BALMM study

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Period: 1 August 2023 to 31 July 2024

Digital PCR-positive Tool Report:

AN ELECTRONIC HEALTH INFORMATION SYSTEMS INTERVENTION TO ROUTINELY MONITOR MISSED OPPORTUNITIES FOR PREVENTING VERTICAL HIV TRANSMISSION

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LIST OF ABBREVIATIONS

ANC	Antenatal care
ART	Antiretroviral therapy
AZT	Zidovudine
CDW	Corporate Data Warehouse (NHLS)
DAG	Data Access Group
ID	Identification
NHLS	National Health Laboratory Service
NICD	National Institute for Communicable Diseases
NVP	Nevirapine
PrEP	Pre-Exposure Prophylaxis
SDW	Surveillance Data Warehouse (NICD)
VHT	Vertical HIV Transmission
VL	Viral load

1. RATIONALE AND AIM

The PCR-positive tool in the form of paper-based forms was introduced in 2015, to identify and close gaps in preventing pediatric HIV infection and facilitate linkages to care. The current paper-based tool faces several challenges in implementation, including limited staff capacity, manual data entry, and long turnaround times for analysis. These limitations hinder the tool's potential to fasttrack progress towards eliminating pediatric HIV infection. A digitized version of the tool could address these limitations, enabling realtime data capture and collation, systematic data collection and analysis, timeous reporting of findings, and multi-site data mapping.

The aim of this report is to disseminate findings of the pilot of the digitized PCR-positive tool to initiate discussions for implementation in districts and sub-districts with high vertical HIV transmission (VHT) rates across South Africa.

2. METHODS: DESIGN OF THE DIGITAL TOOL

ETHICS REVIEW AND APPROVAL: *The research protocol for this pilot activity was reviewed and approved by the South African Medical Research Council Human Ethics committee on 9 May 2023 (protocol number: EC005-2/2023), the KZN provincial ethics committee on 15 May 2023 (NHRD ref:202305_007), the King Cetshwayo District Director on 30 May 2023, and the National Health Laboratory Service through AARMS platform on 10 August 2023 (ref PR2345519).*

2.1 QUESTIONNAIRE DEVELOPMENT

Paper-based PCR-positive tools from Kwa-Zulu Natal (KZN), Gauteng, Limpopo, Mpumalanga and North-West provinces were reviewed. The KZN tool template was modified slightly to accommodate additional variables from other districts, to align the questionnaire with current national and global definitions of key variables and to produce a digital friendly format. The resulting standardized tool contained clinical and healthcare uptake variables.

Scoping reviews of literature were conducted to identify socio-behavioral risk factors associated with VHT, maternal HIV incidence, maternal viral load and adherence to antiretroviral therapy (ART) within South Africa settings (1-23). Common socio-behavioral risk factors reported in literature were added to the tool as optional variables.

2.2 SETUP OF THE DIGITAL DATABASE

The resulting standardized tool was designed on the REDCap database platform (24) (hosted and managed at the research organization – the South African Medical Research Council) with four sections in the following order: facility location, baby register, mother details including basic demographics, (including other caregiver contact details if baby not residing with biological mother), healthcare uptake and optional questions on socio-behavioral indicators, ***Appendix-1***. The data access group (DAG) function in REDCap was used to create blinded facility user access to prevent the data capturer in one facility from seeing data entered by other facilities. One or two users (depending on facility PCR-positive case load) were provided with unique password protected access to the respective facility DAG. District-level data managers were provided unique password protected access to view data from all facilities.

2.3 PILOT SITE AND PILOT PERIOD

The tool was tested in Umhlathuze sub-district during: 1 August 2023 to 31 July 2024. The district has a large regional hospital (Queen Nandi) which drains from neighboring clinics in and around the Richard's Bay area (**Figure 1**).

A total of four facilities received PCR-positive results and used the tool during the period

List of facilities with captured records during the period:

- Queen Nandi Regional Hospital
- Ngwelezana Clinic
- Siboniso Clinic
- Phaphamani Clinic

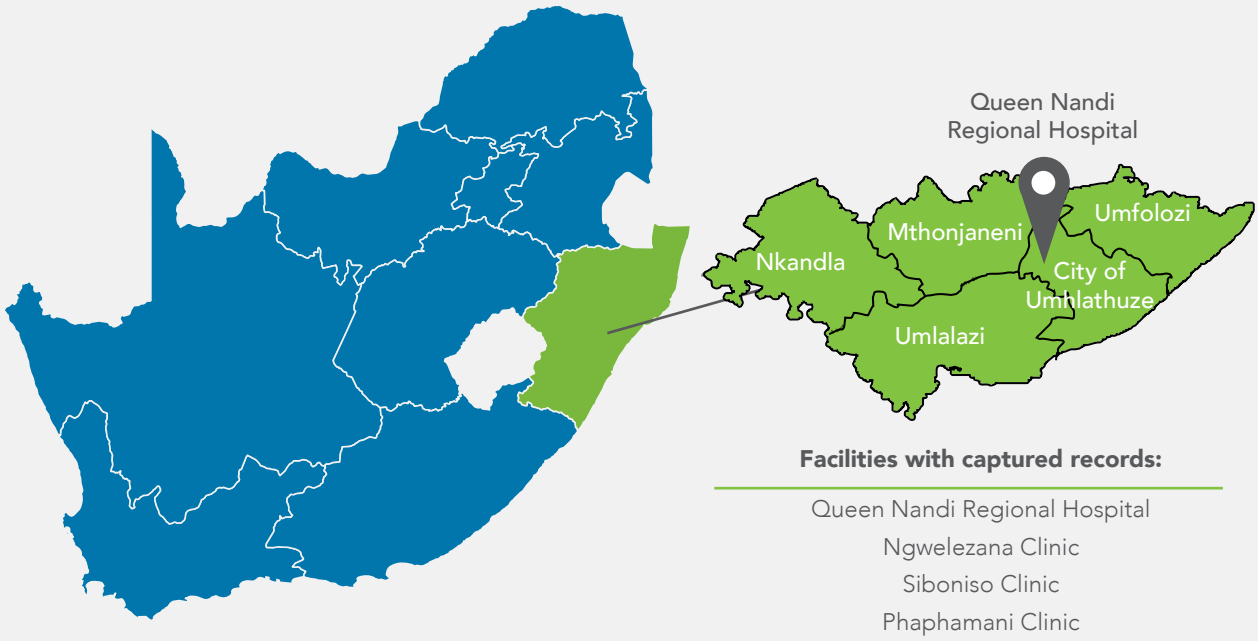


Figure 1: Location of the pilot sites in Kwa-Zulu Natal Province.

2.4 DATA CAPTURING PROCESS

Data were captured by routine staff at the health care facilities after receiving a HIV PCR-positive result from the lab and during mother/caregiver's routine visit for collecting infant PCR test results. Data were entered directly onto the PCR-positive tool electronic database during an active internet connection.

The database host Data Manager reviewed all new records, queried quality control issues with facility staff and locked a record when the facility staff had no further data to add.

2.5 QUALITY CONTROL

2.5.1 HIV Tests Individual level data and facility-level data

The accuracy and reliability of the PCR-positive tool for the individual and facility-level data was evaluated by comparing the data captured on the tool to routine data from the NHLS Corporate Data Warehouse (CDW), captured from the same sub-district during the same observation period. CDW staff extracted the routine data using patient identifiers captured in the PCR-positive tool and all first HIV-positive PCR results in the district captured during the same period. Patient identifiers were accessed only by the study principal investigator and provided to the designated CDW data manager via a POPIA compliant file transfer system called 'moveit' managed by the research host organization. Anonymized, aggregated facility-level counts of HIV PCR-positive results in the first 24 months of life, observed during the same period from the same facilities was extracted by the Paediatric HIV Surveillance Unit based at the National Institute for Communicable Diseases (NICD).

2.5.2 Completeness of data captured in the PCR tool for positive infants

Records captured in the tool were regularly reviewed by the Data Manager to check for data completeness by implementing automated checks within REDCap to flag missing or incomplete entries and using data validation rules to ensure critical fields were not left blank.

2.6 FEASIBILITY AND USER FEEDBACK

Indepth interviews were conducted with recent users of the tool (the facility data capturers), to gather user feedback on the usability and feasibility of the digital PCR positive tool. A recorded telephonic informed consent process was conducted and the consent form was signed digitally within REDCAp, before the interview commenced.

2.7 DATA ANALYSIS

Aggregated data were summarized and described using proportions in graphs and tables. Individual baby PCR-positivity data were presented according to child age milestones, i.e., around birth (0-29 days), 1-12 months, and after 1 year of age. The relationship between different risk factors was described graphically. Recent maternal viral load (received within <12 months of baby PCR-positive result) was plotted on the Y-axis as the primary risk factor, against the pregnancy-to-postpartum timeline on the X-axis. The timing of the rest of the indicators was then plotted within the graph along the corresponding recent maternal viral load row and the corresponding timeline column.

The follow up of HIV re-tests for samples which initially had indeterminate results was described.

3. RESULTS: RELIABILITY OF THE TOOL

A total of 24 HIV-positive results, 3 first indeterminate PCR results and 7 rejected PCR samples were captured in the tool.

3.1 QUALITY CONTROL: INDIVIDUAL-LEVEL DATA

Reliability of the tool to assess HIV-positive PCR results

A total of **24 HIV-positive** results were recorded in the PCR-positive tool and **22** of these were compared with data from the NHLS CDW.

(a) 91% (20 out of 22) of the records were identified in the NHLS CDW as follows:
- 19 out of 20 HIV-positive results were matched, ***95% reliability***
- 1 out of 20 HIV-positive record was found with a mismatched 'indeterminate' result in the NHLS CDW

(b) 9% (2 out of 22) of the records could not be found in the NHLS CDW. Two were PCR HIV-positive results.

**NB: Two records captured after April 2024 were not included in the reliability assessment due to the temporal unavailability of the NHLS CDW.*

Reliability of the tool to capture maternal Viral load (VL)

The recent viral load (VL) of mothers whose infants were recently diagnosed with HIV (**N=22 out of 24**), captured in the PCR-positive tool, was compared with their recent NHLS CDW VL. Mothers' identifiers and VL episodes were searched for in the NHLS CDW across all health facilities in KZN province over the last 12 months. The following were observed:

a) **14/22 (64%)** maternal identifiers were found on NHLS CDW database in KZN and **8/22** mothers could not be matched.
- **2/8** not matched were reported as VL not done in the tool

b) Out of the 14 mothers matched to the NHLS CDW:
- 4 had missing VL results in the PCR-positive tool
- **10 (71%)** had recent results in both the PCR-positive tool and NHLS. Of these:
  - Only 3 had a matching VL test date and result
  - 7 had different dates for the most recent VL test between the Tool and NHLS CDW, with more recent dates in the Tool (likely due to a research study taking place at Queen Nandi Hospital)

**NB: Two records captured after April 2024 were not included in the reliability assessment due to the temporal unavailability of the NHLS CDW.*

3.2 QUALITY CONTROL: FACILITY-LEVEL DATA

During this period, the NICD SDW aggregated data for the four facilities with captured data registered 40 first PCR positives, whereas 24 were captured on the PCR-positive tool.

- The aggregated facility level accuracy of the PCR-positive tool is 60% when assuming that the NICD SDW count of PCR first positives is accurate.
- Per facility, the PCR-positive tool was:
  - 20% accurate for Ngwelezana Clinic (One PCR-positive record captured compared to five in the NICD SDW),
  - 33% accurate for Siboniso clinic (One PCR-positive record captured compared to three in the NICD SDW),
  - 100% accurate for Phaphamani clinic (One PCR-positive record captured compared to one in NICD SDW),
  - 68% accurate for Queen Nandi Regional Hospital (21 PCR-positive records captured compared to 31 in the NICD SDW).

3.3 POSSIBLE REASONS FOR SOME INCONSISTENCES BETWEEN THE PCR TOOL AND THE NHLS CDW/NICD SDW:

1. A total of 2 out of 22 infants captured in the PCR tool were not found in the NHLS CDW ***[the baby demographics (e.g. names, DOB) used might be different between the two systems]***.
2. One mismatched HIV-positive result in the PCR found as 'indeterminate' in NHLS CDW ***[could be a re-test result of a previously indeterminate test as 2 consecutive indeterminate tests are considered to signify HIV acquisition].***
3. The NICD SDW had a higher facility-level count of first positive tests (40 compared to 24) ***[some confirmatory test results are likely to have been counted as a first positive result in the SDW].***

4. Discrepancies observed between the recent maternal VL test dates (hence results) captured in the tool versus the NHLS database *[some (n=3) VL test results reported in the tool were from a study that took place in the facility; the pilot study was only approved to search records from KZN health facilities – it is possible that some of the mothers' VL tests were done outside of the KZN province].*
5. Way forward to improve the measure of reliability of the tool in documenting recent maternal viral load is to search the NHLS CDW across the country and not limit to one province as well as using all baby names documented since birth. Since this involves program implementation, it would be POPIA compliant because it directly affects the child's outcome. District (or sub-district) data manager or other designated health care workers could be given access to the identified data from NHLS CDW, so that 'duplicate PCR tests' versus 'children missed' can be assessed.

3.4 QUALITY CONTROL: COMPLETENESS OF DATA CAPTURED IN THE PCR-POSITIVE TOOL

The proportion of incompleteness for variables which had missing information is shown in the graphs below for child data (Figure 2) and maternal data (Figure 3).

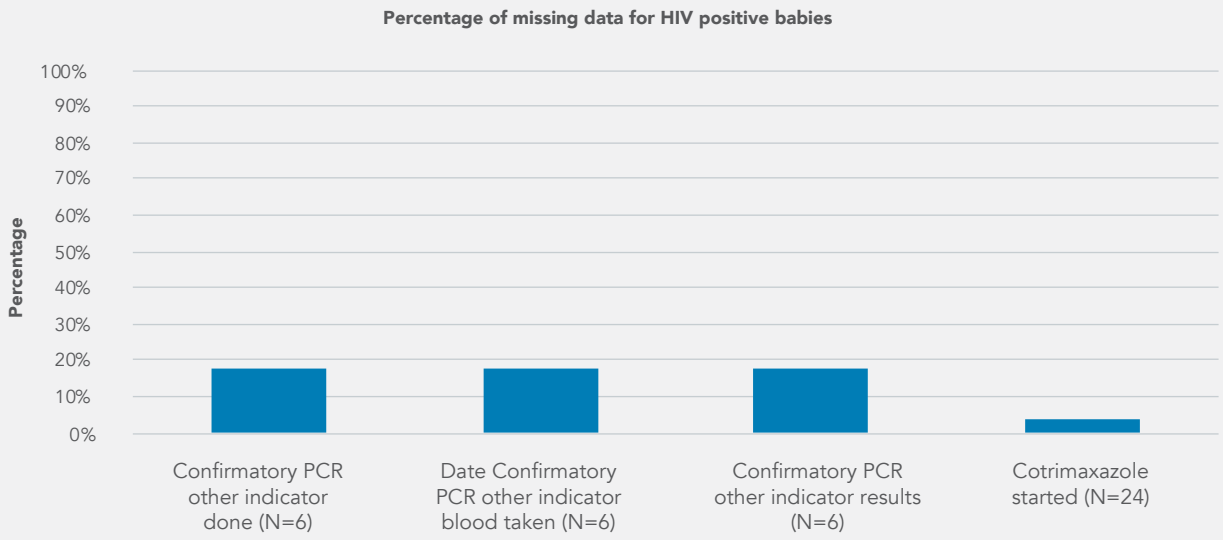


Figure 2: Percentage of missing data for infants. N=The total number of records expected to have a response for the variable.

**NB: For one positive test, the specific type of positive test (whether rapid test or another indicator test) was not specified.*

Missing information was mostly for babies diagnosed clinically symptomatic (i.e., due to other indication), and these missing data were: if a confirmatory test was done, the dates a confirmatory test was taken, and the results of the confirmatory test (17%).

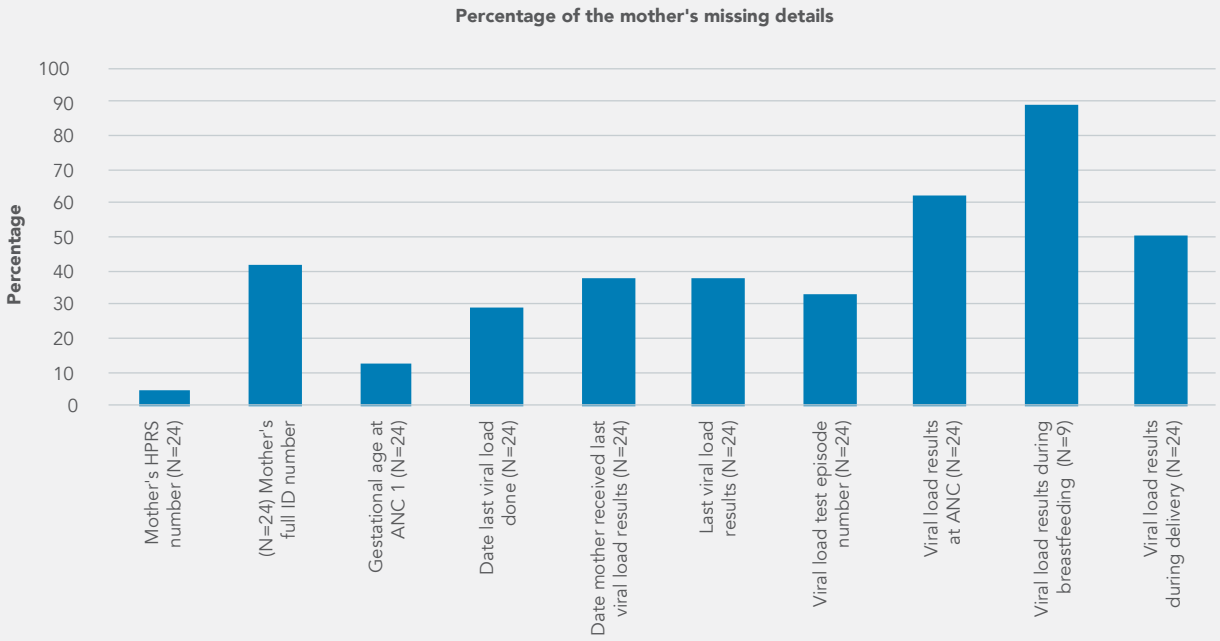


Figure 3 shows Percentage of the mother's missing details. A total of 11 out of 36 data elements for mother's details had missing information. The most commonly missing information included the full mother's identification (ID) number (42%), the mother's VL results at antenatal care (ANC) (63%) and during breastfeeding (89%).

Key observations of Data completeness

- Significant gaps exist in completeness of essential data variables like dates for confirmatory tests, mother's ID number, and mother VL results.
  - Mothers usually don't know their ID numbers and don't have their IDs with them. *NB* Here ID numbers were important for linking to NHLS CDW to assess reliability of the tool.*
- Mother's VL at ANC is unknown for 63% of cases.
  - Data access challenges were reported, especially when antenatal care was received in another district.
- The discrepancy between the recent VL results captured in the tool and the VL results in the NHLS CDW needs investigation.
  - *Documenting Mother's ID is not optimal in both the NHLS and the clinic records*

RECOMMENDATION: **Extra effort is required in identifying and knowing mother's recent VL result upon identifying a new HIV-positive result of an infant. Use of the new unique identifier, the HPRS number, could be the solution to tracing mother's VL test episodes. If all staff have access to TrakCare, then a suggestion would be to ensure that all staff are comfortable/adept at 'searching' TrakCare for results i.e. without having a barcode for the specimen e.g. by searching for results anticipating that some data may be incorrectly entered e.g. searching for the first 3 letters of a surname; giving a date range when specimen was done; etc.**

4. RESULTS: FEASIBILITY AND USER FEEDBACK

During the in-depth interviews with healthcare providers who used the tool (data capturers), several action items were identified, and corresponding solutions have been proposed:

1. Ongoing Training Requirements:
   - Action item: There is a need for continuous in-service training.
   - Recommended solutions:
     - *Conduct annual refresher training sessions to reinforce knowledge and address emerging challenges.*
     - *Create video tutorials to facilitate self-paced learning and serve as quick reference materials.*
     - *District data managers to stay updated with the tool to provide local support*

2. Data Access Difficulties:
   - Action item: Staff encountered problems accessing certain data, particularly ID numbers and viral load results.
   - Recommended solutions:
     - *Encourage mothers to bring their identity documents to facility visits, follow-up telephonically.*
     - *Alternatively, the HPRS number should be used widely as the most reliable unique patient identifier*
     - *Effort should be made routinely to extract mother's viral load from clinic records and TrakCare soon after receiving baby PCR-positive results from the lab and before the caregiver collects baby results.*

3. Tool Length and Redundancy:
   - Issue: The tool was perceived as too lengthy due to socio-behavioral questions.
   - Resolution:
     - *Make the socio-behavioral questions optional.*

5. RESULTS: FOLLOW-UP OF INDETERMINATE SAMPLE RESULTS

Three indeterminate results and **seven rejected** samples were recorded in the PCR-positive tool.
Follow-up and action taken was confirmed for 2 out of 3 indeterminate results and all 7 rejected samples as follows:

- 2 (out of 3) indeterminates results were matched
  - 2 re-tests with 'HIV-negative' result in NHLS CDW and in the tool

- 7 out of 7 rejected samples were matched.
  - *6 re-tests with 'HIV-negative' result in NHLS CDW and in the tool*
  - *1 test with no retest information*

Key observations: Indeterminate results and rejected samples

- Most infants with indeterminate results or rejected samples were retested either at the same facility or referred to another facility (Table 1)
  - All (8 out of 8) with re-test results tested HIV PCR-negative.

Table 1: Summary of the actions taken in response to initial indeterminate test results and rejected samples.

Actions taken for indeterminate and rejected (n=7) samples	Number of participants (out of N=3 indeterminates)	Number of participants (out of N=7 rejected)
Baby's re-test blood sample taken at the same facility	3	1
Baby's mother/caregiver called to bring baby for re-testing	-	2
Baby referred to another facility for re-testing	-	3
No information on action taken	-	1

6. RESULTS: Characteristics of mother and baby exposure factors by PCR-positivity milestones.

6.1 VARIABLE CHARACTERISTICS FOR PCR POSITIVES AT BIRTH

Between August 2023 and July 31, 2024, a total of 24 HIV-positive test results were recorded across four healthcare facilities. Of these, 15 cases were detected around birth at ages between 3-21 days old (**Figure 4**).

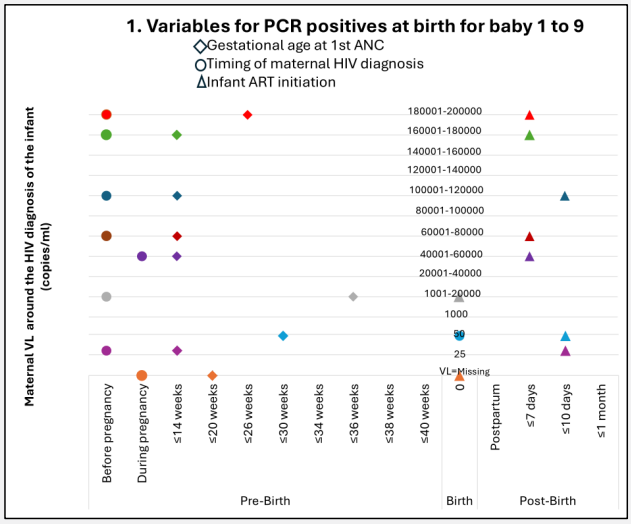
Maternal HIV, ANC, and VL status (Figure 4A):

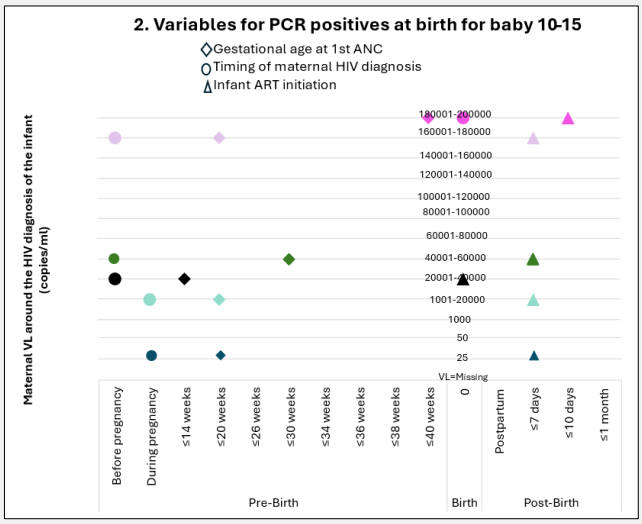
- Mothers of the 15 infants diagnosed with HIV at birth had a median age of 23 years, with an interquartile range of 17 to 36 years.
  - Most (10 out of 15) mothers were in the 17-24 years age group, four in the 25-34 years age group, and one was 36 years old.
- 6 out of 15 mothers were diagnosed during pregnancy/delivery and none of them were on Pre-Exposure Prophylaxis (PrEP) before diagnosis.
- 11 out of 15 mothers (73%) had recent viral load ≥1000 copies/ml within <one month of baby PCR-positivity
  - 9 of these 11 (82%) were diagnosed with HIV before pregnancy (represented by a round shape in Figure 4A). The median timing of the first antenatal care visit (ANC-1) for the 9 diagnosed before pregnancy was 12 weeks (range: 10-36 weeks)
- 3 mothers had suppressed viral load (<50 copies/ml) within <one month of baby PCR-positivity
  - 1 diagnosed before pregnancy
  - 1 diagnosed during pregnancy
  - 1 diagnosed during delivery
- 1 mother had missing viral load information
- 10 out of 15 mothers (66.7%) had first antenatal care visit at ≤20 weeks gestation (represented by the diamond shape)

Infant prophylaxis (Figure 4B) and ART exposure (Figure 4A):

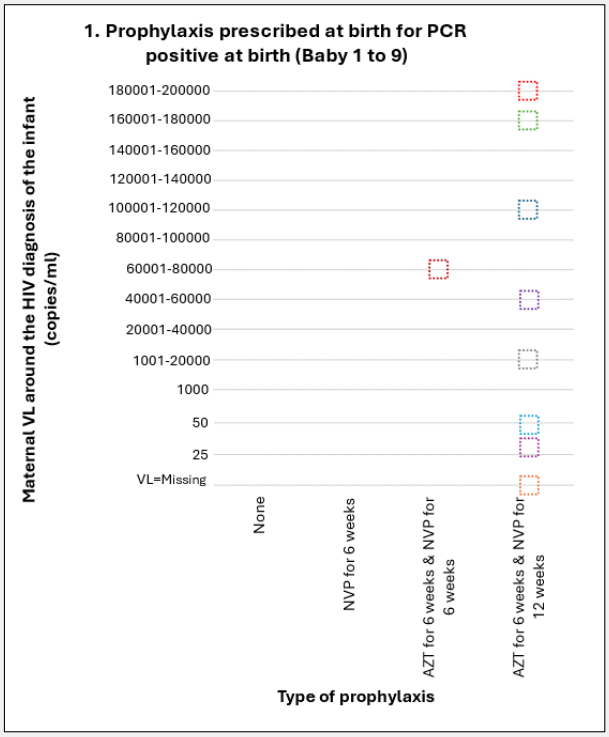
- All infants were prescribed prophylaxis, and nearly all (14 out of 15) were prescribed Zidovudine (AZT) for 6 weeks plus Nevirapine (NVP) for 12 weeks.
- All infants started ART within 10 days of birth (represented by the triangular shape)

A (Mother's recent VL against timing of ANC-1 visit, mother's HIV diagnosis and infant ART initiation)





B (Prophylaxis prescribed to infants at birth)



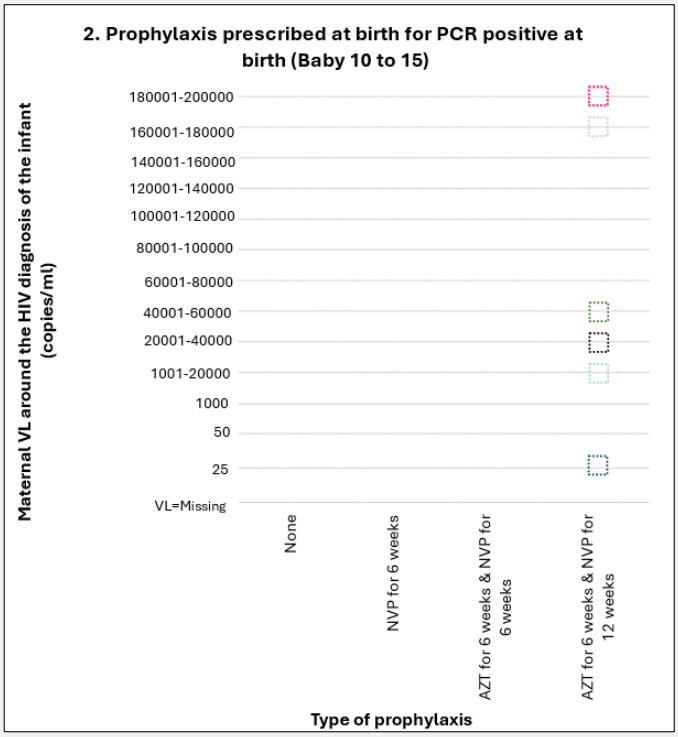


Figure 4: Characteristics of key variables for PCR positives at birth (n=15). Different colors represent individual infants, while different shapes represent various variables. Mother's recent VL was all done within 1 month of child birth.

Examples of interpreting mother-infant pair indicators in Figure 4:

Figure 4-A-1: Red mother-infant pair - mother was diagnosed with HIV before pregnancy, had her first ANC visit around 26 weeks and very high viral load >180000 copies/mL around delivery. The baby was diagnosed with HIV and initiated on ART within 7 days of birth. Dual prophylaxis for 12 weeks had been prescribed for the baby at birth (Fig 4-B-1).

Figure 4-A-2: Purple mother-infant pair - mother had her first ANC visit around delivery, was diagnosed with HIV around delivery with a very high viral load >180000 copies/mL. The baby was diagnosed with HIV and initiated on ART within 10 days of birth. Dual prophylaxis for 12 weeks had been prescribed for the baby at birth (Fig 4-B-2).

Key observations from PCR-positives around birth:

- The prescribed prophylaxis regimen indicates that most infants were identified as high risk due to maternal risk factors during pregnancy
- Transmission occurred by the time of or around birth despite early maternal HIV diagnosis (before pregnancy) and early antenatal care visit in most cases.
- Evidence of possible in-utero transmission during earlier months of pregnancy is supported by a suppressed viral load around delivery in three of the women.

6.2 VARIABLE CHARACTERISTICS FOR INFANTS TESTING HIV POSITIVE DURING 1-12 MONTHS OF AGE

Four infants were diagnosed with HIV between 1 and 12 months of age (**Figure 5**). Three were identified due to clinical symptoms at 3, 4, and 4 months, while the nature of diagnosis (clinically symptomatic or other HIV test milestone) for the fourth child (10 months old) was not specified (but possibly a late 6-month routine test).

Prior HIV testing

- The three infants diagnosed at 3 months, 4 months, and 10 months of age had no record of prior HIV PCR tests
- The one infant who was diagnosed at 3 months of age had their last PCR test at birth which was negative (represented by a dark red dotted circle in Figure 5A)

Maternal HIV, ANC, and VL status (Figure 5A):

- Three mothers of the four infants who were diagnosed with HIV at 1 and 12 months of age were in the 17-24 years age group and one was in the 25-34 years age group
- All mothers either had missing VL results or VL not done
- No recent VL (within last 12 months) was found in NHLS CDW
- The one mother diagnosed during pregnancy (represented by an orange shaded circle) was not taking PrEP before diagnosis.
  - First ANC visit was after 26 weeks gestation (represented by orange diamond shape)
- Two mothers were diagnosed during postpartum period and both were not on PrEP before diagnosis. No earlier maternal HIV test results were collected.
  - Early ANC entry for one mother (before 14 weeks-represented by grey diamond shape)
  - Missing ANC-1 timing information for the other mother.
- One mother diagnosed before pregnancy had
  - Late ANC entry (after 36 weeks-represented by a solid maroon diamond shape)

Infant feeding:

- Three infants reportedly breastfed at time of diagnosis (represented by an X)

Infant prophylaxis (Figure 5B) and ART exposure (Figure 5A):

- Two of the four infants were prescribed prophylaxis, and they were prescribed AZT for 6 weeks with NVP for 12 weeks (represented by a dotted square shape).
- All infants started ART within 7 days of diagnosis (represented by a triangular shape)

Examples of interpreting mother-infant pair indicators in Figure 5.

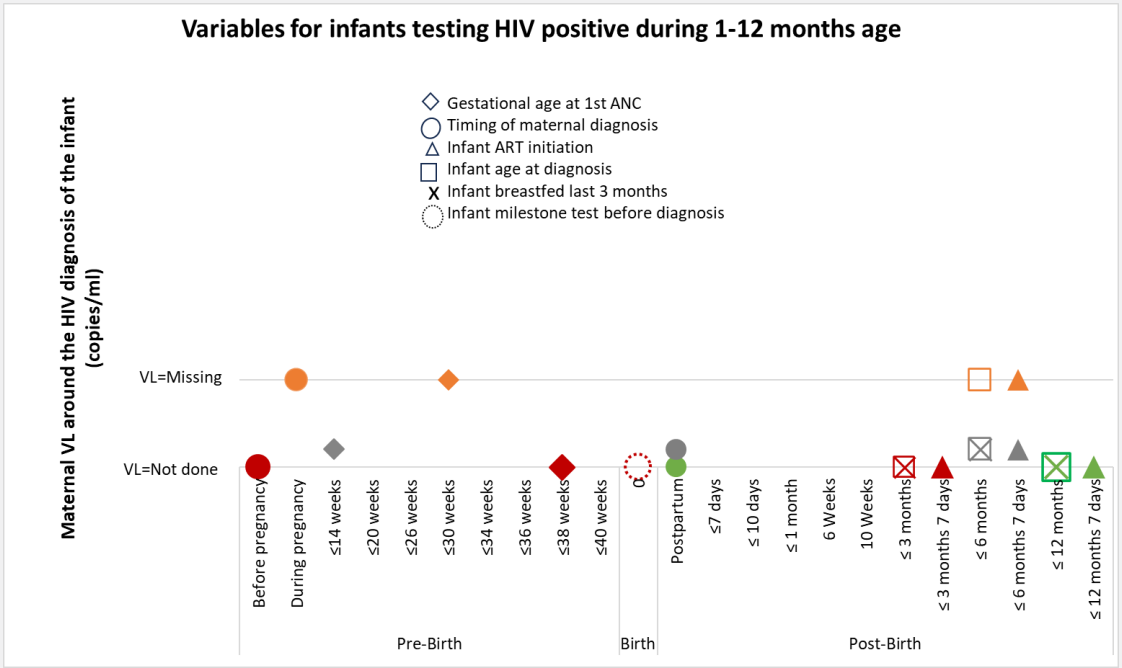
Orange mother-infant pair - mother was diagnosed with HIV during pregnancy, had first ANC visit around 30 weeks and had unknown viral load around time of baby HIV diagnoses at 6 months postnatal visit. The baby was initiated on ART within 7 days and dual prophylaxis for 12 weeks had been prescribed for the baby at birth (Fig 5-B). Prior HIV PCR tests could not be traced.

Grey mother-infant pair - mother had her first ANC within 14 weeks gestational age but was diagnosed with HIV during postpartum and reported no viral load tests. The baby was diagnosed with HIV at 6 months postnatal visit and was still breastfeeding. Baby ART was initiated within 7 days of diagnoses. The baby did not received prophylaxis at birth (Fig 5-B).

Key observations from PCR-positives during 1-12 months postnatal:

- Lack of recent maternal VL data for all cases, potentially hindering proper management
- Late antenatal care entry for two of the three cases with ANC data.

A



B

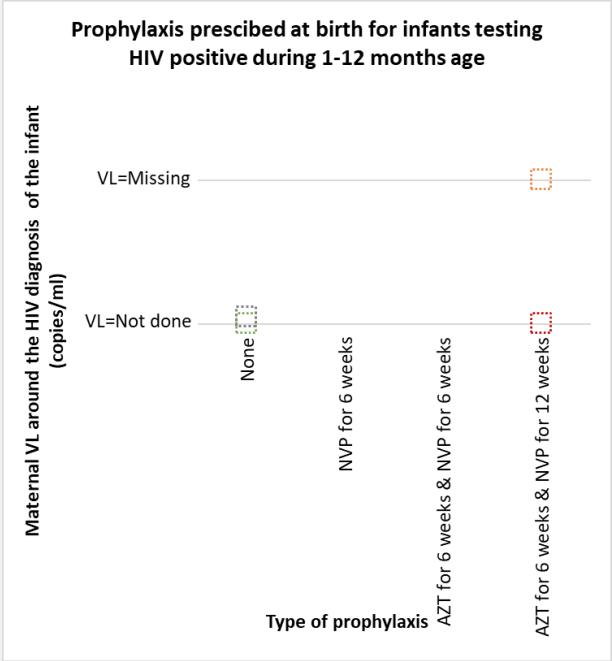


Figure 5: Characteristics of key variables for infants diagnosed with HIV between 1 and 12 months of age (n=4). Different colors represent individual infants, while different shapes represent various variables.

6.3 VARIABLE CHARACTERISTICS FOR INFANTS TESTING HIV POSITIVE AFTER ONE YEAR OF AGE

Five infants were diagnosed with HIV after first year of life (**Figure 6**). Two were identified through rapid tests at 20 months of age and three were diagnosed due to clinical symptoms at 14, 15, and 16 months old.

Prior HIV testing

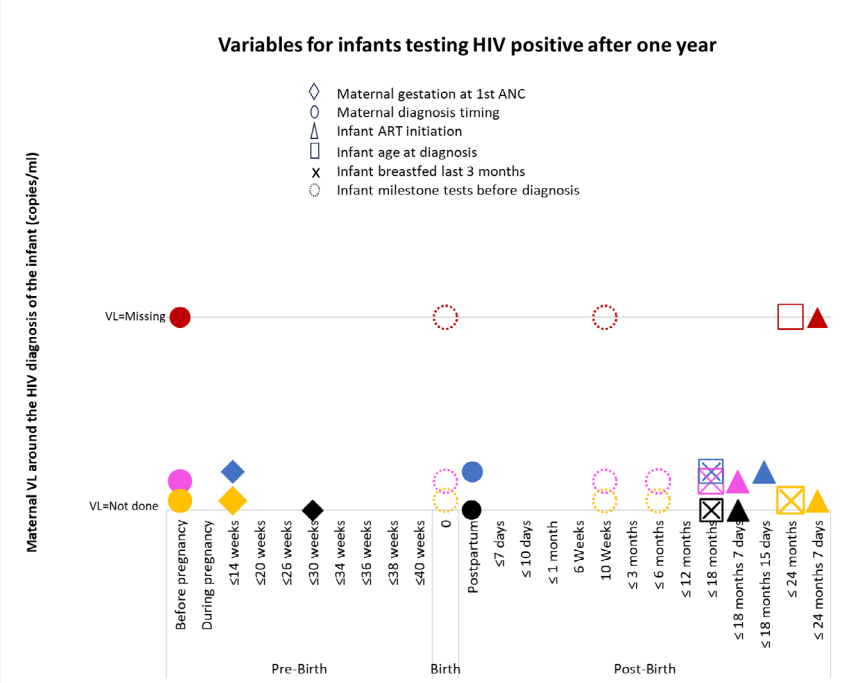
- Two out of 5 infants had no record of any prior PCR tests according to guidelines.
- Of those who received prior PCR tests, one (diagnosed at 20 months) had negative PCR results at birth and at 10 weeks. There were no records of and had negative PCR tests after 10 weeks. Two (diagnosed at 16 and 20 months) had their last negative PCR at 6 months of age and both had previous negative PCR at birth and 10 weeks tests (represented by a dotted round shape).

Maternal HIV, ANC and VL status:

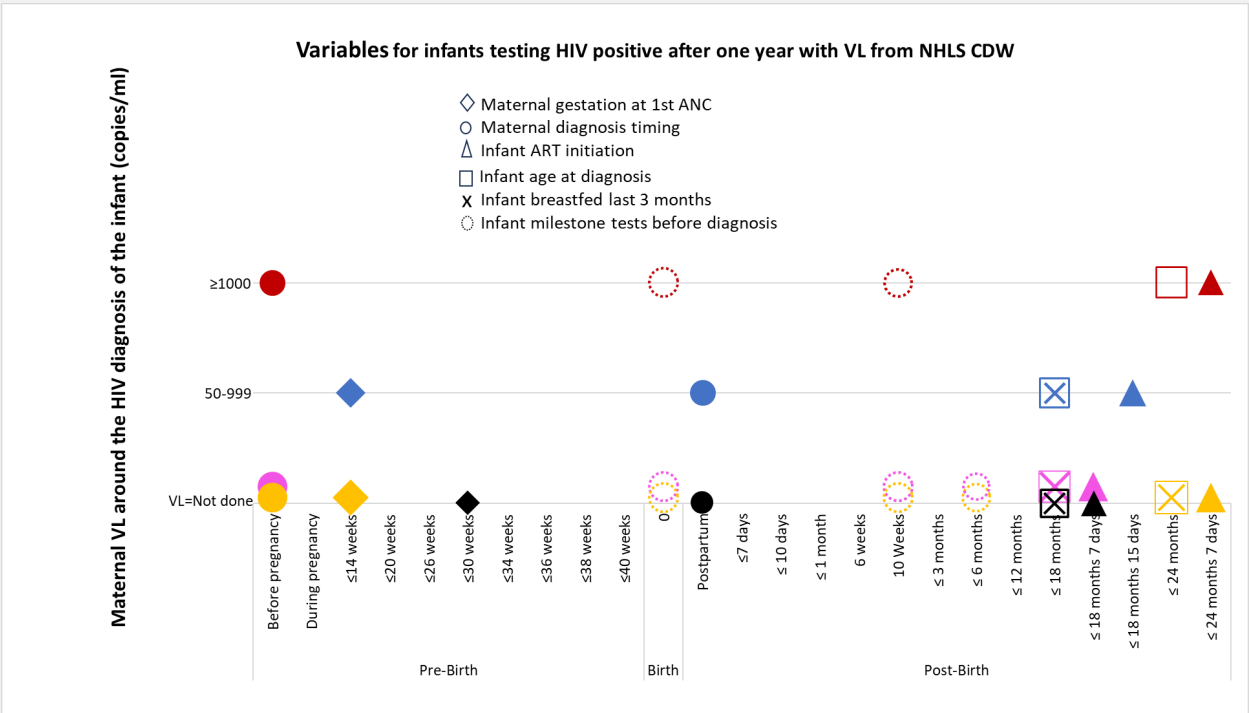
- Mothers of the five babies who were diagnosed with HIV after the first year of life had a median age of 24 years, with an interquartile range of 21 to 39 years.
  - Two mothers were in the 17-24 years age group, one in the 25-34 years age group, and two in the 35-39 years age group.
- Three mothers were diagnosed before pregnancy (represented by a solid round shape)
  - Two had VL not done, and one had missing VL in the tool (Figure 6A).
- Two mothers were apparently diagnosed during postpartum period and they were not on PrEP before diagnosis. Prior HIV testing and collection of results was not investigated.
  - Both reported no VL done in the tool

- Additional recent VL data in the past 12 months was received from NHLS CDW for 2 mothers represented in dark red and dark blue color with missing/not done VL in the tool (**Figure 6B**)

A



B: Same variables but including recent VL found in the NHLS CDW



C

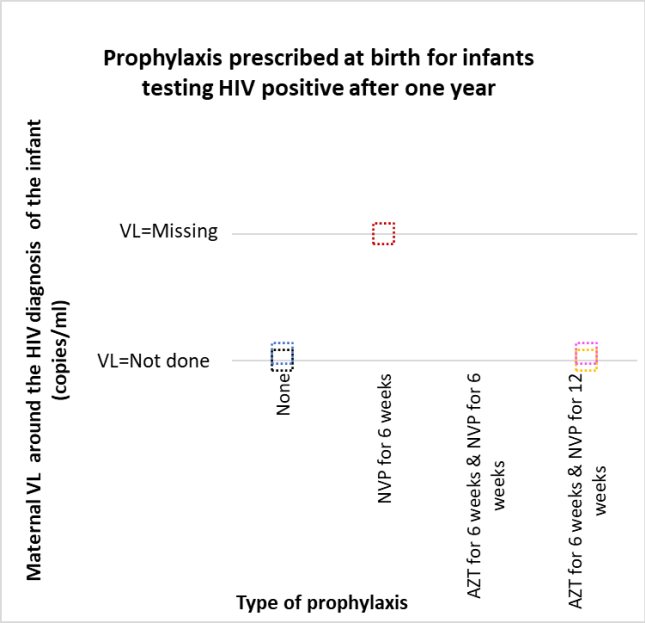


Figure 6: Characteristics of key variables for infants diagnosed with HIV after one year of age (n=5). Different colors to represent individual infants, while different shapes represent various variables.

Infant feeding:

- Both infants of postpartum-diagnosed mothers were breastfed at diagnosis (represented by an X)
- 2 of 3 infants from mothers diagnosed before pregnancy were breastfed at diagnosis

Infant prophylaxis (Figure 6C) and ART exposure:

- 3 out of 5 infants were prescribed prophylaxis, two were prescribed AZT for 6 weeks with NVP for 12 weeks (presented by a dotted square shape) and 1 was prescribed NVP for 6 weeks.
- 4 out of 5 infants started ART within 7 days of diagnosis (represented by a triangular shape)

Examples of interpreting mother-infant pair indicators in Figure 6.

Red mother-infant pair - mother was diagnosed with HIV before pregnancy but there was no information about her first ANC visit. Her recent viral load was unknown at the facility (Fig 6-A) but found in the NHLS CDW (Fig 6-B) to be >1000 copies/ml. The baby was diagnosed with HIV at 24 months postnatal visit and initiated on ART within 7 days. The last negative PCR test was at 10 weeks postnatal visit with no further testing identified. The baby had been prescribed NVP for 6 weeks at birth and the birth PCR was also negative (Fig 6-C).

Yellow mother-infant pair - mother was diagnosed with HIV before pregnancy and had her first ANC visit within 14 weeks of pregnancy. The baby was diagnosed with HIV at 24 months postnatal visit and mother had no recent VL test done but the baby was still breastfeeding. Baby ART was initiated within 7 days of diagnoses. The baby had PCR negative results at birth, 10 weeks and 6 months postnatal visits. There was no record of other PCR tests after 6 months. The baby was prescribed dual prophylaxis for 12 weeks at birth (Fig 6-C).

Key observations from HIV diagnoses after 1 year postnatal:

- Late HIV diagnosis in infants, potentially due to missed early infant diagnosis opportunities and inability to achieve VL suppression despite pre-pregnancy diagnosis
- Findings reflects challenges with retention in care during postpartum of known high-risk mother-infant pairs
- Viral load monitoring gap in the tool
    - 0 Additional VL data from NHLS CDW were available for two mothers with missing/not done VL
- HIV transmission through breastfeeding, even in cases where maternal HIV status was known before pregnancy

7. OVERALL KEY OBSERVATIONS AND RECOMMENDATIONS

From the current dataset of 24 mother-infant pairs with recent vertical HIV transmission, the following potential gaps were observed:

- The majority (15 out of 24) of babies with HIV diagnosis were born to adolescent and young women (aged 17-24 years).
- All mothers who were eligible for PrEP were not on PrEP
- Timing of infant PCR-positivity

  PCR-positivity was common at birth and this needs to be addressed urgently in the district
    - 62.5% (n=15) of vertical transmissions occurred during intra-uterine/peripartum
        + ART initiation and adherence during pregnancy needs to be investigated
    - 37.5% (n=9) of vertical transmissions occurred during the breastfeeding period
        + Support and education for HIV-positive mothers during the breastfeeding period to reduce postpartum transmission needs to be strengthened.
    - Nearly all infants were those identified as high risk for HIV infection (on dual prophylaxis)
        + There is a need for targeted enhanced counselling and case management around adherence and risk reduction education and counselling among high-risk pregnant women to complement dual prophylaxis issued later to their new borns.
        + Retention in care during postpartum needs to be prioritized for high risk infants
        + Prophylaxis period should be extended beyond 12 weeks for infants identified as high risk at birth
    - ART was initiated within 15 days in all infants
    - *NB* the lack of prior PCR testing might not be true in all cases due to commonly unstable infant identifiers during the first year of life.*

- ART non-adherence: 67% of mothers reported having missed a dose of ART in the past 3 months.
- Mothers' recent viral load:
    - Most mothers were diagnosed with HIV before the index pregnancy or initiated ANC before 20 weeks but failed to achieve early and sustained viral suppression
    - High maternal VL was identified within <one month of baby PCR-positivity, with 46% of mothers presenting VL ≥1000 copies/mL
    - For mothers of infants diagnosed from clinical symptom observations, all (N=6) had no VL testing or results since diagnosis captured in the tool, but VL data was found for two mothers in the NHLS CDW.

- Mother's recent HIV VL test information preceding every infant HIV test episode should be easily accessible at clinic level to understand gaps in VL monitoring and directly strengthen patient management.
    - Address gaps in viral load monitoring and result availability, especially for mothers of infants diagnosed through clinical symptoms.

- Postpartum maternal HIV incidence should be overcome – however it is not clear whether prior testing and counselling had been received or not.
  - Mothers with early ANC entry should have been well educated on safe sexual practices to avoid HIV incidence during the breastfeeding period

Other considerations

- Optimized use of the digital tool: Healthcare workers on site to consider using TrakCare and PCR RfA reports to complete information required on the PCR Tool.
- In general, understanding the full history of the mother-baby pair requires good quality health information systems, ease of linkage between these and accessibility to healthcare worker. The current status of health information systems makes this challenging, particularly for the PCR-positives observed during the postnatal period.
- Strengthening data management in the program could improve linkage of baby PCR-positivity to mother's history of viral load monitoring to clearly define the risk profile.
- Honing in on the children diagnosed with HIV at birth, where moms knew their status prior to pregnancy would be useful (if possible). We assume that women diagnosed/on ART prior to pregnancy should have less vertical transmissions because they have the highest chance of achieving VL suppression throughout the risk period for transmission BUT, this is clearly not the case. It would be very helpful to try and document what goes wrong to assist in achieving elimination.
- A summary of the 'optional' socio-behavioral indicators is presented in Appendix 2. Many of the mothers were single, financially dependent on others, and reported condomless sex.

Potential impact of the digitized PCR Tool

The digitized PCR-tool contributes to efficient identification of gaps (red question mark in Figure 7 below) in the vertical transmission prevention program as well as opening an opportunity to trace and support (green animation in Figure 7 below) viral suppression in mother-infant pairs living with HIV (Figure 7).

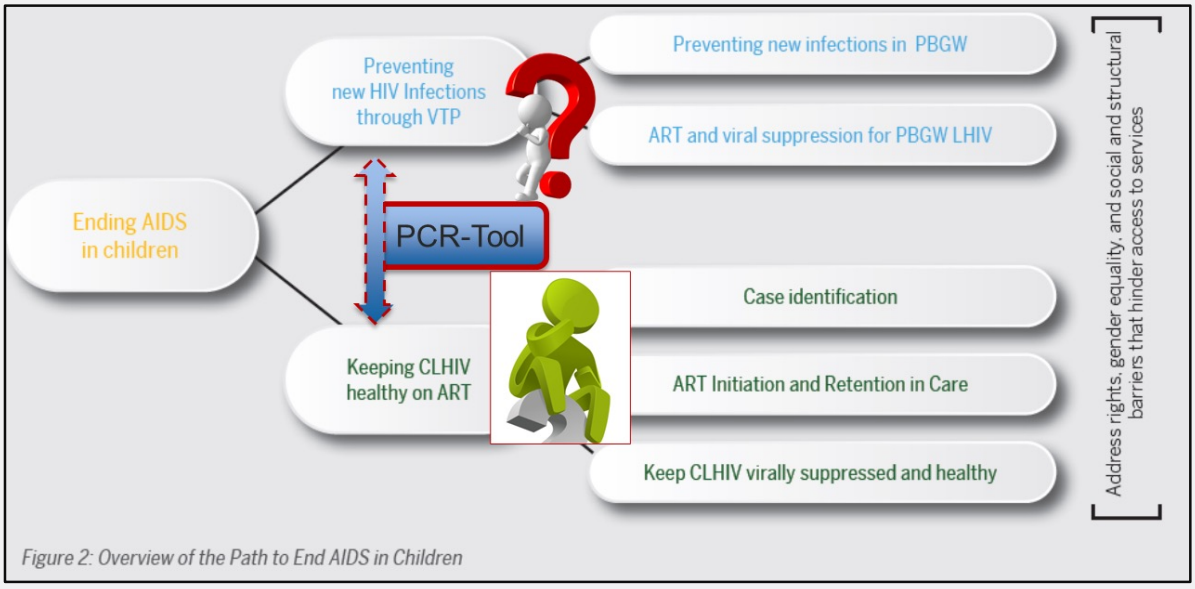


Figure 7: A copy of Figure 2 taken from the South African Global Alliance country plan to end HIV by 2030, with diagrams added to show how the PCR-tool contributes to this agenda.

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9. APPENDICES:

APPENDIX-1: PCR-POSITIVE TOOL QUESTIONNAIRE

Question/ Field label	Responses
FACILITY LOCATION	
Province	KwaZulu Natal
District	King Cetshwayo District
Sub-district	City of Umhlathuze
	Umfolozi
	Mthonjaneni
	Umlazi
	Nkandla
FACILITY NAME	
What type of facility is this where this record is being created?	Regional hospital
	Academic hospital
	Community Healthcare center
	Clinic
What type of locality is the facility located in?	urban
	peri-urban
	rural
Date record created:	

SECTION A	
Baby's register	
Folder/File Number	
Infant's Health Patient Registration System (HPRS) number	
Name	
Surname	
DoB	
Age of infant (in days)	
Age of infant (in months)	
Gender	[0] M
	[1] F
Baby's full name used in clinic records at birth (write 'same' if still same)	
Baby's full name in ID document (write 'same' if still same)	

At which facility was the baby born?	[0] This facility
	[1] Other facility
Facility	
Province of the other facility (select from drop-down menu)	
District	
Sub-district	
At which facility were the PCR bloods taken for this result	[0] This facility
	[1] Other facility
Facility	
Province (select from drop-down menu)	
District	
Sub-district	
What prophylaxis was prescribed for the baby?	[1] NVP for 6 weeks
	[2] NVP for 12 weeks
	[3] AZT for 6 weeks & NVP for 6 weeks
	[4] AZT for 6 weeks & NVP for 12 weeks
	[5] None
What type of PCR result has been received from the lab?	[1] PCR-positive result
NHLS barcode of PCR-positive result	
	[2] Rejected PCR sample
	[3] Indeterminate PCR result
Date bloods were taken for this test	
Date results received by the clinic	
Date results received by mother/caregiver	
What action has been taken?	[1] Baby's blood sample for a re-test was taken today at this facility
	[2] Baby's mother/caregiver called to bring baby to this facility for retesting
	[3] Baby referred to another facility for re-testing
Date bloods for PCR re-test taken	
Date results for PCR re-test received by clinic	
Date results for PCR re-test received by mother/caregiver	
PCR re-test result	[1] Positive [database NOTE: "PLEASE CREATE A NEW PCR-positive record"]
	[2] Negative
	[3] Inconclusive
Has the baby ever been breastfed or given breastmilk?	[0] Yes
	[1] No

During the past 30 days, has the baby received the following foods? *(discuss with the mother)*	
	[1] Breastfeeding
	[2] Formula feeding
	[0] Fresh milk/cow's milk
	[3] Solids (porridge, vegetables etc)
	[3] non-prescribed medication (over the counter)
	[3] Water
At what age did the baby start solids (porridge…)	
During the past 30 days, was the baby breastfed or given any breastmilk?	[0] Yes
	[1] No
At what age (in months) did the baby stop breastfeeding?	
PCR Done at birth	[0] Yes
	[1] No
PCR Results at birth	[1] Positive
	[2] Negative[
	3] Inconclusive
Date PCR test done (at birth)	
Confirmatory PCR test Done at birth	[0] Yes
	[1] No
Confirmatory PCR test Result	[1] Positive
	[2] Negative
	[3] Inconclusive
Date of next visit (around 10 weeks)	
PCR Done (around 10 weeks)	[0] Yes
	[1] No
PCR Results (around 10 weeks)	[1] Positive
	[2] Negative
	[3] Inconclusive
Date PCR test done (for 10 weeks)	
Confirmatory PCR test Done (around 10 weeks)	[0] Yes
	[1] No
Confirmatory PCR test Result (around 10 weeks)	[1] Positive
	[2] Negative
	[3] Inconclusive
Date of next visit (around 6 months)	
PCR Done (around 6 months)	[0] Yes
	[1] No

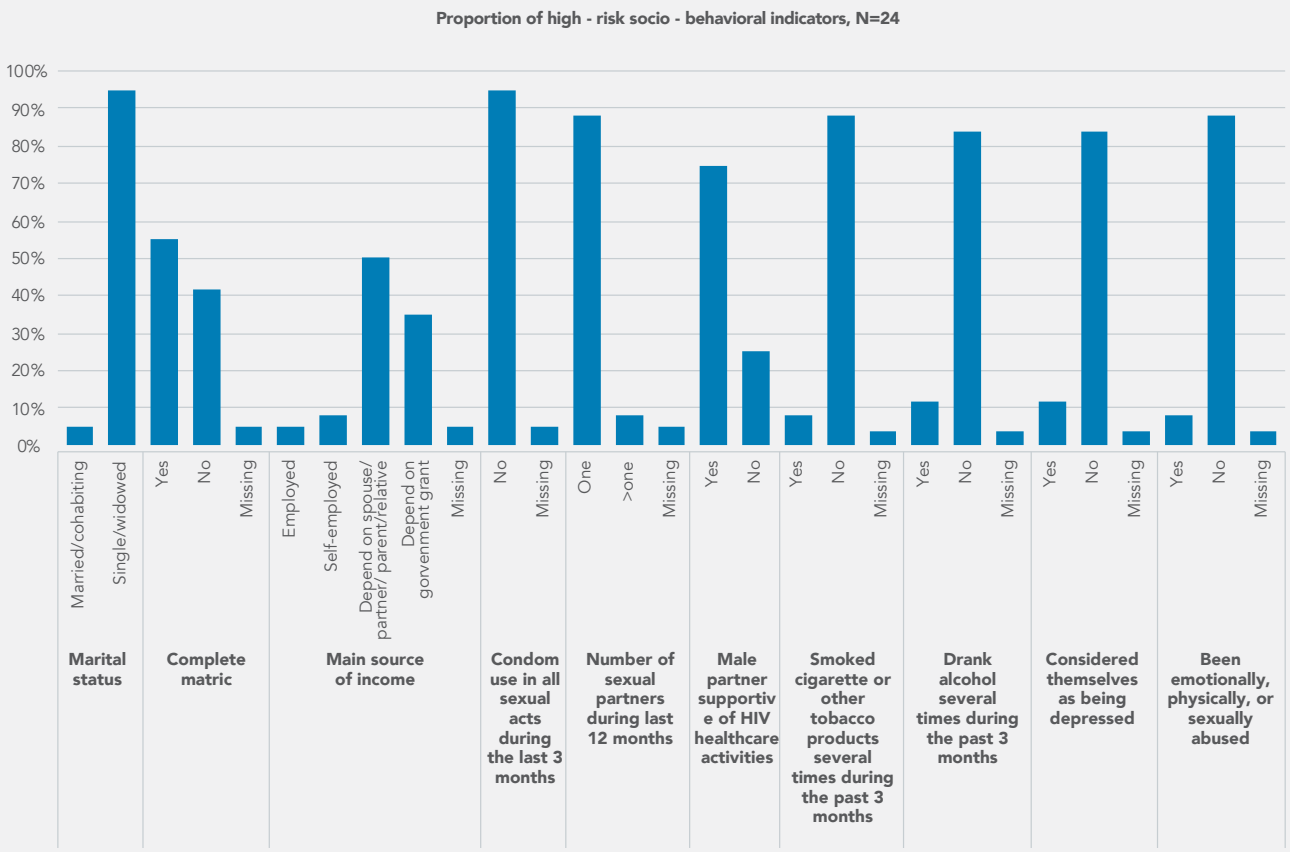
PCR Results (around 6 months)	[1] Positive
	[2] Negative
	[3] Inconclusive
Date PCR test done (for 6 months)	
Confirmatory PCR test Done (around 6 months)	[0] Yes
	[1] No
Confirmatory PCR test Result (around 6 months)	[1] Positive
	[2] Negative
	[3] Inconclusive
PCR Other Indication (Symptomatic/post cessation)	[0] No
	[1] Yes, 6 weeks post-cessation of breastfeeding
	[2] Yes, clinically symptomatic
PCR Other Indication Result (Symptomatic/post cessation)	[1] Positive
	[2] Negative
	[3] Inconclusive
Date PCR Other indication test done (Symptomatic/post cessation)?	
Confirmatory PCR Other Indication (Symptomatic/post cessation)	[0] Yes
	[1] No
Confirmatory PCR Other Indication Result (Symptomatic/post cessation)	[1] Positive
	[2] Negative
	[3] Inconclusive
Date Confirmatory PCR Other indication test done (Symptomatic/post cessation)?	
Rapid HIV Test Done	[0] Yes
	[1] No
Rapid HIV Test Results	[1] Positive
	[2] Negative
	[3] Inconclusive
Date rapid test done	
Confirmatory PCR test Done	[0] Yes
	[1] No
Confirmatory PCR test Result	[1] Positive
	[2] Negative
	[3] Inconclusive
Cotrimoxazole Started	[0] Yes
	[1] No
Infant ART Start Date	

SECTION B	
Mother's basic demographics	
Mother's Health Patient Registration System (HPRS) number	
Mother's Name	
Mother's Surname	
Mother's SA Identity Document/ Passport umber	
Mother's Date of Birth	
Maternal Age in years	
What is your current marital status?	[0] Married/cohabiting
	[1] single/widowed
Did the mother complete matric?	[0] Yes
	[1] No
What is your current main source of income?	[1] Employed- formal
	[2] Employed-informal
	[3] Self-employed
	[4] Depend on spouse/partner
	[5] Depend on parent/relative
	[6] Depend on government grant
	[7] Does not have income
Was this child the first pregnancy?	[0] Yes
	[1] No
Contact Number (mother)	
Physical Address (In case of tracing only)	
Does the baby reside with the biological mother at home?	[0] Yes
	[1] No
Mother's healthcare indicators	-
-	-
At which facility did the mother attend their last ANC visit	[1] This facility
	[2] Other facility
	Other facility name:
	Other facility province name:
Gestational Age (in weeks) at first ANC visit	
When was the mother first diagnosed with HIV?	[1] Pediatrically infected/infected through mother-to-child transmission
	[2] Prior to this pregnancy
Year diagnosed (if mother first was first diagnosed with HIV prior to this pregnancy)	
	[3] During this pregnancy at ANC HIV 1st test

Gestational age at diagnosis (if mother first diagnosed with HIV during this pregnancy at ANC HIV 1st test)	
	[4] During this pregnancy at ANC HIV re-test
Gestational age at diagnosis (if mother first diagnosed with HIV during this pregnancy at ANC HIV re-test)	
	[5] During this pregnancy at delivery
	[6] During breastfeeding/after delivery
Month post-delivery at diagnosis (if mother first diagnosed after delivery)	
	[7] Not yet diagnosed
Has the mother disclosed her status to anyone in the household?	[1] Yes
	[2] No
	[3] Information not available
ART	
Was patient on PreP?	[1] Yes
	[2] No
	[3] Information not available
If Yes, specify duration in months	
If No, why?	[1] I was not informed or offered PrEP
	[2] I wanted PrEP but it was not available
	[3] It was offered but I did not want to take PrEP
	[4] I was given PrEP but I did not take it
	[5] Information not available
ART Start Date	
Gestational Age at ART start (If ART start during current pregnancy)	
For how many weeks did the mother receive ART during pregnancy?	[1] No ART
	[2] During delivery
	[3] Less than 4 weeks before delivery
	[4] more than 1 month
	[5] started ART before pregnancy
What was the ART regimen during pregnancy	
Month post-delivery at ART start (if mother first diagnosed after delivery)	
Current ART Regimen	
Did mother miss a day of ART during the past 3 months?	[0] Yes
	[1] No

Viral load testing	
Viral load test done	[0] Yes
	[1] Viral load not yet done since diagnosis
Last Viral Load Test Date	
NHLS barcode	
Last VL Result	
Date mother received last VL result:	
What was the previous mother's Viral Load result	VL result at ANC _____
	VL result at Delivery _____
	VL during breastfeeding _____
Informed Infant Feeding Decision at ANC	[0] Breastfeeding
	[1] Formula feeding
Mother's socio-behavioral indicators (OPTIONAL)	
When you got pregnant with this baby, did you plan to get pregnant at that time?	[0] Yes
	[1] No
Was a condom used in **ALL** sexual acts during the last 3 months	[1] Yes
	[2] No
	[3] Not applicable
What is the number of sexual partners during last 12 months	[0] One
	[1] More than one
Do you know the HIV status of your most recent male partner?	[1] Yes, positive
	[2] Yes, Negative
	[3] No
Is male partner supportive of your (or the baby's) HIV healthcare activities	[0] Yes
	[1] No
Have you smoked cigarette or other tobacco products several times during the past 3 months?	[0] Yes
	[1] No
Have you drank alcohol several times during the past 3 months?	[0] Yes
	[1] No
In the past 6 months, have you sometimes considered yourself as being depressed?	[0] Yes
	[1] No
In the past 6 months, have you been emotionally, physically, or sexually abused?	[0] Yes
	[1] No

APPENDIX-2: HIGH-RISK SOCIO-BEHAVIORAL INDICATORS



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