HIV-exposed infant follow-up in Mozambique: Formative research findings for the design of a cluster randomized controlled trial to improve testing and ART initiation

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Lúcia Da Costa Vieira
Instituto Nacional de Saúde de Moçambique
luciadacostavieira@gmail.com
ORCID: https://orcid.org/0000-0002-6410-9262

Arlete Miloque Mahumane
Centro de Investigação Operacional da Beira

Manuel Napua
Centro de investigacõa operacional da Beira

Falume Azamo Chale
Centro de Investigação Operacional da Beira

João Manuel
Centro de Investigação Operacional da Beira

Jessica Cowan
University of Washington

Kenneth Sherr
University of Washington

Rachel Chapman
University of Washington

James Pfeiffer
University of Washington-Health Alliance International

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Abstract

Background HIV-exposed infant diagnosis (EID) and initiation of HIV-positive infants on anti-retroviral therapy (ART) requires a well-coordinated cascade of care. Loss-to-follow-up (LTFU) can occur at multiple steps and effective EID is impeded by human resource constraints, difficulty with patient tracking, and long waiting periods. The objective of this research was to conduct formative research to guide the development of an intervention to improve the pediatric HIV care cascade in central Mozambique. The study was conducted in Manica and Sofala Provinces where the adult HIV burden is higher than the national average. The research focused on 3 large clinics in each province, along the highly populated Beira corridor. Methods The research was initiated in 2014 over 3 months at six facilities and consisted of 1) patient flow mapping and collection of health systems data from postpartum, child-at-risk, and ART service registries, 2) measurement of patient waiting times, and 3) patient and health worker focus groups. Results HIV testing and ART initiation coverage for mothers tends to be high, but EID and pediatric ART initiation are hampered by lack of patient tracking, long waiting times, and inadequate counseling to navigate the care cascade. About 76% of HIV+ infants were LTFU and did not initiate ART. Conclusions Effective interventions to reduce LTFU in EID and improve pediatric ART initiation should focus on patient tracking, active follow-up of defaulting patients, reduction in waiting times for PCR results, and initiation of ART by nurses in child-at-risk services.

Background

Diagnosis and care for children exposed to HIV remains a major challenge throughout the developing world [1, 2, 3]. The World Health Organization (WHO) estimates that fewer than 15% of HIV-exposed infants access appropriate Early Infant Diagnosis (EID), before their first birthday [2]. HIV-positive infants should initiate life-long antiretroviral therapy (ART) [4], but in many settings they are not retained in care and never start treatment. The catastrophic costs of failing to identify and treat HIV-positive infants early in life have been well described in multiple observational and randomized trials [5, 6, 7]. The Children with HIV Early ART (CHER) trial in South Africa found a 76% reduction in mortality for infants started on ART before 3 months of age [8]. However, without treatment, more than half of
all HIV infected infants progress to AIDS and death by age two \cite{8}.

Identifying HIV-exposed infants, diagnosing HIV infection, and starting HIV-positive infants on treatment requires a well-coordinated cascade of care. The EID care and treatment cascade has proven challenging in many developing countries, including Mozambique \cite{1,9-14}. Loss-to-follow-up (LTFU) can occur at multiple steps and effective EID is further impeded by human resource constraints, lack of parental understanding for how to navigate care, laboratory stock-outs, and difficulty with patient tracking \cite{9-14}. One recent meta-analysis indicated that most attrition occurs in the first six months of follow-up and 39% of exposed infants were not in care after 18 months, therefore interventions early in the EID cascade might have greater impact on LTFU \cite{14}. To reach the UNAIDS 90-90-90 targets by 2020 improvements in the pediatric HIV treatment cascade are urgently needed \cite{15}.

Because of its high HIV burden, Mozambique is a priority country identified by the UNAIDS Global Plan \cite{16}. In 2012, just before this intervention study was initiated, only 27% of eligible HIV-positive children in Mozambique under 14 received antiretroviral therapy \cite{17}, and rates for infants specifically were even more concerning.

Following WHO guidelines \cite{4}, dried blood spot collection has been scaled up in many facilities, with polymerase chain reaction (PCR) capacity available at centralized laboratories for EID. Referral to pediatric HIV care services is conducted at most health facilities in Mozambique. However high LTFU rates among HIV-positive mothers and their HIV-exposed infants before EID, poor referral of HIV-positive infants to pediatric HIV care have impeded service coverage. Manica and Sofala are included in the provinces that had not reached their goals by 2013 in Mozambique, with 41% and 71% LTFU \cite{18}.

The objective of this research was to conduct formative research to guide the development of an intervention to improve the pediatric HIV cascade in central Mozambique.

Methods
The findings described here were nested within an intervention study that sought to design and
implement an approach to reduce LTFU through increased EID and rapid ART initiation for HIV-positive children in the treatment cascade in six high volume public clinics in Manica and Sofala provinces from 2014-2017. Formative research data were collected as part of a two-phase approach to the study. Quantitative and qualitative data were gathered to identify gaps in the EID and treatment cascade, and solicit experiences, perceptions, and recommendations of HIV-positive mothers and health care workers to reduce LTFU in a pilot intervention. The research team and provincial health authorities then used the data to design the core components of a pilot intervention that was the implemented at the six sites.

**Study Setting and Design**

The formative research findings described here contributed to the design of a clustered (facility-level) randomized controlled trial using a stepped wedge design to test new methods to improve the retention of HIV among the mothers and their infants. The study was conducted in Manica and Sofala Provinces in central Mozambique, where the adult HIV burden is higher than the national average at 15.6% and 17.8% for women, 14.8% and 12.6% for men\(^\text{[19]}\). An estimated 18% of pregnant women were HIV-positive in 2009, based on the last major national survey conducted before this research began\(^\text{[20]}\). Under-5 mortality was estimated at 107 per 1000 live births in Manica and 83 in Sofala\(^\text{[21]}\), and pediatric HIV infection alone was estimated to account for over 16% of under-5 mortality in the two provinces\(^\text{[22]}\).

In 2013, “Option B+” (test and treat for pregnant women) was rolled out in the two provinces. Despite high HIV testing and ART initiation among pregnant women there is still high LTFU, a high rate of vertical transmission, and low EID, so avoidable pediatric HIV remains high. According to health systems reports in 2013, approximately 210,000 women attended a first ANC visit in Manica and Sofala Provinces, and 197,000 were tested for HIV; 19,000 (9.6% of those tested) tested positive; 9,648 initiated ART\(^\text{[23, 24]}\). Nearly 16,000 exposed infants were registered in CCR (*Consulta de Criança em Risco*). Approximately 10,210 PCR tests were conducted for infants less than 8 weeks old yielding 721 positives (7%); 8,417 children were tested at 18 months yielding 796 positives (9.4%).
However, data were not routinely collected at the provincial level for ART initiation among infants in CCR, creating challenges to assessing the treatment linkage for positive infants.

The formative research study included six health facilities, selected in collaboration with the Provincial Health Directorates (DPSs) of Manica and Sofala using criteria of high patient volume and a mix of urban and more rural facilities along the highly populated Beira corridor. The selected facilities included three in Sofala province (Macurungo, Munhava, and Dondo) and three in Manica (Nhamaonha, 1º de Maio, and Gondola). All are public facilities in the National Health Service that provide the full range of PMTCT services, including HIV testing (rapid test and access to PCR test for EID, with 5 of 6 facilities shipping the samples to a referral lab), access to CD4 testing (2 of 6 sites shipped the samples to a referral lab) and ART. The post-partum consultation (known as CPP, or Postpartum Consultations) and child at risk (CCR) consultations were staffed by mid-level maternal-child health (MCH) nurses and ART for infants and children was provided by physician assistants, known as tecnicos de medicina, in Mozambique, and medical doctors. The formative research described here was conducted through a cross sectional study over a 3-month period at the six health facilities. Data were collected to identify inefficiencies and bottlenecks in the follow up of mothers and their infants in maternity, post-partum, CCR and retention in ART services, to guide the identification of key workflow modifications, and develop an enhanced adherence and retention package.

**Data collection**

Data were collected from September to November 2014 at the six sites to identify determinants of LTFU. The research consisted of 1) patient flow mapping, and 2) time and motion studies. Researchers mapped current flow patterns from the maternity and CCR, to ART services cascade at each of the target sites to produce flow charts[^26]. Two researchers also collected data over three months from health systems resources, such as maternity, CPP and CCR book registries, and ART clinical patients process and book registries. In maternities, the team collected data for number of births, HIV positives, ART status and prophylaxis. In CPP, data were collected on number of consults, HIV positives, and children referred to CCR. In CCR, data were collected on the number of exposed HIV infant’s consultations, month of first PCR sample, PCR received in health facility, PCR results given to
a mother, positive PCR tests, ART initiation and retention over three months.

To measure waiting and consultation times, researchers were stationed at clinics and measured the waiting time and consultation duration from the moment mothers arrived at the CPP, CCR, and ART services through consultations.

**Patient and Health Workers Perspectives**

Focus groups discussions (FGDs) were conducted with mothers and health workers by research team members with one note taker. One FGD with mothers (5-8 participants) was completed at each facility. Mothers were recruited through pre-existing mother-to-mother peer support groups organized for HIV-positive women. One FGD discussion was conducted at each facility with nurses, counselors of those services, pharmacists, laboratory, physician assistants, and medical doctors (where available) engaged in EID and pediatric HIV related activities [27]. The FGDs sought to explore three categories of information to: (1) understand the perceptions of the importance to follow up for the HIV-positive mothers and infants, (2) identify facilitators and barriers to retention, and (3) identify potential strategies to improve retention. Researchers conducted 36 in-depth individual interviews (IDIs) with health workers (6 at 6 sites) to support development of new strategies to improve retention. Respondents included MCH nurses, tecnicos, and doctors, and facility directors. In FGDs and IDIs, extensive notes were taken and then coded for key themes based on the three categories.

**Results**

**Workforce**

Health worker numbers by category per facility are provided in Table 1. Munhava, Maio and Gondola Health Centers included psychologists and senior nurses. In all facilities there were general medicine tecnicos in charge of the clinical consultations of HIV+ patients and pharmacists for ART delivery. Macurungo and Nhamaonha health Centers did not have laboratories so MCH nurses drew blood and shipped samples to a referral laboratory for any other non-HIV testing needs. Nhamaonha had a laboratory technician who drew the blood samples, which were then sent to the referral laboratory. All facilities had MCH nurses trained to provide ART care for the pair (mother-child), but ART was still initiated by tecnicos or medical doctors per MoH policy. In all facilities there were community health
workers, known as *activistas*, paid by international NGOs to support the facility and peer support “mother-to-mother” groups program. However, not all mother-to-mother groups were active in the sites.

**Work and Patient Flow Mapping**

The diagram in Figure 1 depicts the flow that is common to all 6 facilities and reflected the standard protocol. The follow-up of the mother-infant pair starts at maternity, where the mother receives Nevirapine syrup to administer to the infant until the 6th week of life. After 28 days, the HIV-positive mother should continue follow up at the CCR; the mother is required to have three follow up visits at the CPP. (Mothers who gave birth elsewhere may also seek consultations at the CPP and enter the cascade).

On her last consultation at the CPP, the pair is transferred to CCR, where infant blood samples are taken for PCR and non-HIV testing. (Mothers who may gave birth elsewhere and did not use CPP may arrive at CCR services through other referrals). The MCH nurse did not initiate ART in CCR, but rather opened the file and then sought out an available tecnico to attend the newly diagnosed child and manage ART through pediatric HIV services at another venue in the clinic. At the pediatric HIV services, the child was given priority, however, and there is a long waiting time in order to locate the mother’s clinical file from another sector of the clinic, which is saved in numeric order of the NID (patient identification number). The child and the mother receive the ARVs at the general pharmacy, therefore, and where they wait in line again.

**Figure 1. Flow Mapping of mothers with exposed or HIV positive children**

Data were collected from each facility to capture patient volume in the cascade for a three month period (see Table 2). These aggregate data indicate that the 6 facilities are achieving high coverage for initiating maternal ART, and providing ARV prophylaxis to exposed infants. However, referral rates of HIV+ infants to CCR are generally low in all facilities.

**Waiting times**

Waiting times showed some variation across facilities (Table 3), but generally long waiting times for most services corroborated responses from qualitative interviews. The median duration of
consultation periods for CCR only ranged from 5 to 11 minutes, with one outlier of 25 minutes in 1º de Maio. Median consult times for pediatric ART visits ranged from as little as 6 minutes to 36 minutes suggesting challenges for sufficient time to explanation and counseling by MCH nurses. A further analysis was conducted to estimate waiting time for PCR results (Table 3). In Sofala facilities there was a median of 26 days, with a minimum of 6 days and a maximum of 82 days and for Manica facilities it was 28 days (14 minimum and 56 maximum).

**Treatment cascade LTFU**

The research team collected and aggregated data from all 6 sites to assess LTFU at each step of the cascade from CCR to ART initiation (see Figure 2). These data were taken from consultation book registries and the PCR samples book registries. A total of 679 HIV exposed infants attended child at risk care (CCR). About 97% (n = 659) had a blood sample taken for PCR testing, of these 84% (n=551) of nurses received results from lab, and 80% (n=444) of these mothers received the PCR result, 12% (67) had positive result and of these only 24% (16) began ART. Of 679 who should have had a PCR completed only 444 mother received results (65%), so 35% were LTFU from PCR testing alone. Of those positive infants with test results given to mothers, only 39% initiated ART. Only 24% of all infants who tested positive started ART. These data therefore indicate two key points in the cascade where HIV exposed infants are LTFU: mothers’ receipt of PCR results, and ART initiation among eligible HIV-positive infants.

**Figure 2. PCR results and ART initiation over three months (aggregated across six facilities)**

**HIV+ woman’s interviews**

Six focus group discussions (FGDs), one at each site, were conducted with mothers and pregnant woman in ANC, postpartum care, and CCR services. Each group included between 6-8 participants and several key themes emerged from the interviews. One of the greatest difficulties encountered is the lack of support from the husband, since she must follow up to the hospital alone. If she tells the husband her HIV-positive state her child risks being beaten or expelled from home. Because of community stigma, many women are afraid to be told that they have HIV and are ashamed to go to
places where she encounters people with HIV in facilities since they may encounter neighbors. Fear of family disclosure and community stigma are exacerbated by the may repeat visits, long waiting periods and short consults at each stage of the treatment cascade. In addition to these long waits, the lack of chairs to sit while waiting for appointments, and lack of understanding and explanation about finding the next follow-up offices created fatigue and confusion for mothers. The long delays in delivery of laboratory results and lack of communication between patients and health professionals led to mothers often not receiving results or not understanding the consequences of a positive test and follow-up steps.

**Health worker interviews**

Corroborating the mothers’ comments, health workers agreed that many women’s husbands do not support their wives taking their children to the facility when they have no perceived reason to go. After the child completes immunization for example, it is difficult to explain why they need to go to the clinic again if the husband does not know the HIV+ status of the wife and child. The health workers report that there is a need to continue to involve the men in the health care of the mother and child. At facility level the difficulties encountered are the congested space where consultations occur and the lack of seats for the users to sit, the need for more training for staff whenever there is a change in strategies, the need to have community health workers (activistas) to support services (referral of users), and to improve the quality of counseling in the CPP, CCR and ART sectors. Taken together the interviews indicate the need for less waiting time, fewer visits, and more support and better counseling for mothers to navigate the treatment cascade and follow-up. The qualitative interviews generally underscored some of the key findings of the health system data analysis which showed patient drop-offs at points in the treatment cascade where longer waiting periods for mothers and transfers of patients from one service sector to another took place (eg. CPP to CCR and CCR to ART). Together the data provided a foundation for developing an intervention strategy to both streamline the cascade and increase support to mothers.

**Discussion**

A sustainable and scalable intervention to reduce LTFU must rely on realistic solutions that consider
the severe resource constraints in low resourced health systems serving populations with high HIV burden. The formative research approach used in this study sought to identify both the determinants of LTFU and the potential solutions that health care workers, managers, and mothers believed might be feasible and effective. The gathering of health systems data to assess the treatment cascade and analyze work and patient flow at the six sites helped identify bottlenecks and process gaps. The evaluation of data included a focus on waiting time for the consultations, and tracking of LTFU indicators from CPP, CCR and pediatric ART. The qualitative interviews were essential to assess both health staff and patient experiences to help explain bottlenecks and drop-offs. Interviews with health professionals and HIV-positive mothers in ANC, CPP and CCR provided essential insights into where and why LTFU occurred at key steps in the treatment cascade, and how those challenges could be addressed in an intervention.

One of the key findings revealed that waiting time is highest in the CCR and ART services. There is major variation in the waiting time for the PCR results from the sample collection to the reception of the results in the health facility in the two provinces. While some arrive on time, often many others take much longer, and this contributes to LTFU as described in the FGDs and interviews. During the period under review, many mothers were not transferred from CPP to CCR. This transfer is critical for an early PCR test, prophylaxis, and continued maternal ART. It is important for HIV-positive children to start ART as soon as possible. The formative data show major challenges at this stage of the cascade. Only 39% of the HIV-positive children whose mothers received the PCR result actually started ART.

The interview results revealed that waiting time for the consultations, lack of understanding of how to follow-up, compounded by stigma and fear of disclosure to partners, contributed to LTFU especially at the PCR results stage and the follow-up to ART initiation. These finding tend to corroborate results from other studies and trials in low resources contexts (10-14). HIV testing and ART initiation coverage for mothers tends be quite high, but EID and pediatric HIV care and treatment coverage are hampered by lack of patient tracking mechanisms, long waiting times for test results, and inadequate counseling and support for mothers to help them understand and navigate each step in the care cascade.
The formative research team solicited mothers’ and health workers’ ideas and “buy-in” for workflow modifications. The provincial health directorates were also solicited to contribute to the design of the intervention. Two core components were developed to constitute the intervention for the stepped wedge roll-out at the six sites\cite{28}. The first component used a patient tracking process using active follow-up of mothers with cell phone Short Message Service (SMS) messages, and active searches to reduce LTFU from CPP to CCR. The second component centered on initiation of ART by MCH nurses in CCR, rather than referrals to separate ART services. New work flow and patient flow diagrams were developed for each site. The intervention was initiated in 2015 through 2017 and outcome results of the intervention study have been presented elsewhere\cite{29,30}.

The formative research had several key strengths. The research team sought to systematically elicit the experiences and perspectives of both mothers and health workers to identify possible factors associated with LTFU and develop intervention components that both groups would consider valuable and feasible. Data were carefully gathered from health facility registries to provide a clear tracking of LTFU at each stage in the care cascade to compare to health worker and patient reports. The data can be generalized the participated provinces. Limitations of the study included difficulty in extracting quality data on ART initiation among infants given the lack of routine data sources and tracking in the health units. The research team was unable to conduct data quality audits to better ascertain the accuracy of routine health unit data.

Conclusions
This formative research approach helped researchers to adjust and adapt the intervention to local needs and constraints, and leverage existing resources at the six health facilities. The mixed methods approach yielded qualitative and quantitative data to triangulate and complement each another to provide a more accurate depiction of the treatment cascade across six facilities. Data were gathered on the policy environment, especially around ART initiation in CCR, and the activities of other MOH “partners” supporting myriad projects in some of the same health facilities. The formative research approach was essential to adapt the intervention to the often-unpredictable context in which implementation research is
Abbreviations

ANC  Antenatal care
ART  Anti-Retroviral Therapy
CCR  Child at-risk care services
CPP  Post-natal care
EID  Exposed Infant Diagnosis
FGD  Focus group discussion
LTFU Lost-to-follow-up
MCH  Maternal-child health
MOH  Ministry of Health
PCR  Polymerase chain reaction test
SMS  Short Message Service

Declarations

Ethics approval and consent to participate

The study was approved by the Mozambique Ministry of Health National Health Bioethics Committee and had administrative authorization from the Ministry of Health. Reference approval was IRB00002657, 278/CNBS/13. The consent process was approved by the Committee. For the qualitative interviews all participants provided written informed consent and for the aggregated quantitative data we had written permission from the provincial health directorate of Sofala and Manica to use the routine data in the Health Facility logbooks.

Consent for Publication

Not applicable

Availability of data and materials

The datasets generated and/or analysed during the current study are not totally publicly available due Bioethics Committee approval restrictions but are available from the corresponding author on reasonable request. We can provide the aggregate quantitative database. The qualitative and waiting time database has restrictions because it has participant specific information. We can provide these
bases when requested to interested persons.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

LV, MN, JP, RC, KS, JC, and JM conceptualized and designed the study. LV, MN, JM, and FC organized implementation of the study and data collection. MN, LV and FC conducted data collection and data management. LV, AM, FC, JC, JP and RC participated in data analysis and interpretation. LV drafted the manuscript. LV, AM, MN, FC, JM,JC KS, RC and JP edited, revised and approved the final draft.

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Tables
| Workforce Categories                              | Munhava | Macurungo | Dondo | 1º de Maio | Nhamaonha | Gondola |
|--------------------------------------------------|---------|-----------|-------|------------|-----------|---------|
| Medical Doctors                                  | 2       | 1         | 3     | 0          | 0         | 2       |
| Other Physician                                  | 4       | 0         | 0     | 1          | 0         | 3       |
| General medicine tecnico                         | 9       | 4         | 7     | 8          | 5         | 3       |
| Pharmacy technician                              | 6       | 2         | 6     | 6          | 2         | 6       |
| Laboratory technician                            | 1       | 0         | 3     | 5          | 1         | 5       |
| MCH midlevel nurse                               | 13      | 9         | 6     | 5          | 3         | 5       |
| MCH basic nurse                                  | 8       | 4         | 9     | 5          | 7         | 3       |
| MCH-elementary nurse                             | 2       | 1         | 1     | 5          | 2         | 4       |
| Nº nurses trained in ART                         | 6       | 2         | 16    | 6          | 9         | 6       |
| Activistas “community health worker”             | Yes     | Yes       | Yes   | Yes        | Yes       | Yes     |
| Support group of mother to mother activities     | Yes     | Yes       | Yes   | Yes        | Yes       | Yes     |
Table 2. Proportion of woman followed up in Maternity and CPP in the previous 3 months (2014)

| Maternity          | Sofala Province | Manica Province |
|--------------------|-----------------|-----------------|
|                    | Munhava | Macurungo | Dondo | 1_Maio | Nhamaonha | Gor |
| Nº of deliveries   | 705     | 296       | 669   | 601     | 676       | 7   |
| Nº of HIV+ women in maternity | 170 (24%) | 57 (19%) | 144 (22%) | 79 (13%) | 77 (11%) | 67 |
| Nº of women in ART | 144 (85%) | 52 (91%) | 108 (75%) | 69 (87%) | 62 (81%) | 63 |
| (% of those HIV+ in mat) | 145 (85%) | 47 (82%) | 140 (97%) | 68 (86%) | 53 (69%) | 65 |
| Nº of infants who received HIV prophylaxis (% mothers HIV+) |  |  |  |  |  |  |
| Post partum consultation | 737     | 342       | 202   | 1127    | 791       | 11 |
| Nº of first consultations | 233 (32%) | 89 (26%) | 64 (32%) | 87 (8%) | 29 (4%) | 46 |
| Nº of HIV+ women at first consultation | 124 (53%) | 55 (62%) | 0 | 101 (53%) | 20 (70%) | 3 |
| Nº of infants referred to CCR in last consultation (% of HIV+ mothers) |  |  |  |  |  |  |

Table 3: Waiting times
### Median waiting time at Child at Risk Consultation (min, max)

| Indicator               | Munhava | Macurungo | Dondo  | Nhamaonha | 1 de Maio | Gondola |
|-------------------------|---------|-----------|--------|-----------|-----------|---------|
| Waiting time for consultation | 01:30   | 02:30     | 01:38  | 00:49     | 02:40     | 0       |
|                         | (0:12, 2:29) | (1:12, 3:22) | (0:38, 3:35) | (0:03, 2:20) | (0:03, 4:48) | 0       |
| Duration of the consultation | 00:08   | 00:11     | 00:10  | 00:05     | 00:25     | 0       |
|                         | (0:02, 1:11) | (0:04, 0:56) | (0:01, 0:29) | (0:01, 0:44) | (0:02, 1:02) | 0       |
| Total time in HF        | 01:41   | 02:43     | 01:51  | 00:57     | 02:59     | 0       |
|                         | (0:25, 2:25) | (1:21, 3:38) | (0:54, 3:45) | (0:22, 2:23) | (0:37, 4:57) | 0       |

### Median waiting time at pediatric ART consultation (min, max)

| Indicator               | Munhava | Macurungo | Dondo  | Nhamaonha | 1 de Maio | Gondola |
|-------------------------|---------|-----------|--------|-----------|-----------|---------|
| Waiting time for consultation | 02:19   | 01:29     | 01:09  | 01:29     | 01:15     | 0       |
|                         | (1:15, 4:56) | (1:03, 3:49) | (0:22, 3:50) | (0:47, 3:39) | (0:34, 2:27) | 0:2     |
| Duration of the consultation | 00:14   | 00:21     | 00:20  | 00:36     | 00:06     | 0       |
|                         | (0:07, 0:28) | (0:02, 0:55) | (0:12, 0:38) | (0:02, 1:26) | (0:03, 0:09) | 0:1     |
| Total time in HF        | 02:35   | 01:53     | 01:30  | 02:00     | 01:19     | 0       |
|                         | (1:43, 5:06) | (1:29, 3:58) | (0:42, 4:13) | (1:39, 4:14) | (0:38, 2:42) | 0:5     |
Waiting time for PCR results in days, mean (min, max)

| Time between the collection of the child’s blood sample, sending and returning results of the results in the HF | Sofala   | Manica   |
|---------------------------------------------------------------------------------------------------------------|---------|----------|
|                                                                                                               | 26 (6;82) | 28 (14;56) |

Time between the availability of the results in the HF and delivery to the mother or guardian

|                                                                 | Sofala | Manica |
|----------------------------------------------------------------|--------|--------|
| 24 (1;99)                                                        | 21(1;120) |

Figures

Figure 1

Flow Mapping of mothers with exposed or HIV positive children
Figure 2

PCR results and ART initiation over three months (aggregated across six facilities)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

renamed_101f2.doc
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