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Closing the prevention of mother-to-child transmission gap in Nigeria: an evaluation of service improvement intervention in Nigeria

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Abstract

Objectives: The objective was to assess improvement, or lack thereof, in the uptake of prevention of mother-to-child transmission (MTCT) services at selected sites supported sites by the Global HIV/AIDS Initiative Nigeria (GHAIN).

Design: The study used aggregated monthly service statistics to evaluate service improvement efforts that were conducted before and after these were undertaken between July 2007-June 2008.

Settings and subjects: The service improvement efforts took place in 60 public healthcare facilities.

Outcome measures: The study measured changes in the number of pregnant women who attended antenatal clinics for the first time, the number of pregnant women tested for human immunodeficiency virus (HIV), the number of HIV-positive women receiving antiretroviral (ARV) prophylaxis, and the service ratio, an indicator of the relative uptake of ARV prophylaxis. An estimate of MTCT events that were averted through ARV prophylaxis taken by the pregnant women was also calculated.

Results: One hundred and twenty thousand, five hundred and thirty-seven women attended an antenatal clinic (ANC) for the first time. There was an average of 167.4 monthly attendances per facility. ANC attendance increased per facility by 11.1 women monthly post-intervention (p -value < 0.01). The uptake of HIV testing was 87%, with a monthly average increase of 17.8 women tested per facility (p -value < 0.01). ARV prophylaxis uptake rose from 3.3-5.4 women per facility per month (p -value < 0.01). The service ratio per facility improved from 5.3 women receiving ARVs to 6.5 for every 10 women who tested positive for HIV (p -value < 0.01). Applying risk reduction estimates of different ARV regimens, it was estimated that between 88-169 MTCT events were averted pre-intervention, and 143-276 events, post-intervention.

Conclusion: Service improvement intervention improved the utilisation of PMTCT services. It should be a key intervention that is used to close the PMTCT gap in Nigeria.

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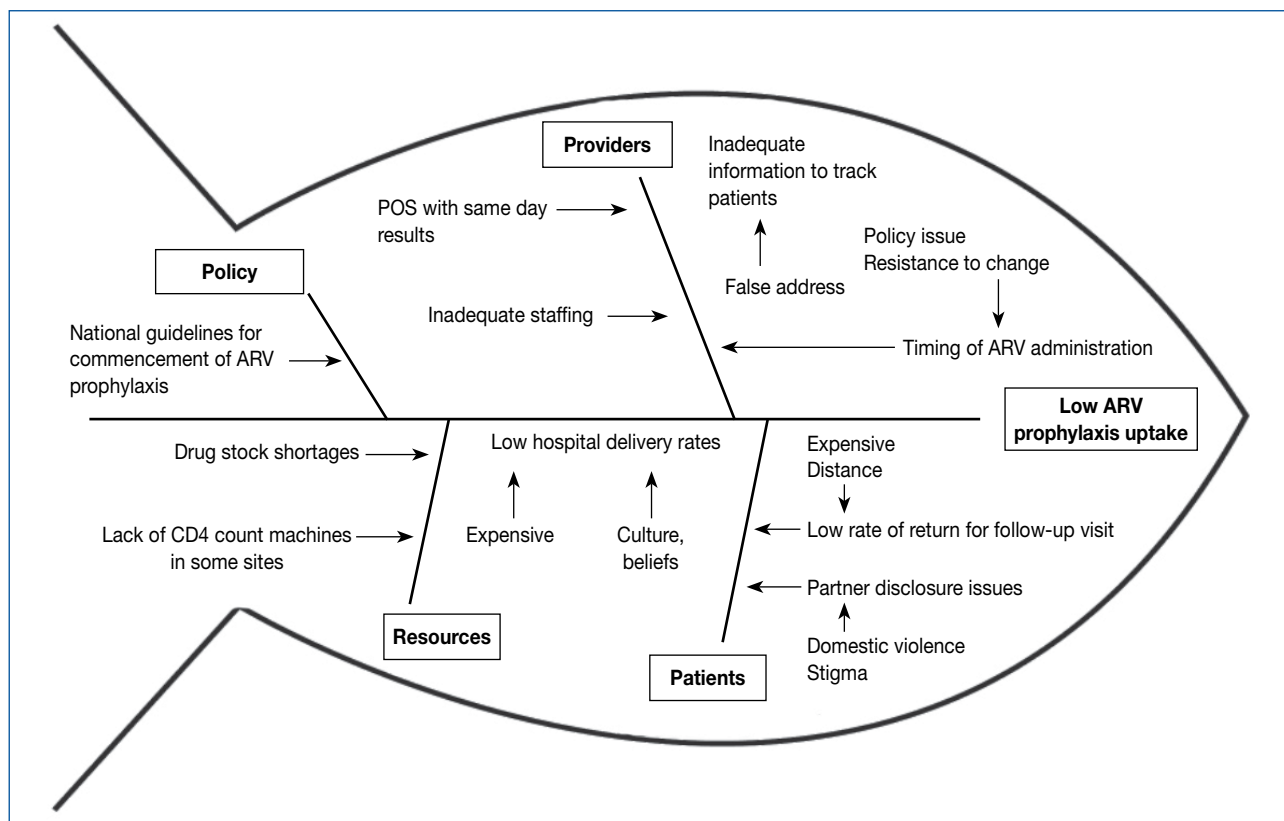
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Introduction

Nigeria has the third largest number of people living with human immunodeficiency virus (HIV) in the world.¹ The HIV prevalence among women attending antenatal clinics (ANC) was 4.6% in 2008, with 5-6 million births recorded annually.² A Nigerian child's greatest risk of infection with HIV is through mother-to-child-transmission (MTCT). In sub-Saharan Africa, in the absence of any prevention, between 16.5-26.4% of children who are born to HIV-positive mothers will be infected during the peripartum period.³ In 2007, 220 000 children were estimated to be HIV-positive in Nigeria.⁴

The provision of antiretroviral (ARV) prophylaxis remains the most efficacious strategy to prevent MTCT. Compared

to placebo, ARVs in sub-Saharan Africa reduces the in-utero and intrapartum risk of MTCT by 50%.⁵ However, the evidence of the effectiveness of ARV prophylaxis is based on data from experimental and closely monitored population studies⁶⁻⁸ which report outcomes based on analyses isolated from the realities of whole healthcare systems.⁹ The benefits of PMTCT become more modest when the constraints of the healthcare systems in resource-poor countries are taken into account. The gap between the number of HIV-positive pregnant women who need prophylaxis in developing countries, and those who receive it, is wide. Nigeria is one of the countries with a large number of pregnant women living with HIV. It had only 11% PMTCT coverage in 2008. Nigeria alone contributes to 30% of the global gap in PMTCT coverage.¹⁰ It is insufficient for ARV



ARV: antiretroviral, CD4: cluster of differentiation 4, POS: point of service

Figure 1: Fishbone diagram shows root causes of low uptake of antiretroviral drugs prophylaxis

prophylactic regimens to be simply efficacious. They also have to be embedded in the routines of healthcare services. Healthcare systems must make them available, services must be organised so that efficiency and effectiveness are optimised, and people in need must be willing and able to use the services.¹¹

This paper reports on the evaluation of a service improvement process that the Global HIV/AIDS Initiative Nigeria (GHAIN) supported to enhance the performance of PMTCT in the Nigerian healthcare system. Generally, the service improvement interventions are underutilised in the public sector of resource-poor settings as an approach to embedding effective treatments. Where they have been used, generally they have been limited to single sites,¹¹⁻¹² or small population groups,¹³ the analysis has not included measurable outcomes,¹⁴ or the research was managed within the context of a community trial.¹⁵

Background

GHAIN initially supported PMTCT services in 26 sites in 2005, and expanded to 157 sites across all 36 states and the federal capital territory by June 2008. Most of the sites are secondary level hospitals and primary healthcare centres. A typical PMTCT site has an ANC with maternity services and access to a laboratory and pharmacy. GHAIN's technical assistance includes six-day training, followed by monthly supervision, to ensure adherence to the Nigerian national guidelines and mentoring on clinical, logistical monitoring

and evaluation. Client registration is open at any stage of pregnancy, although women are encouraged to book early. All pregnant women receive group education on ANCs, HIV in pregnancy, and PMTCT. One-on-one pre-test counselling precedes all HIV testing. Initially, most ANCs did not use the rapid HIV test kits. Samples of blood were sent to the laboratory and the client was given an appointment and asked to return to get the HIV test results. Those clients who tested positive were offered ARV prophylaxis, and could choose from five drug regimens that were recommended by the Nigerian PMTCT national guideline.¹⁶ These were azidothymidine (AZT) only; AZT/lamivudine (3TC)/single-dose nevirapine (sdNVP); AZT/sdNVP; sdNVP and a triple regimen. The sdNVP regimen was recommended only for non-booked mothers in the labour ward. The HIV-positive women were assessed for antiretroviral therapy (ART) eligibility and referred to the ART clinic as appropriate.

The review of monthly routine data identified three problems, namely low attendance at ANCs, the need to sustain the uptake of HIV counselling and testing (HCT) while scaling up PMTCT services, and a low proportion of HIV-positive women receiving ARV prophylaxis. The GHAIN-supported service improvement process began with a cause-and-effect analysis to describe the nature of the problem, explore the factors involved, identify the possible causes of each factor, and generate an analysis based on a fishbone diagram (Figure 1). The analysis was conducted in conjunction with 11 service providers and nine programme managers.

The identified main root causes were grouped in four categories:

- *Service provision-level causes:* The inability to provide HIV test results on the same day, poor quality of counselling due to a high workload, and staff attrition and turnover.
- *Patient-level causes:* A low rate of return after HIV testing to commence ARV prophylaxis because of distance, cost and domestic violence. This led to poor adherence to the timing of ARV prophylaxis administration. The facility deliveries were also low.
- *Resource-level causes:* Lack of cluster of differentiation 4 testing in some facilities, insufficient funding to track defaulting HIV-positive women and occasional stock shortages of ARV drugs.
- *Policy-level cause:* Providers insisted on the triple or dual prophylaxis regimens. SdNVP was perceived to be an inferior option and was seldom provided, even though it was sometimes the only option in practice and part of the guidelines.

The service improvement teams established in healthcare facilities acted on the three problems that were identified during the review of monthly routine monitoring data, namely low attendance at ANCs, sustaining the uptake of HCT and a low proportion of HIV-positive pregnant women receiving ARV prophylaxis.

Firstly, meetings were held with religious and community leaders to advocate ANC service utilisation and the fight against stigma. Secondly, rapid HIV test kits were introduced in all ANCs. This enabled the healthcare provider to provide group pre-test HIV counselling with an opt-out option, individual post-test counselling, and test results on the same day. Thirdly, the frequency of support supervision increased, during which providers received feedback on service output and were encouraged to minimise missed opportunities for ARV prophylaxis. Providers were encouraged to offer AZT/sdNVP or AZT/3TC/sdNVP as the regime of first choice, but to consider all regimens, including the sdNVP which was perceived to be inferior and rarely prescribed by doctors. In instances in which it was not feasible to provide combination ARV regimens, women were counselled on the use of sdNVP in labour and provided with a 200 mg tablet of sdNVP as a minimum therapy.¹⁷

In addition, providers were encouraged to check HIV-positive women for eligibility for ART and to refer them to the ART clinic as appropriate. A new patient-tracking system using diaries was introduced in ANCs to optimise adherence. HIV-positive pregnant women on prophylaxis were given a return date which was recorded in the diary. At the end of every clinic day, a list of defaulters was drawn up and patients were tracked by telephone and home visits. The supervisors included the pharmacy in their visiting schedule. An early warning system for drug stock shortages was implemented. There was monthly monitoring of the

maximum and minimum levels of ARV and HIV rapid test kits at each facility.

Method

The service improvement interventions were evaluated as an indivisible whole, rather than according to individual components, by measuring changes in aggregated ANC routine service data between a six-month period prior to the service improvement process (July-December 2007) and six months after (January-June 2008).

Each site provided monthly reports of aggregated service utilisation. Four output measures were applied to the cascade of PMTCT, from ANC attendance through to completion of ARV prophylaxis:

- Number of women attending the ANC for the first time.
- Number of pregnant women tested for HIV.
- Number of HIV-positive pregnant women receiving ARV prophylaxis.
- Number of HIV-positive women newly initiated on ART.

In addition, a service ratio was used as a proxy indicator of the relative uptake of ARV prophylaxis. Ideally, the relative uptake of ARV prophylaxis would be measured as a proportion of the HIV-positive women giving birth (in a month) who had received ARV prophylaxis. However, the monthly service statistics did not allow for a direct correlation of individual delivery and ARV prophylaxis data. The service ratio calculates the number of women who received ARV prophylaxis in a month, over the number of women who tested positive for HIV in the same month. The working assumption was that a service ratio approaching or slightly exceeding one would indicate that the number of women receiving ARV prophylaxis was nearing the upper limit of known HIV-positive women within the programme.

Data analysis

Data on attendance at ANCs, HCT, and ARV prophylaxis for six months pre- and six months post-intervention were exported from the national district health information system into Stata® 10.0 for analysis. Descriptive methods were used to characterise the monthly changes in the four output measures. Differences between the pre- and post-intervention periods were tested with a bivariate Poisson regression model using the Stata® "xt" command to adjust the standard errors to account for clustering by ANCs. A p-value < 0.05 was the desired level of significance. The service ratio could not be calculated for 10% (71) of the monthly returns. Typically, this occurred when there were no HIV-positive pregnant women and no women receiving HIV prophylaxis (n = 60), or where there were no HIV-positive women and a small number of women receiving HIV prophylaxis (n = 11).

In these cases, the ratio was either undefined (0/0) or infinity (n/0, for all n > 0), and was excluded from the analysis.

A histogram of the service ratio showed it to be skewed with a heavy right tail. A natural log transformation was applied, producing more normally distributed data suitable for analysis with multiple linear regressions. These data were back-transformed in the presentation of the results. Each regression analysis involved one of the measures and the service improvement period was entered as a dichotomous, predictor variable. To determine the reduction in the number of MTCT events, it was necessary to link HIV-positive mothers to the child's confirmed HIV status. This was not possible with the aggregated routine data. Crude estimates were calculated based on the known number of HIV-positive pregnant women in the programme. An estimate was made of the risk of MTCT and the risk reduction in MTCT by different ARV prophylaxis regimens. The estimates of the risk of MTCT without ARV prophylaxis in sub-Saharan Africa are broad-ranging from 21%,⁵ through 25%,³ and up to 40%.³ This risk is spread in three distinct periods, namely the in utero period (risk = 0.222), the intrapartum period of labour (risk = 0.444), and the postpartum period of breastfeeding (risk = 0.333).³

To estimate MTCT events that were averted during the in utero and intrapartum period by ARV prophylaxis taken by the pregnant women, adherence to the regimen was assumed.

The number of averted MTCT events was calculated as the difference between transmission among HIV-positive pregnant women, which would have occurred without ARV prophylaxis [estimated with a lower range of 14% (0.666 x 21%) and higher range of 27% (0.666 x 40%) HIV transmission risk for in utero and intrapartum results combined],¹⁸ and the estimated number of MTCT events in the same group of pregnant women.

The risk reduction effect of the reported ARV prophylaxis was applied using the following estimates per regimen:

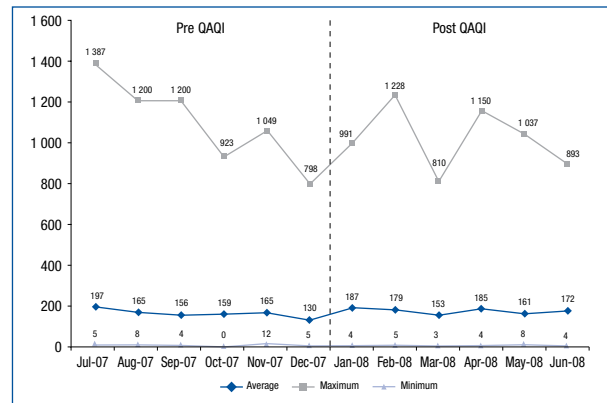
- AZT reduces MTCT risk by 50%.¹⁹
- AZT/3TC regimen reduces MTCT risk by 63%.²⁰
- sdNVP reduces MTCT risk by 48%.²¹

Results

By June 2008, the GHAIN project was supporting 196 PMTCT sites. Of these, 133 became a part of the programmatic support after the service improvement process that started in January 2008. Sixty-three sites had data going back six months prior to the service improvement interventions. Three sites had incomplete data. This evaluation included the 60 sites with complete pre- and post-intervention data only.

First-time attendance at antenatal clinics

A total of 120 537 first-time ANC attendees were recorded at the 60 clinics. There was substantial variation in the number of ANC attendees by facility. Some facilities



QAQI: quality assurance, quality improvement

Figure 2: Number of first antenatal visits per month by facility

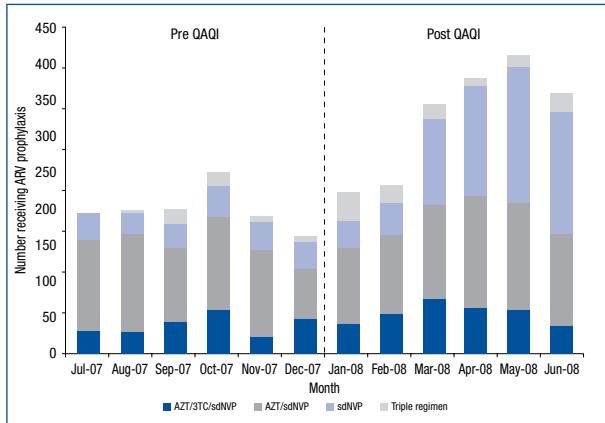
reported monthly averages of more than 900 first-time ANC attendees, while others had fewer than 10 (mean = 167.4, median = 114.3). Figure 2 shows the variation in monthly attendance across the 60 sites. Forty-eight per cent (58 276) and 52% (62 261) of total attendance occurred in the pre- and post-intervention periods, respectively. The post-intervention period had an increase in attendance of 11.1 women per facility per month (p-value < 0.01).

Human immunodeficiency virus testing

A total of 104 851 HIV tests were conducted at the ANC clinics, 48 590 (47%) and 55 631 (53%) pre- and post-intervention respectively. The uptake of testing among first-time ANC attendees increased post-intervention from 85% to 89%, with substantial variation by facility. Some facilities tested just under 900 clients per month, while others tested fewer than 10 (mean = 145.6). The pre-intervention period had on average 136.7 HIV tests per facility per month. This rose significantly to 154.5 post-intervention (p-value < 0.01). Over the 12-month period, an average of 449 pregnant women tested HIV-positive monthly. The average number of identified HIV-positive women rose post-intervention from an average of 424 to 475 per month.

Antiretroviral drugs prophylaxis

Figure 3 shows the changes in the uptake of ARV prophylaxis by drug regimen during the observation period. The monthly number of women receiving ARV prophylaxis increased from 198 pre-intervention to 325 post-intervention. In the pre-intervention period, an average of 3.3 women per facility per month received ARV prophylaxis. This rose to an average of 5.4 women per facility per month (p-value < 0.01). This represents a monthly average across the 60 facilities of 198.3 women who received ARV prophylaxis in the pre-intervention period, rising to 325 women in the post-intervention period. The relative use of sdNVP increased from an average of 17% pre-intervention to 36% post-intervention. The AZT/sdNVP was the most commonly used regime pre-intervention (58%) and post-intervention (40%). There was a minimal change in the proportion of women

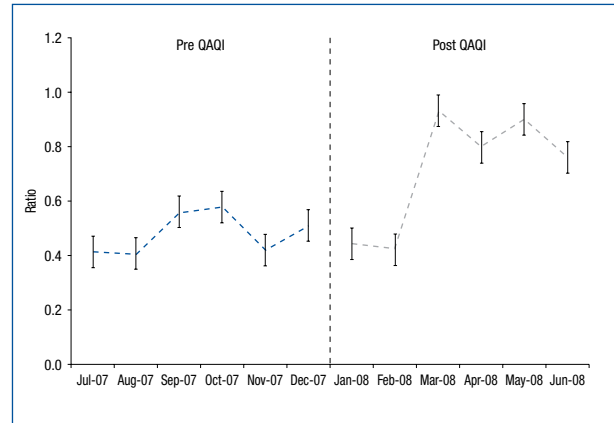


ARV: antiretroviral; AZT/3TC/sdNVP: azidothymidine/lamivudine/single-dose nevirapine; AZT/sdNVP: azidothymidine/single-dose nevirapine; QAQI: quality assurance, quality improvement; sdNVP: single-dose nevirapine

Figure 3: Human immunodeficiency virus-positive pregnant women receiving antiretroviral drugs prophylaxis via an antiretroviral drug regimen

who received AZT/3TC/sdNVP and the triple regimen from 20% to 17%, and 5% to 7%, respectively.

When sdNVP was excluded, there was still a significant rise in the delivery of ARV prophylaxis from a monthly facility average of 2.8 women in the pre-intervention period to 3.5 women in the post-intervention period (p-value < 0.01). This represents a monthly average across the 60 facilities of 164.2 women who received prophylaxis in the pre-intervention period. This rose to 207.6 women post-intervention. Over the 12-month period, 194 of the 5 389 HIV-positive pregnant women received the triple ARV prophylactic regimen in all 60 facilities. This number increased significantly from 60 pre-intervention to 134 post-intervention (p-value < 0.01). Thirty-six of the 60 facilities included in the study had an ART clinic. Of these, 29 facilities had a complete dataset



QAQI: quality assurance, quality improvement

Figure 4: Antiretroviral drugs prophylaxis service ratio

on the number of HIV-positive pregnant women who started ART over the 12-month observation period. This number increased from 240 HIV-positive pregnant women who started ART pre-intervention to 348 post-intervention. It translated to an increase from an average of 1.4 HIV-positive pregnant women who were started on ART per facility per month pre- intervention to two post-intervention (p-value < 0.01).

The service ratio: relative uptake of antiretroviral drugs prophylaxis

Figure 4 shows the changes in service ratio during the observation period. In the pre-intervention period, the service ratio averaged 0.47 per facility per month. In other words, on average, each facility provided ARV prophylaxis to 4.7 women for every 10 women who tested positive for HIV in the same month. In the post-intervention period, this rose to 0.70 per facility per month (p-value < 0.01).

Table 1: Estimates of averted mother-to-child human immunodeficiency transmission events pre- and post-QAQI, by regimen

	Risk reduction	Pre-QAQI			Post-QAQI		
		n	MTCT events*		n	MTCT events*	
MTCT events without ARV drugs			Low	High		Low	High
			14%	27%		14%	27%
MTCT without ARV drugs total HIV-positive women	NA	2 541	355.7	686.1	2 848	398.7	769
MTCT without ARV drugs HIV-positive women on PMTC	NA	1 188	166.3	320.8	1 951	273.1	526.8
MTCT events with ARV drugs							
AZT/3TC/sdNVP	0.63	241	12.5	24.1	333	17.2	33.3
AZT/sdNVP	0.50	684	47.9	92.3	779	54.5	105.2
sdNVP	0.48	203	14.8	28.5	705	51.3	99
Triple regime	0.63	60	3.1	6.0	134	6.9	13.4
Total MTCT events with ARV drugs among HIV-positive women on PMTCT		1 188	78.3	150.9	1 951	130	250.8
MTCT events averted (D = B - C) among HIV-positive women on PMTCT			88.1	169.8		143.1	276

* MTCT event: (n) x (1-risk reduction) x (low/high estimate risk of mother-to-child transmission occurrence)

ARV: antiretroviral; AZT/3TC/sdNVP: azidothymidine/lamivudine/single-dose nevirapine; AZT/sdNVP: azidothymidine/single-dose nevirapine; HIV: human immunodeficiency virus; MTCT: mother-to-child transmission; NA: not applicable because no antiretroviral drugs prophylaxis provided; PMTC: prevention of mother-to-child transmission; QAQI: quality assurance, quality improvement, sdNVP : single-dose nevirapine

Estimates of averted mother-to-child transmission events

A total of 2 541 and 2 848 pregnant women tested positive for HIV pre- and post-intervention, respectively. Table 1 shows estimates of MTCT events in the study population over the observation period. Considering a risk estimate of HIV MTCT in utero and intrapartum combined, ranging from 14-27% without ARV prophylaxis, the estimated number of MTCT events during these exposure periods among the HIV-positive pregnant women would have been between 355-686 pre-intervention, rising to between 398-768 post-intervention. ARV prophylaxis was provided to 1 188 and 1 951 HIV-positive pregnant women pre- and post-intervention respectively. In the absence of prophylaxis, the estimated number of MTCT events in utero and intrapartum combined would have ranged from 166-320, rising to 273-526 post-intervention. When the risk reduction effect of the ARV prophylaxis regimens was applied (no woman received the AZT-only regime), the estimated number of MTCT events decreased to a range between 78-150 pre-intervention and between 130-250 post-intervention. Therefore, the estimated numbers of averted MTCT events ranged between 88-169 pre-intervention, and between 143-276 post-intervention.

Discussion

This study showed that it is possible to undertake valuable implementation research with routine data, the potential of which is largely unexploited, thereby missing opportunities to enhance the increased utilisation of evidence-based interventions. Good routine data provide an opportunity to consider how best ARV prophylaxis can be delivered, and whether a service improvement intervention process can be used as a means of embedding effective treatments within a healthcare system. Service improvement intervention introduces changes in service organisations. This study showed a greater uptake of services accordingly. There was no significant difference between facilities excluded from the study and those included in terms of the communities served, service configuration and historical service output. However, the evidence presented in this paper was limited by the lack of randomisation and unavailability of a control group. Furthermore, the assumptions used to estimate averted MTCT events were drawn from control trials that had near perfect compliance,⁹ which is not always the case in routine service settings. Therefore, our findings tended to overestimate averted MTCT events.

The paper used the service improvement intervention approach for the analysis of the problems and the development of solutions. Many European studies have assessed improvement in hospital outputs for specific disease management and the system's response to quality improvement.²²⁻²⁷ However, these studies did not use routine data, hence their ability to better analyse associations

between individual components of improvement strategies and output. These studies suggest that the patient safety system, changes in service organisation monitored by performance indicators, clinical guidelines and external assessments were associated with improvement in service output. The service improvement intervention presented in this paper included all these components, except the patient safety system.

The increase in ANC attendance post-intervention was encouraging. The factors that influenced poor attendance at ANCs and other services in Nigeria included education, finance, culture and quality of services.²⁸⁻³⁰ Our study's service improvement intervention strategy combined service-related interventions, patient tracking and sensitisation of community leaders. No other systematic changes in the political, socio-economical or general service organisation environment occurred during the observation period. There is evidence elsewhere that the introduction of PMTCT services in ANC settings, by improving the counselling skills of staff, had a positive impact on ANC utilisation.³¹ However, only 35% of pregnant women are likely to complete an ANC programme and have a skilled attendant at delivery in Nigeria.^{9,32} The retention of clients in the ANC system is challenging in Nigeria. When women fail to return for their ANC follow-up appointment, the completion of non-sdNVP prophylaxis regimes is compromised.

This study suggests that an estimated 96 additional MTCT events were averted by improved uptake of ARV prophylaxis. Although AZT/3TC/sdNVP and AZT/sdNVP regimens have a greater HIV transmission risk reduction effect, the uptake of these regimens, which require adherence to multiple doses of treatment, was modest, despite being favoured by providers. However, the number of HIV-positive pregnant women on sdNVP trebled. In resource-constrained settings such as Nigeria, where barriers to access and factors that affect adherence to ARVs remain prevalent, sdNVP is still a valuable option.^{21,33} The sdNVP dose was dispensed at ANCs. The study did not establish if all women used the sdNV at the onset of labour. This problem was often found when evaluating similar PMTCT programmes in sub-Saharan Africa,³⁴ but there has been evidence of good adherence to sdNVP in resource-limited settings.³⁵ Good counselling is important to ensure adherence.³⁶ Using the good uptake of HIV testing (87%) as a proxy indicator for the quality of counselling, this study assumed good adherence. Improvements in service uptake extended beyond the ARV prophylaxis. The number of women who started on the triple ARV regimen also doubled, from 60 to 134, after the service improvement intervention. The programme should cater for the possibility of an increase in nevirapine resistance among women and infants who received sdNVP^{37,38} by training and sensitising healthcare providers about treatment options for nevirapine-exposed women. In Nigeria, improving the quality of services should be a key intervention in closing the PMTCT gap.

Conclusion

This study, using routine service statistics, suggests that there are significant missed opportunities for PMTCT in existing programmes. Closing the PMTCT gap in Nigeria should start by optimising service uptake in existing programmes before starting new PMTCT sites. Simple changes in service organisation, coupled with strengthened support supervision and greater sensitisation of the community significantly improved the uptake of ARV prophylaxis in this study.

Conflict of interest

There was no conflict of interest.

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