the indicator was mostly above 96% during these last 2 periods (Table 3).

*Percentage of MBPs receiving the standard care package.* The mean overall number of MBPs receiving the standard care package monthly was 1034 (SD = 245.6), 90.1% (SD = 2.9; Table 2). The MBPs receiving the package increased rapidly from introduction in June 2013 (0%) to 98% by February 2014. Subsequently, it remained above the median of



**Figure 2.** A, Percentage of HIV-positive pregnant women and lactating mothers who received IYCF counseling at each visit (June 2013 to June 2015). B, Percentage of HEIs adhering to recommended IYCF practices (June 2013 to June 2015). C, Percentage of MBPs who received standard care package (June 2013 to June 2015). D, Percentage of HEIs who are alive at 18 months of age and HIV positive at discharge from EID care point (June 2013 to June 2015). HEI indicates HIV-exposed infant; IYCF, infant and young child feeding.

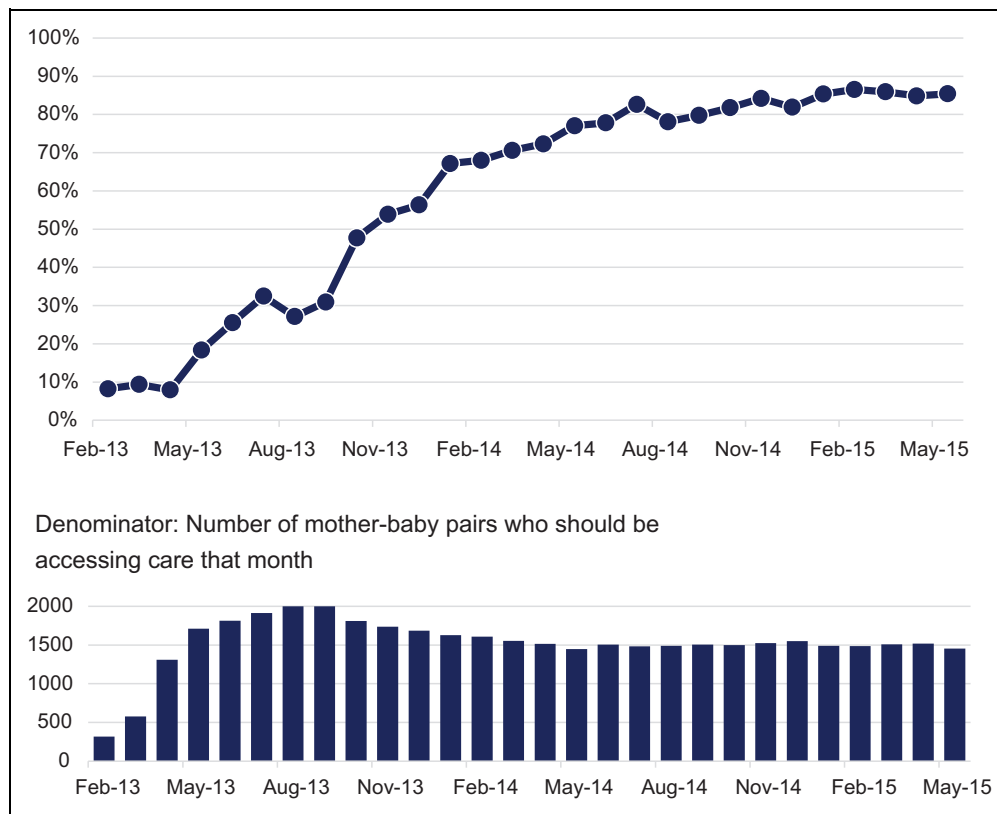
98.5%, reaching 100% by June 2015. It fell slightly in December 2014 when fewer patients were attending care compared to the 6 months prior and after (Figure 1C). The MBPs receiving the packages improved significantly and consistently across each 6-month period (Table 3). For this indicator, as more MBPs were retained over time, more of them were exposed to the standard care package from baseline to period 1 (OR = 0.001, CI: 0.001-0.003), to period 2 (OR = 0.172, CI: 0.083-0.356), to period 3 (OR = 5.874, CI: 2.871-12.044; Table 3).

**Percentage of HEIs who are alive at 18 months of age and HIV positive.** Of the children in PMTCT programs who were HIV-exposed, an average of 6.2% (SD = 4.8) were HIV positive at 18 months. Across smaller and larger facilities, between 38 and 80 HEIs were discharged from EID care points monthly. In the earlier period of implementation, there was more variation in the number of HEIs retained, as well as HEIs testing HIV positive. Variation for the indicator was particularly high before September 2014. After 15 months of implementation,

there was a consistent reduction in the number of HEIs testing positive, and the indicator fell below the median of 5%, the WHO target rate for eMTCT among breastfeeding women. Even though the number of HEIs retained remained consistent and higher than before September 2014, the positivity rate showed less variability (Figure 2, graph D). In particular, the improvement from baseline to period 1 ( $P < .001$ ) and period 3 ( $P < .001$ ) was statistically significant.

**Increasing the Number of MBPs Seeking and Staying in Care**

Overall, more MBPs were reported to seek services over time, resulting in a gradual increase in the denominator for all indicators over the intervention period. The consistently positive trend shows that facilities could keep up with providing quality services (the standard care package) to sustain improvement of the indicators in tandem with increasing numbers of MBPs coming to the facility monthly (Figure 3). The denominator in Figure 3 represents the number of MBPs who should be accessing care every month, which increased in part due to



**Figure 3.** Proportion of mother–baby pairs retained in care each month in 22 PHFS sites in Uganda (February 2013 to May 2015).

improved documentation and largely due to the work done by facility staff to link HIV-positive mothers with their infants and ensure that they were attending monthly clinic visits. This number is calculated using the EID register to identify all HEIs registered up to 18 months prior to the month of interest, and then removing all infants who had died, been discharged, or transferred out of the facility, leaving only active HEI, transfer-ins, and those lost to follow-up.

### Change Packages

The change packages are a collection of tested changes that led to the improvement of the target indicators during the PHFS implementation process. The changes to processes of care, made by QI teams, focused on the main gaps identified during the rapid assessment and subsequent coaching visits of the sites. The change packages associated with care areas covered by the target indicators are shown in Table 4. Components of the change packages were adopted into national PMTCT guidelines for spreading to other facilities during the course of implementation.

### Discussion

While we cannot definitively conclude that reduction in HEI positivity was due to the PHFS intervention alone, the QI work supported improvement in retention of MBPs in care which was tracked over time with documentation of changes

occurring in the facility. Through application of the standard care package, MBPs coming for appointments received consistent and comprehensive care including HIV treatment or prophylaxis to prevent transmission. Overall, there was a statistically significant reduction in the number of HEIs who were HIV positive at 18 months of age. The percentage of HEIs alive and infected at 18 months of age showed significant decrease between period 1 and period 2 (mean = 6.2%, SD = 4.8). This was accompanied by statistically significant improvement in IYCF counseling, adherence to IYCF guidelines by HEI, and adherence to the standard care package. This improvement was sustained over the period of implementation from April 2013 through to August 2015. This is consistent with the results of use of continuous QI to merge content and process to improve performance.<sup>7-9</sup> The percentage of MBPs receiving the standard care package improved from 0% to 100% by period 4 (mean = 98.6%, SD = 22.6) (see Figure 2, graph C). The percentage of HIV-positive pregnant women and lactating mothers who received IYCF counseling at each visit improved from 45% to 100% by period 3 (mean = 93.1%, SD = 15.5) (Figure 2, Graph A). The success of IYCF counseling demonstrates the viability of using the PHFS platform to provide counseling to address barriers to adherence—the percentage of HEIs adhering to recommended IYCF practices increased from 70% to 96% by period 3 (mean = 92.4% SD = 8.5) (Figure 2, graph B). We recognize the



**Table 4.** Change Package for Each Targeted Care Process, Uganda, 2013 to 2015.

Care Processes			
Tested Changes	YCF Counseling for HIV-Positive Women	Promoting Adherence to IYCF Practices in HEI	Delivery of Standard Care Package for MBPs at Routine Visits
	<ul style="list-style-type: none"> <li>On-the-job training on how to use the different IYCF codes</li> <li>Health workers provide simple key messages to mothers at each visit</li> <li>Mothers empowered through education to remind health workers to provide counseling</li> </ul>	<ul style="list-style-type: none"> <li>Health education through the family support groups on IYCF</li> <li>Mentor/peer mothers to support other mothers, provide information and counsel</li> <li>Food demonstrations in some sites to show mothers how to prepare a variety of foods for children starting complementary feeding</li> </ul>	<p>Reducing HIV Infection Among HEI</p> <ul style="list-style-type: none"> <li>Changes which enable health workers to identify eligible infants. Generating a list of expected infants and making a note in the EID register</li> <li>Changes which create a system that prompts mothers to return for their HEI appointments. Give mothers the exact appointment date; call mothers to remind them; provide adequate information on the importance of rapid tests</li> <li>Changes which allow for follow-up. Use community workers like Village Health Teams (VHT), expert clients, and linkage facilitators to follow up with mothers in the community</li> </ul>
			<ul style="list-style-type: none"> <li>Changes to improve the efficiency of the mother–baby care point. Merged the EID and ART clinic services to see MBPs in one place; services moved from ART clinic to MCH clinic to decongest ART clinic and reduce waiting time; assigned specific staff roles in the clinic so all services are provided; dispense both mother and infant’s drugs in the clinic</li> <li>Changes to strengthen linkages between the different entry and service points. Physical referral of MBPs from all entry points</li> <li>Changes to improve the knowledge and skills of the staff. On-the-job training and orientation on IYCF counseling and use of mid upper arm circumference (MUAC) tapes; mothers informed about services so they can remind health workers if a service is not provided</li> <li>Changes to follow up MBPs in the community. Call mother and do a follow-up visit at home; use expert patients or mentor mothers to educate and counsel mothers on keeping appointments; write appointment dates on medicine bottle; inform mothers of next appointment date before they leave the clinic; priority given to those who come as a family to get services; use of male expert clients to involve provided.</li> <li>Changes to improve data quality. MB cards completed as clinicians see them; improvised counter book and tally sheet for documentation</li> </ul>

Abbreviations: EID, early infant diagnosis of HIV; HEI, HIV-exposed infant; IYCF, infant and young child feeding; MBPs, mother–baby pairs.

potential for bias introduced by mothers self-reporting their own adherence to recommended IYCF practices, but consider the data a reasonable estimation of the improvement in adherence to IYCF practices, as this is the way these data are routinely collected by the MOH.

We observed varied performance among facilities with the larger hospitals in urban settings seeing improvements later than the smaller facilities. Larger hospitals have more complex systems and larger departments, and it took longer to merge maternal and HEI services and redesign process flow.

A key factor driving these results is the improvement in documentation and emphasis on measurement in the QI process. As in other countries in the region, poor data quality in health facilities in Uganda is a limitation to assessing progress.<sup>25</sup> The percentage of accurately completed clinical charts was initially 0% across all 22 facilities, but with coaching and the institution of changes to address gaps in the documentation process, the facilities improved to over 95%. The initial preparation done by coaches with facility staff, especially guidance in proper documentation of indicators, had a positive impact on performance. The teams instituted changes that improved the skills and competencies of staff to fill out data tools; changes that ensured primary registers and charts were filled out before patients left the facility and changes that ensured at least one round of checking by another person for accuracy and completion of primary data recording. Another key factor was the use of the all-or-nothing approach to deliver the standard care package. The observed improvement in adherence to the standard care package demonstrated the feasibility of using such packages in low-income settings.

Guideline content on eMTCT was rolled out through trainings and mentorship, and the QI approach used to implement and improve service delivery. By the end of the intervention, all the 22 sites had functional QI teams, and specific improvement activities for PMTCT and nutrition, including provision of the standard care package.

The decision to manage mothers and babies as a unit by keeping the mother and infant clinical cards together, giving one appointment for the pair, and availing one health provider for the pair, led to sharp increases in the retention of MBPs over time, and the momentum was sustained by assigning individuals to review cards after each HEI clinic day. Once data were being captured accurately and analyzed to determine gaps, it became possible for QI teams to see the effect of tested changes on care processes measured by all indicators over time.

For the standard care package indicator, MBPs had to receive all the components of the package at each visit before they were counted in the numerator. If one service, such as nutrition assessment or ART refill, was not provided, then it was considered an incomplete package. The package was tracked as a composite indicator, and each component of the package was also measured individually. The standard care package composite indicator showed an increase in performance after implementation of QI, but since the introduction of the package was a new change idea, this indicator started at 0%. For the IYCF adherence

indicator, neither the numerator nor denominator was recorded by the facilities before the start of the QI process because these are not routinely reported within the national HMIS; therefore, there were no primary reference data sources. The proportion of pregnant and lactating mothers receiving IYCF counseling steadily increased from June 2013 when the standard care package, tally sheets, and coaching were introduced.

The implementation of the PHFS to ensure that facilities provided care according to the new WHO guidelines required facilities to make changes to how services were organized and delivered, especially in order to ensure that the increasing number of MBPs were retained and all received the standard care package at each visit. The clinics had to adjust their workflow to improve efficiency in delivering services. Facility teams were coached to review their clinic flow using flowcharts to determine which services would be provided where, when, and by whom. This process mapping enabled teams to merge steps and remove redundant steps in the patient flow. Facility teams received on-the-job training to equip them with the skills to provide components of the standard care package, including how nutrition assessment and what key messages to give mothers during IYCF counseling. The intervention needed to focus on ensuring women kept appointments over time, so all enrolled MBPs consistently received the full standard care package at their clinic visit. The results show that despite increasing patient load at each clinic from fewer than 100 patients monthly to more than 1000 patients per month across the 22 facilities, the proportion of MBPs receiving the full package of evidence-based interventions increased.

The fluctuations in numbers retained was expected for the outcome indicator—percentage of HEIs alive at 18 months and HIV positive—because the measure is based on an open cohort of children, with some testing negative earlier than 18 months, some being transferred out of the facility, and inclusion of new patients monthly at the QI facilities. The measure was not calculated on the same cohort of children each month. However, the improvement on this indicator is shown later, starting in September 2014, when variability in the positivity rate decreased and was mostly below the WHO standard of 5% and when facilities were retaining a more consistent number of HEIs.

### *Strengths and Limitations*

This article describes the PHFS program implementation in Uganda; our design did not include a control group. Therefore, we cannot conclude that the changes in transmission among HEIs was due to the QI intervention alone. Despite the positive changes resulting from the QI intervention, other service delivery areas also needed to be strengthened, particularly facility–community linkages to sustain the gains and provide a continuum of care; additional services for mothers, including viral load monitoring; and more staff and longer facility hours, which could further reduce patient wait times at facilities. Mothers learned the importance of nutrition through counseling, but still struggled with accessing food in some cases, and requested that food—especially for their children—be provided at the facility.

At the system level, mothers suggested that outreach services be offered in the community, as well as making ART and postnatal care services available at lower level facilities.

While Option B+ can reduce transmission of HIV from mothers to infants and keep mothers healthy, it also poses ART adherence challenges for pregnant and lactating mothers and does not focus on protecting the infants from other primary causes of mortality.<sup>26</sup> However, the QI work done through PHFS in Uganda has been shown to be effective in operationalizing and integrating evidence-based interventions that contribute to improved infant health outcomes.

## Recommendation and Conclusions

We evaluated the effect of a QI approach to improve nutrition and protect infants from HIV infection, demonstrating improvement in PMTCT and IYCF indicators over time. Based on findings from 22 PHFS demonstration sites, the Uganda MOH subsequently released guidelines to establish mother–baby care points (previously called EID care points) to provide comprehensive services for both the mother and baby in one appointment at all 1684 sites that offer eMTCT services in Uganda.<sup>27</sup> The interventions that proved successful in the demonstration sites were scaled up to the rest of the country, using the QI change packages as a guide. Success of this program can be further supported by additional evaluations linking these services and the QI approach to improvement in health status. The PHFS intervention provided an opportunity to integrate and deliver these health services and improve outcomes for mothers and infants in PMTCT care.

## Authors' Note

Tamara Nsubuga-Nyombi and Esther Karamagi contributed equally to this article.

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