Implementation evaluation of the Paediatric and Adolescent Scale-up Plan for 90-90-90 HIV outcomes in the inner City of Johannesburg, South Africa

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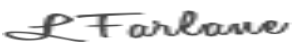
DECLARATION

This thesis is submitted in the divided block format, approved by the Faculty of Health Sciences.

I, *Lindiwe Farlane*, declare that this thesis, *Implementation evaluation of the paediatric and adolescent scale-up plan for 90 – 90 – 90 HIV outcomes in the inner-city of Johannesburg, South Africa* is my own work and that I contributed adequately towards research results that are described herein.

The thesis is being submitted for the degree of Doctor of Philosophy in the School of Clinical Medicine, Wits Reproductive Health and HIV Institute, in the Faculty of Health Sciences of the University of the Witwatersrand, Johannesburg, South Africa. This thesis has not been submitted in the past for any degree or examination at this or any other university.

I have read and understood the sections on referencing and plagiarism in the Wits Plagiarism Policy. I am aware that the University of the Witwatersrand may take disciplinary action against me should plagiarism be found in this work. To the best of my knowledge, I have followed the required conventions in referencing the work of others.

Signature: 

Name: Lindiwe Farlane

Date: 03 April 2025

DEDICATION

I dedicate this work to my late mother Queen Thembekile Nompofana Farlane, my children Natasha and Fernanda, and my sister Nosipho Farlane

Your love and support kept me going during the hardest of times.

Thank you for being patient with me, encouraging me, and inspiring me to be a better person

PRESENTATIONS FROM THIS RESEARCH PROJECT

L Farlane, L Fairlie, S Mullick. *Time to ART initiation among new-born HIV-positive infants in 10 health facilities in the inner City of Johannesburg, South Africa: results from a retrospective analysis of routine data***.** Poster presentation accepted for the 23rd Virtual International AIDS Conference (AIDS 2020), 6 –10 July 2020**.**

L Farlane, L Fairlie, S Mullick. *Improving HIV case finding and linkage to ART for children (0–14 years) and adolescents (15–19 years) in the inner city of Johannesburg, South Africa: Implementation evaluation of the Paediatric and Adolescent Scale-up Plan***.** Poster presentation accepted for the Public Health Association of Southern Africa Conference, College of Cape Town, and 16–18 September 2019.

L Farlane, L Fairlie, S Mullick. *Improving HIV case finding and linkage to ART for children and adolescents in the inner city of Johannesburg, South Africa.* Oral presentation accepted for the Population Association of Southern Africa Conference, University of Venda, 10– 12 July 2019.

ABSTRACT

Background

Global efforts have averted over 1.4 million new HIV infections among children, but in 2017, only half of the 1.8 million HIV-positive children received life-saving antiretroviral treatment (ART). To address this disparity, the ambitious 95-95-95 targets aim for 95% of people living with HIV (PLHIV) to be diagnosed, treated, and virally suppressed by 2030.

Despite progress, gaps persist in achieving South Africa's paediatric and adolescent HIV goals. To bridge these gaps, the Paediatric and Adolescent Scale-up Project (PASP) was implemented in Johannesburg from 2015 to 2018. PASP aimed to enhance diagnosis, treatment, and viral suppression among children (10-14 years) and adolescents (15-19 years) living with HIV. Knowledge on the implementation fidelity of HIV care and treatment strategies for Children Living with HIV (CLHIV) and Adolescents Living with HIV (ALHIV) in public health facilities is limited.

Methods

PASP aimed to enhance HIV care for children and adolescents in Johannesburg, South Africa, through quality improvement and technical assistance from 2015 to 2018. This study analysed data, project records, and stakeholder insights to assess strategy effects, implementation fidelity, and barriers to achieving 90-90-90 targets.

Results

Facility-based strategies showed better outcomes across the HIV cascade, compared to community-based strategies. Index case finding and hospital-based testing, exhibited higher yields (3.3% and 5.3% respectively) of HIV-positivity, while key entry point testing (5.6%) showed higher yield among adolescents. Data-driven strategies improved ART initiation, with 65% of previously diagnosed children traced and initiated on ART. Psychosocial support (PSS) and Enhanced Clinical Care (ECC) improved retention and viral load suppression. By the end of the project, 74% of adolescents and 82% of children were virally suppressed. HIV management guidelines, training and mentoring, and tools facilitated the implementation of these strategies.

Conclusions

The study highlights promising strategies for improving HIV outcomes among children and adolescents in public health facilities. However, few strategies showed a significant effect on the outcomes and limited documentation of process data hindered exploration of implementation fidelity. Ongoing barriers require evidence-based solutions to enhance implementation and patient outcomes. By addressing these challenges, healthcare providers can optimize HIV care and treatment for vulnerable populations, moving closer to achieving the 95-95-95 targets.

Keywords: *evaluation, children and adolescents, implementation fidelity, implementation strategies, 90–90–90 goals, HIV outcomes*

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CONTENTS

APPENDICES

LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ALHIV	Adolescents Living with HIV
ACC	Advanced Clinical Care
ACC	Active Case Management Network
ACT	Accelerating Children's HIV/AIDS Treatment
ANC	Antenatal care
AYFS	Adolescent and Youth Friendly Services
ARV	Antiretroviral
ART	Antiretroviral therapy
BTS	Break-Through-Series
CDC	United States Centres for Disease Control and Prevention
CHW	Community Health Worker
CIFF	Children's Investment Fund Foundation
CLHIV	Children Living with HIV
CBO	Community Based Organization
CQI	Continuous Quality Improvement
DBS	Dried blood spot
DHIS	District Health Information Software
DoH	Department of Health
DREAMS	Determined, Resilient, Empowered, AIDS-free, Mentored, and Safe
DSD	Direct Service Delivery
EAC	Enhanced Adherence Counselling
ECC	Enhanced Clinical Care
EID	Early Infant HIV diagnosis
EMTCT	Elimination of Mother to Child Transmission
HCW	Health Care Worker
HIV	Human Immunodeficiency Virus
HAST	HIV/AIDS STIs and TB
HTC	HIV testing and counselling
HTS	HIV testing services
I-ACT	Integrated Access to Care and Treatment
IMCI	Integrated Management of Childhood Illnesses
ITS	Interrupted Time Series
ITSA	Interrupted Time Series Analysis
LEGS	Leadership, Ethics, Governance and Systems
MIP	Mother-Infant Pair

MDOs	Missed Diagnostic Opportunities
NDoH	National Department of Health
OVCAY	Orphans Vulnerable Children Adolescents and Youth
OVC	Orphans and vulnerable children
PASP	Paediatric and Adolescent Scale-up Project
PC 101	Primary Health Care 101 Guidelines
PCR	Polymerase Chain Reaction
PEDCAT	Paediatric cascade analysis tool
PEPFAR	United States President's Emergency Plan for AIDS Relief
PICT	Provider Initiated Counselling and Testing
PLHIV	People Living with HIV
PMTCT	Prevention of Mother to Child Transmission of HIV
PSS	Psychosocial Support
QI	Quality Improvement
QIP	Quality Improvement Project
RTQII	Rapid Test Quality Improvement Initiative
SAIA	Systems Analysis and Improvement Approach
SRHR	Sexual and reproductive health and rights
SSA	Sub- Saharan Africa
TA	Technical assistance
TB	Tuberculosis
TROA	Total Remaining on ART
UTT	Universal Test and Treat
UNAIDS	The Joint United Nations Programme on HIV and AIDS
USAID	United States Agency for International Development
UTT	Universal Test and Treat
VL	Viral load
VLD	Viral load done
VLS	Viral load suppression
VTP	Vertical Transmission Prevention
WHO	World Health Organization

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PREFACE AND DESCRIPTION OF THESIS SECTIONS

This thesis is divided into eight chapters, according to the faculty of Health Sciences' divided block format for a conventional monograph.

Chapter 1 (Introduction) provides an overview of the global state of paediatric and adolescent goals across the HIV cascade, and the magnitude of the challenges. This section also presents the research gap and relevance of this study.

Chapter 2 (Literature Review) describes the barriers to achieving HIV care and treatment (90–90–90) goals among children and adolescents, implementation strategies to address these gaps and implementation fidelity as an evaluation outcome.

Chapter 3 (General methods) provides an overview of cross-cutting methodological considerations including the overarching implementation context, data collection approaches and data management. Specific methodological issues are described in the results chapters.

RESULTS are presented in four chapters according to the objectives of the study. The study had three objectives. Chapter four to six addressed research questions for objectives one and two while Chapter seven addresses objective three. For each of the results in chapter four to six, the introduction section describes predictors and barriers among children and adolescents and, reviews of strategies used for children and adolescents in the public health sector. The methods and results sections outline the methodology and relative contribution of PASP strategies to patient outcomes. The discussion and conclusion provide the statement of principal findings, key messages and strengths/weaknesses of the study in relation to other studies.

Chapter 4 describes the relative contribution of PASP strategies to the 1st 90, specifically HIV case finding among children and adolescents.

Chapter 5 describes the relative contribution of PASP strategies to the 2nd 90, specifically ART initiation of newly diagnosed children and adolescents.

Chapter 6 describes the relative contribution of PASP strategies to the 3rd 90, specifically retention on ART, re-initiation on ART, loss-to-follow up, viral load monitoring and viral load suppression.

Chapter 7 describes the potential moderators in relation to the project design and highlights the application of the elements of fidelity and barriers to implementation.

Chapter 8 describes the overall meaning of the study (general discussion & conclusions), i.e., implications for clinicians or policymakers, and unanswered questions for future research. This section also provides an overview of the contribution of this study to the body knowledge i.e., new findings from the study.

CHAPTER 1 – Introduction

Chapter One introduces the contextual background and justification for the study. This chapter explores progress towards the 90–90–90 HIV goals by 2020 (replaced by 95–95–95 goals by 2030) among children and adolescents that formed the basis for the evaluation. It also describes the purpose and objectives of the study.

1.1 Background

There have been remarkable scientific successes in paediatric and adolescent focussed HIV clinical research to optimise treatment availability and formulations since the roll-out of antiretroviral therapy (ART). Global efforts have averted over 1.4 million new HIV infections among children, but in 2017, only half of the 1.8 million HIV-positive children received life-saving ART (1). To address this disparity, the ambitious 95-95-95 targets aim for 95% of People Living with HIV (PLHIV) to be diagnosed, treated, and virally suppressed by 2030 (2). Despite progress, gaps persist in South Africa's paediatric and adolescent HIV goals (3). The neglected 'right to science' for Children Living with HIV (CLHIV) and Adolescents Living with HIV (ALHIV) has been previously highlighted by Scanlon et al. (4) and Chaudhury et al. (5). However, the progress made for this population over the past three decades, since the 1990s is notable. Despite these improvements, there are still pertinent questions about implementation strategies to get treatment to those who need it. For children and adolescents, this requires a focus on priority interventions and strategies to ensure that all ALHIV and CLHIV access lifesaving ART and high-quality care.

In 2014, the ambitious UNAIDS 90–90–90 targets asserted that to control the HIV epidemic, 90% of PLHIV should know their status, 90% of these should receive ART and 90% of those on ART should be retained with a suppressed viral load by 2020 (2). Beyond 2020, the goals became even more ambitious- to achieve 95–95–95 across the HIV cascade by 2030 (6). Treatment coverage among children and adolescents remains lower than that of adults, despite some improvements in recent years (7). Sadly, some studies have estimated that without ART, almost half of HIV-positive children will die before the age of two and of those who survive, a further one-third will die before their fifth birthday (8).

In more than two decades of Vertical Transmission Prevention (VTP), HIV transmission reduced remarkably from rates of up to 30–45% in the early 2000s to < 2% in 2018 (9). New HIV infections among children have also declined by 58% in 2022 compared to 2010, and more children who are on ART are aging into adolescence (10). AIDS-related deaths have declined significantly among children, although slower among adolescents aged 15-24 years. Regrettably, in 2022, an estimated 4000 adolescent girls and young women aged 15–24 years were newly infected with HIV globally (11,12).

Commitments such as the Global Plan Towards the "Elimination of New HIV Infections Among Children by 2015", Universal Test and Treat (UTT), and the UNAIDS Accelerating Action to end the AIDS Epidemic by 2030 have given renewed hope for paediatric and adolescent HIV prevention and treatment programmes (13). However, as resources for HIV care and treatment continue dwindling, effective ART roll-out implementation strategies should be refined and scaled up promptly, to take the ongoing evidence-based and improved HIV treatment to those who need it (6,14).

Despite successful efforts in the VTP, some CLHIV remain undiagnosed. According to the UNAIDS estimates, in 2022 only 63% of the 1.5 million CLHIV (0–14 years), knew their HIV status globally, and 57% of CLHIV were on treatment, compared to 77% of adults (15). Moreover, 81% of those known to be HIV-positive on ART were virally suppressed. Viral load suppression rates are typically lower among children and adolescents compared to those of adults. Traditional viral load monitoring and adherence interventions may not necessarily work for infants and children on ART. With the already limited treatment regimens for this population, tailored viral load monitoring and adherence strategies are needed. Reporting on HIV data for adolescents is a global challenge. While the global target was to provide ART to one million adolescents by 2020, data to assess the progress were lacking. About 1.7 million adolescents (10–19 years) were estimated to be HIV-positive in 2019 (16).

There are several reasons for the slow progress toward 90–90–90 targets for children and adolescents (17–20). The evidence on strategies that improve these targets for children and adolescents in public health settings is inadequate. In addition, most donor-funded programmes have been centred around the general HIV response, not

focused on these populations that make up small numbers in the epidemic (21). The PEPFAR programme and the Global Fund have made some of the major investments in the South African HIV response for almost two decades, however, targeted funding to address the gaps for children only began receiving attention in recent years.

In South Africa, age-specific modelled estimates have highlighted the gap in ART coverage and viral load suppression among children and adolescents (22). For example, in 2017, ART coverage was estimated at 50% among children (0–14 years) and 51.7% among 15–24 years old adolescents who knew their HIV status (23–25). Viral load suppression was estimated at 52% among CLHIV and 47% among ALHIV. There is also inadequate evidence on health systems related implementation strategies that improve the HIV cascade among children and young adolescents in South Africa and therefore more rigorous scientific work is still required (26–30).

South Africa has exceptionally progressive HIV management guidelines in place, however, treatment coverage for CLHIV and ALHIV has not significantly progressed towards targets. There are implementation challenges at different levels including at facility, community levels, and health systems. The public health sector needs an optimal mix of implementation strategies that will yield better outcomes for children and adolescents. Because of these gaps, the ELMA-funded Unfinished Business Phase 1(UB1), locally named the Paediatric and Adolescent Scale-up Plan (PASP) implemented targeted strategies for CLHIV and ALHIV to improve early diagnosis and treatment, retention and viral suppression from July 2015 to September 2018.

1.2 Research gap

Several studies in Sub–Saharan Africa (SSA) have pointed to the paucity of literature on targeted strategies for improving paediatric and adolescent HIV outcomes (22, 23, 31). There are many efficacy studies on biomedical interventions for HIV prevention, care, and treatment for this population, but limited effectiveness data in real world settings many years later (32–34). Implementation science is concerned with research methods and strategies that are used to improve the use of evidence-based interventions (35–37). Implementation evaluations on strategies that accelerate the achievement of 90–90–90 targets for children and adolescents are limited in South Africa (26,27,38,39). In addition, most available studies have focused on the

implementation outcomes of acceptability, feasibility, and sustainability, but very few have evaluated implementation fidelity (27).

Implementation fidelity is defined by Carrol et al. (40) as “the degree to which an intervention or programme is delivered as intended” (page.1). Few studies have reported on the application of the framework for implementation fidelity, and even fewer have evaluated HIV programmes using this framework (41–46). The evaluation of implementation fidelity is important because it provides insight into the context and determinants that impacted the effect of the project (47). Without evaluating the implementation process, one cannot discern whether a lack of impact was due to shortfalls within the project design (type III error) or due to poor implementation (48). Indeed, many projects are rarely implemented entirely according to the initial design, especially in a complex donor-funded environment. However, the failure to evaluate the essential elements of the project can lead to inaccurate conclusions about the effect or outcomes of the project.

1.3 Relevance of the study

There are at least eight commonly reported implementation outcomes in public health: acceptability, appropriateness, feasibility, adoption, fidelity, cost, penetration, and sustainability (49). In paediatric and adolescent HIV treatment research that evaluates uptake, fidelity is rarely evaluated. PASP was the only district-wide project in the City of Johannesburg targeted at CLHIV (0–14 years) and ALHIV (15–19 years) in 2015. Lessons from the implementation of the PASP project were important for scaling up to other districts and reducing the gaps in the HIV cascade. However, the implementation fidelity of PASP had not been evaluated and could prove difficult to replicate without understanding the implementation context, determinants, and strategies.

Through this evaluation, the study has established and described the relative contribution of PASP strategies towards 90–90–90 goals. In addition, the study has described the implementation fidelity (potential moderators) and highlighted barriers to implementation, to inform future paediatric and adolescent HIV programming in urban settings with similar dynamics. This knowledge is useful for directing the limited HIV resources towards the most essential strategies for this population.

1.4 Aim and objectives of the study

This study aimed to evaluate the relative contribution of PASP strategies towards 90–90–90 HIV outcomes among children and adolescents in the inner City of Johannesburg (Region F), South Africa. The study had two evaluation approaches:

I. An outcome evaluation to assess paediatric and adolescent HIV outcomes (HIV case finding, linkage to ART, retention in care, and viral load suppression) in facilities that received intensive Quality Improvement (QI), Technical Assistance (TA) & Direct Service Delivery (DSD) and those that only received TA.

The objectives for the outcome evaluation were:

1. To evaluate the relative contribution of the PASP implementation strategies on paediatric and adolescent HIV case finding, linkage to ART, retention, and viral load suppression in region F sub-district, City of Johannesburg.
2. To describe strategies implemented by the Paediatric and Adolescent Scale-up Plan in the City of Johannesburg to improve 90–90–90 HIV paediatric and adolescent outcomes.

II. A process evaluation to explore explanatory factors (potential moderators) associated with the outcomes of PASP.

The objective of the process evaluation was:

1. To describe the potential moderators and barriers to the PASP implementation.

CHAPTER 2 – Literature review

In this chapter, an overview of the literature on implementation strategies for 90–90 – 90 HIV outcomes among children and adolescents, barriers across the HIV cascade, implementation science theories, and the evaluation framework have been described.

A literature review is important for synthesizing what is known about a subject matter and identifying the research questions that remain to be answered. This overarching review supplements the literature presented in the individual results chapters (4–7), by providing a broad overview, while the individual chapters describe specific details applicable to each result.

In conducting the iterative literature search, several keywords have been used including HIV, child, adolescent, 90–90–90, PMTCT, implementation strategy, implementation fidelity, and implementation outcome (list not exhaustive) for studies conducted from 2004 among children and adolescents. The HIV care and treatment programme in South African public health facilities came to effect in 2004. A literature review matrix has been used to summarize and organise reviewed studies according to each objective and to classify implementation strategies. In this review, the primary search tools used to map the literature are PubMed, Google Scholar, Mendeley Library, the Wits University online library, as well as the South African National Department of Health, WHO, and UNAIDS websites. A significant number of results have also been obtained from the Journal of the International AIDS Society (JIAS), AIDS, Plos One, and Implementation Science Communication.

2.1 90–90–90 HIV goals for children and adolescents living with HIV

The background of this study describes the progress towards the 90–90–90 goals for children and adolescents, and the overarching theme is that HIV outcomes for this population lag behind, compared to those of adults. It is not unusual for children and adolescents to have delayed access to research participation and subsequently to interventions, given the complexity around consent, safety, and other ethical considerations such as risk/benefit for a particular intervention.

Globally, an estimated 1.8 million children (0–14 years) were living with HIV in 2017, and in 2020 only 54% were on ART (9). In sub-Saharan Africa (SSA), a study on the

prevalence of undiagnosed CLHIV of different ages in three countries, conducted by McCann et al. (50) has projected a 50–54% likelihood of death within 10 years after birth among all CLHIV born in 2016 without HIV diagnosis. As many as 80–85% of these deaths would occur in the first two years of life.

HIV case finding (1st 90)

In South Africa, new HIV infections among children (0–14 years) have been estimated at 12,000 [6,900–31,000] in 2020 in the UNAIDS Start-free and Stay-free report (9). The study conducted by McCann et al. (50) has projected that 44.2% of 2-year-olds, 29% of 5-year-olds, and 18.3% of 10-year-olds living with HIV were undiagnosed in 2018. At a population level, the projected undiagnosed HIV prevalence has been much lower (0.44% among 2-year-olds; 0.25% among 5–year olds; and 0.24% among 10-year-olds) in South Africa, however, the study has also suggested that there were older children who remained undiagnosed. Early identification of HIV-positive infants through birth HIV polymerase chain reaction (PCR) testing has been an important policy change in South Africa and other countries (51).

In 2017, only 74% (males 68.3%, females 76.4%) of the estimated ALHIV (15–24 years) had been diagnosed with HIV in South Africa (24,25). Results from the 2016 HIV impact assessments in Malawi and Zambia, have shown that less than half (46%) of adolescents (15–24 years) knew their HIV status (52,53). Similarly, Wong et al. (54) has reported that in SSA, only one in five HIV-positive adolescent girls (15–24 years) knew their HIV status in 2017.

ART initiation (2nd 90)

Early identification and initiation of children on ART reduces morbidity and mortality and increases ART coverage in a group highly vulnerable to adverse outcomes if not treated (55). However, a modelling study by Johnson et al. (22) has shown that mortality reduction was modest with immediate ART, regardless of immunologic or clinical status. Similarly, a 2015 study in Southern Africa that assessed outcomes of 4,945 infants who initiated ART between 2004 and 2012 in routine healthcare, has indicated a 16% likelihood of mortality by the age of 3 years, and 29% loss to follow-up, while viral suppression probability was 56% at 12 months (56).

The high mortality among infants has also been highlighted in a study that assessed outcomes among 1,847 infants who were initiated on ART at a median age of 60 days in South Africa between 2006 and 2017 (57). The overall mortality in this study was 5%, reducing to 4.1% after 2013, with the highest probability of mortality being among those initiated on ART between 2006 and 2009 (57). These findings should be interpreted within context, especially given the improved HIV-testing strategies as part of the Voluntary Counselling and Testing (VCT) programme and the roll-out of optimised treatment formulations in recent years.

Retention and viral load suppression (3rd 90)

The 2020 UNAIDS modelled estimates from 21 focal countries have shown that 40% of CLHIV and 74% of children on ART had suppressed viral load, which was lower compared to adults on ART at 89% (48,58). The UNAIDS retention and viral load data on adolescents was not updated due to low reporting from many countries, however, recent Population HIV Impact Assessments (PHIA) data suggest that adolescents aged 15–24 years have lower viral suppression than older adults (58).

The lack of transition programmes for ALHIV has added to their clinical and psychosocial challenges. Transition is defined as the "purposeful and planned movement of children with special health care needs from child-to-adult-centred health care" (59). Data from the 2017/2018 fifth South African national HIV sero-behavioural survey estimates has indicated that ART coverage was lower among the 15–24-year-old adolescents compared to other sub-groups (51.7%), with viral load suppression at 85.2% (25). Gauteng province had the lowest ART coverage at 60.8% out of the nine South African provinces.

2.2 Implementation strategies to improve 90–90–90 goals among CLHIV and ALHIV

The slow progress towards the 90–90–90 targets for children and adolescents suggests the need for evidence-based and targeted implementation strategies. Powell et al. (60) has described implementation strategies as "methods or techniques used to enhance the adoption, operation, sustainability and integration of evidence-based practices into routine care". Similarly, Proctor et al. (61) has defined implementation

strategies as “techniques to improve the adoption, operation, and sustainability of clinical programmes.”

There are causal pathways to be considered for operationalizing implementation strategies, which can influence the implementation outcome. Lewis (62), has recommended that in addition to defining and specifying implementation strategies as recommended by Proctor et al. (61), researchers should establish linkages between the strategy and its mechanisms, articulate the moderators or determinants, and identify the intermediate outcomes. This was important for understanding the pre-conditions (where, when, and why) for strategies to influence implementation outcomes.

A mechanism has been defined as the process through which an implementation strategy functions to impact the preferred implementation outcomes, while a determinant (also known as “barriers” and “facilitators”) facilitates or deters the implementation strategy from producing the preferred outcomes (62). An example of the HIV testing strategy in Figure 2.1 depicts how Provider Initiated Counselling and Testing (PICT) at the health facility level can influence the outcomes if the essential mechanisms are in place and the implementation determinants or facilitators are addressed.

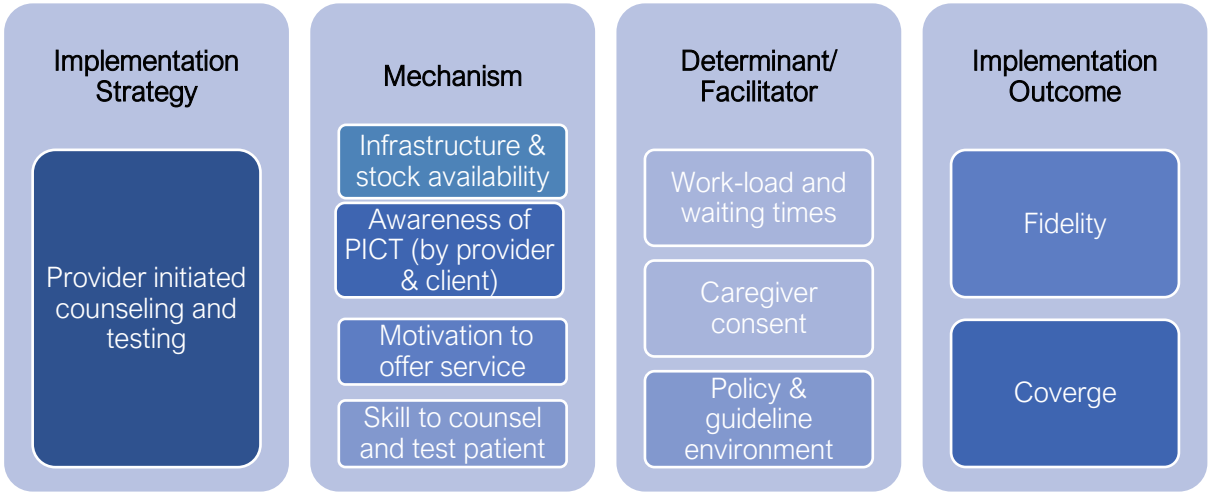

Figure 2. 1 Example of causal pathway from strategy to outcome for Provider Initiated Counselling and Testing

Source: Adapted from Lewis, 2018. From classification to causality: Advancing Understanding of Mechanisms of change in implementation science (62).

This illustration has been used to show a summarised list which depicts that PICT as a strategy on its own may not lead to the implementation outcome, without the

awareness, motivation and skill of the healthcare providers and other factors. In addition, these mechanisms may be in place but deterred by the lack of factors such as caregiver consent to test the child for HIV, high workload for the health provider or lack of clear PICT guidelines.

Evaluations should, therefore, aim to report on clear implementation strategies, mechanisms, and determinants before articulating the implementation outcomes (39). Geng et al. (39) has argued for bringing "implementation itself into clear scientific focus" to address the HIV pandemic is fundamental. In this commentary, the authors have advocated for context-specific questions about the "how" of the implementation with consideration for stakeholder and community perspectives. Effectiveness studies have been criticised for often failing to adequately inform practice when they do not ask questions about implementation strategies used to change systems. Simply reporting on outcomes is not enough, evaluators should describe the process to better deliver interventions in similar contexts.

There are different strategies to improve HIV outcomes among children and adolescents, but these have rarely been evaluated for effectiveness, and those that did, do not often get implemented at scale (63). Many studies have reported on implementation strategies and outcomes for HIV management among children and adolescents, although the majority of these were not nationally representative studies in public health settings (31,32,64). To standardise implementation strategies, Proctor et al. (61) has recommended naming, defining, and specifying implementation strategies, as shown in Table 2.1.

Table 2. 1 Pre-requisites for Measuring Implementation Strategies

Pre-requisite	Requirements
Naming	Name the strategy, preferably using language consistent with existing literature
Defining	Define the implementation strategy and any discrete components operationally
Specifying	
► The Actor(s)	Identify who enacts the strategy (e.g., administrators, payers, providers, patients/consumers, advocates, etc.)
► The Action(s)	Use active verb statements to specify the specific actions, steps, or processes that need to be enacted
► Action target(s)	Specify targets according to conceptual models of implementation. Identify unit of analysis for measuring implementation outcomes
► Temporality	Specify when the strategy is used
► Dose	Specify the dosage of the implementation strategy
► Outcome	Identify and measure the implementation outcome(s) likely to be affected by each strategy
► Justification	Provide empirical, theoretical, or pragmatic justification for the choice of implementation strategies

Source: Proctor et al. 2013. Implementation strategies: recommendations for specifying and reporting (61)

Unfortunately, few programmes have provided detailed descriptions of the strategies prior to implementation, and even fewer have described how the strategies were selected. While this could bring complexity to the evaluation, the PASP project was no exception. In this evaluation study, the implementation strategies for improving 90–90–90 HIV outcomes among children and adolescents have been categorised into data-driven, facility-based, community-based, and cross-cutting and then defined accordingly.

2.2.1 Data-driven strategies

There are few programmes or studies that have reported using data-driven strategies to address bottlenecks in the 90–90–90 cascade. These strategies mostly involve

electronic or paper-based record reviews or file audits to identify missed opportunities for ART initiation, missing viral load testing results, high viral load, poor adherence, and lack of psychosocial or disclosure support. These strategies are mostly used to improve the second and third 90.

The "check–flag–act" approach has been used in Kenya by the Accelerating Children's HIV/AIDS Treatment (ACT) initiative to improve ART initiation and viral load suppression (19). The approach involved reviewing records to identify pre-ART ALHIV and those whose viral load was not suppressed in 116 adolescent-friendly health facilities. This approach resulted in 99% of pre-ART adolescents being initiated on treatment and 85%-90% retained after 12 months of ART. However, the frequency, implementers, and targets for this approach were not described. The ACT initiative was implemented in 9 priority African countries: Cameroon, the Democratic Republic of Congo (DRC), Kenya, Lesotho, Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe (19).

The Active Case Management Network (ACC) was a multi-partner collaboration to promote early infant diagnosis (EID) and prompt ART initiation in Thailand using PCR notification and follow-up (65). Through a record management database established by the network, laboratory officers notified case managers of new PCR-positive tests, which were then reported to the hospital manager, who promptly facilitated ART initiation. The study reported improvements in early infant diagnosis (EID) from 64% to more than 95% and ART initiation from 56% to 88% during the period of August 2014 to July 2018, compared to a national EID survey conducted from October 2007 to September 2011 (65).

2.2.2 Health facility-based strategies

Health facilities provide better opportunities for patients to receive comprehensive services due to the infrastructure, commodities, and availability of different cadres of staff in one place. However, patients who need HIV-related services could be missed if service providers do not proactively offer services, due to competing priorities. There are various strategies at this level of care to improve HIV outcomes for children and adolescents, which are described in more detail in the results chapters.

PICT requires healthcare providers to proactively ask patients about their HIV status and offer HIV testing where applicable. A mixed-methods study in Zimbabwe, which investigated the provision and uptake of PICT among children in primary healthcare facilities, found an HIV positivity rate of 5.3% among children using the PICT strategy. (66).

Despite the effectiveness of PICT in improving HIV diagnosis, many healthcare providers expressed concerns about the long patient waiting times associated with providing PICT, stock-outs of test kits, insufficient time to adequately counsel children, and refusal of consent by some caregivers. Additionally, male caregivers were more likely to refuse consent for children to be tested for HIV. The study recommended that successful implementation of PICT for children should be complemented by clear legislation on consent and addressing health system challenges, such as staff shortages, to ensure effective implementation.

Facility-based index testing involves identifying undiagnosed potential HIV-positive individuals through existing patients (e.g., parents, siblings, sexual partners) who are already receiving HIV services (63,67–69). Although this approach may be time- and cost-intensive, it has a higher potential to identify more undiagnosed CLHIV and ALHIV than routine non-targeted testing. In Tanzania, index testing among 18,820 siblings who were first-time testers showed an HIV-positivity rate of 5%, compared to 1% from routine HIV testing in health facilities (19). Notably, 98% of those testing HIV-positive were linked to treatment. This strategy, implemented from January 2015 to April 2016, was scaled up to 48 health facilities. Similarly, an evaluation across 60 high-volume clinics in Nyanza reported that 3,033 eligible children were identified through index clients and tested for HIV, with at least 5.4% testing HIV-positive, compared to 1.5% in inpatient and less than 1% in outpatient services (19).

HIV testing at the point-of-care in this study refers to HIV testing and counselling offered to patients at the service point where they are receiving care for other reasons, such as TB clinics, malnutrition clinics, paediatric wards, immunization clinics, family planning, or primary health care. PICT is an ideal approach to improve case finding at child and adolescent service points. The World Health Organization (70) recommended symptom-based HIV testing in TB services and among malnourished

children and adolescents in 2010 as part of the medical diagnostic process. In Tanzania, testing of 25,282 children attending TB clinics showed an HIV positivity rate of 1% (263 children) across 25 health facilities participating in the ACT Initiative from 2015 to 2016 (17). Notably, these children would have been missed if PICT and quality improvement change ideas had not been implemented at this service point.

Screening of mothers of infants attending immunization services in high-prevalence settings has also been recommended to improve HIV diagnosis (7). Although the VTP programme has made considerable progress in reducing new HIV infections in children, targeted screening at immunization service points could identify the few remaining undiagnosed cases (71). For instance, in South Africa, 9.2% of children tested at immunization clinics were found to be HIV-positive in 2009, although this prevalence has decreased substantially in recent years due to the success of the VTP programme (72).

Children admitted to hospitals or consulted as outpatients are often not routinely tested for HIV, which represents a missed opportunity for diagnosis. However, hospitals present an opportunity to identify children who were missed at birth or other time points in the vertical HIV prevention cascade. Previously, high HIV prevalence has been observed among patients tested for HIV in hospitals. For instance, 29% of children tested in a paediatric ward in Zambia were HIV-positive, similarly, 31% of children tested from the nutrition ward in Uganda were HIV-positive, and 8.5% of children tested by counsellors in a paediatric inpatient ward in Malawi were HIV-positive (73–75).

Early ART among infants has been shown to save lives and prevent morbidity and neurodevelopmental delays, as reported by Violari et al. (76). In their study of 252 infants (6-12 weeks) on early ART and 125 infants on deferred treatment until guideline-recommended criteria for ART initiation were met, the researchers found that ART initiation within seven weeks of birth reduced the likelihood of dying by 76% and disease progression by 75% among infants compared to the deferred group (76). Without ART, almost half of CLHIV die before the age of two, and of those who survive, a further one-third die before their fifth birthday (8). At the health facility level, tracking of mother-infant pairs and mobile health or communication technology are commonly

reported strategies for paediatric and adolescent HIV programmes, which are described in more detail in Chapter Five.

Adherence interventions for adolescents transitioning to adult care, such as youth clubs, service integration, targeted and focused structured/specialty clinics, support groups, and peer navigators, have previously been recommended in other studies (59). Peer counselling and support are crucial for ALHIV and can have a positive impact on emotional well-being and treatment adherence. HIV-positive adolescents (15–24 years) often experience poorer ART treatment outcomes, including virological response, high loss to follow-up (LTFU), and virological failure, compared to adults receiving ART (31). In Kenya, adolescents with adherence issues or high viral loads were paired with trained mentors for personalized support to improve adherence and viral load monitoring and suppression (19). Additionally, the use of linkage registers by peer educators who helped HIV-positive children navigate the health system resulted in a remarkable 97% linkage rate between different facilities. (19).

Similarly, adherence clubs provide patients with a safe space to share their experiences and receive advice from their peers. These clubs have since become widely established at both facility and community levels. In South Africa, the Youth Care Club (YCC) model, which accommodated younger and older adolescents, provided monthly adherence sessions tailored to their ages. This resulted in 75% viral load suppression at 12 months and 81% retention in YCC care among 589 adolescent patients (77,78).

Enhanced adherence counselling (EAC) can help patients who default from their treatment schedule by understanding the holistic issues affecting them and assisting them in navigating solutions. However, there are mixed results on the effect of EAC with or without Enhanced Clinical Care (ECC), such as switching to second-line ART or optimal regimen and dose adjustments. In Lesotho, a 2014 study found that viral suppression after EAC and being switched to second-line therapy were associated with retention in care and viral suppression at 18 months of follow-up among 116 patients, although there was no association with age, gender, or duration on ART (79). In contrast, Jobanputra et al. (29) found no association between receiving EAC and viral load suppression among 1,941 patients with unsuppressed viral loads in Swaziland.

Notably, the study reported that children and adolescents were more likely to have unsuppressed viral loads, as were patients who had been on ART for longer, those with last CD4 counts of less than 350 cells/µl, and those with WHO Stage 3/4 disease(70).

2.2.3 Community-based strategies

According to the systematic review by Sharma et al. (63), both community-based and facility-based strategies improved case finding, but significant differences existed between these strategies. Community-based strategies had higher HIV testing coverage, with lower HIV positivity rates (6-11%) compared to facility-based strategies (18-20%). Furthermore, community testing had a higher proportion of first-time testers, with smaller proportions in South African studies than in other Sub-Saharan African (SSA) countries.

Community-level testing modalities, such as home visits, mobile testing, index testing, campaign testing, and self-testing, are effective ways to reach undiagnosed patients who may not seek care at a health facility when they are asymptomatic. Several studies, including Sharma et al. (63), Thurman et al. (17), Ahmed et al. (80), and Thompson et al. (21) have reported that higher testing coverage and uptake, as well as increased case identification, can be achieved using various testing modalities. These strategies are described in more detail in the subsequent results chapters.

Home visits by community-based care workers increased the likelihood of a child being tested by 97%, with a pronounced effect on orphans, compared to orphans living in similar households that did not receive home visits (17) This highlights the potential for increasing HIV counselling and testing access among high-risk children through targeted community-based initiatives. Facilitated community testing also showed higher linkage to care (87-98%) compared to lower linkage rates (18-36%) without a facilitator.

Orphaned and vulnerable children are at higher risk of HIV infection due to economic vulnerability, sexual abuse, or early sexual debut (7). Therefore, prioritizing access to HIV testing services for all children and adolescents in OVC care services is crucial. In Mozambique, a 3% HIV prevalence was found among 735 OVC in Inhambane and 2,849 in Maputo City who received HIV testing and TB screening at orphanages and

boarding schools (19). However, in Zimbabwe, the HIV prevalence was higher (18%) among orphaned children (aged five years and younger) who attended community-based early childhood development play centres (81).

Community-based ART through capacity building and deploying Community Health Workers (CHWs) to link children to ART in collaboration with outreach teams has been recommended. CHWs are essential in identifying and testing hard-to-reach populations like children and adolescents (82). Community-driven demand creation through CHWs has also been recommended for improving HIV case finding and addressing bottlenecks across the HIV cascade (68,83,84). For example, the Tingathe Programme in Malawi found a 10-fold increase in the number of CLHIV identified and enrolled in HIV care and treatment services when using CHWs for home-based HIV counselling and testing (84).

School-based services can reach more undiagnosed children and adolescents without access to health facilities. However, evidence for the school-based approach is still limited. In Zimbabwe, an evaluation of school-linked HIV testing and counselling found 2.7% HIV prevalence among 4,386 pupils with a median age of 9 years and 6.8% for children under 15 (30) A retrospective study assessing countries implementing the DREAMS programme found HIV prevalence in schools ranged from 1% to 9.8%, with a strong association between being in school and reduced odds of being HIV-positive in Lesotho, Swaziland, and Uganda (85). Many school-based interventions have focused on HIV prevention rather than treatment.

Although implementing HTC in schools has been controversial in South Africa due to concerns around consent, parents play a significant role in supporting children who test HIV-positive and are supportive of school-based HTC rollout. A cross-sectional household survey assessing the acceptability of school-based HIV testing among 804 parents in two South African provinces found that 92.9% of parents supported school-based HIV testing and counselling (86). Furthermore, 87.7% of parents would allow their children to be tested at school, with 46% not believing consent necessary for HIV testing and 39.4% wishing to be present when children receive HIV test results (87). This addresses consent as a key barrier in achieving the 1st 90 of the HIV cascade among children.

2.2.4 Cross-cutting strategies

Strengthening health system building blocks, such as Leadership, Ethics, Governance, and Systems (LEGS), can form a solid foundation for implementing targeted programmes (88). Service delivery strategies, health workforce, and information are crucial for improving HIV outcomes.

In Kenya, the Systems Analysis, and Improvement Approach (SAIA) was adopted to improve HIV outcomes for children and adolescents in six health facilities (89). This multi-component implementation strategy has previously shown improvement in the HIV care cascade for pregnant women and infants. SAIA consists of three components: Continuous Quality Improvement (CQI), Paediatric Cascade Analysis Tool (PedCAT), and flow mapping. Frontline healthcare workers and managers used these tools for root cause analysis and testing micro-interventions to improve the system. Following SAIA implementation, viral load testing rates improved significantly, but viral load suppression rates did not change. An evaluation of SAIA's acceptability showed that users found CQI and flow mapping highly acceptable and used them consistently, whereas PedCAT was considered too complex (90).

Social protection interventions, patient record reviews, and laboratory data can identify and track HIV-positive patients to link them to ART. Social protection involves incentive-based interventions addressing structural deprivations to improve health outcomes. Evidence suggests that these interventions, such as cash transfers, parenting support, and educational support, can improve HIV testing, linkage to ART, and adherence in resource-limited settings (91–93). For example, financial incentives increased paediatric HIV testing in an urban health facility in Kenya by Njuguna et al. (94) among HIV- positive female caregivers in a pilot study, irrespective of the amount or form of receiving the incentive (i.e., cash, mobile money transfer or non-cash such as food). A total of 73% of caregivers who received incentives tested children within a two-month window compared to 15% who did not receive an incentive. Cluver et al. (91) argue that social protection is a key strategy for mitigating the negative impacts of living with HIV, contributing to HIV prevention, adherence, and removing socio-economic barriers to treatment access among adolescents.

Finally, communication technology and mobile health have received attention for improving access to information, providing counselling, and sending treatment reminders to patients (19). In Tanzania, the ACT initiative used WhatsApp messaging to reduce the turnaround time for Dried Blood Spot (DBS) results (from 3 weeks to 4 days) and increased the proportion of DBS results delivered to mothers to 79% (19).

2.3 Facilitation strategies to improve 90–90–90 goals among children and adolescents

Facilitation strategies enhance and systematize implementation fidelity (40,61). These strategies include the provision of manuals, guidelines, training, monitoring and feedback, capacity building, and incentives (61). While these strategies may not have an independent effect on the outcomes of an intervention, they enable implementation strategies to be carried out in a standard manner and improve the quality of delivery (95).

Adolescent and Youth Friendly Services (AYFS) refer to a basic package of clinic and community services for improving the quality of health care for adolescents (7). The AYFS approach has been promoted by the National Department of Health and Development partners to standardize the quality of adolescent healthcare services in South Africa (96). AYFS is crucial for improving HIV outcomes among adolescents and youth. PEPFAR recommended the following elements outlined in Table 2.2 as a minimum standard for AYFS in 2018 (7).

Table 2. 2 Key essential and supportive elements of Adolescent-Friendly Services

Essential	Supportive
• Convenient and consistent operating hours • Privacy and confidentiality • Competent (both technical and culturally) staff • Respect for adolescents • Package of essential services available • Sufficient supplies of commodities and drugs • Integrated health services where appropriate • Referrals available • Waiting time appropriate • Affordable or absent fees • Separate space and/or hours for youth	• Youth input/feedback to programmes • Accessible location • Publicity that informs and reassures young people • Welcoming setting • Peer educators, providers, and support • Educational materials available for girls and boys at a developmentally appropriate age • Partners, caregivers, and parents welcomed • Non-medical staff trained and supervised • Community-based outreach services available from trained workers

Source: PEPFAR, 2018 Strategies for Identifying and Linking HIV-Infected Infants, Children, and Adolescents to HIV Care and Treatment (7)

In South Africa, health facilities must achieve 10 standards for AYFS certification. To achieve these standards, health facility staff should be trained and mentored. However, a 2018 evaluation of 14 health facilities in Johannesburg indicated that none achieved the minimum criteria of five standards (96). In another study, Cluver et al. (97) described a minimum of five factors which were associated with retention in a 53-clinic study in South Africa referred to as **STACK**: clinics **S**tocked with medication; staff with **T**ime for adolescents; adolescents **A**ccompanied to the clinic; enough **C**ash (money) to get to clinic safely; and staff who are **K**ind. About 56% of adolescents had self-reported retention in care, validated against lower detectable viral load in health facilities that met these five factors. AYFS are still an important foundation for improving health and HIV outcomes among adolescents.

Stakeholder and peer involvement, training and roll-out of adolescent-friendly SRH curricula and the “fast-track” peer-navigated services were used in the Red-Carpet Programme (RCP) in Homa Bay County, Kenya (98). A pre-post evaluation of the RCP on timing and outcomes of linkage to care among adolescents (15–19 years) and youth (20-21 years) found that linkage to ART improved from 56.5% pre-implementation to 95.7% within 6 months. In addition, retention on ART improved from 66% to 90% at three months, and from 54.4 to 98.6% at 6 months (98).

Lastly, intensive supervision and mentoring were associated with Community Health Workers’ long-term satisfaction in the Zimbabwe study for Enhancing Testing and Improving Treatment of HIV in Children (ZENITH) randomised control trial (68). So was the provision of job aids, standardized manuals, refresher training and formalized links between clinics and CHWs. The contribution of these strategies was observed in the improvement of HIV case finding and retention among children.

2.4 Theoretical approaches in implementation science

Theories are “sets of principles designed to structure our understanding of the world, showing domains, relationships, and specific predictions” (99). There are several theoretical approaches used in implementation science, including process models, determinant frameworks, classic theories, implementation theories, and evaluation frameworks (61,100–102). Figure 2.1 depicts groups of TMFs (Theories, Models and Frameworks) often used in implementation science.

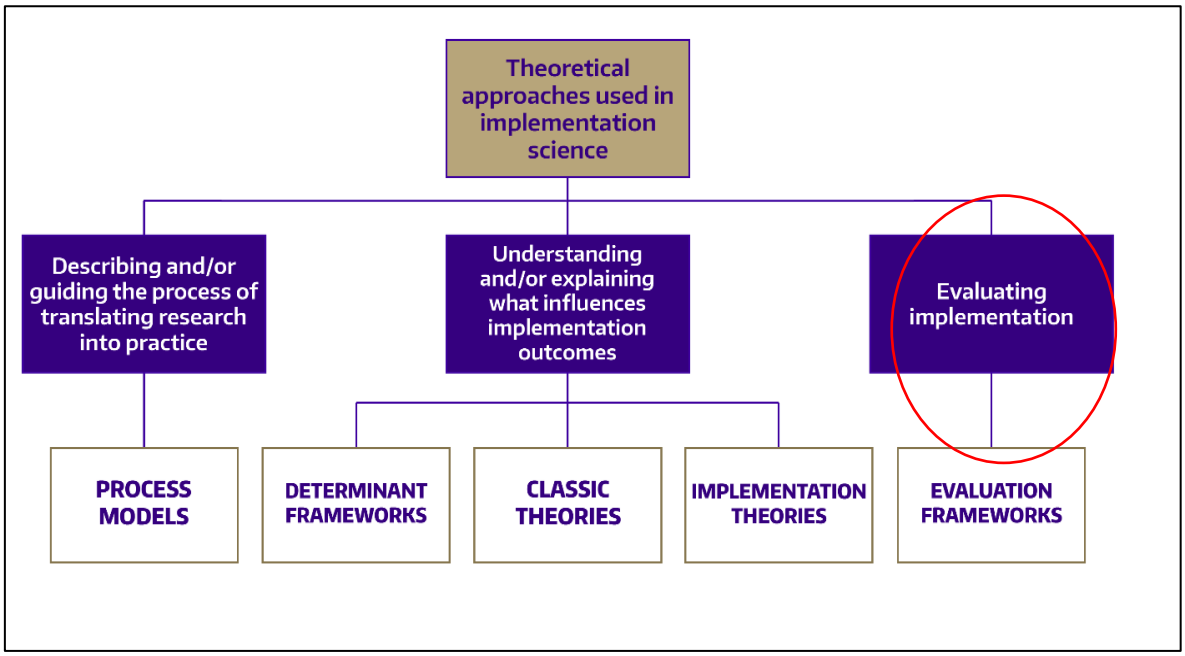

Figure 2. 2 Theoretical approaches in implementation science

Source: Nilsen P (2015). Making sense of implementation theories, models, and frameworks (99).

Process models are concerned with describing how research outcomes are translated into routine practice. Determinant frameworks, classic theories, and implementation theories seek to provide an understanding of factors that influence implementation outcomes. Evaluation frameworks seek to understand how the intervention was implemented and to identify the key elements of implementation that affected the success. In this relatively new field, there are few studies that have explored the implementation fidelity or some of its elements in addressing the uptake of HIV care and treatment services. Intervention effectiveness and achievement of high implementation fidelity are important considerations for replicating success.

Theories, models, and frameworks (TMFs) used in implementation science research include the Quality Implementation Framework (QIF), Theory Domains Framework (TDF), Social Cognitive Theory, RE-AIM, PRECEDE-PROCEED, Consolidated Framework for Implementation Research (CFIR), and others (40,101–106). The shift towards progressively using theories in this field helps to explain the success or failure of programmes and improve implementation. Interventions and programmes should be evaluated with appropriate measurements that are consistent with their context and aims. The framework for evaluating implementation fidelity has been used in this study to identify the key elements of implementation that affected the project outcomes.

2.5 Framework for evaluating implementation fidelity

There are eight common implementation outcomes for health interventions: acceptability, appropriateness, feasibility, adoption, fidelity, cost, penetration, and sustainability (49). The most frequently evaluated outcomes are acceptability, feasibility, cost, and sustainability, while very few studies have evaluated implementation fidelity, especially in HIV programmes (41,42). Implementation fidelity is defined by Carrol et al. (40) as “the degree to which an intervention or programme is delivered as intended”.

The conceptual framework for evaluating implementation fidelity was chosen for this study due to the complexity of the PASP intervention and the importance of the implementation process in replicating strategies in similar settings (40). The RE-AIM and PRECEDE-PROCEED frameworks are commonly used in programme evaluations, although the Theoretical Domains Framework, Normalization Process Theory, and COM-B are also relatively common (99). While all these frameworks are advantageous for specifying which elements of interventions could be evaluated, they do not provide adequate measurement for fidelity which was a key implementation outcome in this study.

In advancing the framework for implementation fidelity, Carroll et al. (40) critiqued the inadequacy in the conceptualization of implementation fidelity in previous studies, citing a lack of acknowledgment of intervention complexity and relationships among elements. The authors proposed a new framework to allow for measuring the implementation process which included two additional elements: intervention complexity and facilitation strategies.

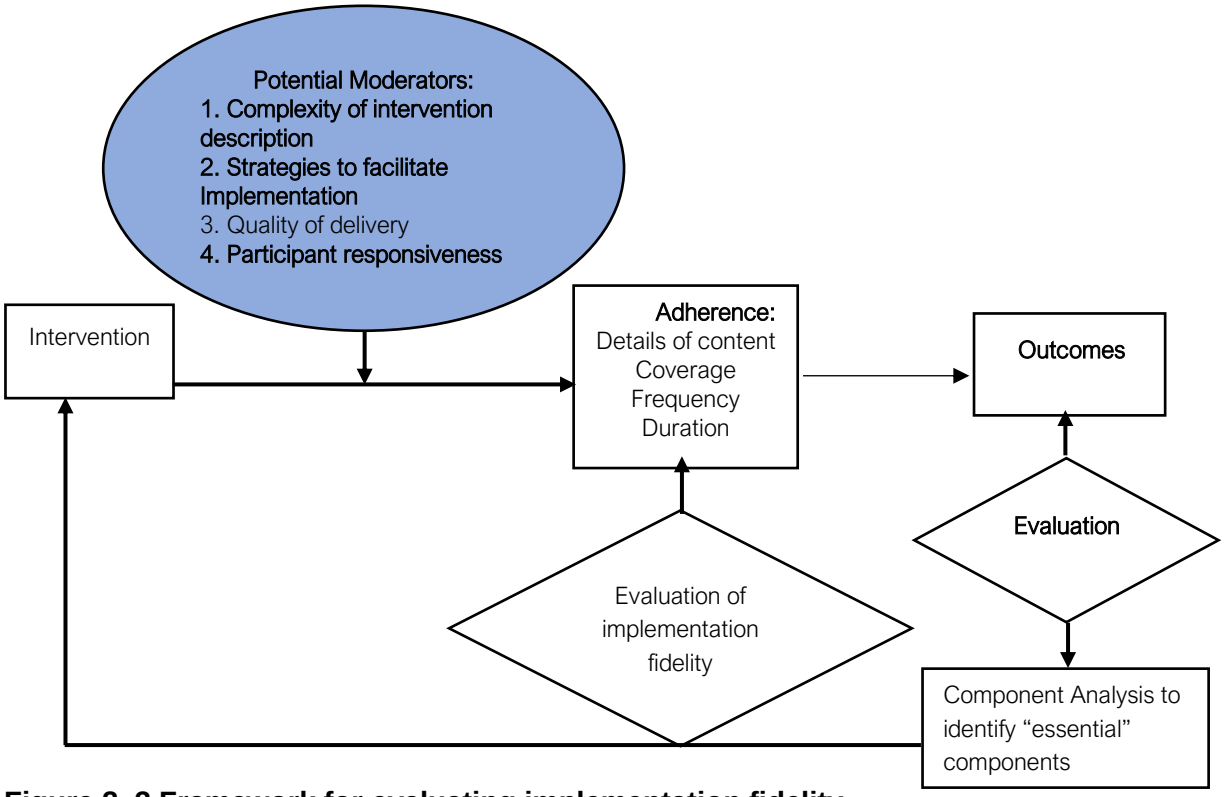

Figure 2. 3 Framework for evaluating implementation fidelity

Source: Carrol et al. 2007. A conceptual framework for implementation fidelity (40)

This framework enables a systematic description of the complex interventions, specification of potential moderators, adherence, outcomes and the relationship between these elements (40). Fidelity was an important implementation outcome to assess in PASP, to accurately account for and interpret patient outcomes. Few studies have explored the implementation fidelity or some of its elements in addressing the uptake of HIV care and treatment services.

Specifically, the potential moderators (complexity of intervention description, strategies to facilitate implementation, and participant responsiveness) from this framework were included in the evaluation, based on the available data at the end of the project and the review of key implementation activities. Moderators are defined by Lewis et al. (62) as "factors that can increase or decrease the level of influence of an implementation strategy". These moderators are described in more detail in Chapter Seven.

This framework enables a systematic description of complex interventions, specification of potential moderators, adherence, outcomes, and the relationship between these elements (40). It was important to assess this implementation outcome

in PASP to accurately account for and interpret patient outcomes. Intervention effectiveness and achievement of high implementation fidelity are important considerations for replicating success. This framework has been applied in other studies, however very few in Africa. Most studies that evaluated implementation fidelity have been on smoking cessation programmes, parenting, mental health, and substance abuse, but rarely on HIV programmes (42,43,45,107,108).

Lastly, implementation fidelity is best interpreted alongside adaptation (where applicable), especially when the projects being evaluated show deviations from the original design whether in part or whole (109). Adaptation of a programme can occur at the context and the content level. The tension between fidelity and adaptation has challenged implementers for many years, often when the project is in a sustainment phase (44). This study described adaptations made to the PASP project and how they impacted fidelity in Chapter Seven.

2.6 Summary of the literature review

There is notable progress towards the prevention of mother-to-child transmission of HIV, however, for CLHIV and ALHIV there are still major gaps in HIV diagnosis, treatment coverage, retention and viral suppression compared to adults. Adolescents are particularly likely to be lost to follow-up and have higher viral load as they cope with the transition from child to adult care. There are many reasons why children and adolescents lag behind in the HIV treatment cascade ranging from refusal to consent for HIV testing by caregivers, sub-optimal paediatric treatment regimens, poor adherence among adolescents, or the lack of capacity among health workers to manage CLHIV and ALHIV.

Improving 90-90-90 HIV outcomes requires evidence-based implementation, facilitation strategies, and mechanisms to address implementation barriers. Several interventions have implemented strategies to improve outcomes across the 90-90-90 cascade in Africa and beyond. Table 2.3 shows a summary of implementation and facilitation strategies described in the literature review.

Table 2. 3 Summary of strategies to improve CLHIV and ALHIV outcomes

Strategy description	Population, Country	Outcome	Reference
Data-driven implementation strategies			
File audit ("Check-flag-act"): review pre-ART & unsuppressed patient records for personalised intervention	Adolescents, Kenya	99% of pre-ART patients initiated, 85%–90 % retained on ART at 12 months	PEPFAR & Children's Investment Fund Foundation , 2017
PCR notification & follow-up: record management database established to notify & track ART initiation of newly diagnosed infants from 14 national HIV PCR laboratories	Infants, Thailand	Improved EID from 64% to >95%(15,951infants); ART initiation from 56% to 88% (267 infants)	Lolekha R. et al., 2020
Facility-based implementation strategies			
Provider Initiated Counselling and Testing (PICT): HCWs offer and perform HIV testing and counselling to all patients attending clinical services in six clinics	Children (6-15 years), Zimbabwe	5.3% HIV positivity among 1,534 children tested	Kranzer K, Meghji J, Bandason T, Dauya E, Mungofa S, et al., 2014
Index case finding: Test all children of adults receiving any HIV services (PMTCT, care, ART) or with HIV-positive siblings through facility- or home-based index case testing using a family-centred approach	CLHIV & ALHIV, Tanzania Children, Kenya Children (0-14 years), Kenya	18,820 eligible siblings tested, 5% HIV-positivity rate 3,033 eligible children identified; 5.4% HIV diagnosed 3,005 eligible children identified, 2848 (94.8%) tested, 127 (4.5%) HIV diagnosed	PEPFAR & Children's Investment Fund Foundation , 2017 PEPFAR & Children's Investment Fund Foundation , 2017 Okoko N, Kulzer JL, Ohe K, et al.,2020
Peer support: patients with poor adherence/high viral load paired with trained mentors for individual support	Children, Kenya	The use of linkage registers by peer educators resulted in a 97% linkage rate	PEPFAR & Children's Investment Fund Foundation , 2017
Adherence clubs: younger and older adolescents receive monthly adherence sessions according to their ages through Youth Care Clubs in 31 health facilities	Adolescents (10- 24 years), South Africa	589 adolescent patients, 75% viral load suppression at 12 months, 81% retention in care	Imrie J, Michalow J, Farlane L, Carmichael B, Ndlovu T, Sekhukhune H, et al., 2017

Enhanced adherence counselling (EAC): find non-stable clients with poor adherence or treatment response and/or signs of treatment failure • educate about the outcome of the latest clinical assessment • assess barriers to adherence • correct any misconceptions	Patients >16 years, Lesotho	EAC and being switched to second-line therapy associated with retention and VLS at 18 months of follow-up among 116 patients	Labhardt ND, Ringera I, Lejone TI, Cheleboi M, Wagner S, Muhairwe J, et al., 2017
	Children (<16 years), Lesotho	49 of 191 children with unsuppressed VL enrolled in EAC, 19% VL suppressed at 18 months follow-up	Lejone T.I, Ringera I, Cheleboi M, Wagner S, Muhairwe J, Klimkait T, Labhardt N.D., 2017
EAC + Enhanced clinical care(ECC): assessment with dose adjustments, switching to second-line ART or optimal regimen and targeted VL monitoring	CLHIV (<10 years) and ALHIV (10 – 19 years), Swaziland	60% of children and 52% of adolescents with virological failure at 6 months follow-up among 50 previously unsuppressed patients receiving EAC	Jobanputra K, Parker LA, Azih C, Okello V, Maphalala G, Jouquet G, et al., 2014
Entry point testing: routinely provide HIV Counselling and Testing services at paediatric & adolescent service points			
TB clinic	Children, Tanzania	25,282 children from 25 health facilities tested at TB clinics, 1% (263) positivity	PEPFAR & Children's Investment Fund Foundation , 2017
Malnutrition clinic	Infants (6,10 or 14 weeks), South Africa	9.2% HIV prevalence among 332 infants tested in malnutrition clinics	Rollins N, Mzolo S, Moodley T, Esterhuizen T, Van Rooyen H., 2009
Hospital paediatric ward	Children (0-18 years), Uganda	29% HIV prevalence among 9,867 children tested	Wanyenze RK, Nawavvu C, Ouma J, Namale A, Colebunders R, Kamya MR, 2010
Hospital nutrition ward	Children (<15 years), Zambia	29.2% HIV prevalence among 11,571 children tested	Kankasa C, Carter R.J, Briggs N., Bulterys M., Chama E., 2009
Hospital paediatric inpatient ward: tested by counsellors	Children (7-50 months), Malawi	8.5% HIV prevalence among 5,465 children tested	McCollum ED, Preidis GA, Kabue MM, Singogo EBM, Mwansambo C, Kazembe PN, et al., 2010

Community-based implementation strategies			
Home visits by community-based care workers	Children (0-17 years), South Africa	Increased likelihood of child HTC by 97% with a pronounced effect on orphans among 1,324 participants	Thurman TR, Luckett B, Taylor T, Carnay M., 2016
Home-based HIV testing and counselling to contacts of HIV-positive patients by CHWs	Children, Malawi	A 10-fold increase in the number of CLHIV identified and enrolled in HIV care and treatment services	Kim MH, Ahmed S, Buck WC, Preidis GA, Hosseinipour MC, Bhalakia A, et al., 2012
Facilitated community testing by CHWs	Children, South Africa	Higher linkage to care (87–98%), compared to lower linkage rates of 18–36% without a facilitator	Thurman TR, Luckett B, Taylor T, Carnay M., 2016
HIV testing and counselling in Orphanages and boarding school	Children, Mozambique	3% HIV prevalence among 735 OVC in Inhambane and 2,849 in Maputo City tested for HIV	PEPFAR & Children's Investment Fund Foundation , 2017
HIV testing and counselling for orphaned children in Early Childhood Development Centres	Children (<5 years), Zimbabwe	18% HIV prevalence among, 410 children HIV tested out of 697 OVC	Patel D, Matyanga P, Nyamundaya T, Chimedza D, Webb K, Engelsmann B., 2012
School-linked HIV testing and counselling	Children (6- 15 years), Zimbabwe	6.8% HIV prevalence among 4,386 pupils HIV tested	Bandason T, Langhaug LF, Makamba M, Laver S, Hatzold K, Mahere S, et al., 2013
	Young women (15-19 years): 9 African countries*	1% to 9.8% HIV prevalence among 20,429 HIV tested	Mee P, Fearon E, Hassan S, Hensen B, Acharya X, Rice BD, et al., 2018

Cross-cutting implementation strategies			
Systems Analysis and Improvement Approach (SAIA): adapted to improve the HIV outcomes in 6 health facilities	CLHIV and ALHIV, Kenya	VL testing and suppression rate improved significantly after SAIA	Beima-Sofie K, Wagner AD, Soi C, Liu W, Tollefson D, Njuguna IN, et al., 2022
Social protection: incentive-based interventions for structural deprivations to improve health outcomes	Caregivers, Kenya	73% of caregivers agreed to test children within 2 months compared to 15% who did not receive an incentive	Njuguna IN, John-Stewart G., 2017
Facilitation strategies			
Adolescent and Youth Friendly Services: basic package of clinic and community services for improving the quality of health care for adolescents	Adolescents, South Africa	56% of adolescents had self-reported retention in care, validated against lower detectable viral load	Cluver L, Pantelic M, Toska E, Orkin M, Casale M, Bungane N., 2018
Training, the roll-out of adolescent-friendly SRH curricula and the "fast-track" peer-navigated services	Adolescents, Kenya	Linkage to ART improved from 56.5% pre-implementation to 95.7% within 6 months	Ruria EC, Masaba R, Kose J, Woelk G, Mwangi E, Matu L, et al., 2017

* Lesotho, Swaziland, Uganda, Kenya, Malawi, Mozambique, Tanzania, Zambia, Zimbabwe

There are many considerations for implementation research, which also underpin this evaluation. Firstly, research questions should include the perspectives of participants, i.e., patients and HCWs. Secondly, systems within which implementation occurs should be examined before placing the burden on users. Thirdly, implementation design is crucial to success or failure. If the design is flawed, the likelihood of success is limited.

Lastly, there are numerous theories, models, and frameworks in implementation science, each with its own purpose. While many studies have evaluated implementation outcomes such as acceptability, feasibility, and sustainability, few have assessed fidelity, particularly in HIV programmes. The complex donor environment and factors within public health facilities can compromise the fidelity of implementation programmes. This evaluation is one of the few studies examining the implementation fidelity of HIV programmes in urban public health facilities.

CHAPTER 3 – Methods

This chapter describes an overview of the intervention being evaluated, the study design and setting, population, and methodological considerations. Detailed methodological descriptions for each level of the cascade (1st, 2nd, and 3rd 90) and potential moderators are provided in the results chapters.

3.1 The Paediatric and Adolescent Scale-up Project (PASP)

PASP was a multi-partner collaboration designed to improve HIV diagnosis, treatment, and retention in the care of CLHIV and ALHIV in the City of Johannesburg Health District (JHD), South Africa. The project was implemented in seven sub-districts (A-G) of Johannesburg. This study focuses on sub-district F (inner city), specifically examining the 10 public health facilities where the WITS Reproductive Health and HIV Institute (WITS RHI) played a leading implementation role. Table 3.1 provides an overview of the project and its intended patient-level outcomes.

Table 3. 1 Paediatric and Adolescent Scale-up Project summary

Project Description	The Paediatric and Adolescent Scale-up Project (PASP) was designed to achieve paediatric and adolescent 90-90-90 goals in the City of Johannesburg through a multi-partner consortium.
Implementation period	July 2015 – September 2018
Transition period	October 2018 – April 2019
Targeted population	Infants and Children (0–14 years), Adolescents (15–19 years)
Outcome Measures	HIV Case Finding (1st 90) Number and % of children tested HIV-positive Number and % of adolescents tested HIV-positive
	ART initiation (2nd 90) Number and % of HIV-positive children initiated on ART Number and % of HIV-positive adolescents initiated on ART
	Retention and viral load suppression (3rd 90) Number and % of children retained on ART at 12 months Number of children remaining on ART with suppressed viral load Number of adolescents retained on ART at 12 months Number of adolescents remaining on ART with suppressed viral load

Source: PASP proposal document

A Programme Advisor (Paediatric Medical Officer) was responsible for project oversight, implementation, and reporting of PASP. The Strategic Information Manager and Data Capturer were responsible for PASP monitoring and evaluation including data collection, cleaning, and providing patient lists for tracing patients who were not on ART and updating those who were subsequently initiated. The PASP clinical mentor (Professional Nurse), a psychosocial mentor (Social Worker), and linkage officers (Social Auxiliary Workers) facilitated the provision of targeted services to children and adolescents in four of the ten health facilities. Table 3.2 shows the team composition for implementing PASP in Region F.

Table 3. 2 PASP Implementation team composition

Occupation	Gender	Designation
Paediatric Medical Officer	Female	Programme Advisor
Professional Nurse	Male	Quality Improvement Advisor
Professional Nurse	Female	Clinical Mentor
Data Manager	Male	M&E Advisor
Social Worker	Female	Psycho-social Mentor
Social Worker	Female	Data Capturer
Social Auxiliary Worker	Female	Linkage Officer
Social Auxiliary Worker	Female	Linkage Officer
Social Auxiliary Worker	Male	Linkage Officer

Source: PASP annual report: September 2016 – December 2017

3.2 Study setting

The study was conducted in ten health facilities in the inner-city Johannesburg, specifically in Region F sub-district. The City of Johannesburg had a population of 5,428,564, comprising 50.1% females, according to the 2020 estimates (110). Approximately 15% of the city's population resided in Region F sub-district, a uniquely complex and dynamic environment that has undergone significant demographic, social, and economic shifts over the last few decades (110). The inner city is densely populated, encompassing the flatland areas of Hillbrow and Berea, as well as the Johannesburg Central Business District. Figure 3.1 illustrates the distribution of the seven regions in the City of Johannesburg, highlighting the location of Region F sub-

district.

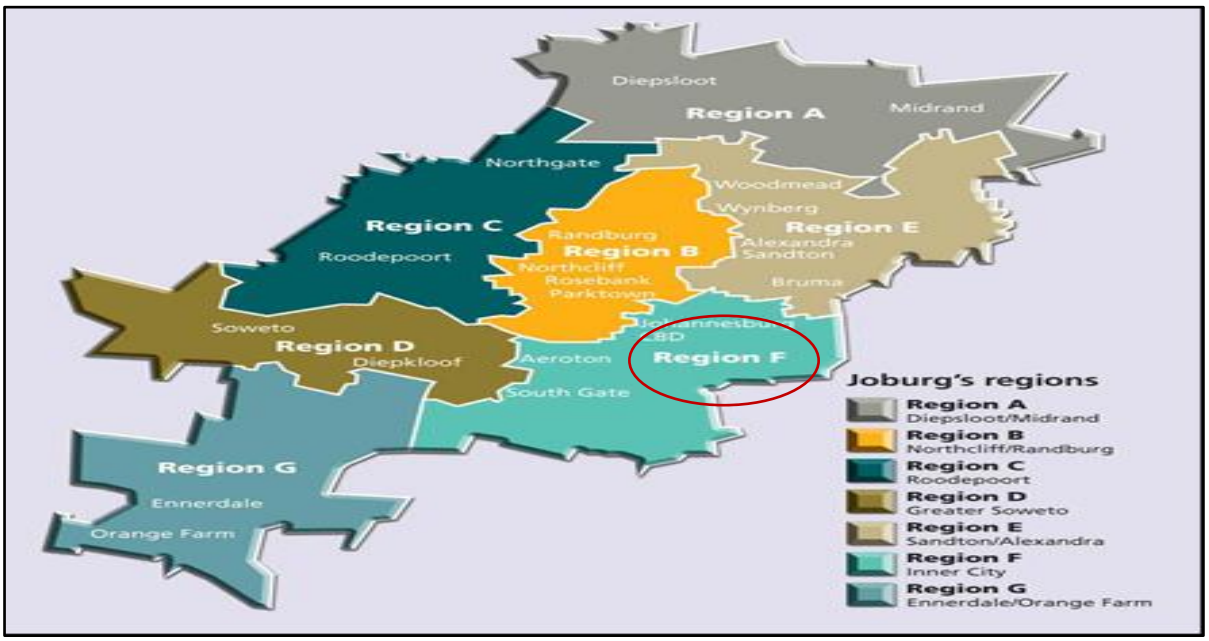

Figure 3. 1 City of Johannesburg Map

Source: https://www.cogta.gov.za Johannesburg district profile, accessed on 07/10/2024

The ten health facilities which included two hospitals, one Community Health Centre (CHC), and seven clinics were prioritized in PASP based on the following criteria:

- High headcount of children under 5 years old
- High volume of adults receiving ART (i.e., more than 2,000 adults)
- High volumes of children receiving HIV care (i.e., a high possibility that children and siblings would be at risk)

Furthermore, the selection criteria included the strategic alignment with available project resources, specifically tapping into support from two concurrent projects operating within the same facilities. By the end of the project, three of the ten facilities were closed due to:

- Two facilities being affected by renovations
- One facility being re-purposed for other government programmes

3.3 Study design

This study was a retrospective evaluation of the Paediatric and Adolescent Scale-up Project (PASP) using an Interrupted Time Series (ITS) design (111,112). The study period spanned from July 2015 to September 2018.

The ITS design is ideal for evaluating routine data, requiring a relatively long time series. It involves a continuous sequence of observations on a population, taken repeatedly over time, usually at regular intervals (daily, weekly, monthly, quarterly, or yearly). The design suits evaluations of real-life interventions, particularly where randomization or control groups are not feasible.

The ITS study design requires adequate time points before and after the intervention, and outcomes that can be observed within a brief period or defined lag. Equally distributed time points before and after the intervention enhance design power. However, this design is susceptible to validity threats including lack of control for time-varying confounders such as seasonality.

The ITS design was chosen due to its: strength in evaluating interventions without randomization or control groups, cost-effectiveness in utilizing routine programme data, high external validity due to real-world setting data collection and ability to assess long-term intervention effects.

There following limitations and considerations are essential when using the ITS design

- Interpreting causal effects with caution due to potential confounders
- Addressing confounding issues to enhance the robustness of the analysis
- Defining model specification and methodological extensions control for confounders

By utilizing the ITS design, this study provides a comprehensive evaluation of the PASP project's effectiveness and implementation fidelity, as opposed to a before and after design. The ITS application is described in Chapters 4 to 7, considering the varying interventions across distinct levels of the cascade.

Qualitative data

This study also assessed implementation fidelity through qualitative and quantitative approaches, evaluating potential moderators and barriers. Participants were purposively selected from 10 health facilities participating in the Paediatric and Adolescent Scale-Up Plan (PASP). This included seven health facility managers and two PASP project implementers (Clinical and Psychosocial mentors). Participants were

chosen based on their roles in implementing or managing PASP activities. Of the initial 10 facilities, three were excluded due to operational closures, and interviews were conducted at the remaining seven facilities.

3.4 Data collection

Quantitative data for evaluating the relative contribution of PASP strategies to routine CLHIV and ALHIV outcome variables were extracted from the District Health Information Software (DHIS) export, Tier.Net[1] database (ART patient management system) export and routine PASP project measurement tools in Microsoft excel (113,114).

The South African National Department of Health (NDoH) uses the DHIS for monthly age-disaggregated health data recorded at the public health facility level. The Tier.Net database is used at the public health facility level to record longitudinal individual HIV-related patient information, including HIV testing, viral load status, laboratory results, and clinical markers.

The project measurement tools contained verified aggregated data at the sub-district and facility level from specific strategies documented monthly from July 2015 to September 2018. HIV case finding and linkage to ART data were routinely captured and cleaned in the PASP measurement tools for analysis by the PASP team. Where applicable, the Thembisa HIV data modelling estimates were used as estimates for the number of CLHIV in the study sites (115). Data for outcome variables were quantified monthly, categorized, and transformed in Microsoft Excel 2016 and then exported into STATA 15 for descriptive and regression analysis. Specific data collection procedures for each strategy and outcome are described in Chapters 4 to 6.

Qualitative data were obtained from the following sources:

- Review of project documents
- Retrospective analysis of patient outcome data
- Patient record review

[1] Tier.Net is a 3-tier approach to monitoring patient level data for ART services that includes a paper-based system (tier 1), an electronic version of the paper register (tier 2), and full electronic medical record software (tier 3).Tier.Net enables health departments to implement one of the three tiers at health facility level

- Interviews with project implementers and health facility managers

Semi-Structured Interviews

The researcher conducted virtual interviews with PASP project implementers and health facility managers. Pre-determined themes included implementation strategies, participant responsiveness, and barriers. Interview guides were pilot-tested and refined based on participant feedback. All interviews were conducted in English, lasting between 30–60 minutes, and were audio-recorded with participant consent. Transcripts were anonymized and cross-checked for accuracy.

3.5 Data management and analysis

Analysis

The analysis of HIV case finding, linkage to ART, retention, and viral load suppression outcomes was conducted using STATA 15, incorporating both descriptive and regression analysis (116). To visualize trends, patterns, and anomalies, data were illustrated through scatter plots and line graphs. Summary statistics, including means, standard deviations, and key characteristics, were calculated to describe data distribution and central tendencies. Findings were presented in tables and graphs, highlighting trends and effects. Data analysis for specific implementation strategies and associated outcomes are described in chapters 4 to 6.

Modelling

Data were modelled using Prais-Winsten iterated (AR) estimates of interrupted time series to predict the effect of implementation strategies on the project outcomes and to specify the effect on post-implementation compared to pre-implementation (117). This model uses the generalized least squares method to estimate the parameters in the linear regression model, assuming errors follow an autoregressive process (118).

Prais-Winsten offers several methods to transform the original observations based on pooled autocorrelation estimates, removing correlation between errors in each observation period and those in the preceding observation period (119). This model inherently tests for autocorrelation using the Durbin-Watson statistic (119). Linear regression analysis (Lincom) was utilized to evaluate trends following the intervention (120). The specific model used in this study is: $Yt = \beta0 + \beta1Tt + \beta2Xt + \beta3XtTt + \varepsilon t$

Where:

- Yt is the outcome measured at each equally spaced time point t
- Tt is the time since the start of the study
- Xt is an indicator variable representing the intervention (0 pre-intervention, otherwise 1)
- XtTt is an interaction term between the intervention variable and time since the start of the study
- β0 is the intercept at the start of the intervention
- β1 represents the trajectory of the outcome until the introduction of the intervention
- β2 is the change in the level of the outcome that occurs in the period immediately following the introduction of the intervention
- β3 is the difference between pre and post-intervention slopes of the outcome
- εt represents the error term

Data analysis for specific implementation strategies and associated outcomes are described in chapters 4 to 6.

Impact model

The choice of impact model in ITS analysis depends on the research hypothesis regarding the intervention's impact on the outcome of interest. Impact models consider two key factors:

- Whether the intervention's effect is immediate or delayed
- The duration of any lag period

This decision is often informed by prior research and understanding of the intervention's mechanisms. Figure 3.2 shows examples of different impact models common in ITS designs, described as:

(a) Level change

(b) Slope change

(c) Level and slope change

(d) Slope change following a lag

(e) Temporary level change

(f) Temporary slope change leading to a level change

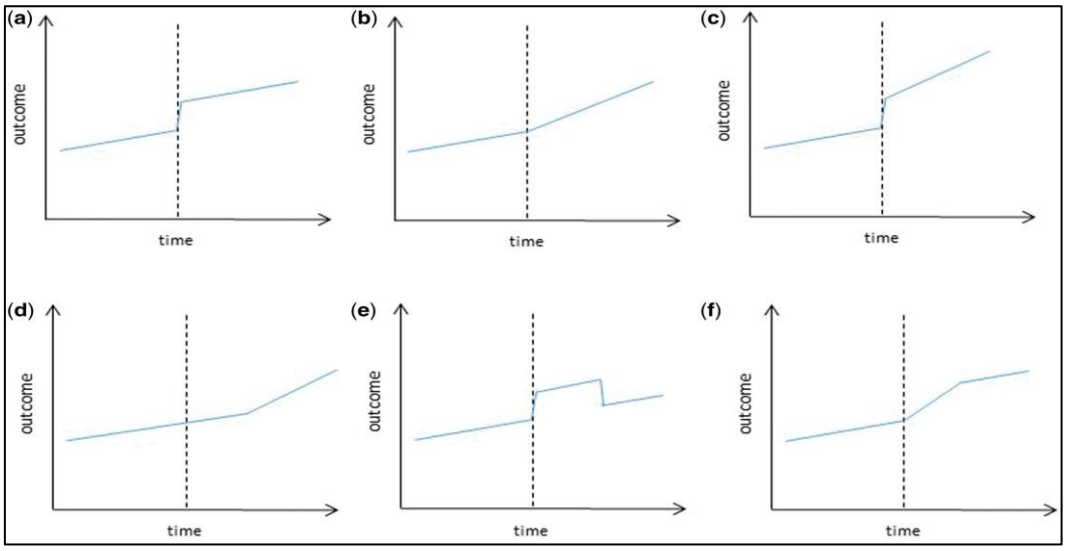

Figure 3. 2 Examples of impact models for interrupted time series design

Source: Bernal, Cummins & Gasparrini, 2017. Interrupted time series regression for the evaluation of public health interventions : a tutorial(118)

In this study, the temporal slope change leading to a level change impact model (f) was chosen based on the following rationale:

- While the official project start was July 2015, capacity-building activities preceding interventions would influence a gradual change in the pre-intervention slope.
- This would be followed by a gradual increase post-intervention and a level change towards the end of the project.

The level change was expected due to the following reasons:

- The interventions were expected to scale down as implementing staff transitioned from the project and saturation was reached.
- This level change was previously observed in routine data from similar projects in Region F, once saturation in targeted facilities was reached or project funding ended.

The PASP project undertook extended administrative activities from inception (July 2015) and technical assistance (training, mentoring, workshops, tools) with gradual phased implementation of strategies from 2016. Figure 3.3 depicts a visual presentation of the projected slope for this study.

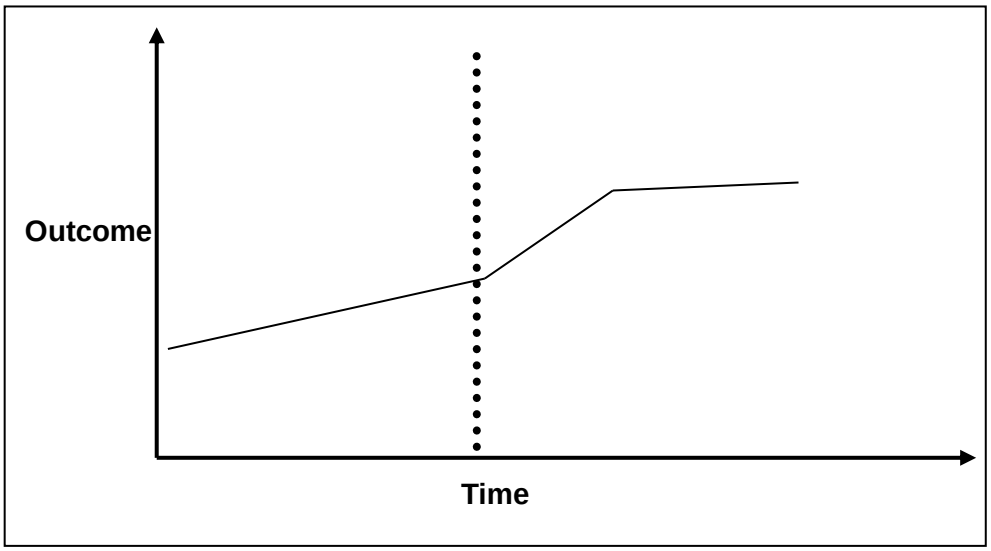

Figure 3. 3 Illustrative projected slope following a lag

Qualitative data analysis

Deductive content analysis was used to identify themes aligned with the study objectives. An iterative coding approach ensured clarity and refinement of codes. Nvivo software was employed for data management and thematic analysis. Trustworthiness was ensured through triangulation of data sources (e.g., interview transcripts, project reports, and patient records) and peer debriefing sessions. Data management and analysis for qualitative data are described further in Chapter 7. Tables 3.3 to 3.5 show the themes derived from the synthesis of project documents and the pre-determined deductive themes from interviews with project staff and healthcare providers

Table 3. 3 Implementation fidelity – concepts from project documents

Theme	Sub-theme
Quality improvement	
Quality improvement initiatives	18 month barometer Paediatric screening tools Hospital forum
Facilitation strategies	
Technical assistance	Training Mentoring NIMART case workbook
HIV management guidelines	Birth PCR testing Universal test and treat
Direct service delivery	DSD hours invested HIV case finding and linkage to ART Retention and viral load super
Barriers to implementation	
	Health worker Health system Patient level Data related

Table 3. 4 Themes to evaluate project staff experience of PASP

Theme	Sub-theme
Intervention	
Implementation strategies	Facility, data driven and community based strategies Clinic support, CLHIV and ALHIV management Implementation challenges - Caregiver, adolescent
Potential moderators	
Planning and service delivery	Direct service delivery and team collaboration Mentoring and clinic support
Management and leadership	District health support - Health provider responsiveness
Quality of services	Quality improvement approaches
Data management and strategic information	File audits for patient management

Table 3. 5 Themes to evaluate health care provider experience of PASP

Theme	Sub-theme
Role of the paediatric and adolescent HIV programme	
Awareness and understanding of PASP	Contribution of PASP to the Paediatric and Adolescent HIV programme Essential strategies implemented through PASP Improvement to PASP implementations Barriers and enablers
Role of health facilities	
Paediatric and Adolescent HIV services	Systems for Paediatric and Adolescent HIV services provision Paediatric and adolescent HIV Service Delivery Stock-outs
Quality Improvement	Quality Improvement (QI) System Assessment and Utilization of Performance Data Documentation in QI activities

Limitations

Patient outcomes are influenced by many factors, including clinical regimens, which were not part of the project's implementation strategies. Therefore, the literature review and methods were limited to the implementation strategies and their possible contribution to HIV outcomes. The confounding effect of factors such as patient experience of regimens was not assessed in this study. However, the study highlighted relevant clinical research studies that informed the project and the study.

Documentation

Several strategies and change ideas were implemented in the project; however, not all strategies had quantifiable process and output data to measure their effect on patient outcomes. Additionally, there was an overlap in the start of implementation strategies, with some starting at the same period, as well as strategies from other projects, which meant that the independent effects of each strategy could be affected.

Data sources

Data were collected from multiple sources (Thembisa estimates, DHIS, Tier.Net, and project measurement tools), which allowed for triangulation but also revealed data discrepancies, which are difficult to manage, unlike data from a single source. While

this was the case, data variability was consistent across all facilities, indicating a level of validity and reliability.

RESULTS

The results are organized into two components:

1. Outcome Evaluation (Chapters 4-6): Assessing PASP's relative contribution to improving 90-90-90 outcomes among children and adolescents:

- Chapter 4: HIV case finding (1st 90)
- Chapter 5: Linkage to ART (2nd 90)
- Chapter 6: Retention and viral suppression (3rd 90)

2. Process Evaluation (Chapter 7): Investigating factors that influenced implementation, project design adjustments, and challenges encountered :

- Moderators of PASP implementation strategies
- Project design adjustments
- Implementation barriers

CHAPTER 4 – Relative contribution of PASP strategies to HIV case finding

4.1 Introduction

HIV case-finding is a gateway to antiretroviral therapy (ART) among PLHIV. Progressive changes in HIV testing guidelines for infants have led to early identification through birth polymerase chain reaction (PCR) testing and other testing schedules for infants. However, despite successful efforts in the Vertical HIV Transmission Prevention (VTP) programme, some CLHIV were missed in previous guideline iterations and remained undiagnosed, particularly those born before 2010 when rigorous HIV testing was implemented.

In the absence of targeted HIV testing strategies, children often present for treatment with advanced clinical and immunological disease (121). The South African ART guidelines require all HIV-exposed infants to be tested at birth, 10 weeks, 6 months, and 6 weeks post-cessation of breastfeeding, followed by a rapid test at 18 months, confirmed with a PCR if positive (122). Early infant diagnosis through birth PCR and subsequent PCR test guidelines are well-adopted in many public health facilities, with high testing rates at birth.

The common predictors of HIV testing include age of consent, gender, level of healthcare, and health provider awareness (30, 66,123). In South Africa and other countries, parental/primary caregiver consent is required for HIV testing of children below 12 years, becoming a barrier for children accompanied to public health facilities by someone other than their primary caregiver. For example, a mixed-method study in Zimbabwe found a 55.3% refusal rate for provider-initiated HIV testing (PICT) with male caregivers and guardians less likely to consent to HIV testing of sick and older children (66).

Consent has been a challenge for community-based index testing as well. In Zimbabwe, Chikwari et al. (124) found caregivers were reluctant to provide consent due to fear of managing treatment if a child tested HIV-positive. The study also found that ART management for children was perceived as burdensome and disruptive in routine care of other siblings, especially for caregivers who were also HIV-positive.
Older children and adolescents have limited HIV testing opportunities outside public health facilities, particularly since Sexual and Reproductive Health (SRH) services

have been poorly implemented in schools (125). HIV testing in schools is complex due to limited mechanisms for managing privacy and disclosure, coupled with low coverage for Adolescent and Youth-Friendly Services (AYFS) in public health facilities, hindering effective case finding among adolescents (96). Older children (5-14 years), adolescents, and males usually exhibit poor health-seeking behaviour compared to females. A Johannesburg study on self-reported HIV testing during Universal Test and Treat (UTT) guidelines reported a low recent clinic attendance rate of 38.2% among males compared to 59.8% among females (126).

There are many barriers to PICT at the point of care in fixed health facilities. PICT was recommended by the World Health Organization before Universal Test and Treat (UTT) implementation in 2016; however, it is not yet fully implemented. A study investigating PICT barriers and facilitators in Ekurhuleni District, South Africa, reported clinical staff do not consider PICT part of their scope. Healthcare providers often conduct PICT based on patient appearance and suspicion. Lay counsellors facilitated HIV testing despite space and recognition challenges (127). Targeted strategies can address challenges caused by lack of service integration, poor access to health, and weak health system building blocks, including staff shortages; however, these strategies are rarely evaluated (65).

4.1.1 Strategies to improve HIV case finding among children and adolescents

Facility-based HIV testing strategies, such as index testing, point-of-care or entry-point testing, and community-based testing modalities, have been recommended (63,67–69). Community-based and facility-based HIV case-finding strategies can improve 90-90-90 target achievement; however, differences between strategies are significant (63). A study conducted by Sharma et al. (63) found community-based strategies had higher HIV testing coverage but lower HIV prevalence (6-11%) compared to facility-based prevalence (18-20%).

PICT is convenient and cost-efficient in health facilities despite consent and health worker willingness challenges. Kranzer et al. (66) found 5.3% HIV positivity among 1,534 children (6-15 years) tested through PICT. Targeted integration of HIV testing into selected child health service delivery points and Family-Centred Approaches using adults living with HIV as index cases have shown higher HIV prevalence (65). Index

testing has been widely implemented to improve HIV diagnosis, with evidence of higher prevalence from this strategy (19,128).

Point-of-care testing at key child entry points and routine testing of infants in paediatric service points can expand coverage for paediatric HIV diagnosis (69). For instance, up to 29% of malnourished children in sub-Saharan Africa were living with HIV in 2015, making nutritional services ideal for case-finding and linkage to care. However, HIV testing of sick children in paediatric points of care was not previously implemented as routine practice (18,129)**.** The UNAIDS Start Free-Stay Free-AIDS Free report (2020) showed that point-of-care testing in five focus countries improved paediatric linkage to antiretroviral therapy (ART) from 30 days to same-day enrolment in care (9). Hospital wards have yielded higher HIV prevalence rates for infants and children, ranging from 8.5% in Malawi, 9.2% in South Africa, and 29% in Uganda and Zimbabwe. Addressing missed opportunities for testing children in hospitals and overcoming barriers is crucial to improve HIV diagnoses at this level of care.

Community-based testing modalities, including home visits, mobile testing, index testing, campaign testing, and self-testing, have gained recognition in recent years (17,69,82,94,123,130). A systematic review of HIV testing strategies found that mobile testing in South African communities resulted in a higher testing rate for males (52%) compared to testing in fixed health facilities (38). Additionally, HIV self-testing kits provided to pregnant women led to a 12-fold increase in male partner testing.

Community Health Workers (CHWs) play a vital role in community-based HIV testing for CLHIV and ALHIV (63,67,68). Although community case finding has higher implementation costs and lower yields, it is effective in remote communities with limited access to fixed health facilities (67,131). Thurman et al. (15), reported a 97% likelihood of HIV testing among Orphans and Vulnerable Children (OVC) who received home visits from community health workers in South Africa.

In Kenya, Njuguna et al. (94) found that financial incentives increased paediatric HIV testing in an urban health facility. The pilot study, conducted among HIV-infected female caregivers, showed improved testing regardless of incentive type (cash, mobile money transfer, or non-cash items like food). Although HIV prevalence among children

was not reported, 73% of caregivers agreed to test their children within two months, compared to 15% without incentives. Financial incentives can thus enhance HIV testing uptake.

Lastly, an optimal mix of effective case-finding strategies is necessary to identify undiagnosed CLHIV and ALHIV and achieve the first 90 goals. The United States Agency for International Development (USAID) and the Centres for Disease Control and Prevention (CDC) recommend prioritizing strategies with higher HIV prevalence among children and adolescents and the lowest cost per newly identified case (7).

4.2 Methods

4.2.1 Study design and setting

This study employed an interrupted time series design (described in Chapter 3) to examine trends among undiagnosed children and adolescents (less than 19 years) in Region F sub-district. The study utilized routine public health data from the District Health Information System (DHIS) and project measurement tools, aggregated over 39 months (July 2015 to September 2018). The study setting consisted of 10 public health facilities (2 hospitals, 1 community health centre, and 2 primary healthcare clinics) and adjacent communities within the sub-district.

Study population

The study population consisted CLHIV (0-14 years) and ALHIV (15-19 years) who accessed HIV testing services between July 2015 and September 2018. This included infants born to HIV-positive mothers during this period who underwent antibody HIV testing.

4.2.2 Data collection

Implementation Data

The study extracted data on HIV case-finding strategies from the project proposal document and three annual project reports (Years 1-3). These documents provided critical insights into strategy implementation, contextual factors, and challenges encountered during project execution

Data Sources and Variables

This retrospective study utilized secondary data from the District Health Information System (DHIS) and PASP project measurement tools to examine HIV testing trends among children and adolescents. DHIS data included pre-defined variables for PCR tests at birth, 10 weeks, 18 months, and HIV tests at 19-59 months and 5-14 years for infant/child HIV testing. Birth PCR test data was only available from April 2016 (hospitals) and August 2015 (CHC). The PASP project measurement tools contained HIV testing data for adolescents (15-19 years) and routine data for implementation strategies. Key variables extracted for analysis included strategy, health facility, gender, age and HIV status.

4.2.3 Data management and analysis

The initial phase of analysis investigated the impact of various implementation strategies on HIV case finding. The analysis encompassed:

HIV testing outcomes:

- Number of children/adolescents tested
- Number and percentage tested HIV-positive per strategy

Birth PCR testing:

- Number of tests performed
- Live births per month

Overall HIV case finding:

- Total number of HIV-positive children/adolescents identified
- Percentage of HIV-positive cases among those tested"

The secondary analytical phase adopted an interrupted time series design to investigate the relationship between implementation strategies and HIV-positive outcomes among CLHIV and ALHIV. Specifically, Prais-Winsten estimation identified associations between implementation strategies and outcome variables.

Regression modelling (Prais-Winsten, Cochrane-Orcutt) assessed the effectiveness of implementation strategies, controlling for autocorrelation with Durbin Watson statistics. Results were presented in tables and graphs, including: Coefficients, Standard errors, R-squared (R^2) and adjusted R-squared (ARs), 95% confidence intervals (CIs) and p-values ($p < 0.05$ significance threshold).

4.3 Results and Discussion

4.3.1 Strategies to improve HIV case finding among CLHIV and ALHIV

Strategies were selected based on available literature for the highest possible yield as opposed to non-targeted testing. Consultations were also held with the Department of Health (DoH), and other programme teams within the Region F sub-district.

In the first year of the project (July 1015 – September 2016), the project focused on establishing baseline performance and setting targets for HIV testing, while the second year (October 2016 – December 2017) was focused on full implementation, hospital engagement and improved reporting. The final year of the project (January – September 2018) focussed on transition and sustainability.

Table 4.1 shows the implementation strategies for HIV case finding, definitions, and implementation timelines using the modified recommendations for defining implementation strategies (Proctor et.al, 2007).

Table 4. 1 Overview of PASP implementation strategies for improving HIV case finding among undiagnosed children and adolescents

Strategies	Definition	Actor(s)	Action(s)	Action target(s)	Period
Index case finding					
Adult/child/ partner index testing	Eliciting and offering HIV tests to contacts of PLHIV	Linkage officers	Elicit and test undiagnosed consenting contacts of PLHIV	All eligible contacts with consent for an HIV test	January 2017– June 2018
Case finding in key entry points					
Child key entry point testing:* EPI, IMCI, PHC	HIV tests offered to caregivers of children at EPI, IMCI, and PHC service points	Nurses, Linkage officers	Nurses offer HIV testing and/or refer patients to linkage officers for testing on consultation	All children of unknown HIV status receiving services at child entry points	June 2016– December 2017
Adolescent key entry point testing: Family Planning, AYFS	HIV tests offered to adolescents attending family planning and AYFS service points	Nurses, linkage officers	Nurses offer HIV testing after consultation and/or refer consented adolescents to a linkage officer for testing	All adolescents of unknown HIV status attending services at adolescent entry points	June 2016 - December 2017
Case finding in the community					
Strengthen two-way referral (facility ◄► community)	Testing of patients at community level and referral for health and psychosocial services	Linkage officers, Community Health Workers	Testing children and adolescents through community modalities and referring them to the clinic for ART initiation	All patients who tested HIV-positive were escorted to the nearest clinic for ART initiation	January 2016 – May 2018
Testing of Orphans, Vulnerable Children, Adolescents and Youth (OVCAY)	Recruitment of children and adolescents from Community-based Organizations (CBOs) that provide services to orphaned and vulnerable children	Community health workers	Collaboration with CBOs to find undiagnosed CLHIV and ALHIV through the OVCAY health screening	All undiagnosed OVCAY accessing community services offered an HIV test, with consent from parents	Not implemented in Region F

Mobilization in schools	Approach schools with outreach nurses to mobilise learners to come for HIV services at clinics on selected days	Community Health Workers	Mobilise children and adolescents in schools to come for health services (including HIV tests) on selected days at health facilities	All children and adolescents with consent who come for their appointments in health facilities	Not implemented in Region F

* Expanded Immunization Programme (EPI), Integrated Management of Childhood Illnesses (IMCI), Primary Health Care (PHC)

Index testing, child and adolescent key entry point testing and community-based testing were key strategies for achieving the outcome for HIV case finding. Implementation approaches for index case finding included eliciting contacts from HIV-positive patients in the adult or child clinics and partners of adolescents.

For key entry point testing the initial approach was to train and mentor staff at child and adolescent entry points to identify opportunities and offer HIV testing to at-risk patients and later infused with direct service delivery from project staff to increase the reach.

The community-based strategy involved strengthening a two-way referral mechanism between public health facilities and communities, testing orphans and vulnerable children and adolescents, as well as mobilising in schools for HIV testing. This was done in collaboration with outreach teams from the department of health. Figure 4.1 illustrates PASP's theory of change for increasing HIV case finding among undiagnosed CLHIV and ALHIV.

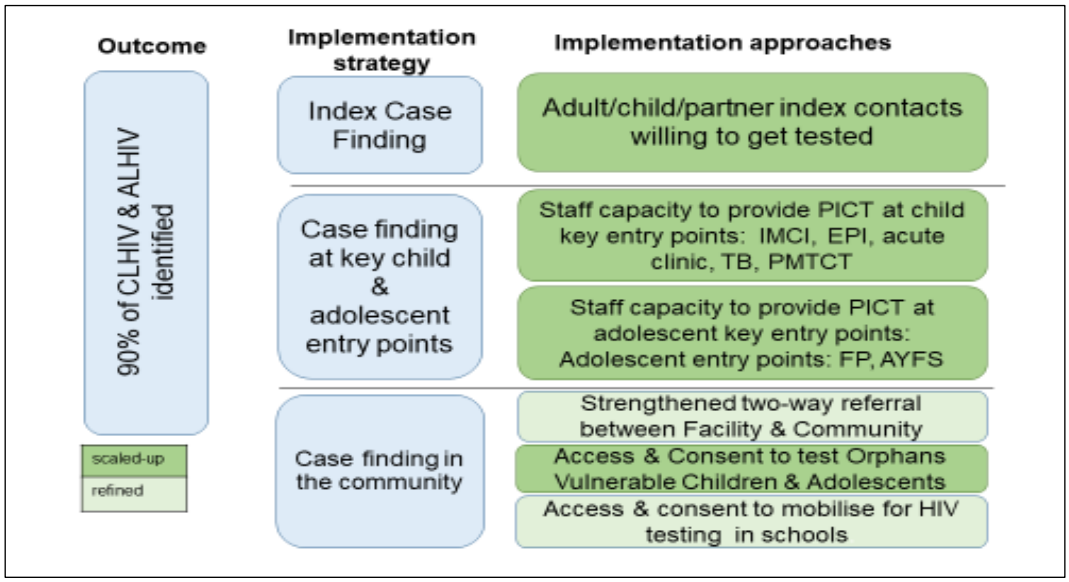

Figure 4. 1 PASP theory of change for HIV case finding

Source: PASP Theory of change

Some of the implementation approaches: two-way referral and mobilization in schools had to be refined by the end of the project, as they were not ready to be scaled up as shown in figure 4.1. HIV testing at centres for Orphaned, Vulnerable Children, Adolescents and Youth (OVCAY) and mobilization in schools were not implemented in Region F and therefore data were not available.

CLHIV and ALHIV data from the index testing, key entry point testing and community testing measurement tools were analysed and stratified by strategy, age and HIV test result to evaluate contribution of each strategy to HIV case finding. The yield was calculated as a proportion of HIV-positive patients from those HIV tested. Table 4.2 summarises HIV case finding outcomes from the implemented strategies.

Table 4. 2 HIV case finding strategy outcomes among children and adolescents

	Children (0 – 14 years)		Adolescents (15 – 19 years)	
Strategy	HIV tested (n)	HIV positive (n), yield (%)	HIV tested (n)	HIV positive (n), yield (%)
Index case finding	1,745	57 (3.3%)	56	2 (3.6%)
Key entry point case finding	384	5(1.3%)	2,174	128 (5.9%)
Community case finding	367	4 (1.0%)	735	10 (1.3%)

Source: PASP project measurement tools

Table 4. 2 shows that adolescents accounted for the highest HIV positive rates across all strategies. Among children, index case finding showed the highest yield (3.3%) from 1,745 who were tested, followed by key entry point case finding (1.3%). Community testing had the least yield (1.0%) among 367 children tested for HIV.

At key entry points a high number of adolescents were tested (2,174) with a yield of 5.9% reached, followed by index case finding where few adolescents were tested (56) reaching a yield of 3.6%. The lowest yield among adolescents was from community case finding (1.3) however there were more adolescents tested (735) and found HIV positive (10) in community compared to index case finding.

Index case finding

Index case finding was implemented from January 2017 to June 2018 as a quality improvement initiative to enhance HIV case finding. This strategy involved screening household members of HIV-positive adults, yielding promising results for identifying undiagnosed CLHIV and ALHIV. Initial phone-based recruitment was replaced with health facility-based recruitment, leveraging: ART clinics, Adherence clubs, and Primary Health Care and TB clinics. This strategic shift improved identification of undiagnosed CLHIV and ALHIV.

A retrospective analysis of index testing database records (N = 2,491) was conducted to assess HIV case finding among paediatric and adolescent populations recruited through index testing in the study sites. The analysis involved:

i) Data cleaning: removing duplicates (70)
ii) Data summarization: aggregating records by age, service point, and HIV test result
iii) Variable extraction: recruitment date, Facility, File number, Age, Parent recruitment source and HIV test result (reactive/non-reactive)

The analytical sample comprised 1,801 records, excluding 1,163 patients with already known HIV status those with missing information (n = 12). The yield was calculated as a proportion of HIV positive patients from those HIV tested. Table 4.3 shows the index case finding outcomes among individuals recruited from each service point.

Table 4. 3 HIV case finding outcomes at index recruitment points in 8 public health facilities

	CLHIV and ALHIV(0- 19 years)		
Service point	HIV tested (n)	HIV-positive (n)	Yield (%)
Adult ART clinic	21	3	14.2 %
Adherence club	1,295	50	3.8%
Primary Health Care	70	1	1.4%
Other*	392	5	1.2%
TB Clinic	23	0	0.0%
Total	1,801	59	3.3%

*EPI, IMCI, Family Planning, I-ACT support group, key populations

Source: PASP project measurement tool

The results in table 4.3 show a 3.3% overall HIV positivity rate among 1,801 individuals tested for HIV, with variations in HIV prevalence across service points. Individuals tested from adult ART clinics and adherence clubs had higher HIV positivity at 14.2% and 3.8% respectively, although the patients recruited through the adult ART clinic were fewer. The primary health care yield was 1.4% with one HIV positive diagnosis while other service points had a yield of 1.2%. There were no HIV-positive CLHIV and ALHIV diagnosed from TB clinics which also had a very low number of children tested.

The index case finding data were subsequently stratified by health facility to facilitate a more nuanced analysis. Index case finding was implemented in 8 of the 10 study sites (excluding hospitals), and two community shelters close to Rossetenville clinic. The yield was calculated as a proportion of HIV positive patients from those HIV tested. Table 4.4 shows index case finding in each health facility.

Table 4. 4 Index HIV case finding outcomes by health facility

	CLHIV and ALHIV(0- 19 years)		
Health facility	HIV tested (n)	HIV-positive (n)	Yield (%)
Hillbrow CHC(TA++)	214	38	17.8%
Joubert Park clinic(TA)	47	4	8.5%
Jeppestown clinic(TA++)	95	5	5.3%
80 Albert street clinic (TA)	112	3	2.7%
Malvern clinic (TA++)	114	2	1.8%
Yeoville clinic (TA++)	244	2	0.8%
Rossetenville clinic (TA)	253	1	0.4%
Esselen Street Clinic(TA)	12	0	0.0%
*Other	710	4	0.6%
Total	1,801	59	3.3%

*Community shelters

Source: DHIS, PASP project measurement tool

The highest number of children and adolescents were tested in Rossetenville clinic (253) with one HIV positive, Yeoville clinic (244) with two HIV positive and Hillbrow CHC (214) with 38 HIV positive. Hillbrow CHC demonstrated the highest HIV positivity rate of 17.8%, followed by Joubert Park clinic at 8.5% and Jeppestown clinic at 5.3%, highlighting varying yields across the health facilities. Esselen Street clinic faced operational challenges, remaining closed for over 24 months, resulting in limited testing and no identified HIV-positive cases. Community shelters also yielded less than1% of HIV test positive patients. Targeted index case finding efforts demonstrated potential for identifying undiagnosed HIV cases, particularly in high-prevalence areas like Hillbrow CHC.

Key entry point testing

HIV testing's integration into existing key services – such as family planning, immunization programmes, and primary health care – facilitated HIV testing and case identification. Key entry point testing demonstrated potential for early HIV detection and intervention, particularly among vulnerable adolescent populations. The 5.9% HIV positivity rate among adolescents underscores the critical need for targeted interventions and support services tailored to this demographic. The success of adolescent key entry point testing was bolstered by collaborative efforts with the Adolescent Innovations Project, enhancing reach and impact.

Paediatric key entry points included: Integrated Management of Childhood Illness (IMCI), Expanded Programme for Immunization (EPI), and Primary Health Care (PHC). Adolescents key entry points included: Family Planning (FP), AYFS, and support groups implemented in collaboration with the Adolescent Innovations Project. The programme team selected entry points based on the assumption that undiagnosed CLHIV and ALHIV were most likely to be diagnosed at these service points. Project staff (nurses, linkage officers, medical officer) delivered direct services at key entry points, supplementing facility staff, reducing wait times, and enhancing HIV testing.

Monthly key entry point testing data were aggregated to calculate the cumulative number of HIV-positive children and adolescents identified during the project period. The yield was calculated as a proportion of HIV positive patients from those HIV tested. Table 4.5 shows the HIV case finding in each of the key entry points.

Table 4. 5 HIV case finding outcomes at key entry points in 8 health public facilities

	CLHIV and ALHIV(0- 19 years)		
Key entry point	HIV tested (n)	HIV-positive (n)	Yield (%)
Child - EPI	259	3	1.2%
Child - IMCI	67	1	1.5%
Child - PHC	58	1	1.7%
Children (0–14 years)	384	5	1.3%
Adolescents (15 –19 years)	2,174	128	5.9%
Total (0 – 19 years)	2, 558	133	5.1%

Source: PASP project measurement tool

Over 2,500 children and adolescents underwent HIV testing through key entry points, with a notable 5.1% testing positive. The highest yield came from adolescent key entry points (5.9%). The data shows a disparity between adolescent and paediatric key entry point testing, with 5.9% and 1.3% positivity rates, respectively. Immunization clinics (EPI) had the highest number (259) of children tested, however adolescent had the highest overall HIV tests and yield, at key entry points.

Data for adolescents were not disaggregated by the entry points, however, the findings from the review of project reports (July 2015–September 2017) highlighted that the family planning entry point had the highest yield (14%) followed by yield ranging from 3.6% to 10% in the AYFS clinics among the 10–19 year old group. Where data were stratified for the 10–14 year old group the yield was found to be lower (2–3%) and fewer individuals in this age group were coming to health facilities in the targeted key entry points. More adolescents (15–19 years) were seen to independently access health facilities without being accompanied by adults, than those below the age of 15 years.

Community–based HIV case finding

Between January 2016 and May 2018, a community-based HIV testing programme was implemented over 29 months, leveraging a partner organization's expertise in community outreach. In year two, innovative HIV testing campaigns targeting school-going children and adolescents (5-14 years) were launched on Saturdays and weekdays around Yeoville Clinic, strategically located near high foot traffic areas. Further hotspot targeting was informed by analysis of HIV yield data from direct service delivery.

Region F's primary community-based HIV case finding modality was the Family Wellness Day initiative, aimed at creating a stigma-free environment for HIV testing. Held in a public park adjacent to a PASP-supported health facility, these campaigns provided an integrated wellness package comprising:

- HIV Testing and TB screening for children and adults
- Blood pressure and diabetes screening
- Eye testing (in partnership with optical care providers)
- Screening for cervical cancer (women) and prostate cancer (men)
- Health screening for children (height, weight, hearing, nutritional assessment)

Aggregated data from the community testing project measurement tool were categorized by age and gender trends, and summarized to examine HIV outcomes. The yield was calculated as a proportion of HIV positive patients from those HIV tested. The findings, presented in Table 4.6, illustrate the demographic distribution of HIV case finding achieved in community-based settings.

Table 4. 6 HIV case finding outcomes in community settings

	CLHIV and ALHIV (0- 19 years)		
	HIV tested (n)	HIV test positive (n)	Yield (%)
Age			
19 – 59 months	169	2	1.2%
5 – 14 years	198	2	1.0%
15 – 19 years	765	10	1.3%
Gender			
Male	432	0	0.0%
Female	670	14	2.1%
Total	1,102	14	1.3%

Source: PASP project measurement tool

The community-based testing strategy reached 1,102 children and adolescents, with adolescents comprising the majority of those tested. The testing yield revealed an overall HIV prevalence of 1.3%, with 14 cases identified. Similar to index and key entry point testing, with fewer children testing positive compared to adolescents.

Testing of Orphans, Vulnerable Children, Adolescents and Youth (OVCAY)

The OVCAY initiative aimed to facilitate HIV testing and linkage to care for children and adolescents through a health screening project. Community-Based Organizations (CBOs) working with vulnerable populations were intended to lead this strategy in various regions. However, in Region F, the absence of suitable CBOs necessitated alternative implementation approaches. Project reports from October 2016 to December 2017 revealed significant implementation barriers in other regions, primarily attributed to inadequate involvement of Department of Health Ward-Based Outreach Teams (WBOT), resulting in limited coverage.

Mobilization in schools

To expand reach to school-aged children and adolescents not typically accessing health facilities for routine services like immunizations or family planning, this strategy leveraged partnerships between health facilities and schools. Health facilities identified schools linked to outreach nurses, facilitating access for counsellors to mobilize students outside school premises and encourage them to access services, including HIV testing, at clinics on designated days. However, implementation in Region F was hindered by challenges in securing school access.

4.3.2 Effect of HIV case finding strategies on among CLHIV and ALHIV identified

This analysis included 28,058 children and 8,485 adolescents who received HIV testing between July 2015 and September 2018. Of these, 570 children and 546 adolescents were newly diagnosed with HIV. The outcome of interest was the number of CLHIV and ALHIV newly diagnosed HIV positive and target achieved. The yield was calculated as a proportion of HIV positive patients from those HIV tested. The percentage of target achieved was calculated using HIV positive individuals as a proportion of the project target. Table 4.7 shows the HIV case finding against targets among children and adolescents.

Table 4. 7 HIV case finding outcomes among children and adolescents

	CLHIV and ALHIV(0- 19 years)					
Age	HIV tested (n)	% of total HIV tested	HIV-positive (n)	Yield (%)	Project target (n)	Project target achieved (%)
<18 month	11,078	30,3%	212	1.9%	54	392,6%
18–59 month	13,478	36,9%	174	1.3%	229	76,0%
5–14 years	3,502	9,6%	184	5.3%	960	19,2%
15–19 years	8,485	23,2%	546	6.4%	1,872	29,2%
Total	36,543	100%	1,116	3.0%	3,115	35.8%

Source: DHIS, PASP project measurement tool

A total of 36,543 children and adolescents underwent HIV testing, resulting in 1,116 positive cases and an overall positivity rate of 3%. The 18-59 months age group accounted for the highest HIV tests (36.9%), while the 5-14 years age group had the lowest (9.6%). With regards to HIV positivity, adolescents and older children exhibited

higher positivity rates (6.4% and 5.3%, respectively) compared to infants and younger children (1.9% and .1.3% respectively).

The project aimed to identify 3,115 HIV cases among CLHIV and ALHIV, but achieved 35.8% of this target by its conclusion. The 39-month project targets for HIV testing among various age groups revealed varying degrees of success. Adolescents (15-19 years) and children (5-14 years) had limited target achievement (29.2% and 19.2%, respectively), whereas younger children (18-59 months) and infants (<18 months) showed more promising results (76% and 392.6% target attainment).
Figure 4.2 illustrates the monthly performance trends against targets.

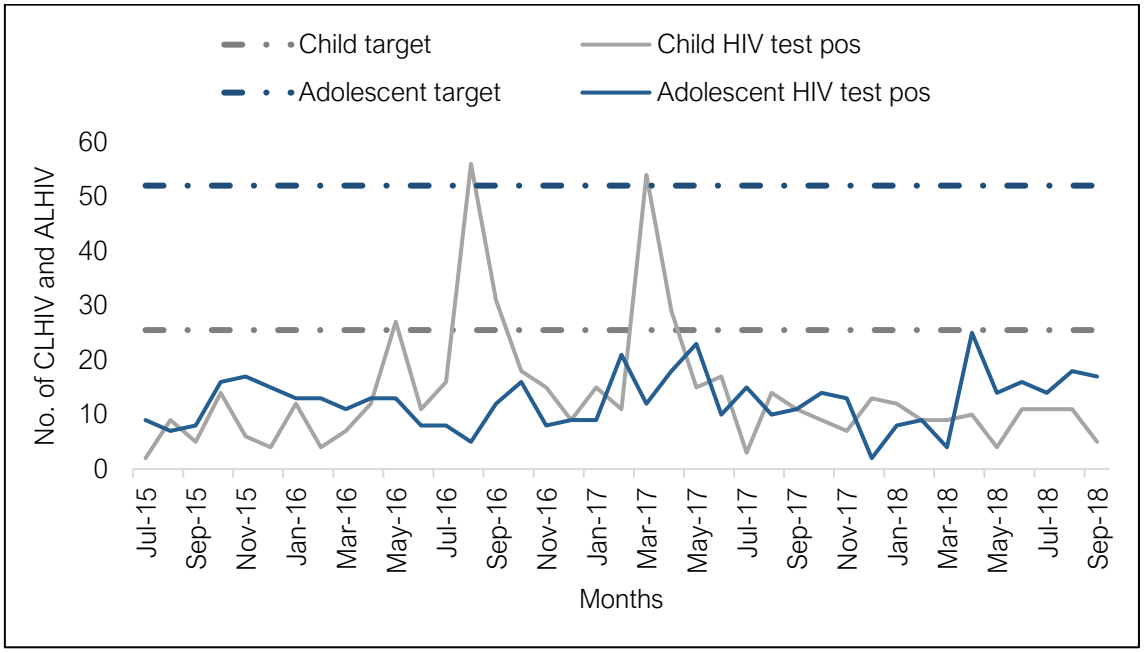

Figure 4. 2 Monthly HIV case finding against project targets

Source: PASP project measurement tool

The monthly HIV case test positive target for children was 26 and 52 for adolescents. Among children, the monthly target was only achieved in three out of 39 months (May 2016, August 2016 and March 2017), while monthly targets were not achieved at any given month in the series for adolescents.

HIV testing was predominantly conducted in health facilities, including those receiving TA and DSD (TA^{++}), TA-only facilities, a tertiary hospital, and a district hospital. Data stratification focused on children aged 18 months to 14 years, excluding those under 18 months due to repeated testing at early developmental milestones. Data for ALHIV

was not stratified by type of health facility. The yield was calculated as a proportion of HIV positive patients from those HIV tested. Table 4.8 illustrates the distribution of HIV-positive children by health facility type.

Table 4. 8 HIV case finding outcomes by facility type

	Children (18 – 59 months)			Children (5 – 14 years)		
Facility type	HIV tested (n)	HIV-positive (n)	Yield (%)	HIV tested (n)	HIV-positive (n)	Yield (%)
TA++ (n=4)	10,637	113	1.0%	2,828	95	3.3%
TA only (n=4)	2,372	29	1.2%	216	17	7.8%
District Hospital	279	18	6.4%	359	33	9.1%
Tertiary Hospital	190	14	7.3%	99	39	39.4%
Total	13,478	174	1.3%	3,502	184	5.2%

Source: DHIS, PASP project measurement tool

The total number of young children 18 – 59 months tested for HIV was 13,478 with 174 HIV positive and a yield of 1.3%. There were fewer older children tested (3,502), however more HIV positive identified (184) and a higher yield of 5.2%. A high number of children were tested in the TA^{++} health facilities (10,637 and 2,828) while very few were tested at the tertiary hospital (190 and 99). The TA only facilities tested a higher number of younger children (2,372) compared to 216 in the 5–14 year age group. The HIV positivity among younger children 18 – 59 months ranged from 1% at TA^{++} facilities, 1.2% in TA only, 6.4% at the district hospital to 7.3% at the tertiary hospital. Among the 5–14-year old children, the HIV positivity ranged from 3.3% at TA^{++} facilities, 7.8% in TA only facilities, and 9.1% at the district hospital to 39.4% at the tertiary hospital. However, few children were tested at the hospital compared to other facilities.

Routine HIV testing data, were analysed to describe distribution in monthly HIV case finding from the start of the project in July 2015 to the end of the project in September 2018 over a 39 month time series. The outcome of interest was the HIV positive children and adolescents per month. The yield was calculated as a proportion of HIV positive patients from those HIV tested. Table 4.9 shows the descriptive summary of the monthly HIV case finding among CLHIV and ALHIV.

Table 4. 9 Descriptive summary of monthly HIV case finding among children and adolescents

Variable	Mean	Std. Dev.	Variance	Skewness	Kurtosis	Min.	Max.
HIV tested (n)							
Children	719.435	352.481	124243.3	-.142	2.036	105	1,353
Adolescents	217.564	82.038	6730.358	1.025	3.739	98	455
HIV test positive (n)							
CLHIV	14. 615	11.875	141.032	2.284	8.356	2	56
ALHIV	14	4.255	18.105	.367	3.373	4	25
Yield (%)							
CLHIV	.024	.019	.000	1.423	3.956	.002	.075
ALHIV	.072	.032	.001	.926	3.463	.013	.158

Source: DHIS, PASP project measurement tool

Table 4.9 presents the average monthly HIV testing, with 719 tests estimated among children and 217 among adolescents. However, the monthly testing numbers fluctuated substantially for children, ranging from 105 to 1,353, and adolescents ranging from 98 to 455, which was also reflected in the HIV test positive data.

For HIV test positivity, an average of 15 CLHIV new cases (SD: 11.875) were diagnosed monthly and 14 among ALHIV (SD: 4.255). The number of positive cases varied widely, from a minimum of 2 to a maximum of 56 for CLHIV and 4 to 25 for ALHIV. The average yield among children was less than 3% percent for children and less than 8% among adolescents. The maximum yield was above 7% among child and above 15% among adolescents.

The HIV test positive data for CLHIV indicated a non-normal distribution (skewness: 2.284, kurtosis: 8.356). In contrast, HIV test positive data for ALHIV followed a normal distribution pattern (skewness: 0.367, kurtosis: 3.373).
These trends are visually represented in Figure 4.3

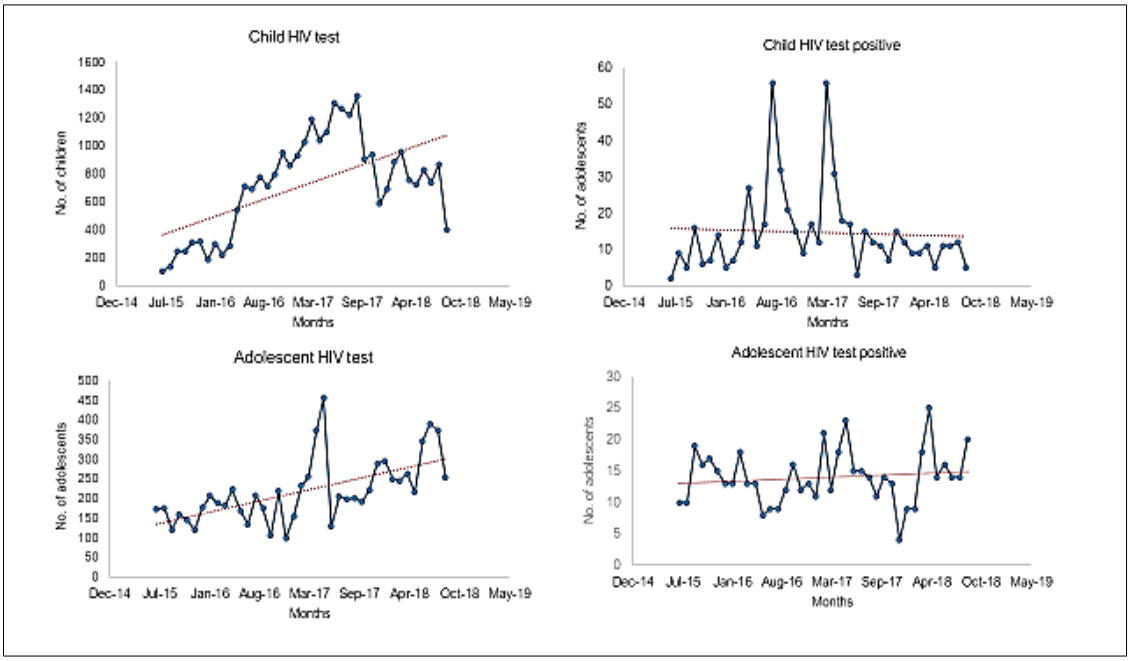

Figure 4. 3 Trend in HIV testing and HIV positivity among children and adolescents

The run chart for child HIV test shows a steady upward trend in HIV testing numbers from July 2015 and steep decline from September 2017. The child HIV test positive run chart on the other hand shows that, the number of HIV-positive cases slightly decreased over the project period. Two major spikes were observed: August 2016 and March 2017, attributed to data cleaning efforts which led to the identification of 56 positive cases in August 2016 and 52 in March 2017. The lowest number of HIV positive children (2) were identified in July 2015 while the maximum (56) were identified in August 2016.

The adolescent HIV testing run chart shows a steady increase in HI testing numbers over the project period, with a consistent rate of HIV-positive cases. However, some fluctuations were observed: May 2017 saw a significant surge in testing (455) and positive cases (23). In contrast, December 2016 had the lowest testing rate (98), yet still identified 13 positive cases. Additionally, December 2017 recorded the fewest positive cases (4), while April 2018 saw the highest number (25).

To estimate whether HIV case finding strategies: index case finding, case finding in key entry points, had an effect on HIV positivity, data were modelled using Prais Winsten estimates in Stata 15. These HIV case finding strategies were included in the model:

- Index case finding : pre implementation period (July 2015 to December 2016), post implementation period (January 2017 to June 2018)
- Key entry point case finding: pre implementation period (July 2015 to May 2016), post implementation period (June 2016 to December 2017)
- Community case finding: pre implementation period (July 2015 to December 2015), post implementation period (January 2016 to May 2018)

Table 4.10 shows the effect of the three strategies on HIV positivity among children and adolescents.

Table 4. 10 Effect of case finding strategies: Prais-Winsten AR (1) regression iterated estimates

	Child HIV test positive				Adolescent HIV test positive			
	Coef.	Std. error	P - value	95% CI	Coef.	Std. error	P - value	95% CI
Index case finding	.932	5.663	0.87	(-10.56 to 12.44)	1.352	1.822	0.46	(-2.35 to 5.06)
Key entry point case finding	8.773	5.587	0.13	(-2.67 to 20.22)	-.366	1.876	0.47	(-5.21 to 2.48)
Community case finding	9.190	6.836	0.19	(-4.72 to 23.10)	-.729	2.448	0.77	(-5.71 to 4.25)

Source: PASP project measurement tool

The results in Table 4.10 indicate that Index case finding was not significantly associated with HIV positivity among children (p-value=0.87, 95% CI: [-10.58 to 12.44]) or adolescents (p-value=0.46, 95% CI: [-2.35 to 5.06]). The Durbin-Watson statistic revealed no autocorrelation for either children (1.99) or adolescents (1.98), no corrections were made.

Key entry point testing also showed no significant association with HIV positivity among children (p-value=0.13, 95% CI: [-2.67 to 20.22]) or adolescents (p-value=0.47, 95% CI: [-5.21 to2.48]), and a negative co-efficient was observed among adolescents (-.366). Durbin-Watson statistic indicated limited autocorrelation for children (1.94) and adolescents (1.81), no corrections were made.

Lastly, community-based HIV case finding was also not significantly associated with HIV positivity among children (p-value=0.19, 95% CI: [-4.72 to 23.10]) or adolescents (p-value=0.77, 95% CI: [-5.71 to 4.25]) and a decline in the co-efficient was observed

among adolescents (-.729) although not significant. Durbin-Watson statistic revealed no autocorrelation for children (1.95) and limited autocorrelation for adolescents (1.93), no corrections were made. The community HIV case finding strategy was implemented merely seven months after the project's commencement (January 2016), with a subsequent post-intervention period spanning 29 months (January 2016 to May 2018). However, this strategy yielded relatively few HIV diagnoses among children and adolescents (n=14). Given these circumstances, it was deemed unnecessary to conduct further interrupted time series analysis (ITSA) to assess the impact on the level and trend of HIV-positive cases identified through this strategy.

Index case finding

ITSA was conducted to compare HIV positivity rates before and after the implementation of index case finding. The analysis focused on children testing HIV positive as the outcome variable. The intervention period commenced in January 2017 (month 19). The ITSA model employed a single-group design. The model was estimated using the Prais-Winsten and Cochrane-Orcutt methods with a one-lag specification to account for autocorrelation. The time series spanned 36 months, from July 2015 to June 2018. Table 4.11 presents the results of the ITSA, highlighting the effect of index case finding on HIV positivity among children and adolescents before and after implementation.

Table 4. 11 Effect of index case finding on CLHIV and ALHIV test positive: Prais-Winsten AR (1) regression - iterated estimates

	Child HIV test positive				Adolescent HIV test positive			
	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P-value	95% CI
Pre-intervention intercept	4.894	3.110	0.13	(-1.44 to 11.23)	13.930	2.090	0.00	(9.67 to 18.19)
Pre-intervention slope	1.181	.567	0.045	(.03 to 2.34)	-.092	.184	0.67	(-.47 to .28)
Intervention intercept change	-1.142	10.756	0.92	(-23.05 to 20.77)	2.472	3.204	0.45	(-4.05 to 9.00)
Post-intervention slope	-2.337	.864	0.01	(-5.00 to -.58)	.063	.365	0.86	(-.68 to .81)
Post intervention linear trend	-1.156	.610	0.07	(-2.40 to .09)	.029	.305	0.92	(-.65 to .59)

As shown in Table 4.11, among children tested HIV positive, the pre-intervention intercept was estimated at 4.894 (p-value=0.13, 95% CI: [-1.44 to11.23]). The pre-intervention slope indicated a significant increase in HIV case finding at a rate of 1.181 per month (p-value=0.045, 95% CI: [.03, 2.34]) before index case finding implementation.

In the first month of implementation, the number of children tested HIV positive decreased at a rate of 1.142 per month (p-value=0.92, 95% CI: [-23.05 to 20.77]), followed by a significant decline at a rate of 2.337 per month (p-value=0.01, 95% CI: [-4.01 to -0.58]) post-intervention. The post-intervention linear trend showed a marginally significant decline in HIV positivity at a rate of 1.156 per month (p-value=0.07, 95% CI: [-2.40 to 0.09]). The Durbin-Watson statistic (1.940) indicated limited autocorrelation for children HIV test positive and no corrections were made.

Among ALHIV, the pre-intervention intercept was estimated at 13.930 (p-value<0.001, 95% CI: [9.67 to 18.19]). The pre-intervention slope showed a decline in HIV case finding at a rate of .092 per month (p-value=0.62, 95% CI: [-.47 to .28]). In the first month of implementation, there was a non-significant increase of 2.472 HIV-positive

adolescents per month (p-value=0.446, 95% CI = -4.053, 8.998]), followed by a decline at a rate of .063 per month (p-value=0.864, 95% CI = [-.682, .808]). The post-intervention linear trend showed a non-significant decrease in HIV positivity at a rate of 0.03 per month (p-value =0.92, 95% CI: [-.65to .59]). Durbin-Watson statistic (1.91) indicated limited autocorrelation for adolescents HIV test positive.

Figure 4.4 provides a visual representation of these results.

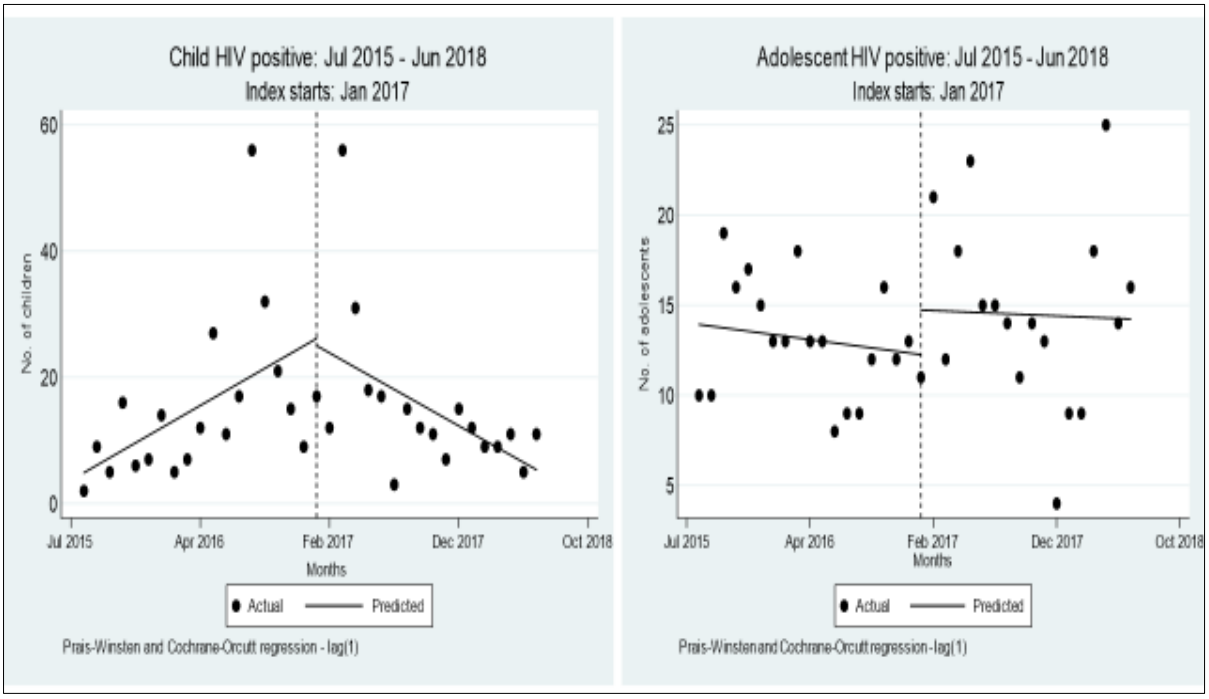

Figure 4. 4 Interrupted time series analysis: effect of index case finding on HIV positivity among children and adolescents

HIV case finding in key entry points

Similar to index HIV case finding, data were examined to determine whether introducing key entry point testing led to changes in the level and trend of HIV-positive cases identified among children and adolescents compared to the pre-intervention period. The intervention period commenced in June 2016 (month 12). The ITSA model employed a single-group design. The model was estimated using the Prais-Winsten and Cochrane-Orcutt methods with a one-lag specification to account for autocorrelation. The time series spanned 30 months, from July 2015 to December 2017. Table 4.12 shows the Prais-Winsten AR (1) regression estimates for HIV case finding in key entry points for children and adolescents.

Table 4. 12 Effect of Key Entry Point Testing on CLHIV and ALHIV Identified: Prais-Winsten AR (1) Regression - Iterated Estimates

Key entry point	Child HIV test positive				Adolescent HIV test positive			
	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P-value	95% CI
Pre-intervention intercept	3.785	2.859	0.20	-2.09 to 9.662	13.279	2.446	0.000	8.25 to 18.31
Pre-intervention slope	1.276	.665	0.07	-.09 to 2.65	.196	.360	0.59	-.54 to .936
Intervention intercept change	9.562	9.400	0.32	-9.76 to 28.89	-3.025	2.857	0.30	-8.89 to 2.85
Post-intervention slope	-2.137	.882	0.02	-3.95 to -.32	-.130	.433	0.77	-1.02 to .76
Post intervention linear trend	-.860	.583	0.15	-2.06 to .34	.065	.232	0.78	-.41 to .54

As shown in Table 4.12, among children, the pre-intervention intercept was estimated at 3.785 per month (p-value=0.19, 95% CI: [-2.09 to 9.66]). The pre-intervention slope indicated a marginal increase in HIV case finding at a rate of 1.276 per month (p-value=0.07, 95% CI: [-0.09 to 2.65]) which is not statistically significant.

In the first month of key entry point testing implementation, there was a non-significant increase of 9.562 per month HIV-positive children identified (p-value=0.32, 95% CI: [-9.76 to 28.89]). The post-intervention slope showed a significant decline of 2.137 per month HIV-positive children per month (p-value=0.02, 95% C: [-3.95 to-.32]).

The post-intervention linear trend indicated a decline in HIV positivity at a rate of .860 per month (p-value=0.15, 95% CI: [-2.06 to .34]) which is not statistically significant. Durbin-Watson statistic (1.965) showed no autocorrelation at lag 1 and no corrections were made.

Among adolescents, the pre-intervention intercept was estimated at 13.279 (p-value <0.001, 95% CI: [8.25, 18.31]). The pre-intervention slope indicated an increase in HIV case finding at a rate of .196 per month (p-value =0.59, 95% CI: [-.54 to .94]), however not significant.

In the first month of key entry point testing implementation, there was a non-significant decline of 3.025 HIV-positive adolescents identified (p-value=0.30, 95% CI: [-8.89 to 2.85]). The post-intervention slope showed a marginal decline of .130 HIV-positive adolescents per month (p-value=0.77, 95% CI: [-1.02 to.76]).

The post-intervention linear trend indicated a non-significant increase in HIV positivity at a rate of .065 per month (p-value=0.78, 95% CI: [-.41 to .54]). The Durbin-Watson statistic (1.714) showed limited autocorrelation at lag 1 and no corrections were made. Figure 4.5 shows a visual display of these results.

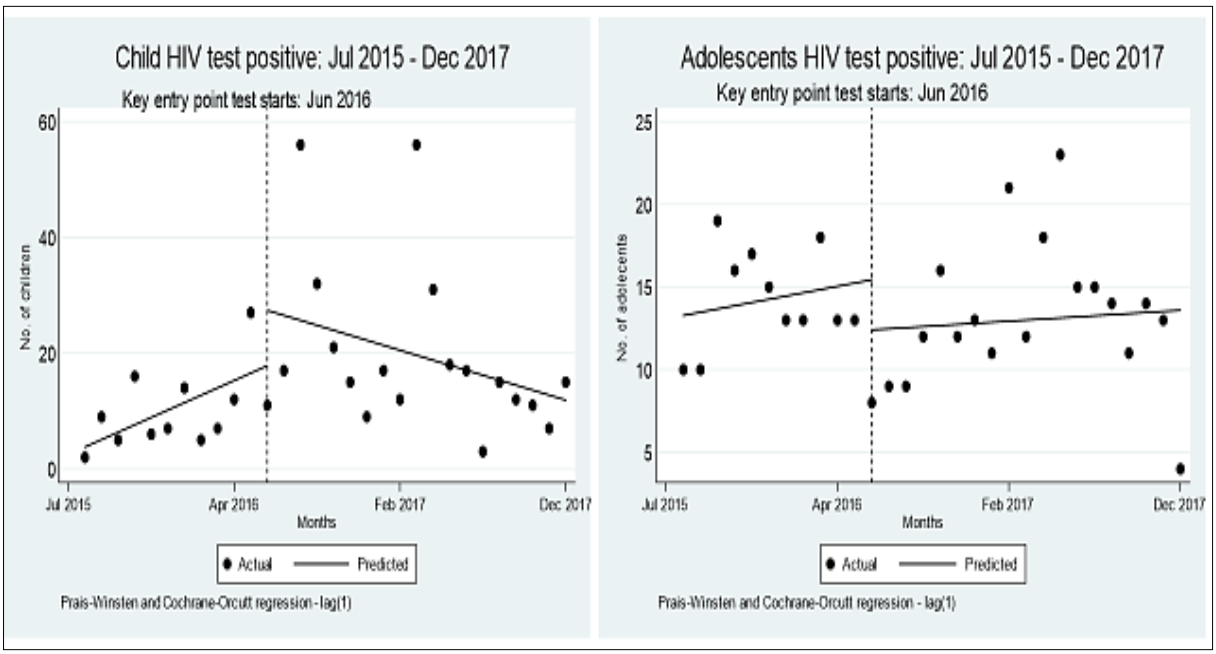

Figure 4. 5 Interrupted time series analysis: effect of key entry point testing on HIV positivity among CLHIV and ALHIV

Discussion

This chapter highlights implementation strategies for improving HIV case-finding among undiagnosed CLHIV and ALHIV in urban settings. Key trends emerged regarding age, gender, and level of healthcare.

Notably, HIV testing at fixed health facilities yielded higher prevalence rates compared to community-based testing, with index testing through adult ART clinics showing particularly promising results among children, while key entry point showed high HIV positivity among adolescents at project level. Furthermore, female adolescents and younger children comprised a larger proportion of those teste and PHC facilities conducted more tests than hospitals. However, hospitals reported the highest HIV positivity rates among children and adolescents.

HIV case-finding strategies

The study's results show that among children facility-based index testing yielded the highest HIV positivity, followed closely by key entry points, while community-based testing had the lowest. Among adolescents, key entry point testing HIV positivity was higher than index, and community testing had the lowest yield.

The key messages for HIV case finding strategies are:

- Facility-based index testing: highest HIV prevalence among children
- Key entry points: highest HIV prevalence among adolescent
- Community-based testing: lowest HIV prevalence among children and adolescents

Individuals solicited through adult ART clinics and adherence clubs demonstrated the highest HIV positivity rates, indicating these service points are optimal for identifying undiagnosed CLHIV and ALHIV. These findings align with existing literature. For instance, a 2015 evaluation in Kenya reported a 5.4% HIV prevalence among 3,033 children tested through index testing, highlighting the effectiveness of this strategy in other settings (128). Consistent with the findings of this study findings, the ACT initiative, a joint effort by PEPFAR and the Children's Investment Fund Foundation(CIFF) (19) , reported a notably higher HIV prevalence of 5% among 18,820 siblings who underwent index testing as first-time testers in Tanzania, surpassing the 1% prevalence rate observed through routine HIV testing in health facilities. Despite its high yield among children, time series analysis indicated that index testing was not significantly associated with HIV positivity in the ten public health facilities. This outcome should be interpreted in context given the complexity of implementation within multiple projects and other confounders such as the closure of the 3 study sites.

A major challenge reported in the PASP with index case finding was the low uptake in, with less than half of eligible children and adolescents undergoing HIV testing. This phenomenon is not unique to this study, as low uptake of index testing has been consistently observed in previous research. In Zimbabwe, research by Chikwari et al. (124) revealed that caregivers' lack of understanding about perinatal HIV infection and paediatric testing hindered child testing. Even when caregivers considered testing for

their children and adolescents, they faced significant barriers, including the cost of visiting health facilities and the fear of unintentionally disclosing their own HIV status. To tackle these challenges, exploring efficient approaches to improve index testing coverage is crucial. Community-based index testing, combined with self-testing resources, may be the key to successful index testing, particularly when users are ready to test during home visits. Thus this study recommends future exploration of strategies for increasing index testing uptake which include:

- Community-Based Index Testing: This approach focuses on offering testing services to children and sexual partners of index case clients at the community level
- Self-Testing Commodities: Providing self-testing resources can increase testing frequency and improve affordability, as seen in Lesotho where HIV case finding increased from 3% to 5%.
- Home-Based Testing: Home specimen collection kits can facilitate testing, especially for those hesitant to visit public health facilities.

By implementing these strategies, implementers can address the knowledge gaps and accessibility issues that hinder child and adolescent testing, ultimately improving index testing coverage and HIV case finding.

Key entry point testing had the highest yield of 5.6% among adolescents, although it contributed modestly to HIV case finding, with an overall yield of 1.3%, despite a larger number of HIV tests conducted compared to other strategies. This finding aligns with results from the ACT initiative in Tanzania, which reported a 1.6% HIV prevalence among 16,263 children tested through a quality improvement approach in TB clinics and paediatric wards. Notwithstanding the lower HIV prevalence and limited testing numbers in this study, key entry point testing is recommended for paediatric HIV diagnosis due to its potential to facilitate timely diagnosis, reduce turnaround times and improve treatment initiation. This approach can be particularly effective in settings with limited resources and high paediatric HIV burden (69). Despite the high yield among adolescents, regression analysis did not show any significant association between key entry point testing and HIV positivity among adolescents. A significant decline was observed among children in the post-intervention trend. Similar reasons as in the case of index case finding are most likely, and should thus be explored further.

Screening patients at key entry points and Mother-Infant-Pair (MIP) clinics can facilitate targeted testing and improve HIV case finding. Evidence from Malawi supports this approach, where MIP clinics yielded a higher HIV prevalence of 2.4% from 3,552 PCR tests conducted. This targeted testing strategy can help to enhance early infant diagnosis, identify HIV-positive mothers and infants and initiate timely ART. By integrating HIV testing into key entry points and MIP clinics, healthcare providers can optimize resource allocation and improve HIV diagnosis and treatment outcomes (19). Mother-Infant-Pair (MIP) Clinics and PICT. The MIP clinics not only reinforced VTP messages but also improved infant testing rates. Although this study did not collect data on PICT, existing research suggests its effectiveness. A mixed-methods study in Zimbabwe found that PICT yielded a 5.3% HIV prevalence among 1,534 children tested in primary healthcare facilities. This Zimbabwean study highlights the potential of PICT to identify HIV-positive children, initiate early ART and improve treatment outcomes. The integration of PICT into key entry points can enhance HIV testing and treatment among children and adolescents (66).

This study found a lower HIV prevalence of 1-1.3% through community-based testing, with a smaller sample size (367 children and 735 adolescents) compared to health facility testing, even though the strategy started much earlier within seven months of project inception. The Family Health Day campaign was the sole community testing modality reported in Region F. Despite lower HIV prevalence, community-based testing remains crucial for identifying CLHIV and ALHIV, particularly when combining effective modalities. However, home-based testing posed challenges in densely populated and insecure settings. For instance, in urban inner-city settings like those targeted by PASP low coverage was reported. Barriers included poor access to informal settlements, staff safety concerns and in general, a lack of tailored modalities for urban contexts. These findings underscore the need for adaptable and targeted community-based testing strategies to effectively reach CLHIV and ALHIV in diverse and densely populated urban settings.

Other studies such as those conducted by Sharma et al. (63) and Thurman et al. (17) underscore the efficacy of diverse testing modalities in enhancing HIV testing coverage, particularly among hard-to-reach populations. Strategies such as home visits, mobile testing, index testing, and self-testing have shown promise (131). In addition, Thurman et al. (17) as well as Kisesa and Chamla (82) have recognised that

community health workers play a vital role in facilitating HIV case finding, while peer support and micro-mapping can further improve testing coverage. In urban areas, hard-to-reach buildings pose significant HIV testing barriers. Collaborative efforts with residents, community-based testing, peer support, and targeted interventions (micro-mapping, incentives, self-test distribution) can help address access and safety concerns (132).

Implementation of school-based testing and CBO facilitated testing for Orphaned and Vulnerable Children and Youth (OVCAY) was hindered in Region F due to logistical challenges and a scarcity of eligible CBOs. Nevertheless, empirical evidence consistently indicates an elevated HIV risk among OVCAY, underscoring the necessity for tailored interventions (2,17,20,133,134). Evidence supports school-based testing as an effective approach for identifying undiagnosed CLHIV and ALHIV. Bandason et al.'s (30) evaluation of school-linked HCT in Zimbabwe revealed significant HIV prevalence with 2.7% among 4,386 learners (median age 9) and 6.8% among children <15 years. Addressing school HIV testing policy restrictions and parental consent hurdles is crucial for enhancing access to HIV testing services among this demographic.

Effect of strategies on HIV testing outcomes

This study evaluated the effect of HIV testing strategies, including index case finding, key entry point testing, and community case finding, among children and adolescents. Index case finding and key entry point testing showed promise, but regression analysis revealed no significant link to increased HIV positivity. HIV positivity declined among children, but results were mixed among adolescents. There are varied factors attributed to this decline, including saturation in the study sites and the declining HIV incidence at a population level, compared to that of adolescents. Among adolescents, there was a slight increase in the HIV positivity after the introduction of index case finding however this increase was not significant. Surprisingly, there was a decline in HIV positivity at introduction and post implementation of key entry point testing, although this strategy had the highest yield for among adolescents at project level.

Community case finding had limited impact due to implementation challenges. Fewer children and adolescents were tested through community case finding and only one of the three planned approaches were implemented. While the other approaches

(OVCAY and school-based HIV testing) have shown evidence of effectiveness in other studies, this could not be evaluated in PASP. Future research should focus on refining testing strategies, addressing implementation limitations, and exploring innovative approaches.

This study observed a disproportionate representation of infants and young children undergoing HIV testing, contrasting with their relatively low HIV prevalence. Infants and young children underwent most HIV tests, driven by PCR testing guidelines and easy access to immunization/primary healthcare services, compared to fewer adolescents and older children. Overall, HIV positivity was the lowest among infants and young children and similar to other studies, while testing coverage was high for birth PCR, although the case-finding target not achieved. There's a pressing need to develop and implement targeted strategies for older children and adolescents, addressing the disparities in HIV testing and prevalence. This includes exploring innovative testing approaches and improving access to healthcare services for these age groups.

Females outnumbered males in HIV testing, which was attributed to their access to family planning, antenatal care, and targeted programmes like DREAMS. Adolescent males had lower testing rates, consistent with South African trends, highlighting the need to address gender disparities in HIV testing. For example, Ramirez-Avilla (34) also found that among 12–17-year-old adolescents, 30% of males tested for HIV compared to 49% of females seen at an outpatient clinic in Durban. The persistently low HIV testing rates among males necessitate innovative strategies, including peer outreach, community-based index testing, and self-testing initiatives to increase testing uptake.

Lastly, this study highlights variations in HIV prevalence across healthcare settings and the importance of early testing in outpatient/inpatient wards. HIV prevalence ranged from 3.3-7.4% in primary health clinics, with higher rates in tertiary and district hospitals. Early HIV testing in outpatient and inpatient wards is crucial for timely treatment and improved survival chances among children. While hospital admission offers a gateway for HIV testing, children who are diagnosed in hospitals with co-morbidities while already immunocompromised and sick, have been reported to have

decreased chances of survival previously (69). Addressing barriers to early diagnosis at community level and primary health care is important.

4.4 Conclusion

This study contributes to the growing body of research on differentiated HIV case-finding strategies for children and adolescents. The findings underscore the importance of innovative HIV case-finding strategies.

Index testing, hospital-based testing, and key entry-point testing yielded high diagnosis rates for CLHIV and ALHIV, but testing coverage remained low. Index testing should be adopted in public health facilities despite its complexity and resource intensity. Key entry point testing provided high reach, especially for younger children, although yield was lower in this group and higher among adolescents. However, community-based approaches showed low reach and yield and required refinement.

There are opportunities for improving HIV case finding among CLHIV and ALHIV such as integrating mother-infant pairs and improving screening at key entry points. Exploring school-based HIV testing and integration into school health programmes as a largely untapped approach. Refining community-based strategies, addressing implementation barriers and providing targeted outreach to older children and male adolescents with innovative approaches should be prioritised.

Future research at this first level of the HIV cascade should explore additional strategies including home-based index testing, self-testing through peer recruitment and incentives, and addressing barriers for hard-to-reach groups (children aged 5-14, male adolescents). Lastly, effective HIV case-finding strategies can improve diagnosis and treatment outcomes for CLHIV and ALHIV. However, addressing patient and health system barriers, and exploring innovative approaches, is crucial for increasing testing coverage and reach.

CHAPTER 5 – Relative contribution of PASP strategies to linkage and ART coverage

In Chapter Four, the study evaluated the contribution of PASP strategies towards HIV case finding (1st 90) among children and adolescents. This chapter examined implementation strategies for enhancing early ART initiation among CLHIV and ALHIV. The relative contribution of the PASP initiative to patient outcomes, specifically: ART initiation rates among CLHIV and ALHIV and proportional increase in ART coverage were evaluated.

5.1 Introduction

Despite advancements in paediatric and adolescent HIV case finding, South Africa faces challenges, with a persistent gap in CLHIV and ALHIV not accessing ART and marginal improvements in ART coverage among CLHIV and ALHIV between 2016 and 2021. In 2016, the estimated ART coverage among CLHIV was 55% and 56% among adults (3). The 2021 HIV estimates reported lower ART coverage for CLHIV (48%) compared to 74% among adults (135). The global decline in CLHIV on ART is primarily attributed to the "ageing out" of the 0-14 year's cohort, as they transition into adolescent and adult care (9). While many CLHIV on ART are surviving and ageing into adolescence and new infections are fewer (<2%) among infants, there were still undiagnosed children and loss to follow-up of those on ART which contributes to low ART coverage.

In Sub-Saharan Africa, only one in five HIV-positive adolescent girls aged 10–24 years knew their HIV status in 2017, while six in seven new HIV infections among adolescents aged 15–19 years were among girls in 2021 (1,13). This region has the highest number of ALHIV (54). Results from the 2016 HIV impact assessments in Malawi, Zambia, and Zimbabwe showed that less than half (46%) of adolescents (15–24 years) knew their HIV status, and of those just 82% were on treatment(52,53). Similarly, in South Africa, only 51.7% (males 58.8%, females 49.1%) of the estimated ALHIV (15-24 years) were on ART in 2018 (24,25).

The ART initiation rate is calculated as the proportion of individuals from pre-ART care who have been initiated on ART (136). Apart from children and pregnant women, prior to September 2016, eligibility for ART was determined mainly through a CD4 cell count

threshold and clinical staging, with many patients meeting the criteria for pre-ART care. Universal Test and Treat (UTT) guidelines which came into effect in September 2016, recommend that all people PLHIV get initiated on HIV treatment within a week of diagnosis, irrespective of CD4 count or clinical staging, provided other clinical criteria have been met (137). Early ART reduces early infant mortality and delays HIV progression, while delayed treatment contributes to the gap in ART coverage (76). It is important to address barriers to early ART initiation and implement strategies that work for CLHIV and ALHIV (138).

5.1.1 Predictors and barriers to early ART initiation among children and adolescents

The most common predictors of ART initiation include age, gender, level of healthcare, cadre of health providers, and migration. For example, in a study that enrolled 18,315 CLHIV and ALHIV (0–19 years) in Tanzania, Chaudhury et al. 2018 found that age sub-groups of 0–4, 10–14, and 15–19 years were less or almost as likely to receive ART prescriptions than older children (5–9 years) before 28 days (5).

In addition, the 2020 UNAIDS Start Free Stay Free AIDS Free report on modelled estimates and survey data suggested that two-thirds of the CLHIV who are not receiving treatment were in the older age groups (aged 5–9 and 10–14 years) in 21 focus countries. The most common predictors of ART initiation include age, gender, level of healthcare, cadre of health providers, and migration. Older CLHIV and young ALHIV are more likely to drop off at the ART initiation stage of the HIV cascade (5). The study also underscored - those infants and young children (0–4 years) were predominantly at risk of early death. In addition, the 2020 UNAIDS Start Free Stay Free AIDS Free report on modelled estimates and survey data suggested that two-thirds of the CLHIV who are not receiving treatment were in the older age groups (aged 5–9 and 10–14 years) in 21 focus countries (58). This lower ART coverage is primarily because these groups have limited opportunities to interact with the health sector, while the HIV testing and treatment access points at the community level are also limited.

Adolescent males are less likely to be initiated on treatment compared to females. Among 2,922 early ALHIV (10–14 years) in the Tanzanian study, females were most

likely to receive ART prescriptions compared to males. However, among the 4,169 older paediatric patients (5–9 years), the males were most likely to receive prescriptions. The study asserted that male-gender children were at a higher risk of early death, even when linked to care (5). Among late ALHIV (15–19 years), males were more likely to receive prescriptions than females, although a third of the females were pregnant at the time of enrolment. This may suggest a gap in the PMTCT coverage among late adolescent females, poor integration of family planning and HIV services, or other health systems issues within the PMTCT cascade (5).

Previously, ART initiation of CLHIV outside of hospital-based specialised care was not common. This was mainly due to the lack of confidence among untrained nurses to initiate young CLHIV and infants on ART at the primary care level (19). Studies in Sub-Saharan Africa have shown evidence of the feasibility of ART management below the hospital level (139,140). The policy regulations and implementation of Nurse Initiated Management of Antiretroviral Therapy (NIMART) brought the much-needed scale to the HIV programme. For instance, in the city of Johannesburg (Region F), following NIMART training and mentorship, Primary Health Care facilities were initiating patients on ART by the end of September 2011, and ART initiation referrals to hospitals decreased by 12 immediately after NIMART and further by an average of 18 every month (141). Notably, Lazarus et al. (140) found that nurse management of ART was rated better than physician management in four South African studies reviewed for health service delivery models in ART scale-up.

Training and mentoring nurses to initiate ART does not always translate into the expected or desired coverage. For example, in a study that asked nurses if they were initiating ART two months post-training, 62% (79/126) had started initiating new adult patients on ART, but only 7% (9/126) were initiating ART in CLHIV (142). According to the study, nurses cited a lack of mentoring, being assigned to other tasks due to staff shortages, lack of consulting rooms and shortage of stationery (patient records) for low ART initiation although these were not specific to CLHIV. This is a concern because it increases the time to initiation and possibly loss to care prior to initiation of CLHIV as well as morbidity.

There are many barriers to early linkage to ART among newly diagnosed CLHIV and ALHIV. At the patient level, denial of HIV status, fear of stigma and non-disclosure are

common. At the health system level, limited optimal formulations for CLHIV, poor documentation, long waiting times and lack of service integration have been reported (82,129,143). Lastly, a lack of confidence among health workers, and a lack of patient navigation opportunities to fast-track ART initiation can delay prompt linkage to ART.

5.1.2 Strategies for improving linkage and ART among CLHIV and ALHIV

The global effort to combat HIV/AIDS has led to significant advancements in treatment access. However, CLHIV and ALHIV continue to face barriers in linking to ART. This chapter describes the complex factors influencing ART linkage and identifies evidence-based solutions to improve treatment outcomes.

At the health facility level, tracking of mother-infant pairs and mobile health or communication technology are commonly reported for paediatric and adolescent HIV programmes. Community-based ART through capacity building and deploying Community Health Workers (CHWs) to link CLHIV to ART in collaboration with outreach teams has been recommended. Lastly, the effects of social protection interventions, patient record reviews and laboratory data to identify and track HIV-positive patients to link them to ART have been highlighted.

Tracking mother-infant pairs has been implemented widely across countries, with varying outcomes. In Malawi, this approach resulted in 92% of HIV positive infants being linked to HIV clinical care among those who were tested in a 2012 pilot study (84). Mother-infant pairs were led by community health workers from the mother's diagnosis during antenatal care through HIV test result confirmation for all HIV-exposed infants.

Communication technology-enhanced solutions have been recommended by the WHO Consolidated Guidelines for HIV to improve linkage to ART in resource-limited settings (144). Through the ACT initiative in Tanzania, a WhatsApp platform was used to improve referral systems for HIV care and treatment for CLHIV. This approach resulted in an 89% linkage rate among CLHIV, and the reduction of the turnaround time for DBS results from three weeks to four days with up to 79% of DBS results being delivered to mothers (19).

Community-based approaches are important in improving access and uptake of ART services, but few community ART studies are focused on CLHIV and ALHIV. In a pre-post evaluation of the Red Carpet Programme (RCP) in Homa Bay County, Kenya among adolescents (15–19 years) and youth (20–21 years), 3-day training curricula for healthcare workers and peer educators on caring for ALHIV improved linkage to ART from 56.5% pre-implementation to 95.7% within six months (98).

Facilitated linkage to ART is important beyond the HIV test result. Sharma et al. 2015 found that community-based HIV testing with facilitated linkage to ART where counsellors followed up on the newly diagnosed eligible pre-ART care patient's linkage to care was higher (87–98%), compared to 18–36% without a facilitator (63). Community health workers are critical in case identification and linkage to ART of hard-to-reach populations. Their knowledge and access to communities as well as their ability to understand the language and cultural dynamics can open opportunities for improved ART coverage.

HIV testing for infants done through PCR relies on receipt of laboratory data to be actioned by the staff who have first contact with the results. Unlike rapid HIV tests where results are available immediately and decisions on ART enrolment can be made quicker, PCR samples are sent to the laboratory and can take up to more than 24 hours. In Thailand, the active notification of PCR-positive test results improved ART initiation from 56% to 88% among children in a study that compared implementation outcomes of the ACC from August 2014 to July 2018 to the national EID survey from October 2007 to September 2011 (65). Through a record management database established by the ACC network, the laboratory officers notified case managers of new PCR-positive tests, these were reported to the hospital manager who promptly facilitated ART initiation.

Patient records are important for documenting longitudinal patient data from HIV diagnosis to treatment. In cases where patients are not initiated on ART immediately after the diagnosis, there is often a need to review these records and contact patients to bring them in to initiate ART. Patient-level record reviews were conducted in Kenya through the ACT initiative to identify, trace and counsel ALHIV not on ART. Using a patient-level data review (referred to as “check–flag–act”) approach to identify missed

appointments, provide psychosocial support for ALHIV and initiate them on ART, 99% (3,442) of ALHIV (15–19 years) were initiated on ART by the end of implementation (19). These different strategies work in their contexts and should be tailored as appropriate with consideration for each setting and population.

5.2 Methods

5.2.1 Study design and setting

This study used a descriptive interrupted time series design to examine trends among CLHIV and ALHIV initiated on ART in Region F sub-district. The study utilized routine public health data from the Tier.Net database and project measurement tools, aggregated over 39 months (July 2015 - September 2018). The study setting comprised 10 public health facilities (2 hospitals, 1 community health centre, 2 primary healthcare clinics) and adjacent communities within the sub-district.

Study population

The study sample consisted of CLHIV (0-14 years) and ALHIV (15-19 years) receiving HIV care in 10 health facilities within Region F sub-district between July 2015 and September 2018. Eligibility criteria included new ART initiation during the study period while transferred in, re-initiated and those with prior ART experience were excluded.

5.2.2 Data collection

Implementation Data

The study extracted data on linkage to ART strategies from the project proposal document and three annual project reports (Year 1-3). These documents offered critical insights into strategy implementation, contextual factors, and challenges encountered during project execution.

Data Sources and Variables

This retrospective study utilized secondary data from Tier.Net and PASP project measurement tools to examine ART trends and effect of targeted strategies among CLHIV and ALHIV. Monthly ART initiation records from Tier.Net (July 2015 to September 2018) were categorized and transformed in Microsoft Excel for analysis. Key variable selected in the dataset were: Facility, ART start date, method into ART, pregnancy status at ART initiation, age at ART start and gender. Data cleaning for

patient outcomes was done by verifying missing and erroneously recorded information such as date of birth vs ART start date in consultation with a qualified statistician. Data were categorised and managed in Microsoft Excel and then exported into STATA15 for analysis (116).

5.2.3 Data management and analysis

Initial analysis entailed:

- Examining implementation strategies in relation to ART initiation
- Evaluating the contribution of each strategy to ART initiation

Primary descriptive analyses were stratified by period, age gender, and health facility level and univariate analyses were conducted for HIV positivity and ART initiation. The following patient variables were included in the analysis:

- The number of CLHIV and ALHIV initiated on ART per month
- The number and % of CLHIV and ALHIV initiated on ART against project targets

Data were then presented in graphs and tables where appropriate.

The secondary analytical phase adopted an interrupted time series design to assess the effects of implementation strategies on linkage to ART among CLHIV and ALHIV. Specifically: Prais-Winsten estimation identified associations between implementation strategies and outcome variables. Regression modelling (Prais-Winsten, Cochrane-Orcutt) assessed the effectiveness of implementation strategies, controlling for autocorrelation with Durbin Watson statistics. Results were presented in tables and graphs, including: Coefficients, Standard errors, R-squared (R^2) and adjusted R-squared (ARs), 95% confidence intervals (CIs) and p-values ($p < 0.05$ significance threshold).

5.3 Results and Discussion

5.3.1 Strategies to improve ART initiation

The following summary of implementation strategies employed through PASP is informed by Proctor's framework for specifying and reporting implementation strategies (61). Table 5.1 provides definitions and durations for strategies targeting linkage to ART among CLHIV and ALHIV.

Table 5. 1 Overview of PASP implementation strategies for improving ART initiation among CLHIV and ALHIV

Strategy	Definition	Actor(s)	Action(s)	Action target(s)	Duration
Data-driven strategies					
Track ART initiations on Tier.Net	Tracing and linking of PCR +ve infants, CLHIV and ALHIV	PASP SI Manager and Data Capturer	Review the Tier. Net database to extract lists of patients eligible for ART for tracing	Weekly review and update of patient files who tested HIV-positive not on ART	July 2016 to March 2018
NHLS Results for Action (RFA)	Weekly list of infants with PCR-positive test results from the NHLS	PASP Clinical Mentor	Extract laboratory lists & follow-up (phone, track & trace) caregivers for ART initiation of infants	Weekly follow-up of caregivers with infants who had a PCR-positive result	
Community-based linkage strategy					
Same day escort	Two-way referral community to ART imitation site	PASP Linkage Officers	Linkage officers escort ALHIV and caregivers of CLHIV after an HIV-positive test to a nurse at the nearest site for same-day ART initiation	During each community HIV testing outreach event or campaign	Jan 2016–Dec 2017

Source: Project proposal and annual reports

As presented in Table 5.1, data-driven and community-based linkage strategies were employed to achieve 90% ART initiation among CLHIV/ALHIV in targeted regions. Implementation approaches comprised: Tracking HIV-positive patients on Tie.Net, Leveraging NHLS results for tracing and follow-up, and Health worker capacity building which is described in this study as a facilitation strategy in Chapter 7. All approaches for linkage to ART were scaled up for use in the second phase of PASP. Figure 5.1 illustrates PASP's theory of change for improving ART initiation among CLHIV and ALHIV.

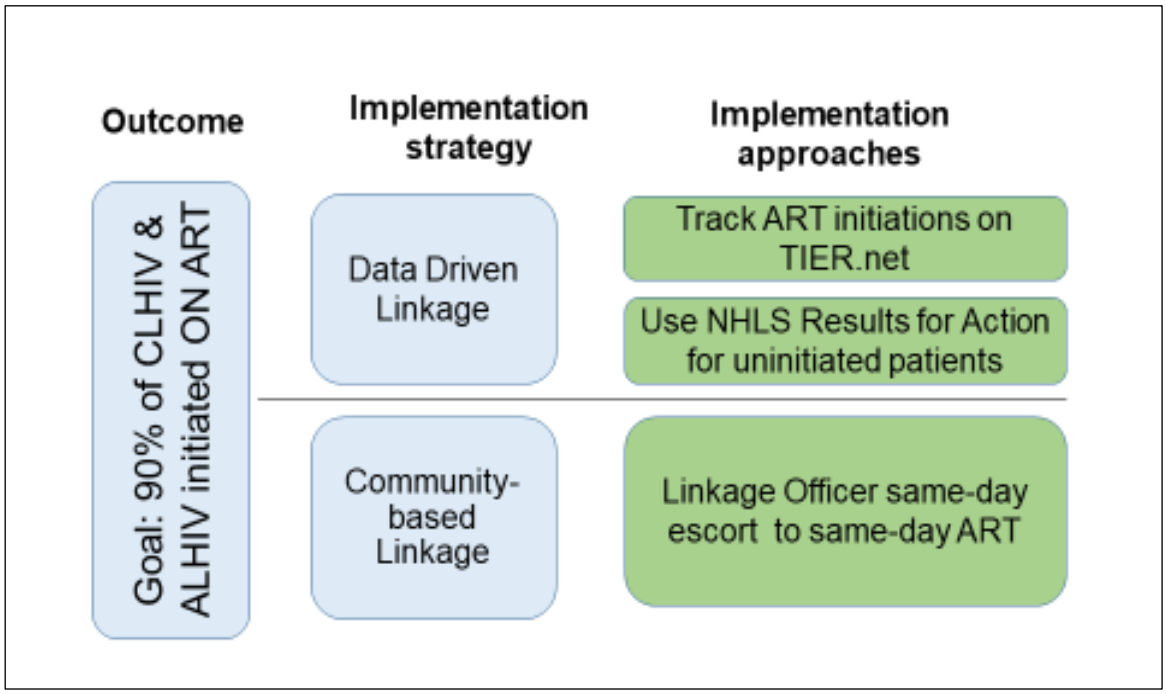

Figure 5. 1 PASP theory of change for improving linkage to ART

Source: **PASP Theory of Change**

Routine project data from the PASP measurement tool were analysed to determine linkage to ART through the specified strategies. The percentage linked to ART was calculated as a proportion of individuals linked to ART from those identified HIV positive. Table 5. 2 shows the number and proportion of CLHIV and ALHIV linked to ART through data driven strategy and bi-directional referral.

Table 5. 2 ART linkage outcomes: data-driven and community-based Initiatives

	CLHIV and ALHIV linked to ART		
	HIV test positive (n)	Linked to ART (n)	Linked to ART (%)
Data-driven linkage: PCR-positive infants	216	140	65%
Community-based linkage: CLHIV and ALHIV referred for ART initiation	14	3	21.4%

Source: PASP project measurement tools

A total of infants 216 HIV positive infants were identified from the RfA data and 140 of them were linked to ART through the data – driven tracing strategy. The proportion of infants linked to ART (65%), far exceeded CLHIV and ALHIV linked through community referral (21%) although the number of individuals referred was smaller in community referral.

Data-driven linkage to ART

The data-driven linkage approach to ART utilized NHLS results for action reports and generated lists of HIV-positive patients not initiated on ART from the PASP project measurement tool for tracing. Implemented as a quality improvement initiative, this strategy involved:

- Weekly dissemination of HIV PCR laboratory results and other tests
- Infant tracing documentation over 21 months (July 2016 - March 2018)

Aggregated routine quarterly data were analyse to determine the tracing outcomes among infants. Figure 5.2 shows a visual display of the results from tracking and tracing of HIV positive infants who were previously not linked to ART.

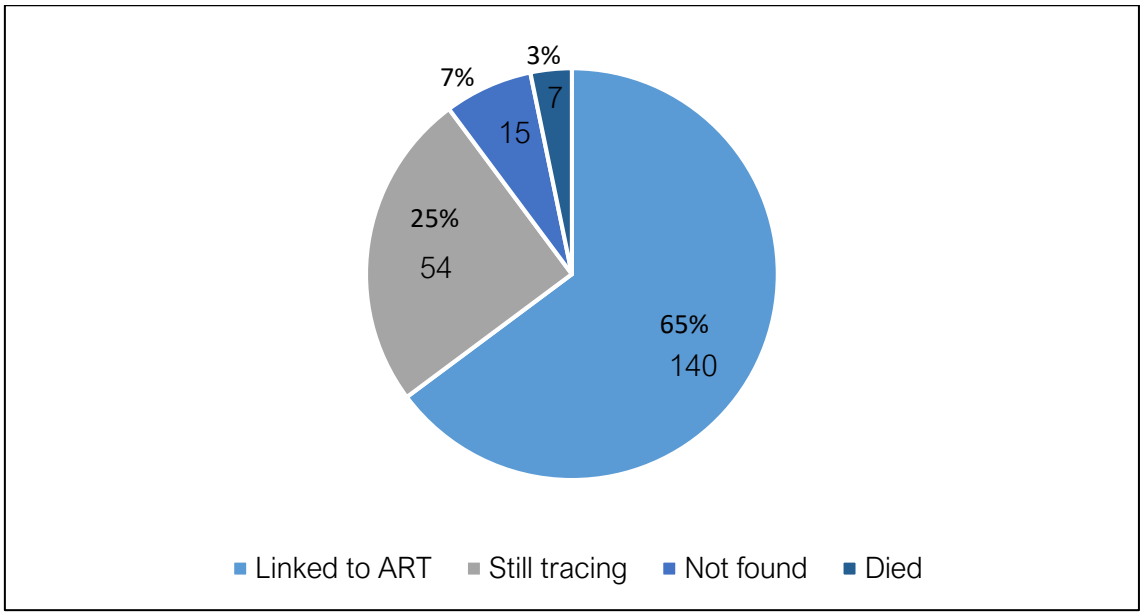

Figure 5. 2 Data-driven linkage to ART through tracing from PCR results for action

Source: PASP project measurement tool

Figure 5.2 shows that 140 (65%) of traced infants were linked to ART, while 54 (25%) were still being traced at the end of the project. Overall 15(7%) infants could not be found, and 7(3%) had died.

Community-based linkage to ART

The community-based linkage strategy employed family health days to identify HIV-positive children and adolescents, facilitating referral and same-day ART initiation. Linkage officers conducted telephonic follow-up and home visits to the families of CLHIV and ALHIV not linked to ART. The percentage linked to ART was calculated as a proportion of individuals linked to ART from those identified HIV positive. Table 5.3 shows the age disaggregated number and proportion of CLHIV and ALHIV linked to ART from community referral.

Table 5. 3 ART Initiation among CLHIV and ALHIV through community referral

	CLHIV and ALHIV linked to ART			
	HIV test positive (n)	Referred for ART(n)	Linked to ART (n)	Linked to ART (%)
19-59 months	2	2	0	-
5-14 years	2	2	1	50%
15-19 years	10	10	2	20%
Total	**14**	**14**	**3**	**21%**

Source: PASP project measurement tool

A total of 14 CLHIV and ALHIV were diagnosed and referred for ART initiation, however on 3 (21%) were linked to ART. Further data analysis revealed six non-initiated children/adolescents, with follow-up outcomes showing 4 invalid addresses, 2 declined treatment, and 5 remaining unreachable. ALHIV comprised a number of referred patients (10) with only two starting ART. This strategy had the least contribution to the 2nd 90, overall.

5.3.2 Effect of strategies on linkage to ART

A total of 1,636 CLHIV and ALHIV were initiated on ART although 1,116 were newly tested HIV-positive from July 2015 to September 2018. The mean age at ART start was 4 years for children and 17 years for adolescents. Table 5.4 shows the demographic profile of CLHIV and ALHIV linked to ART between Jul 2015 and Sep 2018.

Table 5. 4 Characteristics of Individuals Linked to ART: gender, age, and facility

	CLHIV and ALHIV linked to ART	
	n	%
Gender	1,636	100%
All children (0 – 14 years)	802	49%
Male adolescents (15 – 19 years)	132	8%
Female adolescents (15 – 19 years)	702	43%
**Pregnant at ART Start (15–19 years)*	*233*	*33%*
Age (years)	1,636	100%
0 - 4 years	497	30%
5 - 14 years	305	19%
15 -19 years	834	51%
Facility type	1,636	100%
Tertiary hospital	295	18%
District hospital	93	6%
CHC	600	37%
Clinics facilities n =7	648	39%

* Percentage represents those who were pregnant at ART start of the 702 female adolescents

Source: Tier.Net ART patient database

CLHIV aged 0-14 years represented 49% of ART initiations, with 30% under five and 19% between 5-14 years. Adolescent females accounted for 43% of ART initiations, while males only accounted for 8%. Pregnant adolescents comprised 33% (n=233) of ART initiations, and 10% (n=70) were uncertain about pregnancy status. Overall 49% of individuals linked to ART were CLHIV, while 51% were ALHIV. Clinics had the highest CLHIV and ALHIV linked to ART (39%), followed by CHC (37%). The lowest number of ART initiation was in the district hospital (6%).

The project successfully linked existing HIV-positive children and adolescents to ART, with more individuals initiated on treatment than newly diagnosed. Referral mechanisms and outreach strategies may have contributed to the high linkage rates. By the end of the project, a total of 802 children under 15 years had been initiated on ART, exceeding the number of new HIV-positive diagnoses (570) during the same period. Similarly, 834 adolescents were initiated on ART between July 2015 and September 2018, surpassing the 546 new HIV-positive diagnoses among adolescents. Figure 5.3 shows the HIV clinical cascade for linkage to ART and a visual display of the rate of linkage compared to newly diagnosed CLHIV and ALHIV.

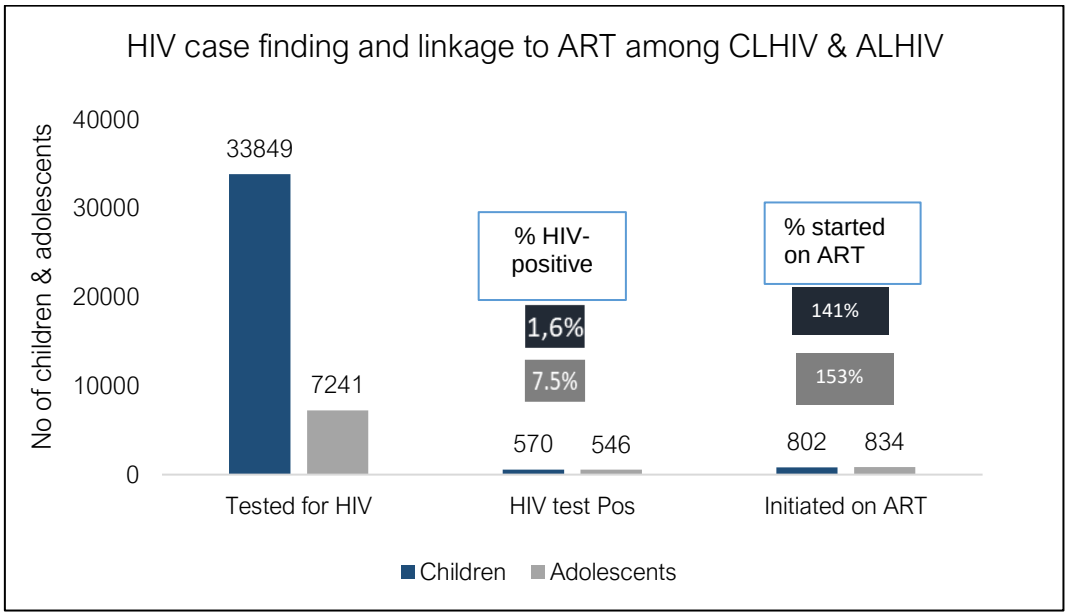

Figure 5. 3 Linkage to ART cascade for children and adolescents

Source: PASP project measurement tool

The average number of individuals linked to ART per quarter was 63 for CLHIV and 56 for ALHIV. Figure 5.4 shows a visual representation of the quarterly trends in ART

initiation among children and adolescents, highlighting the shifting focus and potential saturation of existing cases.

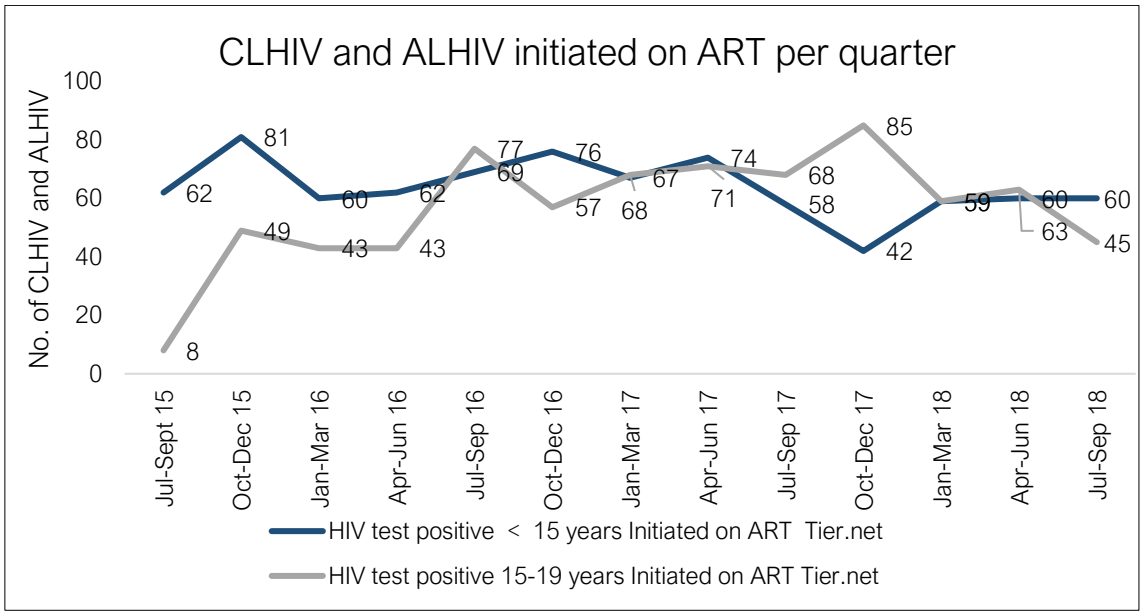

Figure 5. 4 ART initiation among children and adolescents

Source: PASP project measurement tool

Figure 5.4 shows that the trend for CLHIV linked to ART decreased from the 3rd quarter of implementation and remained steady through the end of the project. The number of ALHIV linked to ART increased gradually every quarter in the first year of the project and declined in the last two quarters of the project.

Routine ART linkage data from Tier.Net recorded monthly, were analysed to describe distribution in monthly linkage to ART from the start of the project in July 2015 to the end of the project in September 2018 over a 39 month time series. The outcome of interest was CLHIV and ALHIV linked to ART per month. Table 5.5 shows a descriptive summary of monthly linkage to ART.

Table 5. 5 Descriptive summary of monthly linkage to ART among CLHIV and ALHIV

Variable	Mean	Std. Dev.	Variance	Skewness	Kurtosis	Min	Max
CLHIV linked to ART	21.333	5.653	31.964	1.430	8.010	11	44
ALHIV linked to ART	21.410	4.950	24.511	.516	3.734	12	36

Source: Tier.net ART patient database

The mean monthly linkage to ART for CLHIV/ALHIV was 21.333 with standard deviation (SD: 5.653) among CLHIV and (SD: 4.950) among ALHIV. The minimum and maximum monthly linkages were 11 and 44 for CLHIV, and 12 and 36 for ALHIV, respectively. Distribution analysis indicated non-normality for CLHIV (skewness: 1.430, kurtosis: 8.010) and near-normality for ALHIV (skewness: 0.516, kurtosis: 3.734). A steep declining trend was observed for CLHIV, whereas ALHIV exhibited a slightly upward trend as shown in the visual display on Figure 5.5.

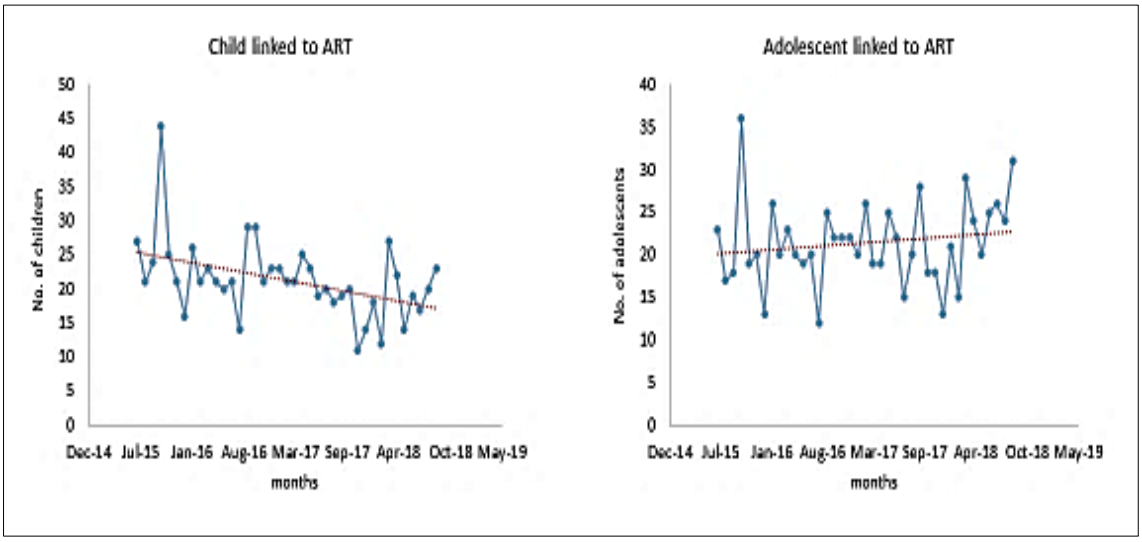

Figure 5. 5 Monthly trends of CLHIV and ALHIV linked to ART in 10 health facilities

Figure 5.5 illustrates opposing trends in ART initiation among CLHIV and ALHIV linked to ART. CLHIV demonstrated a gradual decline from November 2015, whereas ALHIV exhibited a slight increase from September 2015. The highest ART linkage values occurred in October 2015 for both groups (CLHIV: n=44, ALHIV: n=36). Conversely, the lowest values were recorded in November 2017 (CLHIV: n=11) and August 2016 (ALHIV: n=12). The October 2015 peak is attributed to data cleaning for annual funder reporting.

To estimate the effect of implementation strategies: infant tracing and community referrals on ART linkage among CLHIV and ALHIV, Prais-Winsten regression analysis was conducted and the modelled interventions were:

- Infant tracing (Jul 2016 to March 2018)
- Community referral (January 2016 to December 2017)

There was no documented tracing intervention for ALHIV, hence there is no data provided. Table 5.6 shows the regression results.

Table 5. 6 Effects of tracing and community referral on HIV outcomes: Prais-Winsten AR (1) regression iterated estimates

	CLHIV linked to ART				ALHIV linked to ART			
	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P-value	95% CI
Infant tracing	-1.198	1.695	0.49	(-4.66 to 2.26)	-	-	-	-
Community referral	-1.697	2.134	0.43	(-6.04 to 2.64)	-1.42	1.79	0.44	(-5.06 to 3.13)

Source: PASP project measurement tool

These results show that infant tracing and community referral did not have statistically significant effects on CLHIV linked to ART. Among CLHIV linked to ART, through infant tracing there was a negative coefficient of -1.198, however, not statistically significant (p-value = 0.49, 95% CI: [-4.66 to 2.26]). Durbin-Watson statistic (1.890) showed moderate autocorrelation and no corrections were made. The model failed to establish a significant association between infant tracing and CLHIV linked to ART, as evidenced by a non-significant model coefficient (0.378) and low R-squared value (0.025) and adjusted R-squared (AR) value (-0.006), suggesting that other factors may have contributed to the outcome.

Similarly, for community referral among CLHIV there was a negative coefficient of -1.697, however not statistically significant (p-value = 0.43, 95% CI: [-6.04to 2.64]). Durbin-Watson statistic (1.909) suggested limited autocorrelation and no corrections were made. Among ALHIV linked to ART through community referral the coefficient was -1.417, but no statistically significant association (p-value = 0.44, 95% CI: [-5.06 to 2.23]). Durbin-Watson statistic of 2.085 indicated no significant autocorrelation, therefore no corrections were necessary.

The model did not provide compelling evidence of an association between community referral and the outcome variables. Specifically:
For CLHIV linked to ART, the model coefficient was non-significant (0.284), with a low R-squared value (0.034) and adjusted R-squared (AR) value (0.005), suggesting other factors influenced the outcome. For ALHIV linked to ART, the model coefficient was also non-significant (0.386), with a low R-squared value (0.022) and AR value (-0.006), indicating other factors likely contributed to the outcome. Community referral started in January 2016, with very few observations in the pre-intervention period (6) with most

observations concentrated in the post intervention period (24). Due to this limitation, no further specifications were made for this strategy.

Infant tracing

To specify whether the introduction of the infant tracing resulted in a change in the level and trend of CLHIV linked to ART, compared to those of the pre-intervention period, interrupted time series analysis was conducted. The model specified a single-group ITSA with CLHIV linked to ART as the outcome. The time series comprised 39 months between July 2015 (project start) and March 2018, and the start date of tracing was June 2016 (month 13). The model was estimated using Prais Winsten and Cochrane Orcutt with one lag. Table 5.7 presents the results of the Interrupted Time Series Analysis assessing the effect of infant tracing on CLHIV linked to ART.

Table 5. 7 Effect of infant tracing on CLHIV linked to ART: Prais-Winsten AR (1) regression - iterated estimates

	CLHIV linked to ART			
	Coef.	Std. error	P- value	95% CI
Pre-intervention intercept	22.358	1.798	0.000	(18.68 to 26.04)
Pre-intervention slope	-.156	.212	0.47	(-.59 to .28)
Intervention intercept change	3.483	2.513	0.18	(-1.66 to 8.62)
Post-intervention slope	-.207	.283	0.47	(-.79 to .37)
Post intervention linear trend	-.364	.197	0.08	(-.77 to .04)

Source: Tier.Net ART patient database

The overall results suggest that infant tracing did not significantly change the level or trend of CLHIV linked to ART, although there was a marginal decrease in CLHIV linked to ART over time after introducing infant tracing. In the pre-Intervention Period the initial level of CLHIV linked to ART before the introduction of infant tracing was estimated at 22.358. The pre-intervention slope suggested a non-significant change at a rate of 0.156 per month (p-value = 0.47, 95% CI: [-.59to .28]).

Immediately after the intervention, there was an estimated increase of 3.483 in CLHIV linked to ART, but this change was not statistically significant (p- value = 0.17, 95% CI: [-1.66to 8.62]). In the post-Intervention period, the number of CLHIV linked to ART declined slightly at a rate of 0.207 (p-value = 0.47, 95% CI: [-.79 to .37]), indicating no

significant change in CLHIV linked to ART. In the post-intervention linear trend. CLHIV linked to ART declined at a rate of 0.364 per month, however this decrease was not statistically significant (p-value = 0.08, 95% CI: [-.77 to, .04]).

The Durbin-Watson statistic (1.940) indicated no significant autocorrelation, suggesting that the residuals were randomly distributed and no corrections were necessary. However, the model failed to establish a significant relationship between infant tracing and changes in CLHIV linked to ART. Specifically: The model coefficient for infant tracing was non-significant (0.238), indicating no substantial association with the outcome variable. The low R-squared value (0.186) suggested that infant tracing explained only a small proportion of the variance in CLHIV linked to ART. Overall, the results did not provide compelling evidence supporting the association between infant tracing and changes in CLHIV linked to ART.
Figure 5.6 shows a visual display of these results.

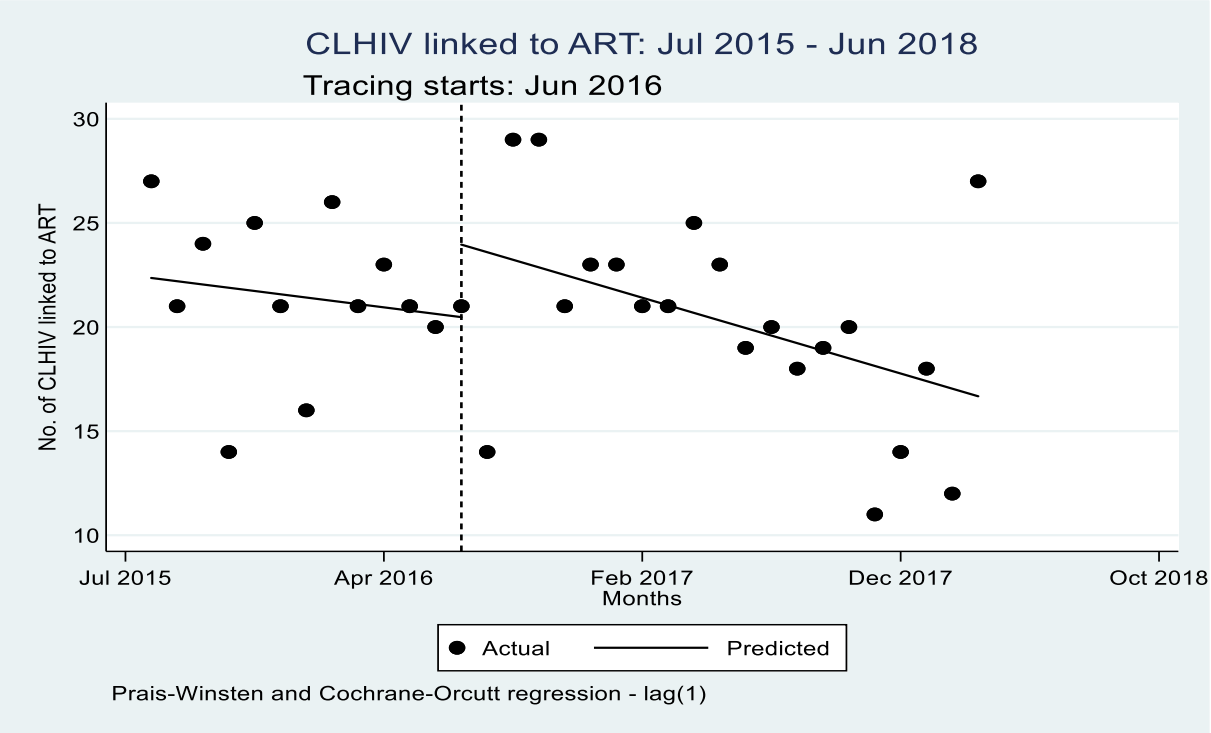

Figure 5. 6 Interrupted time series analysis: effect of tracing on HIV positive case finding among children

Discussion

This chapter highlights strategies for enhancing ART initiation among children and adolescents. Implementation strategies showed varying degrees of success, with data-driven linkage emerging as the most promising approach at a project level. Community

referral and same-day escort approaches did not yield the anticipated outcomes. Regression analysis did not show a significant association between the linkage strategies and the outcome for CLHIV and ALHIV.

Implementation of the data-driven strategy was facilitated by the NHLS Results for Action reports which provided weekly HIV PCR-positive results. Similar successes were reported by Lolekha et al. (65) in Thailand, where ART initiation improved from 56% to 88% among follow-up children. The Red-Carpet Programme (RCP) in Kenya achieved 95.7% linkage to ART among adolescents and youth through data driven approaches (98).

Community-based linkage approaches have shown mixed results, with facilitated community testing reporting higher linkage rates (63). For example, facilitated community testing was reported to have a higher linkage to care (87–98%) by Sharma et al. (63) which is much higher than the observed 21% in PASP. However, a much lower linkage rate of 18–36% without a facilitator was reported. In this study, community-based linkage did not yield the expected outcomes, although it has been seen as effective in other settings (146–148). Patients identified at the community level who were not escorted to health facilities on the same day were difficult to trace. Without adequate information on the fidelity of the same-day escort by linkage officers of the project, it is difficult to determine the exact barriers to linkage.

The PASP evaluation found a higher linkage to ART, than newly diagnosed children and adolescents by the end of September 2018. Linkage to ART was well above 90%, with a total of 1,636 children and adolescents initiated on ART against 1,116 newly diagnosed HIV-positive in the same period, likely because of catch-up campaigns to ensure that all CLHIV and ALHIV were initiated on ART. While achieving 90% ART initiation was not a challenge in this study, it was not possible to ascertain whether all newly diagnosed patients during the project implementation phase were initiated on ART.

With regards to project targets for the 2nd 90, the data shows that fewer older CLHIV were initiated on ART (19%), compared to those under five years (30%). The older children are most likely the group that needs intensified and targeted case-finding strategies, as they do not have many opportunities to access HIV testing. The age of

consent allows adolescents to test and initiate ART once 12 years and older, compared to children who require parental/caregiver consent. However, very few male ALHIV (8%) were initiated on ART from all patients on ART in the PASP evaluation. This is not unexpected, as this trend has been reported in other studies.

Among 2,922 early adolescents (10–14 years) in a Tanzanian study, females were most likely to receive ART prescriptions compared to males. However, among the 4,169 older paediatric patients (5–9 years), the males were most likely to receive prescriptions (5). The study also asserted that male-gender children were at a higher risk of early death, even when linked to care.

Limitations

The sample size in this study was limited to 39 months of available data or limited data points. This may have affected the observed results on the effect of the implementation strategies. There may have been potential confounding variables outside of the project that influenced the trends in the data. Further research could help to refine and contextualize implementation strategies. Community-based linkage challenges, including same-day escort and variations in urban and rural community-based approaches require further investigation.

5.4 Conclusion

This study underscores the potential of data-driven linkage to improve ART initiation among CLHIV and ALHIV. By leveraging laboratory results and notification systems, healthcare providers can enhance treatment outcomes and reduce HIV-related morbidity and mortality.

Data-driven linkage and case management should be prioritized to enhance paediatric ART initiation. Targeted interventions are needed for older CLHIV and male ALHIV, who are often underrepresented in ART initiation and tailored interventions addressing gender disparities and age-specific needs are essential to achieve optimal ART coverage.

Where guidelines permit ART initiation outside of health facilities and where resources for pre-ART clinical procedures are available, linkage to ART at the community level can be improved.

CHAPTER 6 – Relative contribution of PASP strategies to retention and viral suppression

This chapter examines the impact of PASP implementation strategies on retention in care and viral suppression among CLHIV and ALHIV. The evaluation focuses on two key aspects:

1. An analysis of strategies used to enhance retention and viral suppression outcomes.
2. An assessment of PASP's relative contribution to the number and proportion of children and adolescents achieving viral suppression.

6.1 Introduction

Globally, an estimated 1.8 million children (0–14 years) were living with HIV in 2017, but in 2022 only 57% of CLHIV were on treatment, compared to 77% of adults (9). The UNAIDS 2022 estimates show that only about 65% of 10–19-year-old ALHIV were on ART. The 2020 UNAIDS modelled estimates from 21 focal countries also showed that 74% of CLHIV on ART had suppressed viral load, lower compared to that of adults at 89%(1,9,58). In South Africa, only 48% of the estimated CLHIV (0–14 years) were on ART in 2021, compared to 75% of adults, while in 2017, children had a cumulative loss to follow–up (LTFU) rate of more than 50% (21).

About 1.7 million adolescents (10–19 years) were also estimated to be HIV-positive in 2019, however, reporting on HIV treatment data for adolescents has remained a global challenge (16). In 2022 viral load data on ALHIV were not updated due to low reporting from countries, however, recent Population HIV Impact Assessments (PHIA) data suggest that ALHIV aged 15–24 years have lower viral suppression than older adults(58). According to the 2017 South African National HIV Prevalence, Incidence, Behaviour and Communication Survey, only 51.7% of ALHIV (males 58.8%, females 49.1%) were on ART. Viral suppression among ALHIV on ART was 85.2% (80.6% males and 87.1% females) (23).

The goal is to achieve an undetectable viral load which indicates treatment success but also reduces risks of onward horizontal and vertical HIV transmission as well as improving clinical outcomes. Routine viral load monitoring helps to identify any concerns and provide interventions for patients who have challenges with the prescribed regimens or with adherence. The Viral Load Suppression (VLS) thresholds

in South Africa according to the National Consolidated Guidelines, 2023 were <50 copies/mL(149).

Retention on ART refers to patients who are alive and adhere to treatment, excluding those who were lost to follow-up (LTFU), discontinued ART and died. The definition of LTFU can vary from one month since a patient last had clinical contact to more than six months depending on the country and programme. The South African DoH recognises the threshold of >90 days since the patient last had clinical contact as LTFU (150).

Predictors and reasons for attrition and high viral load among children and adolescents

Age, gender, clinical staging, duration of ART, type of treatment combination, level of health care, distance to health facilities and role of caregiver are the common predictors of treatment adherence and viral suppression for CLHIV and ALHIV (31,151–154).

Among CLHIV, predictors of ART attrition include younger age, severe immunosuppression, and shorter duration on ART with higher attrition observed in the first 12 months after ART initiation (155). In addition to young age (<1 year) at ART initiation, recent year of ART start, mother as a primary caregiver, and being underweight have been previously associated with LTFU in the first 12 months of ART among children (156). This attrition is potentially related to unidentified death in the first few months after initiation, especially because of similarities between predictors of death and those of LTFU among young children.

Caregivers play a key role in treatment dosing, monitoring and adherence for young CLHIV. In a cross-sectional study among Ethiopian CLHIV and their caregivers, CLHIV with married and widowed/divorced caregivers were more likely to adhere to their ART treatment compared to those with single caregivers (157). In addition, CLHIV who were not aware of their HIV status, and those with higher baseline WHO clinical stage (III/IV) were more likely to adhere to their ART treatment. However, some CLHIV were more likely to experience adherence challenges based on their different treatment regimens (157).

Difficulties with ART adherence for CLHIV are mostly caused by poor palatability of formulations and large pill sizes which can be difficult to swallow and require improvements in administration (158). The promise of simplified treatment regimens can reduce pill burden and poor adherence, especially for CLHIV on second-line or third-line ART. Fixed Dose Combinations (FDC) are recommended as they reduce pill burden and improve adherence. Vreeman et al. (159) highlighted that the undesirable physical and psychological effects of ART also affect treatment uptake among CLHIV. Although there is progress in developing child-friendly ART, the delayed approval of new and alternative drugs remains a concern (151,159–162).

In South Africa, a study among 135 CLHIV in the City of Johannesburg reported that CLHIV older than 60 months, those with more than one year on ART, those with a WHO clinical staging of I and II, and CLHIV who had missed an ART visit were most likely to be lost to follow-up. However, children who had at least one high viral load were less likely to be LTFU, possibly due to increased intervention and more frequent visits. The study reported a 10.8 per 100 person-years overall rate of loss-to-follow-up (153).

Among ALHIV, duration of ART, age and gender, as well as the level of healthcare, influence treatment adherence. Kariminia et al. (152) reported a 30% LTFU from a large global cohort of 61,242 ALHIV (10–19 years) in 34 countries. Higher LTFU rates were observed among female ALHIV who started treatment at age ≥5 years, and those in care at district hospitals or in rural settings. However, the risk of death was lower for females receiving care at a district hospital and in rural settings compared to primary health centres and in urban settings.

In South Africa, a retrospective cohort study of 2,251 ALHIV (10–24 years) in two provinces reported that adolescents were at a greater risk of unsuppressed viral load than adults. Up to 11.1% of ALHIV were lost to follow-up by 12 months of ART (31). The study also found that young ALHIV were less likely to be lost at any period after ART initiation compared to older ALHIV. In addition, Maskew et al. (163) 2016 reported a 38% rate of missed scheduled visits among ALHIV within 24 months of enrolment in a Johannesburg study that enrolled 126 ALHIV (12–20 years). Although the sample

was small, the study also reported that older ALHIV (18–20 years) were more likely to miss a visit compared to younger ALHIV.

There are several reasons why adherence and viral suppression among CLHIV and ALHIV remain lower than that of adults. These range from severe immunosuppression, lack of confidence to manage drug choices and dosage by health workers, low drug tolerance among CLHIV, low treatment literacy and forgetfulness among caregivers, and non-disclosure or lack of psychosocial support (18,123,129,155,157,164).

Severe immunosuppression and TB co-infection are related issues, with the latter being the leading cause of death among CLHIV (165). Chamla et al. (64) reported that TB co-infected CLHIV are poorly retained in care, mainly because health providers find it difficult to monitor dosing and manage symptoms in this group.

Forgetting and low HIV treatment literacy among caregivers usually results in inaccurate dosing of CLHIV. For example, in Ethiopia, Biressaw et al. (157) found that caregivers often forgot to give children the medication and that refusal by the children to swallow medication was a major reason for missing doses. In some instances, the caregiver may also be infected with HIV and their own inadequate HIV care can cause poor HIV care for the CLHIV (166).

Lastly, the lack of psychosocial support and non-disclosure among older CLHIV and adolescents affects adherence and viral load suppression. Non-disclosure is usually caused by the difficulty in approaching the conversation, guilt, possible unresolved grief and fear of stigma from peers and the community (167). In addition, barriers to health service access such as clinic operating hours, distance to clinics coupled with lack of transport and unfriendly clinic staff can deter adolescents from going to health facilities (168). The need for optimal strategies and health systems such as AYFS and peer support to address barriers to adherence and viral suppression is much greater for ALHIV, given the complexities around their treatment access.

Strategies to improve retention and viral suppression among CLHIV and ALHIV

There are few targeted implementation strategies for improving retention and viral load suppression among CLHIV and ALHIV (169,170). Nonetheless, social protection has been recommended as a largely untapped strategy, while adherence tools such as

EAC and psychosocial support, adherence clubs, mother-infant pair clinics, mentor mothers, peer counselling and support are widely used (21,83,91,171,172).

EAC with or without ECC is commonly used for patients with treatment adherence issues or poor clinical response to prescribed treatment. However, there is mixed evidence on the effect of EAC. While a 2014 study in Lesotho found a positive association between EAC, retention and viral suppression after 18 months of follow-up, a similar study in 2015 found no association in Swaziland (29,79).

Facility-based adherence clubs and peer support groups for ALHIV or caregivers of CLHIV involve pairing patients with poor adherence or high viral loads with a trained mentor to ensure personalised support. In the ACT initiative, patients who missed their appointments and those with high viral load were identified through a review of clinical records using a "*check–flag–act*" approach (19). This approach improved viral load testing, disclosure and adherence. Community-based adherence support, however, was found to only have a positive association with retention for adults but not for ALHIV and young people in low and middle-income countries (173).

Patient navigators are usually trained peers or PLHIV who facilitate the interaction of new patients with the health care system (21). Peer navigation ("fast-tracking") improved retention in the Red Carpet Programme (RCP) in Homa Bay County, Kenya among adolescents (15–19 years) and youth (20–21 years), from 66 to 90 % at 3 months, and from 54.4 to 98.6% at 6 months(98). Peer support is also important in helping caregivers approach disclosure to CLHIV in a sensitive and age-appropriate way, as well as ALHIV to deal with disclosure and treatment adherence. Some studies have shown that ALHIV prefer disclosure by HCW, peers and trained facilitators compared to family members (160,167).

Lastly, social protection is one of the strategies recommended by Cluver et al. (91), Hargreaves et al. (93) and Haberer et al. (92) for improving adherence to ART in resource-limited settings. Social protection removes the socio-economic barriers to treatment access, through direct provision of food and transport and in some cases cash incentives. Cluver et al. (91) argue that social protection is a largely untapped and key strategy for HIV prevention, adherence and treatment access among adolescents.

6.2 Methods

6.2.1 Study design and setting

This retrospective study used the routine public health Tier.Net data for secondary data on active CLHIV and ALHIV with viral load suppression. Interrupted time series design was used to examine trends among CLHIV and ALHIV (<19 years) retained on ART and virally suppressed in Region F sub-district, aggregated over 39 months (July 2015 - September 2018). The study setting comprised 10 public health facilities (two hospitals, one community health centre, and seven primary healthcare clinics).

Study population

The study sample consisted of all CLHIV (0–14 years) and ALHIV (15–19 years) who were active on ART. Newly initiated on ART patients per month were included in the study sample. CLHIV and ALHIV who were no longer on ART in July 2015 were excluded. A subset of active CLHIV and ALHIV who had suppressed viral load were included.

6.2.2 Data collection

Implementation Data

Implementation context and data on strategies for improving retention on ART and viral load suppression were extracted from the Project proposal document and three annual project reports (Year 1-3). These documents offered critical insights into strategy implementation, contextual factors, and challenges encountered during project execution.

Data Sources and Variables

This retrospective study utilized secondary data from Tier.Net and PASP to examine ART trends and effect of targeted strategies among CLHIV and ALHIV. Key variables selected in the dataset were: Facility, last ART visit date, outcome and date, last viral load count and date, current age and gender. ART patient records from Tier.Net (July 2015 to September 2018) were categorized monthly and transformed in Microsoft Excel and exported into STATA15 for analysis. (116).

In this study, retention included patients who had not missed a clinic visit for more than 90 days. Patients retained at 12 months were a subset of all patients who were initiated

in the preceding 12 months. The denominator for viral load done was the number of patients remaining on ART during the periods of interest who were eligible for a viral load test. Viral load suppression included patients who had a viral load of less than 400 copies/mL out of all those who had a viral load done.

6.2.3 Data management and analysis

Initial analysis entailed:

- Examining implementation strategies in relation to retention on ART and viral load suppression
- Evaluating the contribution of each strategy to retention on ART and viral load suppression

Primary descriptive analyses were stratified by period, age gender, and health facility level. Retention and viral load suppression was presented against the HIV clinical cascade targets. The following variables were included in the analysis:

- Retention in care at 12 months after ART initiation
- Baseline and follow-up CD4 count.
- Total remaining on ART (TROA).
- Viral load testing and suppression (<400 copies/mL)
- Loss to follow-up, death, or transfer out

The secondary analytical phase adopted an interrupted time series design to assess the effects of implementation strategies on retention and viral load suppression among CLHIV and ALHIV. Specifically: Prais-Winsten estimation identified associations between implementation strategies and outcome variables. Regression modelling (Prais-Winsten, Cochrane-Orcutt) assessed the effectiveness of implementation strategies, controlling for autocorrelation with Durbin Watson statistics. Results were presented in tables and graphs, including: Coefficients, Standard errors, R-squared (R^2) and adjusted R-squared (ARs), 95% confidence intervals (CIs) and p-values ($p < 0.05$ significance threshold).

6.3 Results and Discussion

6.3.1Strategies to improve retention and viral load suppression

The summary of the strategies implemented through PASP is based on an adaptation of Proctor's recommendations for specifying and reporting on implementation

strategies (61). Table 6.1 outlines the implementation strategies for improving retention and viral load suppression

Table 6. 1 Overview of PASP implementation strategies for improving retention and viral suppression

Strategy	Definition	Actor(s)	Action(s)	Action target(s)	Duration
	Data-driven strategies				
1. Review of missed appointment lists	Defaulters and viral load due lists generated weekly for tracing	**Data Capturer**: generates lists **Linkage officer**: phone to track & trace patients	VL monitoring, and defaulter tracing to facilitate rapid return to care	All patients on the defaulter & viral load due lists	October 2016 – September 2018
2. Results for action Dashboards (RfADs)	Weekly dashboards of patients with unsuppressed viral load	PASP Clinical Mentor, linkage officers, and DoH Ward Based Outreach Teams	Follow-up (phone, home visit) patients with high VL for clinical intervention	All patients flagged with high VL	October 2016 – September 2018
3. File Audits	Audit paper records of patients with unsuppressed viral load	PASP SI Manager, Data Capturer, PSS and Clinical mentors	Review clinical notes for reasons and interventions for unsuppressed viral load	All records flagged for unsuppressed viral load	October 2016 – September 2018
	Facility-based strategies				
4.Psychosocial support (PSS)	Disclosure sessions for ALHIV, CLHIV and caregivers using approved manuals	PASP Psychosocial Mentors, Social workers, counsellors, Youth Care club facilitators	Establish adherence and disclosure groups for ALHIV, CLHIV and caregivers and facilitate sessions	Newly initiated patients, Patients with poor adherence	January 2017 – September 2018
5. Clinic support days	Dedicated days for comprehensive care and support of HIV-positive CLHIV and ALHIV	PASP Clinical and Psychosocial Teams	Support groups, viral load management, adherence and disclosure counselling, tracing of children and adolescents	All patients booked for the day booked patients who did not attend	January 2017 – September 2018

6. Technical assistance: ECC	Mentoring of DoH clinical staff to manage high viral load	PASP Clinical Mentor and Medical officers	Review viral load results and files of patients with high viral load, monitoring and case management	All patients with high viral load	January 2017 – September 2018
	Community-based strategies				
7. Integration with Orphans & Vulnerable Children and Youth (OVCYs) and CYCWs	Home visits to provide PSS support, mentoring of Child-Youth Care Workers (CYCW)	Community-based implementing partners	PSS support for CLHIV and ALHIV newly initiated on ART or with high viral load	All patients who did not attend scheduled visits at the health facility	January 2017 – September 2018
8. Strengthen referral pathways and monitoring	A two-way facility-community referral, linking and tracking system	Ward-based outreach teams (WBOTS) and community health workers	Home visits for newly identified CLHIV/ALHIV or those with high viral load, Referral of patients to dedicated staff at the facility for clinical and PSS management	All patients who did not attend scheduled visits at the health facility	January 2017 – September 2018
***9. Technical Assistance for adherence support**	Adherence platforms for CLHIV and ALHIV established at the community level	Community-based implementing partners	Counsellors trained in support group facilitation, CLHIV and ALHIV adherence clubs established	*This strategy was planned but not implemented in Region F	N/A

Table 6.1 highlights data-driven, facility-based, and community-based strategies for improving retention and viral load suppression among CLHIV and ALHIV. Data-driven strategies included reviewing missed appointment lists, Results-for-Action (RfA) dashboards, and file audits, implemented from October 2016. Facility-based strategies, implemented from January 2017 to September 2018, included psychosocial support, clinic support days, and ECC. Community-based strategies, implemented from January 2017 to September 2018, included integration with Orphans and Vulnerable Children and Youth programmes and strengthening referral pathways. Technical assistance for adherence was not implemented. Figure 6.1 shows the PASP theory of change for improving retention and viral load suppression among CLHIV and ALHIV.

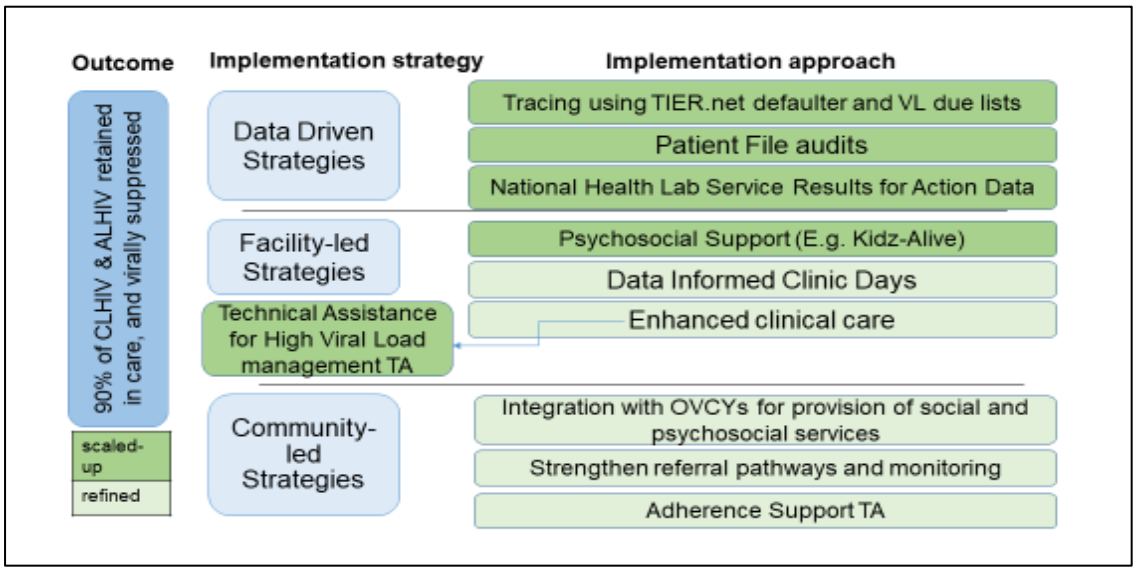

Figure 6. 1 PASP theory of change for improving retention and viral suppression

Source: PASP Theory of Change

The outcome for the 3rd 90 was 90% of CLHIV and ALHIV retained in ART with viral suppression. Data-driven strategies, including tracing patients with missed appointments and those due for viral load testing, patient file audits, and use of RfADs from the National Health and Laboratory service, were implemented and scaled up.

At the health facility level, psychosocial support was a key approach implemented and scaled up, while clinic support days and ECC were refined. ECC included providing healthcare facilities with technical assistance for managing high viral loads, which was scaled up.

Community-level strategies were implemented and refined for the next phase of implementation. These strategies collectively contributed to achieving the 90% retention rate and viral suppression among CLHIV and ALHIV.

Data-driven strategies

Data-driven strategies included retrieval of missed appointment lists from the Tier.Net ART patient database, review of RfADs received routinely from the National Laboratory Services to track and trace patients, and file audits. Data from the PASP project measurement tool were reviewed to determine the number of CLHIV and ALHIV reached through these strategies. Table 6.2 shows the retention outcomes from missed appointment lists generated from the Tier.Net ART patient database.

Table 6. 2 Data-driven strategies for improving retention among CLHIV and ALHIV

	CLHIV and ALHIV remaining on ART		
	Traced (n)	Returned to care (n)	Returned to care (%)
Missed appointment lists	26	21	80%

Source: PASP project measurement tool

A total of 26 CLHIV and ALHIV who were identified through the missed appointment lists were traced and 21(80%) of them returned to care. The Year 2 annual report highlighted that through the results for action dashboard only 30% of were returned to care.

There were no data recorded on the number and outcomes of audited files. From October 2016, the project's data capturer and strategic information manager generated weekly missed appointment lists from the Tier.Net database. These lists identified patients who missed clinical visits (defaulters) and those with missing viral load results. The lists were shared with linkage officers, who initiated contact with patients and facilitated their return to the health facility.

In addition, a Quality Improvement (QI) intervention was implemented in July 2016 to enhance viral load monitoring. The change idea involved retrieving and capturing paper-based viral load results into the Tie.net database. This allowed for effective tracing of patients who missed their last viral load appointment for more than a week

and identification of those who had defaulted. To initiate tracing, outreach teams received lists of patients who missed their viral load appointment or clinical visit.
The National Laboratory Services (NHLS) provided weekly Results for Action Dashboards (RfADs) detailing patients with high viral loads for all health facilities. Registered users, typically clinicians, could access these dashboards on the NHLS platform. From October 2016, the clinical mentor led the review process, flagging patient results and collaborating with facility-based clinical and psychosocial teams for interventions. Using demographic details from the dashboards, patient records were retrieved and flagged with coloured stickers for attention during the next clinical visit to manage high viral loads. This targeted approach resulted in approximately 30% of patients requiring viral load management being successfully traced and reintegrated into health facilities for necessary interventions.

File audits were conducted by a multidisciplinary team (clinical, psychosocial, and strategic information) from October 2016. They used lists of patients with high viral loads to identify reasons for unsuppressed viral loads and update missing results from laboratory scripts or patient databases. The psychosocial team audited child records using a checklist and identified defaulters through clinic support day bookings for follow-up. The audits checked clinical notes for unsuppressed viral loads, disclosure status and scheduled sessions as well as ART monitoring and refill, viral load testing, opportunistic infection treatment, contraception, support groups, peer support, and disclosure cases.

File audits uncovered notable deficiencies in patient record completion and guideline implementation, specifically: Inaccurate viral load test timing, suboptimal dosing and premature issuance of 3-month prescriptions, prior to receiving laboratory results.
To ensure timely follow-up, files with overdue viral load tests were flagged with color-coded stickers, serving as visual reminders for clinicians during future consultations.

Facility-based strategies

Facility-based strategies for improving retention and viral load suppression included psychosocial support, clinic support days, and ECC. Data from PASP annual project reports were reviewed and analysed to determine the role of these strategies. Table

6.3 shows the approaches implemented towards retention and viral load suppression among CLHIV and ALHIV.

Table 6. 3 PSS and ECC strategies for retention and viral load suppression among CLHIV & ALHIV

Intervention	CLHIV, ALHIV reached (n / %)
CLHIV completed KidzAlive HIV support group sessions	392
ALHIV completed the Vhutshilo care package	382
CLHIV and ALHIV enrolled in YCC	146
CLHIV and ALHIV started on second-line ART	207
CLHIV and ALHIV in YCC retained in care for after 6 months	75%
CLHIV and ALHIV in YCC with viral suppression	81%

Source: PASP annual project reports

As shown in table 6.3, PSS strategies dominated the retention and viral suppression strategies, with 392 CLHIV enrolled in KidzAlive support groups and 382 ALHIV enrolled in Vhutshilo. In addition 75% of ALHIV who were enrolled in YCCs were retained on ART and 81% of them were virally suppressed. ECC accounted for 207 CLHIV and ALHIV started on second-line ART.

Psychosocial support (PSS) played a crucial role in promoting retention and viral suppression. Led by the social auxiliary worker and psychosocial mentor from the PASP project, PSS provided technical assistance to facility-based adherence counsellors and support group facilitators. Through weekly patient database reviews, newly initiated children and those struggling with adherence or viral load issues were promptly identified and supported. A total of 12 adherence sessions, 36 full disclosure sessions, 60 partial disclosure sessions, 18 youth care clubs, and 10 family strengthening sessions were conducted among CLHIV, ALHIV and Caregivers.

Adherence and disclosure sessions were conducted, through caregiver and paediatric support groups. Disclosure groups, limited to 15 individuals, consisted of seven sessions each, but faced facility space constraints. These groups provided targeted education, focusing on partial disclosure support for younger children (3-9 years old) and full disclosure support for older children (10-19 years old).Emphasis on disclosure

was crucial, as children often travelled during school holidays, potentially leading to medication non-adherence and disclosure risks due to unaware host family members. Among older children and adolescents, adherence support was provided through Youth Care Clubs (YCC) by the Adolescents Innovations Project (78).

The Youth Care Club (YCC) model, a group-management approach, provided a differentiated care model for ALHIV and youth aged 12-24 years, aiming to improve ART initiation, retention in care, and adherence. (174). YCCs provided integrated clinical and psychosocial care through 12 sessions to closed groups of 15-20 adolescents/youth, stratified by age (12-15 years, 16-19 years, and 20-24 years). YCCs met monthly for 1 hour and 15 minutes at clinics, facilitated by trained counsellors and clinicians, featuring interactive discussions on clinical care and psychosocial support.

Three family-based psychosocial assistance packages were implemented to enhance ART adherence: Family Strengthening Intervention (FSI), KidzAlive and Vhutshilo These programmes offered targeted support to children and families affected by HIV, addressing psychosocial needs and promoting ART adherence[2]. An intake tool was used to identify the specific needs of children and enrol them in their respective support groups.

Clinic support days were established to provide mentoring for DoH staff and comprehensive clinical and psychosocial services to patients. Groups of CLHIV and ALHIV received targeted care, including case management for complex cases, viral load monitoring, and treatment of other ailments by clinical mentors. Complex cases were referred to hospital teams for further management.

[2] **Family strengthening interventions** are designed to empower caregivers with parenting skills to provide safe environments that support mental health and prevent abuse for children and adolescents, beyond social protection (money) The efforts directed at children and adolescents are therefore complemented by providing parallel support for their caregivers, which addresses their personal challenges and provides them with emotional coping and parenting skills. **KidzAlive** is 'a child-cantered, holistic model developed to find children with undiagnosed chronic illness or who have been abused; support primary caregivers with information, care, and disclosure support; capacitate health facilities and communities to provide linkage to care, adherence and psychosocial support to children and their families; help children, to understand their illness or abuse using age-appropriate language and fun tools' http://kidzalive.co.za/v2/. **Vhutshilo** is a life skills intervention targeted at 14-17/18-year-old age individuals, usually in secondary school but may include learners older than 18 years who are still in school.

These support days addressed a critical gap in targeted interventions for CLHIV and ALHIV, ensuring their unique needs for adherence support, disclosure, and peer support were met. Although routine process data on clinic support days and patient numbers were not collected, staff hours spent on adherence, retention, and viral load care were documented. This approach aligns with recommendations for effective HIV care and treatment, emphasizing the importance of trained staff, comprehensive services, and targeted interventions.

ECC was delivered through technical assistance for managing high viral loads among complex patients. ECC was a hospital-based strategy targeting CLHIV and ALHIV with complex needs, specifically those with two or more consecutive unsuppressed viral loads, resistance to treatment, and co-infections, such as Tuberculosis (TB), who received intensive viral load and clinical monitoring and management from trained Advanced Clinical Care (ACC) project.

Community-based strategy

Community-based approaches enhanced psychosocial services through strengthened referral pathways from health facilities to CBOs, while Technical Assistance (TA) supported Child and Youth Care Workers (CYCW) in providing adherence support to HIV-positive Orphans, Vulnerable Children, Adolescents, and Youth (OVCAY). These approaches were undergoing refinement for the project's second phase. Data from the PASP annual progress reports (July 2015 to September 2018) were reviewed and analyse to describe the contribution of community interventions on retention and viral load suppression. Table 6.4, provides an overview of the number of CLHIV and ALHIV individuals reached through various community-based interventions

Table 6. 4 CLHIV and ALHIV reached through community-based interventions

Intervention	CLHIV, ALIHV (n)
CLHIV enrolled in community support	257
CLHIV enrolled for adherence and disclosure support	115
Caregiver peer support	61
ALHIV peer support	90
CLHIV traced and linked back to facilities	12
CLHIV referred for other services	56

Source: PASP annual project reports

Table 6.4 shows that more CLHIV were enrolled in community level interventions than ALHIV. For CLHIV, 257 were enrolled in community support, 115 in adherence and disclosure support, 61 received caregiver peer support, 12 were traced and linked back to facilities, and 56 were referred for other services. For ALHIV, 90 received peer support.

A total of 266 individuals, comprising 115 CLHIV aged 5-14 years, 61 caregivers, and 90 ALHIV aged 15-19 years, enrolled for adherence and disclosure support. At least 12 children who had stopped treatment were traced and re-initiated on ART, and 56 children were referred to other sectors, such as the Social Security Service and the Home Affairs Department, for social worker support, identification documents, and childcare grants, facilitated by technical assistance to Child and Youth Care Workers (CYCWs). However, outcome data on adherence for the enrolled CLHIV and ALHIV were not available.

A bi-directional referral form was created to streamline the referral process for health workers, connecting patients with essential services like sexual and reproductive health, psychosocial support, HIV Testing Services (HTS), ART, and social welfare services at both community and facility levels. This innovative tool ensured seamless tracking of referrals by both the referring professional and the service provider.
Key features of the bi-directional referral form:

- Streamlined Referral Process: Connecting patients with necessary services
- Traceable Referrals: Ensuring accountability and follow-up

Comprehensive Services: Covering sexual and reproductive health, psychosocial support, HTS, ART, and social welfare services

6.3.2 Effect of strategies on retention and viral load outcomes

As of September 2018, 1,886 CLHIV and ALHIV were actively receiving ART, with 1,461 (77.4%) achieving viral suppression. Routine data from the Tier.Net ART patient database were analysed to determine CLHIV and ALHIV remaining on ART who were virally suppressed in July 2015 and September 2018. Total remaining on ART was assessed as at 01 July 2015, and 30 September 2018 and categorised into retained in care y age group. A subset of CLHIV and ALHIV who had a last viral load recorded were further categorised as suppressed or unsuppressed based on the threshold for suppression of <400 copies/mL. Table 6.5 highlights the pre- and post-implementation changes in retention and viral load suppression among CLHIV and ALHIV on ART across 10 health facilities.

Table 6. 5 Change in TROA and Viral load suppression among CLHIV and ALHIV

	CLHIV & ALHIV on ART				CLHIV & ALHIV virally suppressed			
Age(years)	2015	2018	change		2015	2018	change	
		n		%		n		%
0–9	474	582	108	23	339	448	109	32
10–14	574	620	46	8	489	510	21	4
Male	298	294	-4	-1	250	253	3	1
Female	276	326	50	18	239	257	18	8
15–19	605	684	79	13	464	503	39	8
Male	297	287	-10	-3	226	209	-17	-8
Female	308	397	89	29	238	294	56	24
Total	1,653	1,886	233	14	1,292	1,461	169	13

Source: Tier.Net ART patient database

The data suggests progress in expanding ART coverage and achieving viral suppression among CLHIV and ALHIV, particularly among younger age groups and females. The total number of CLHIV and ALHIV on ART increased by 14% from 1,653 in 2015 to 1,886 in 2018.

The percentage of CLHIV and ALHIV with viral suppression also increased by 13% from 1,292 in 2015 to 1,461 in 2018. The largest increase in ART coverage was seen in the 0-9 age group with 108 patients (23%) and the 15-19 age group with 79 patients

(13%). Females showed greater increases in ART coverage and viral suppression than males across most age groups. The number of males on ART decreased slightly in the 15-19 age group (-8%) but remained relatively stable in the 0-9 and 10-14 age groups. Viral suppression rates among males showed minimal changes, with a 1% increase in the 10-14 age group and a -8% decrease in the 15-19 age group. Figure 6.2 shows the HIV treatment cascade for CLHIV and ALHIV at the end of the project.

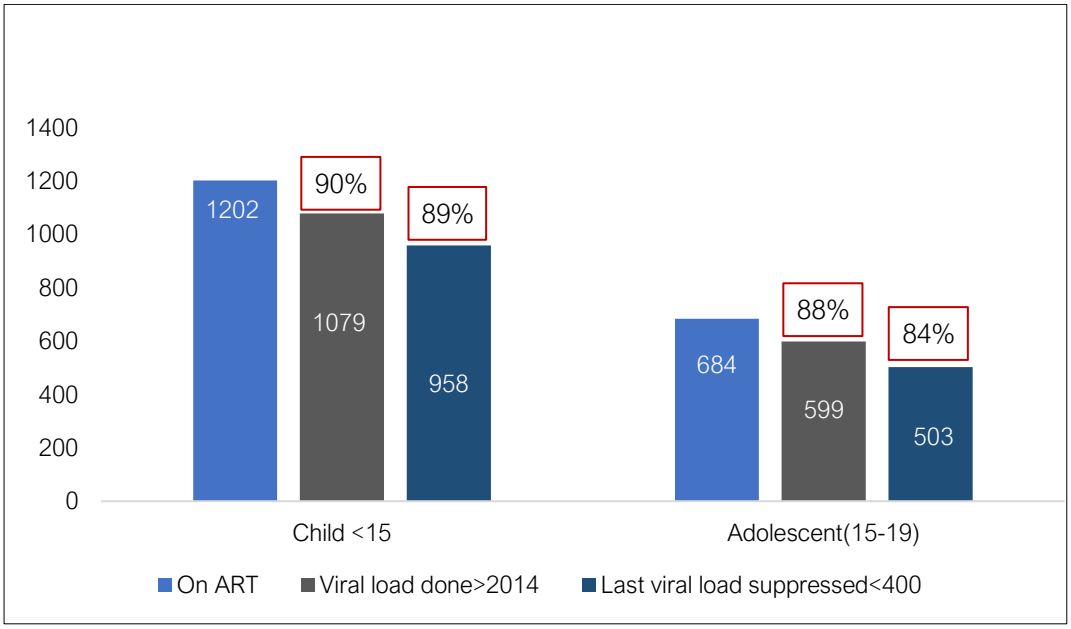

Figure 6. 2 CLHIV and ALHIV viral load cascade, September 2018

Source: Tier.Net ART patient database

A total of 1,202 CLHIV and 684 ALHIV were on ART at the end of September 2018. The target for viral load suppression among children was 1,144 CLHIV, however 1,079 (90% of those on ART) CLHIV had a viral load done and 958 (89%) of them had a suppressed viral load. Among the 684 ALHIV who were on ART, 599 (88%) had a viral load done and 503 had a suppressed viral load.

Retention at 12 months

Between July 2014 and June 2018, a cohort of 1,037 CLHIV and ALHIV newly initiated on ART were evaluated for 12-month retention. To calculate retention in ART at 12 months, the denominator was the number of patients who were initiated on ART 12 months ago, and the numerator included patients remaining on ART after 12 months, excluding those who died or lost to follow-up. Results showed that 694 (67%) remained on ART after 12 months, excluding those who died or were lost to follow-up.

Figure 6.2 illustrates the 12-month retention rates over the three-year implementation period of the PASP programme.

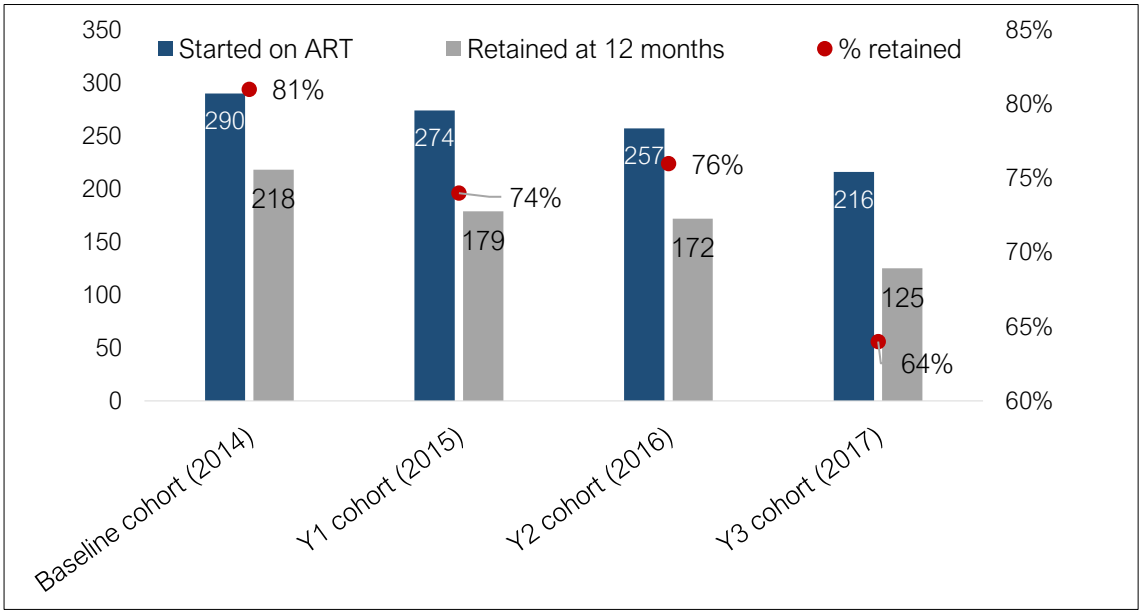

Figure 6. 3 Cohort comparison of CLHIV retained on ART at 12 months

Source: Tier.Net ART patient database

At baseline, 290 children were initiated on ART, with an impressive 81% retention rate at 12 months (218). Over three years, ART initiation numbers fluctuated: 274 (Year 1), 236 (Year 2), and 216 (Year 3). However, 12-month retention rates fell short of the 95% target: 74% (Year 1), 76% (Year 2), and 64% (Year 3). Year 3 saw the lowest ART initiation and retention rates. This decline may be attributed to under-reporting due to filing and data capture backlogs following the changeover of implementing partners in the district. The overall average 12-month retention rate for CLHIV was 71%.

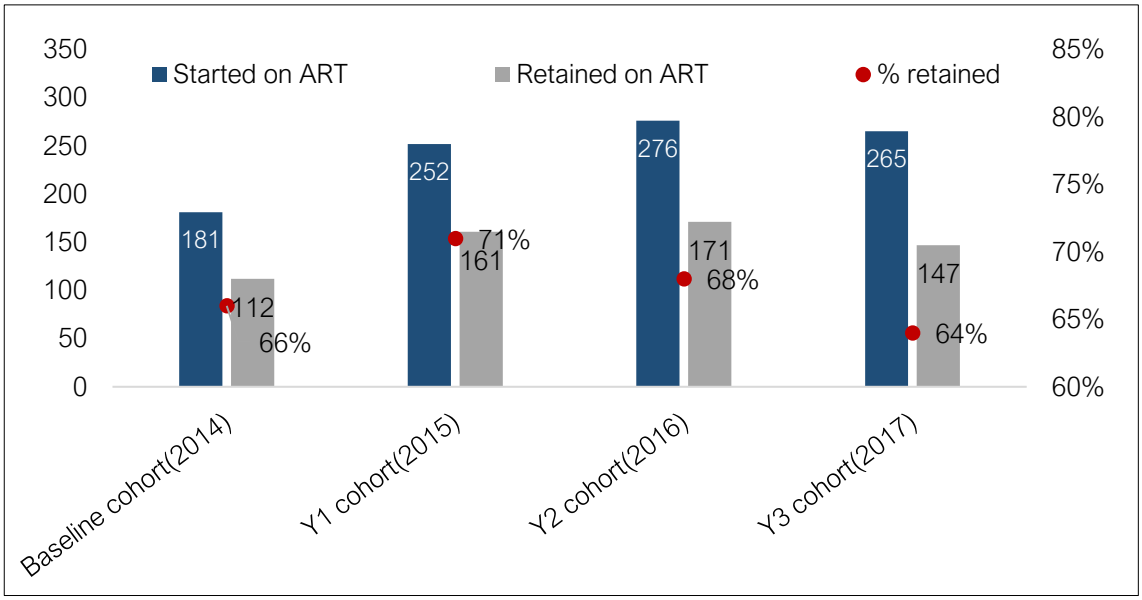

Figure 6. 4 Cohort comparison of ALHIV retained on ART at 12 months

Source: Tier.Net ART patient database

Figure 6.4 illustrates the trends in ART initiation and 12-month retention among ALHIV. At baseline, 181 ALHIV were initiated on ART, with 66% retained in care at 12 months. The number of ALHIV initiated on ART increased to 252 in Year 1, 276 in Year 2, and 265 in Year 3. Retention at 12 months also increased to 71% in Year 1 and 68% in Year 2, however, it dropped to 64% in Year 3. Similar to CLHIV, the decline in Year 3 is attributed to changes in project implementation. The average retention at 12 months for ALHIV was 60%, lower than that of CLHIV.

There are several reasons for poor retention on ART, but the primary contributors are poor treatment adherence and loss to follow-up. Loss to Follow-up (LTFU) is defined as when a patient's whereabouts or status becomes unknown, and they do not return for treatment. In the cohorts of CLHIV and ALHIV, Loss to Follow-up (LTFU) was the most significant reason for attrition among newly initiated patients within the first 12 months of ART. Figure 6.4 illustrates the number and percentage of CLHIV and ALHIV who died and those lost to follow-up from each cohort.

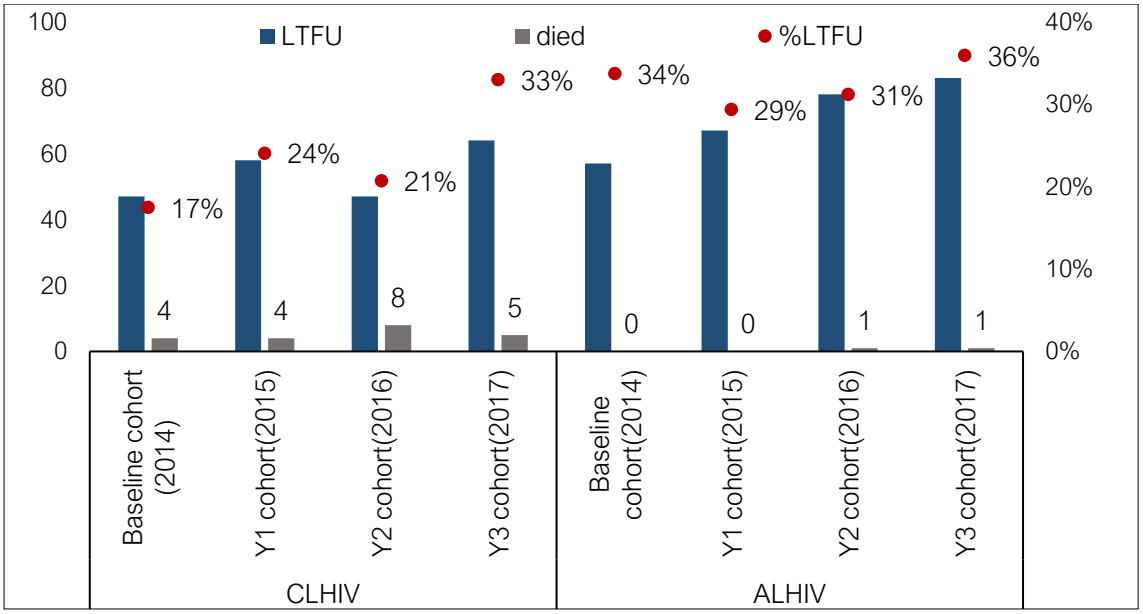

Figure 6. 5 Cohort comparison of CLHIV and ALHIV attrition at 12 months of ART

Source: Tier.Net ART patient database

LTFU trends among CLHIV and ALHIV showed varying patterns. Among CLHIV, LTFU increased from 17% at baseline to 24% in Year 1, decreased to 21% in Year 2, and peaked at 33% in Year 3. In contrast, ALHIV showed a decline from 34% at baseline to 29% in Year 1 and 31% in Year 2, before peaking at 36% in Year 3. Mortality rates were higher among CLHIV, with 4 deaths at baseline and Year 1, 8 deaths in Year 2, and 5 deaths in Year 3. Among ALHIV, only one death was recorded in Year 2 and Year 3, with no deaths reported at baseline and Year 1.

CD4 count clinical outcome

The Tier.Net database export limitations restricted access to historical viral load data, providing only the last viral load date and result. Consequently, evaluating 12-month viral load suppression for patients initiated from baseline to the second year of the project was not feasible, as earlier data was overwritten by the most recent viral load results. However, baseline CD4 count and last CD4 count data were accessible for all patients. Figure 6.5 presents the baseline and last CD4 counts among CLHIV and ALHIV across the four cohorts assessed for retention on ART.

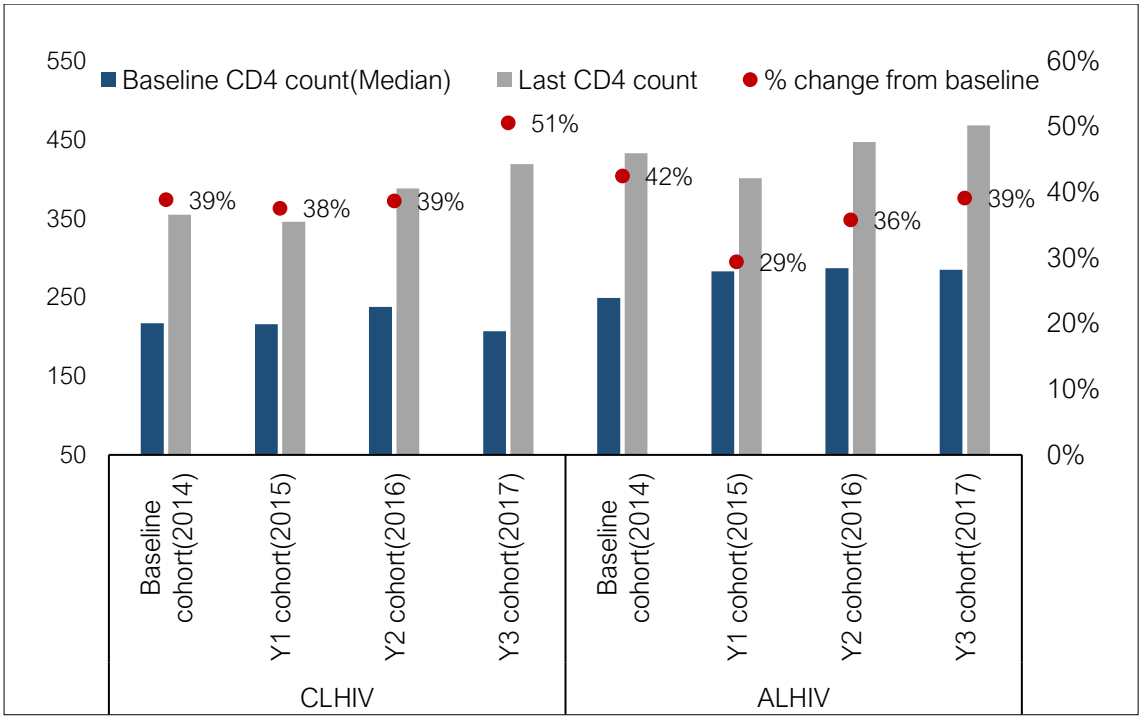

Figure 6. 6 Cohort comparison of CD4 outcomes among CLHIV and ALHIV

Source: Tier.Net **ART patient database**

The median CD4 count among CLHIV demonstrated improvement, increasing from 39% at baseline cohort to 51% in the Year 3 cohort. Among adolescents, the baseline cohort's CD4 count was 42% and then lowest in the Year 1 cohort at 29%, while Year 3 and Year 4 had 36% and 39% respectively.

Among ALHIV the median baseline CD4 count ranged from 249 in the baseline cohort, 283 for Year 1, 287 for Year 2 and 285 for Year 3. The median last CD4 count ranged from 42% for the baseline cohort, 29% for Year 1, 36% for Year 2 and 39% for Year 3. Overall, there was an increase from the median baseline CD4 count to the median last CD4 count among ALHIV with the highest change observed in the baseline cohort (42%) while the Year 1 cohort had the lowest increase at 29%.

Total CLHIV and ALHIV remaining on ART

The total remaining on ART (TROA) represents the cumulative number of patients actively receiving ART since the inception of the HIV care and treatment programme at a health facility. By the end of the project, 1,886 CLHIV and ALHIV remained on ART, with 77% (1,461) achieving viral suppression. This compares to 1,653 individuals on ART and 78% (1,292) with viral load suppression at the project's commencement.

Routine monthly time-series data on CLHIV and ALHIV enrolled on ART and achieving viral load suppression from Tier.Net were summarized and analysed for the period July 2015 to September 2018 to describe trends in the outcome variables. This analysis assessed the trend in CLHIV and ALHIV retention on ART (TROA) and Viral load suppression rates (VLS) as outcomes of interest. The descriptive statistics for TROA are presented in Table 6.6.

Table 6. 6 Descriptive statistics of monthly CLHIV and ALHIV remaining on ART

Variable	Mean	Std. Dev	Variance	Skewness	Kurtosis	Min	Max
CLHIV TROA	1,212	77.215	5962.301	-.339	2.165	1,065	1,333
ALHIV TROA	633	20.417	416.883	.210	1.938	604	684

The average TROA was 1,212 for CLHIV and 634 for ALHIV. The range of TROA values was 1,056 to 1,333 for CLHIV and 604 to 684 for ALHIV. The standard deviation for TROA was 77 among CLHIV and 20 among ALHIV. TROA followed a close to normal distribution with skewness of -0.34 and 0.21 for ALHIV, and were platykurtic (2.17 and 1.94) for CLHIV and ALHIV respectively.

Among ALHIV remaining on ART, the trend remained relatively constant with a gradual increase towards the project's end. The mean TROA values and trend analysis indicate that the programme maintained a relatively stable retention rate for ALHIV, while CLHIV retention rates fluctuated over time. Figure 6.7 shows a gradual increase in the trend for CLHIV remaining on ART, followed by a steep decline towards the project's end.

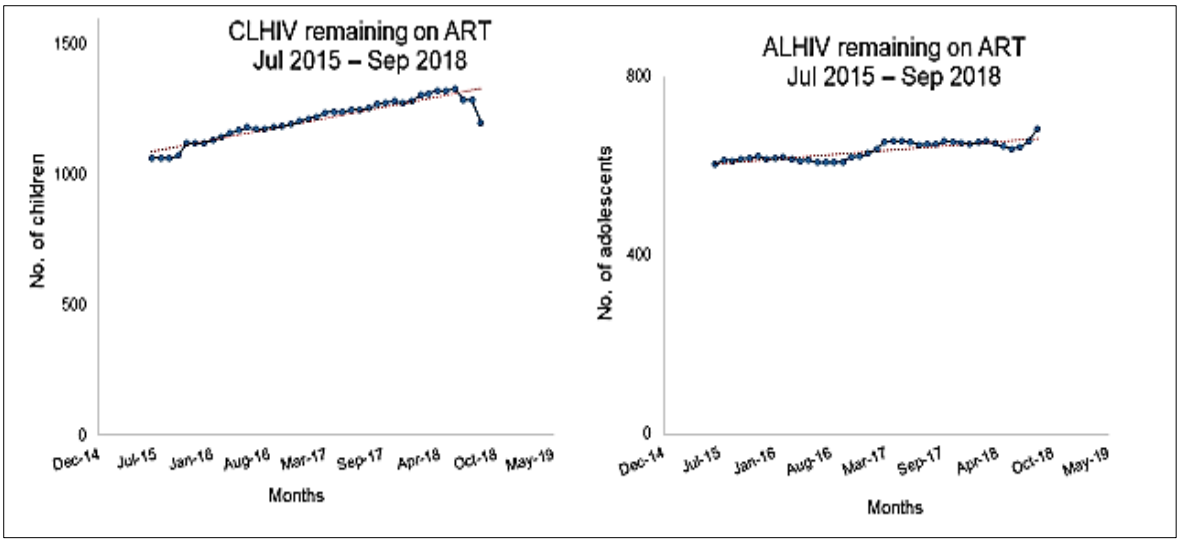

Figure 6. 7 Trend in total CLHIV and ALHIV remaining on ART

To evaluate the effect of ECC/PSS, and File Audits/Clinic support in improving retention on ART among CLHIV and ALHIV, regression analysis was conducted using Prais-Winsten estimates in Stata 15. The analysis accounted for two interventions:

- ECC combined with Psychosocial Support, implemented from January 2017 to July 2018
- Clinic support days augmented by File Audits, implemented from October 2016 to September 2018

The results of this analysis are presented in Table 6.7 highlighting the estimated effect of these interventions on CLHIV and ALHIV retention on ART.

Table 6. 7 Estimated effects of strategies on CLHIV and ALHIV remaining on ART: Prais-Winsten AR (1) Regression

	CLHIV remaining on ART				ALHIV remaining on ART			
	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P-value	95% CI
ECC/ PSS	14.256	19.831	0.48	(-25.93 to 54.44)	33.890	4.446	0.000	(24.88 to 43.00)
Clinic support/ file audits	9.254	19.890	0.64	(-31.05 to 49.56)	3.264	7.425	0.66	(-11.78 to 18.31)

As shown in table 6.7 the ECC/PSS intervention had no statistically significant effect on CLHIV retention on ART (p-value=0.48, 95% CI: [-25.93 to 54.44). The coefficient suggested a positive effect, but not significant, indicating that ECC/PSS may not have

a direct effect in improving CLHIV retention. The Durbin-Watson statistic (1.035) indicated positive autocorrelation, potentially due to the small sample size. However, the model demonstrated compelling evidence of association between ECC/PSS and CLHIV retention in ART ($p < 0.001$), with high R^2 (0.864) and AR (0.861) values. Given the robust model findings, no corrections were made. Nevertheless, future studies with larger samples may benefit from exploring alternative methods to address potential autocorrelation concerns.

Among ALHIV ECC/PSS interventions showed a statistically significant increase in retention on ART (p-value<0.001, 95% CI: [24.88 to 43.00]). Every monthly increase in ECC/PSS, ALHIV retention increased by 33.89. The 95% CI suggests that the true effect lies between 24.88 and 43.00. The Durbin-Watson statistic (1.727) indicated minimal autocorrelation, supporting the model's reliability. Strong evidence demonstrated ECC/PSS's association with ALHIV retention on ART ($p < 0.001$), with high R^2 (0.967) and AR (0.966) values. These results suggest ECC/PSS is a dominant predictor, accounting for almost 96.7% of variance in ALHIV retention on ART.

The clinic support/file audits intervention had no statistically significant effect on CLHIV retention on ART (p-value = 0.64, 95% CI: [-31.05 to 49.56]). Although the model coefficient suggested a positive effect, it was not significant. The Durbin-Watson statistic (1.214) indicated slight positive autocorrelation, potentially due to the small sample size. Further investigation, with a larger sample could help reconcile these findings.

Among ALHIV, clinic support/file audits intervention had no statistically significant effect on retention on ART (p-value = 0.66, 95% CI: [-11.78 to 18.31]). The coefficient suggested a small positive effect, but it was not significant. The Durbin-Watson statistic (1.005) showed minimal positive autocorrelation, attributed to sensitivity to the small sample size. These findings suggest clinic support/file audits may not improve ALHIV retention on ART. However, the model coefficient was significant (<0.001), with high R2 (0.912) and AR (0.910) values. Further investigation, with a larger sample could help reconcile these findings.

Overall ECC/PSS showed a significant effect on ALHIV retention on ART, but not CLHIV retention on ART. Clinic support/file audits has no significant effect on either CLHIV or ALHIV retention. These findings suggest that targeted interventions, such as ECC/PSS, may be more effective in improving retention among ALHIV.

To evaluate the impact of introducing ECC and psychosocial support on the level and trend of CLHIV and ALHIV remaining on ART, an interrupted time series analysis (ITSA) was conducted using Stata 15. The ITSA model was estimated using Prais-Winsten and Cochrane-Orcutt methods with one lag, employing a single-group design.

This study examined the impact of introducing ECC and PSS in January 2017 on CLHIV and ALHIV retention on ART. The analysis spanned 39 months (July 2015 - September 2018), divided into:

- Pre-intervention period (July 2015 - December 2016): 18 months
- Post-intervention period (January 2017 - September 2018): 21 months

This ITSA aimed to determine whether the introduction of ECC and psychosocial support resulted in significant changes in immediate changes in CLHIV and ALHIV retention on ART and/or changes in the slope of CLHIV and ALHIV retention on ART over time. The estimated effects of ECC and psychosocial support on CLHIV and ALHIV retention on ART are presented in Table 6.8

Table 6. 8 Effect of ECC/PSS on CLHIV and ALHIV remaining on ART: Prais-Winsten AR (1) Regression Analysis

	CLHIV remaining on ART				ALHIV remaining on ART			
	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P-value	95% CI
Pre-intervention intercept	1,069	7.552	0.000	(1054.11 to 1084.84)	606	4.052	0.000	(598.11 to 614.60)
Pre-intervention slope	8.560	.597	0.000	(7.44 to 9.87)	1.306	.592	0.04	(.100 to 2.51)
Intervention intercept change	-.977	6.768	0.89	(-14.75 to 12.79)	6.688	3.747	0.08	(-.94 to 14.31)
Post-intervention slope	-3.162	1.238	0.01	(-5.68 to -.64)	-.608	1.093	0.58	(-2.83 to 1.62)
Post intervention linear trend	5.488	.997	0.000	(3.46 to 7.52)	.697	.626	0.27	(-.58 to 1.97)

In the pre-intervention period the initial number of CLHIV remaining on ART was estimated to be 1,069, with a significant monthly increase of 8.560 CLHIV (p-value < 0.001, 95% CI: [7.44 to 9.87]). During the intervention period the introduction of ECC/ PSS resulted in a non-significant decrease of .977 CLHIV remaining on ART per month (p-value = 0.89, 95% CI: [-14.75 to 12.79]). In the post-Intervention period following the intervention, the number of CLHIV remaining on ART decreased significantly at a rate of 3.162 per month (p-value = 0.02 95% CI: [-5.68to .64]). However, the long-term post-intervention linear trend indicated a significant increase at a rate of 5.488 CLHIV per month (p-value <0.001, 95% CI: [3.46 to 7.52]) which suggested a need for further investigation, with a larger sample. Durbin-Watson statistic (1.404) showed limited linear auto-correlation for CLHIV retained on ART, however the model showed a strong statistical association (p-value <0.001) and high R^2 value (0.966) between ECC/PSS and CLHIV retention on ART, therefore no corrections were made.

Among ALHIV, in the pre-intervention period the initial number remaining on ART was estimated to be 606. This was followed by a significant monthly increase of 1.306 ALHIV remaining on ART per month (p-value = 0.04, 95% CI: [.100 to 2.51]). During the intervention period the ECC/PSS interventions resulted in a marginally significant increase at a rate of 6.688 ALHIV remaining on ART per month (p-value = 0.08, 95% CI: [-.94 to 14.31]). In the post-intervention period following the intervention, there was a non-significant decline in the number of ALHIV remaining on ART, at a rate of 0.98 (p-value = 0.58, 95% CI: [-2.83 to 1.62]). The long-term trend indicated a non-significant increase of .697 ALHIV per month (p-value= 0.27, 95% CI: [-.58 to 1.97]). Durbin-Watson statistic (1.542) showed minimal linear auto-correlation in residuals and the model showed a strong association between ECC/PSS and ALHIV retention on ART, as the model coefficient was significant (<0.001) and high R^2 value (0. 0.982). Figures 6.8 and 6.9 provides a graphical illustration of these findings.

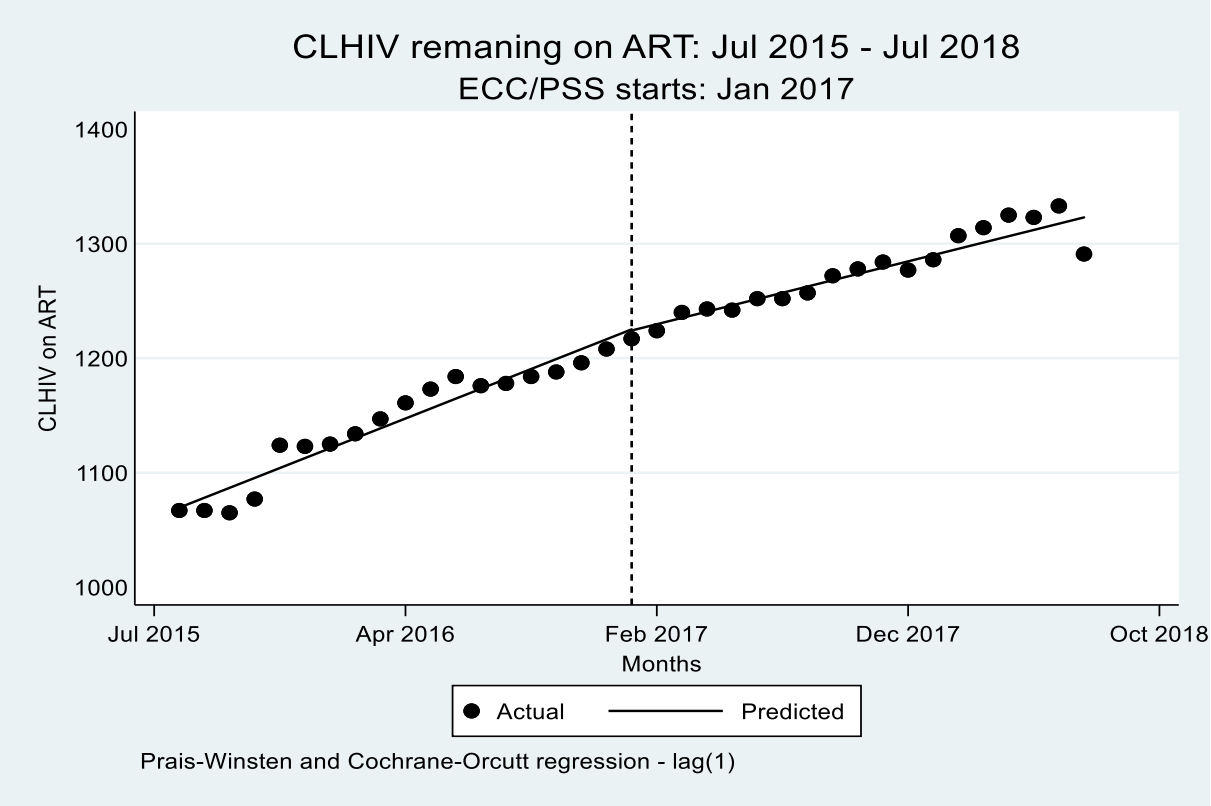

Figure 6. 8 Trend for CLHIV remaining on ART before and after ECC/PSS

Source: Tier.Net ART patient database

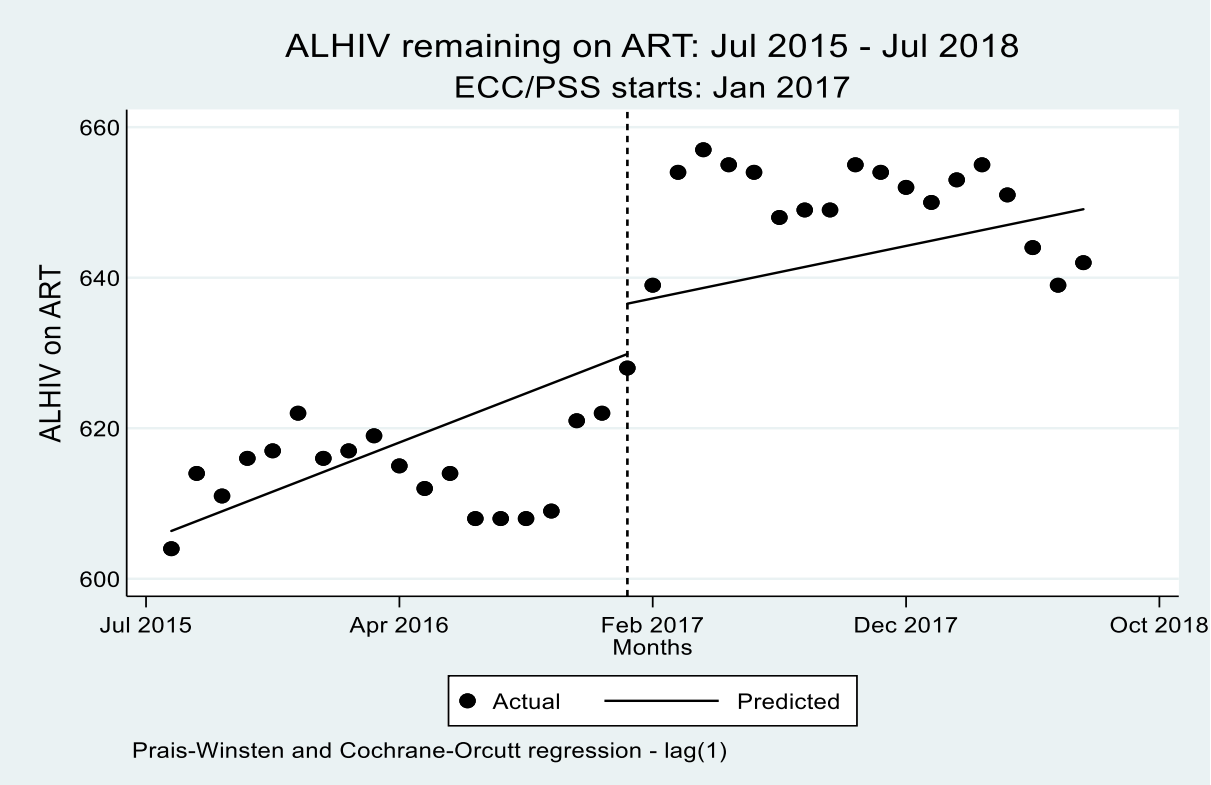

Figure 6. 9 Trend for ALHIV remaining on ART before and after ECC/PSS

Source: Tier.Net ART patient database

Overall, the ECC/PSS intervention demonstrated differing effects on CLHIV and ALHIV retention on ART, highlighting the need for targeted interventions and further investigation into the underlying mechanisms.

To evaluate the impact of introducing clinic support days and file audits on the level and trend of CLHIV and ALHIV remaining on ART, an interrupted time series analysis (ITSA) was conducted using Prais-Winsten and Cochrane-Orcutt methods. This interrupted time series analysis (ITSA) covered a 39-month period, divided into:

- Pre-intervention phase (July 2015 - September 2016, 15 months)
- Post-intervention phase (October 2016 - September 2018, 24 months), initiated by the introduction of clinic support days and file audits in October 2016 (month 16).

The analysis aimed to determine whether the introduction of clinic support days and file audits resulted in a significant change in the level and trend of CLHIV and ALHIV remaining on ART, compared to the pre-intervention period. Table 6.9 presents the estimated effects of clinic support days and file audits on total CLHIV and ALHIV remaining on ART. The results provide insight into the effectiveness of clinic support days and file audits in improving CLHIV and ALHIV retention on ART.

Table 6. 9 Effect of clinic support/file audits on CLHIV and ALHIV remaining on ART: Prais-Winsten AR (1) Regression Analysis

	CLHIV remaining on ART				ALHIV remaining on ART			
	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P-value	95% CI
Pre-intervention intercept	1,064	8.448	0.000	(1,047.05 to 1081.40)	609	5.779	0.000	(597.49 to 620.96)
Pre-intervention slope	9.936	1.017	0.000	(7.87 to 12.00)	.603	.664	0.37	(-.75 to 1.95)
Intervention intercept change	3.575	16.214	0.83	(-29.34 to 36.49)	1.368	3.458	0.70	(-5.65 to 8.39)
Post-intervention slope	-6.869	2.345	0.01	(-11.15 to -1.63)	1.806	1.370	0.20	(-.98 to 4.59)
Post intervention linear trend	3.549	1.858	0.06	(-.22 to 7.32)	2.410	.895	0.01	(.59 to 4.23)

Before the introduction of clinic support days and file audits, CLHIV showed a significant increase in the outcome variable (TROA), with an estimated rate of change of 9.94 per month (p-value < 0.001, 95% CI: [7.87 to 12.00]). In contrast, ALHIV did not show a significant change in TROA during this period, with an estimated rate of change of 0.60 per month (p-value = 0.37, 95% CI: [-0.75 to1.95]).

Upon immediate introduction, clinic support days and file audits did not result in significant immediate changes in the TROA for either CLHIV or ALHIV. The estimated change in the TROA immediately after the intervention was 3.58 for CLHIV (p-value = 0.83, 95% CI: [-29.34 to 36.49]) and 1.37 for ALHIV (p-value = 0.70, 95% CI [-5.65 to 8.39]).

In the post-intervention period, CLHIV showed a significant decrease in the TROA, with an estimated rate of change of -6.39 per month (p-value = 0.01, 95% CI: [-11.15 to -1.63]). Durbin-Watson statistic (1.956) showed limited auto-correlation for CLHIV retained on ART and no corrections were made. The model showed a strong evidence that Clinic support/File audits were associated with CLHIV retention on ART, as the model coefficient was significant (<0.001) and high R^2 value (0.900).

In contrast, ALHIV did not show a significant change in the TROA during this period, with an estimated rate of change of 1.81 per month (p-value = 0.196, 95% CI [-0.98-4.59]). In the long-term post-intervention period CLHIV showed a marginally significant positive linear trend in the TROA after the intervention, with an estimated rate of change of 3.55 per month (p-value = 0.06, 95% CI: [-0.22 to7.32]). ALHIV showed a significant positive linear trend in the TROA after the intervention, with an estimated rate of change of 2.41 per month (p-value = 0.01, 95% CI: [0.59 to 4.22]). Durbin-Watson statistic (1.214) showed limited auto-correlation for CLHIV retained on ART and no corrections were made. The model showed a strong evidence that Clinic support/File audits were associated with CLHIV retention on ART, as the model coefficient was significant (<0.001) and high R^2 value (0.970).

Overall CLHIV had increasing TROA values before the interventions. Clinic support days and file audits did not result in immediate significant changes. After the interventions, CLHIV showed significant decreases, while ALHIV showed no significant change. CLHIV showed a marginally significant positive long-term trend,

while ALHIV showed a significant positive long-term trend. Figures 6.9 and 6.10 show a visual display of these results.

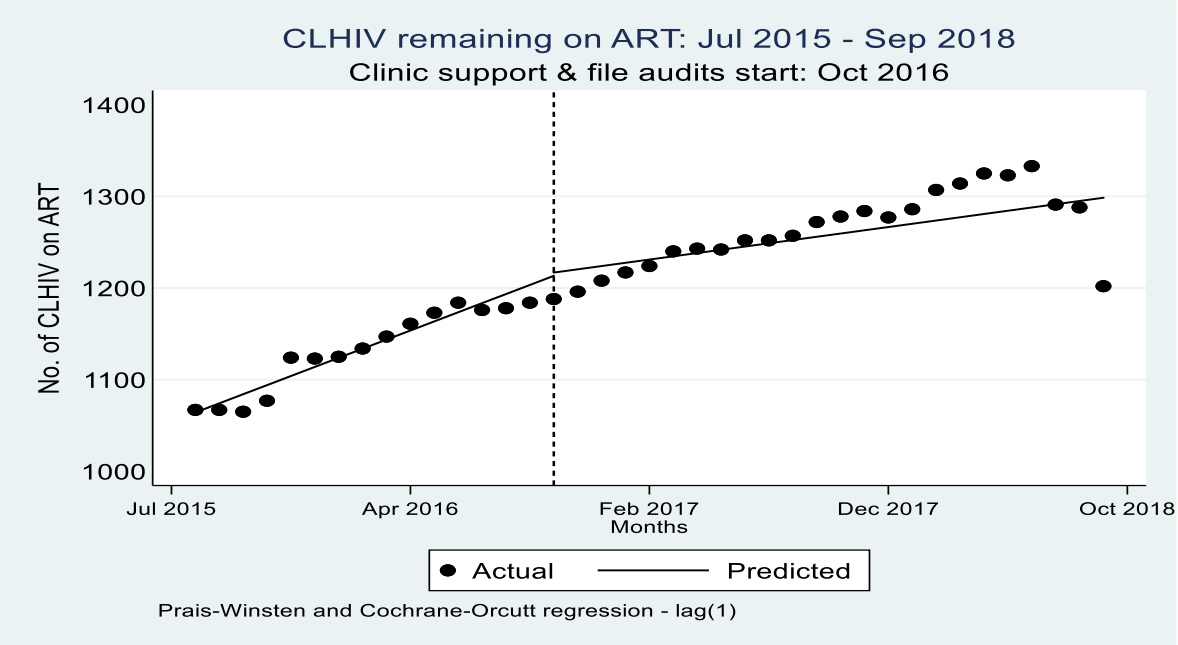

Figure 6. 10 Trend for CLHIV remaining on ART before and after clinic support/file audits

Source: Tier.Net ART patient database

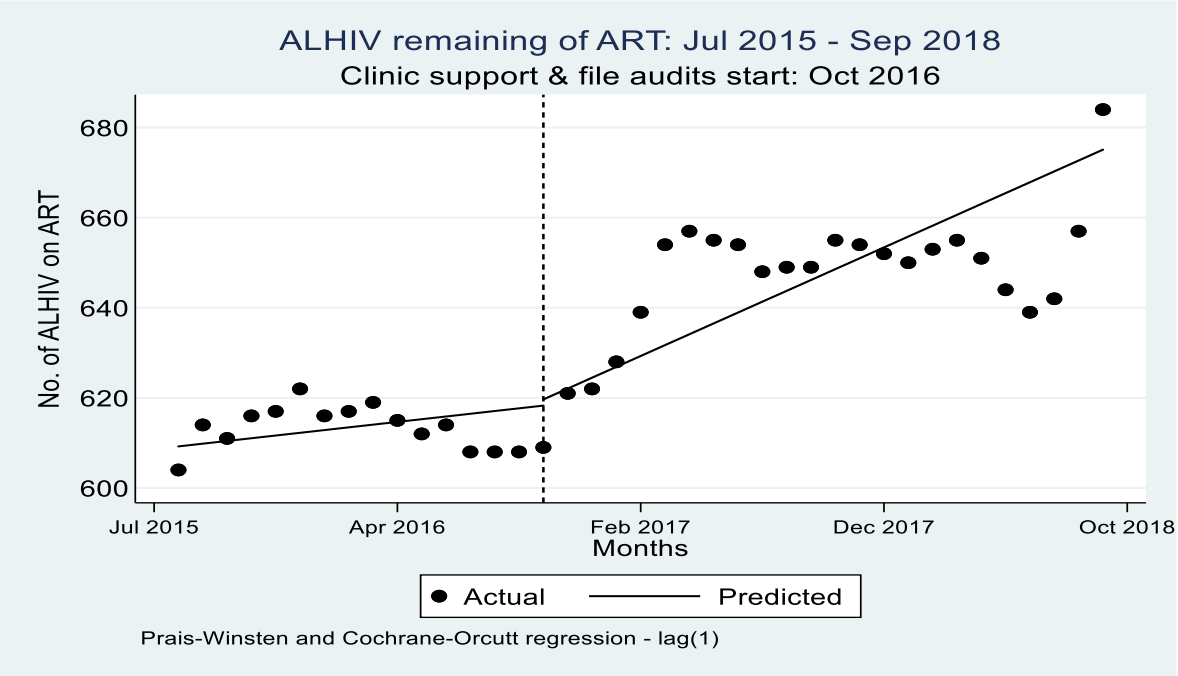

Figure 6. 11 Trend for ALHIV remaining on ART before and after clinic support/file audits

Source: Tier.Net ART patient database

Viral load suppression

This study examined the trends in viral load suppression among CLHIV and ALHIV remaining on ART over 39 months (July 2015 to September 2018). Viral load suppression was defined as a viral load below 400 copies/mL. Table 6.10 shows the monthly distribution of CLHIV and ALHIV with viral suppression.

Table 6. 10 Descriptive Statistics for viral load suppression among CLHIV and ALHIV

Variable	Mean	Std. Dev	Variance	Skewness	Kurtosis	Min	Max
VL suppressed (n)							
CLHIV	944	50.850	2585.779	-.613	2.139	841	1,008
ALHIV	492	14.026	196.736	-.249	1.602	464	511
(%) of VL suppressed							
CLHIV	.779	.015	.0002	-1.108	3.795	.737	.803
ALHIV	.776	.010	.0001	-.973	7.771	.735	.802

The data in table 6.12 shows that CLHIV has a significantly higher absolute number of individuals with viral load suppression (mean: 944.56) compared to ALHIV (mean: 492). CLHIV and ALHIV have remarkably similar viral load suppression rates, with mean percentages of 77.9% and 77.6%, respectively. The narrow ranges (CLHIV: 73.7 to 80.3%, ALHIV: 73.5 to 80.2%) and low standard deviations (CLHIV: 1.5%, ALHIV: 1.0%) indicate stable viral load suppression rates over time, suggesting consistent programme performance. The skewness and kurtosis values indicate that the distributions of viral load suppression rates are relatively normal, with a slight leftward skew for CLHIV (Skewness: -1.108) and ALHIV (Skewness: -0.973). ALHIV shows slightly lower variability in viral load suppression rates (Variance: 0.0001, Std. Dev: 1.0%) compared to CLHIV (Variance: 0.0002, Std. Dev: 1.5%).

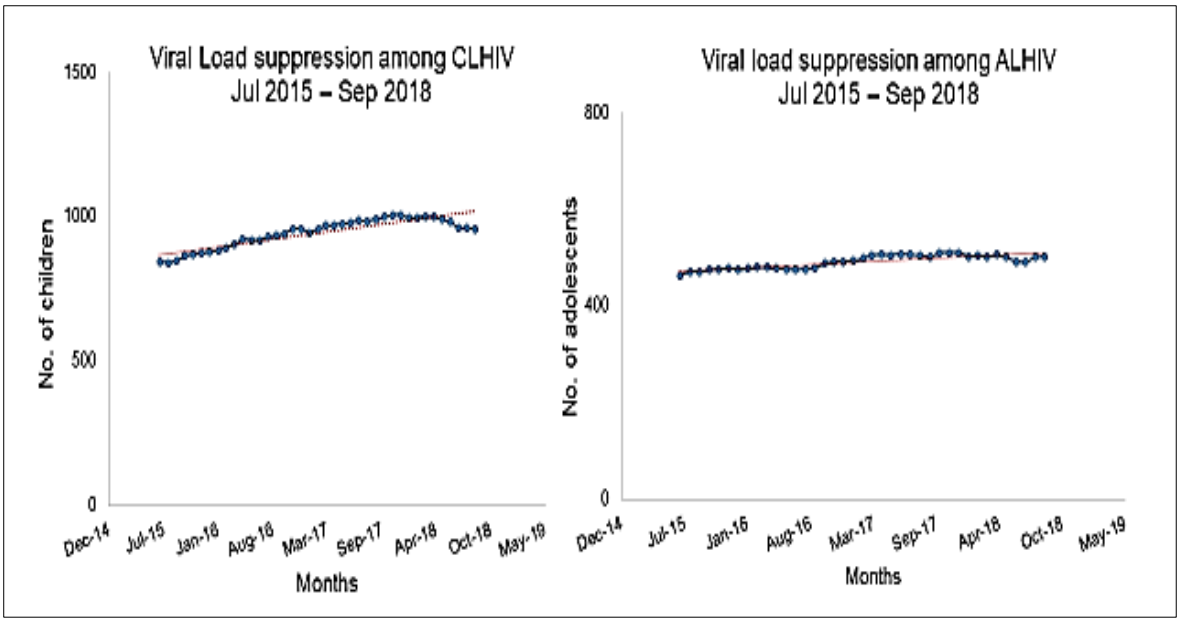

Figure 6. 12 Trend for CLHIV and ALHIV with suppressed viral load

Source: Tier.Net ART patient database

A similar trend in viral load suppression was observed among CLHIV and ALHIV, consistent with expectations since viral load suppression is a subset of those remaining on ART.

To assess the impact of ECC, Psychosocial Support (PSS), and File Audits on viral load suppression among CLHIV and ALHIV, a Prais-Winsten regression analysis was conducted using Stata 15.Table 6.11 presents the estimated effects of these strategies on viral load suppression among CLHIV and ALHIV.

Table 6. 11 Factors associated with viral load suppression among CLHIV and ALHIV: Prais Winsten Regression Analysis

	CLHIV with suppressed viral load				ALHIV with suppressed viral load			
Variable	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P-value	95% CI
ECC/ PSS	-11.534	8.971	0.21	(-29.70 to 6.66)	4.529	4.320	0.30	(-4.22 to 13.28)
Clinic support/ file audits	9.036	9.169	0.33	(-9.54 to 27.62)	16.239	3.712	0.000	(8.72 to 23.76)

The Prais-Winsten AR (1) regression analysis showed that the ECC/PSS intervention did not have a statistically significant association with viral load suppression among CLHIV (p-value= 0.21, 95% CI: [-29.70 to 6.66]) with a coefficient of -11.52. Durbin-Watson statistic (1.035) showed minimal linear auto-correlation for CLHIV retained on AR. The model showed a strong association between ECC/PSS and CLHIV retention on ART, as the model coefficient was significant (<0.000) and high R^2 value (0.864) and AR value (0.861). Among ALHIV, the ECC/PSS intervention also did not show a statistically significant association with viral load suppression (p-value = 0.30, 95% CI: [-4.22 to 13.28]) with a coefficient of 4.53. Durbin-Watson statistic (1.727) showed minimal linear auto-correlation for ALHIV retained on AR. The model showed a strong association between ECC/PSS and ALHIV retention on ART, as the model coefficient was significant (<0.000) and high R^2 value (0.967) and AR value (0.966).

Similarly, clinic support/file audits did not demonstrate a statistically significant association with viral load suppression among CLHIV (p-value= 0.33, 95% CI: [-9.54 to 27.62]) with a coefficient of 9.04. Durbin-Watson statistic (1.293) showed minimal linear auto-correlation for CLHIV retained on AR. The model showed a strong association between ECC/PSS and CLHIV retention on ART, as the model coefficient was significant (<0.000) and high R^2 value (0.894) and AR value (0.891).However, among adolescents clinic support/file audits demonstrated a statistically significant and strong positive association with viral load suppression among ALHIV (p-value < 0.000, CI: [8.72 to 23.76]) with a coefficient of 16.24. Durbin-Watson statistic (1.784) showed minimal linear auto-correlation for ALHIV retained on AR. The model showed a strong association between ECC/PSS and ALHIV retention on ART, as the model coefficient was significant (<0.000) and high R^2 and AR values (0.979).

These results suggest that clinic support/file audits may be a more effective strategy for promoting viral load suppression among ALHIV compared to ECC/PSS intervention. However in practice, these interventions are often not independent of each other and should be integrated to optimise viral load outcomes.

To evaluate the impact of ECC and Psychosocial Support (PSS) on the retention of CLHIV and ALHIV on ART, an interrupted time series analysis was performed using Stata 15. The results, presented in Table 6.12, show the effect of these interventions on viral load suppression among CLHIV and ALHIV.

Table 6. 12 Effect of ECC/PSS on viral load suppression among CLHIV and ALHIV: Prais-Winsten AR (1) Regression Analysis

	VLS among CLHIV on ART (n)				VLS among ALHIV on ART (n)			
	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P-value	95% CI
Pre-intervention intercept	842	5.705	0.000	(830.76 to 853.98)	465	2.187	0.000	(460.57 to 469.46)
Pre-intervention slope	7.586	.760	0.000	(6.04 to 9.13)	1.888	.340	0.000	(1.19 to 2.58)
Intervention intercept change	-17.181	6.297	0.01	(-29.99 to -4.37)	.884	2.927	0.76	(-5.07 to 6.84)
Post-intervention slope	-6.258	1.817	0.002	(-9.96 to -2.56)	-1.969	.779	0.02	(-3.56 to -.38)
Post intervention linear trend	1.327	1.298	0.31	(-1.31 to 3.97)	-.081	.549	0.88	(-1.20 to 1.04)

As shown in the regression results table, among CLHIV, the initial viral load suppression level was estimated at 842 individuals achieving viral suppression (p-value <0.001, 95% CI: [830.76 to 853.98]), and this level increased significantly by 7.586 each month before the intervention (p-value< 0.001, 95% CI: [6.04to 9.13]). The implementation of ECC/PSS resulted in a significant immediate decrease in viral load suppression at a rate of 17.181 per month among CLHIV (p-value =0.01, 95% CI: [-29.99 to -4.37]). In the post-intervention period, the viral load suppression trend

decreased significantly by 6.258 per month among CLHIV (p-value = 0.002, 95% CI: [-9.96to -2.56]). The post-intervention linear trend shows that among CLHIV, there was no significant additional change in viral load suppression over time after the intervention (p-value= 0.31, 95% CI: [-1.31 to 3.97]). Durbin-Watson statistic (1314) showed minimal linear auto-correlation for CLHIV retained on ART. The model showed a strong association between ECC/PSS and CLHIV retention on ART, as the model coefficient was significant (<0.000) and high R^2 value (0. 0.978).

Among ALHIV, the initial viral load suppression level was estimated at 465 individuals with viral suppression (p-value<0.001, 95% CI: [460.57 to 469.48]), and this level increased significantly at a rate of 1.888 per unit time before the intervention (p-value<0.001, 95% CI: [1.19, 2.58]). The implementation of ECC/PSS did not have a significant immediate effect on viral load suppression among ALHIV as the co-efficient increase at a rate of .884 (p-value= 0.76, 95% CI: [-5.12 to 8.19]).

After the intervention, the viral load suppression trend decreased significantly at a rate of 1.969 per unit time among ALHIV (p-value= 0.02, 95% CI: [-3.56 to -.382]). The post-intervention linear trend showed that, there was no significant additional change in viral load suppression over time after the intervention (p-value = 0.88, 95% CI: [-1.20, 1.04]). Durbin-Watson statistic (1.601) showed limited auto-correlation for ALHIV retained on AR. The model showed a strong association between ECC/PSS and ALHIV retention on ART, as the model showed a significant correlation (p-value<0.001) and high R^2 value (0. 0.984). Figure 6.10 shows a visual display of these results.

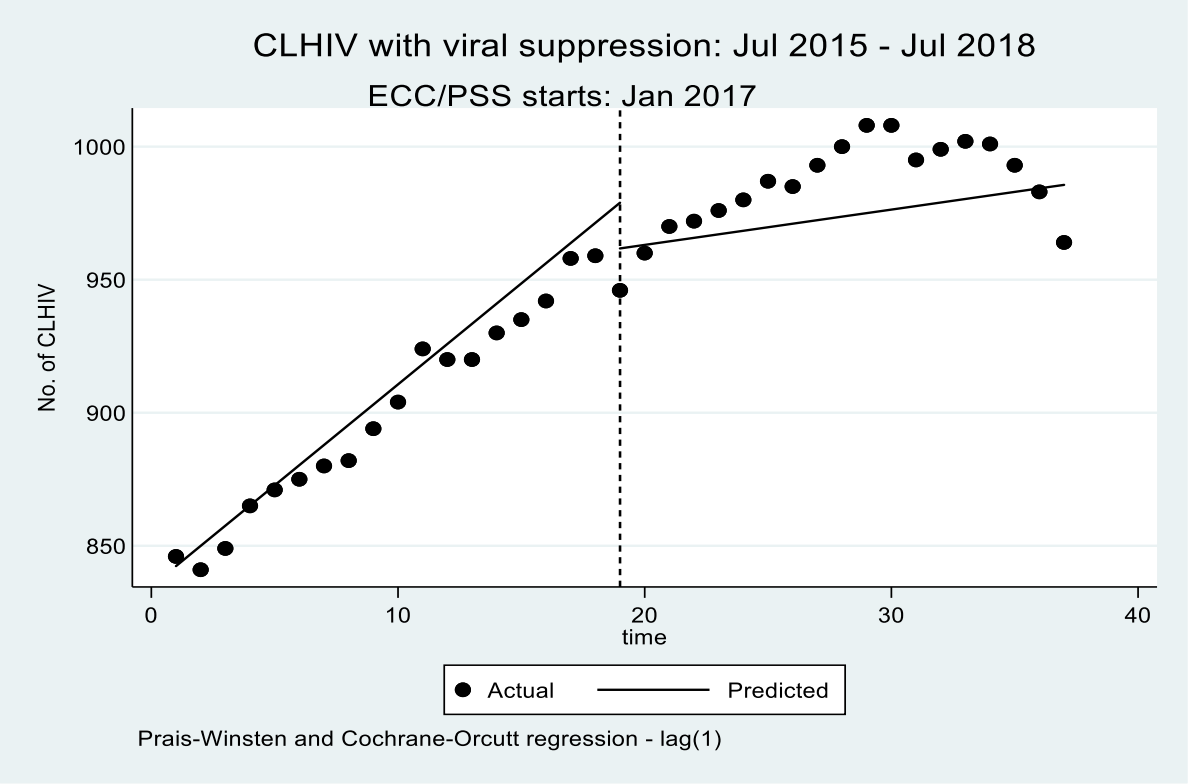

Figure 6. 13 Trend in viral suppression among CLHIV from Jul 2015 – Sep 2018

Source: Tier.Net ART patient database

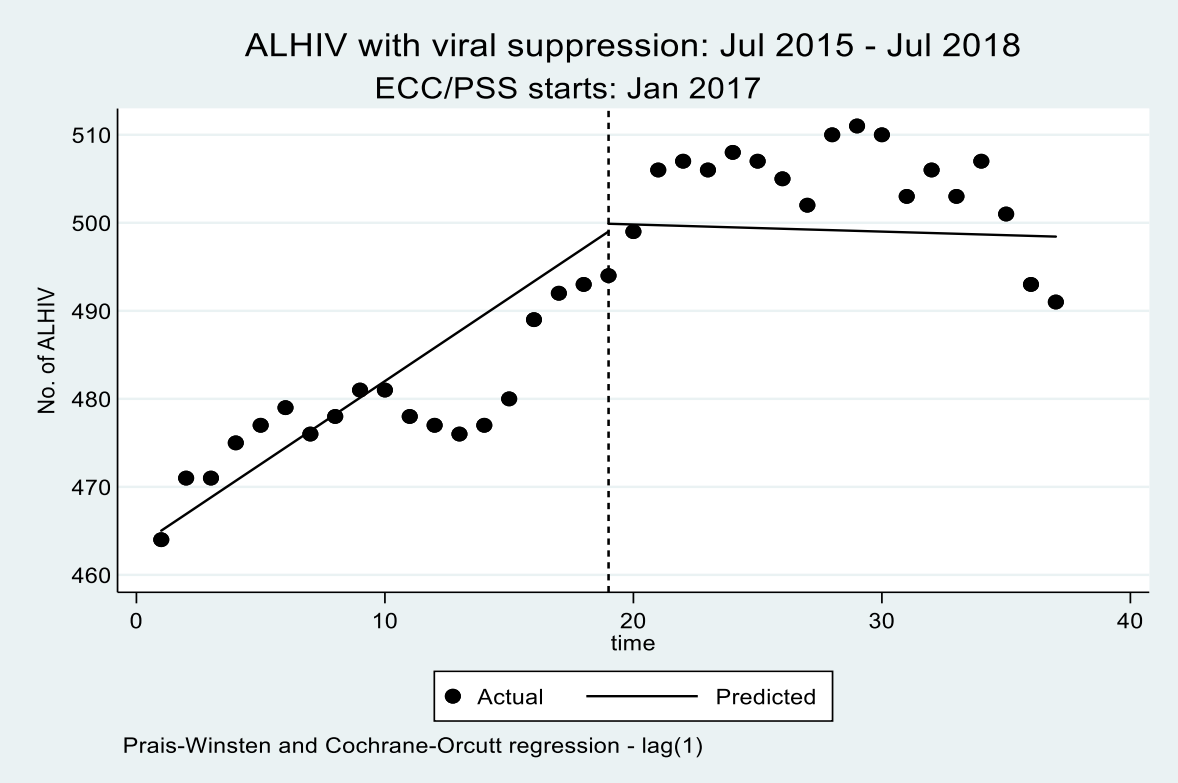

Figure 6. 14 Trend in viral suppression among adolescents

Source: Tier.Net ART patient database

Similarly, to specify whether the introduction of clinic support days and file audits resulted in a change in the level and trend of CLHIV and ALHIV remaining on ART, compared to the pre-intervention period, interrupted time series analysis was conducted in Stata 15. Table 6.13 shows the effect of clinic support days and file audits on the total CLHIV and ALHIV with suppressed viral load.

Table 6. 13 Prais-Winsten AR (1) regression iterated estimates for viral load suppression

	VLS among CLHIV on ART (n)				VLS among ALHIV on ART (n)			
	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P- value	95% CI
Pre-intervention intercept	846	3.836	0.000	(838.89 to 854.47)	467	3.456	0.000	(460.27 to 474.31)
Pre-intervention slope	7.265	1.048	0.000	(5.14 to 9.39)	1.336	.370	0.001	(.585 to 2.09)
Intervention intercept change	1.619	4.529	0.72	(-7.58 to 10.81)	8.906	2.889	0.004	(3.04 to 14.77)
Post-intervention slope	-6.372	1.835	0.001	(-10.10 to -2.65)	-.942	.631	0.14	(-2.22 to .34)
Post intervention linear trend	.892	1.020	0.39	(-1.18 to 2.96)	.393	.388	0.32	(-.40 to 1.18)

As shown in table 6.13 that the starting number of CLHIV who had suppressed viral load was estimated at 846, and appeared to increase significantly every month prior to October 2016(month 13) by 7 CLHIV (p-value < 0.001, CI:[5.14 to 9.39]). In the first month of the intervention (October 2016), there appeared to be a marginal increase in the number of virally suppressed CLHIV of 1 (p-value = 0.72, CI: [−7.58 to 10.81]), followed by a significant decline in the monthly trend of CLHIV on ART (relative to the pre-intervention trend) of 6 CLHIV per month (p-value < 0.001, CI: [−10.10 to -2.65]).

The Lincom estimate shows that after the introduction of clinic support days and file audits, CLHIV with suppressed vial load increased marginally at a rate of .89 (p-value = 0.38, 95% CI:[−1.18 to 2.96]) which was not statistically significant. Durbin-Watson

statistic (Durbin–Watson (0.36) = 1.59) shows limited autocorrelation at lag 1 among CLHIV and among ALHIV (Durbin-Watson (0.59) = 1.71). Figure 6.11 shows a visual display of these results.

Among ALHIV who had suppressed viral load the estimated of 467 appeared to increase significantly every month prior to October 2016 (month 13) although by 1 ALHIV (p-value < 0.001, CI: [.585 to 2.09]). In the first month of the intervention (October 2016), there was a significant increase in the number of virally suppressed ALHIV of 8 (p-value = 0.004, CI: [3.04 to 14.77]), followed by a slight decline in the monthly trend of ALHIV on ART (relative to the pre-intervention trend) of less than one ALHIV per month (p-value = < 0.14, CI: [-2.22 to .34]). The Lincom estimate shows that after the introduction of clinic support days and file audits, ALHIV with suppressed vial load increased marginally at a rate of less than one (p-value = 0.32, 95% CI:[-.40 to 1.18]) which was not statistically significant. Durbin-Watson statistic (Durbin–Watson (1.05) = 1.25) shows limited autocorrelation at lag 1.

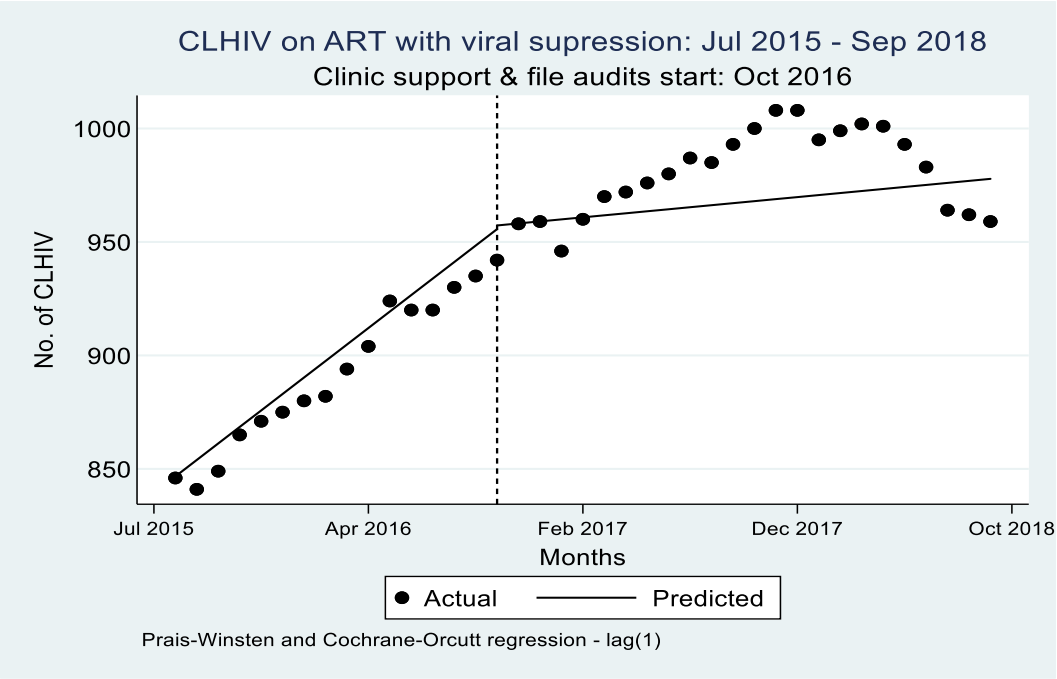

Figure 6. 15 Trend in viral suppression among CLHIV

Source: Tier.Net ART patient database

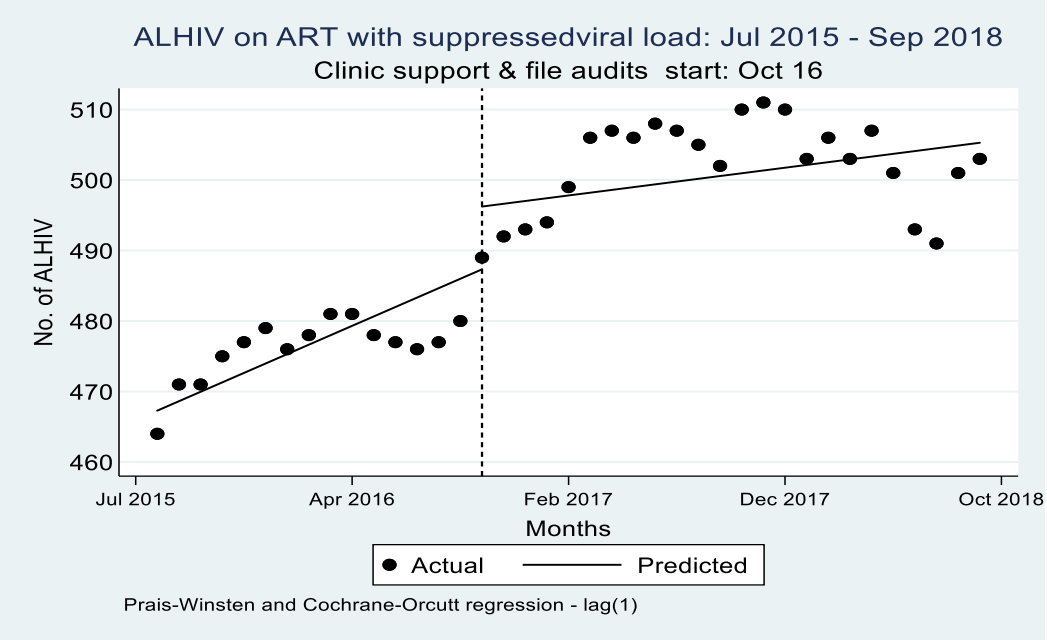

Figure 6. 16 Trend in viral suppression among ALHIV

Source: Tier.Net ART patient database

Although the target for viral load suppression was not achieved at the end of the project, there was a slight increase in retention and viral load suppression between 2015 and 2018. The data showed an overall increase of 14% in patients on ART and 13% for those who were virally suppressed. The increase in the number of children (0–9 years) on ART was 23% and 32% for viral load suppression in 2018 compared to 2015. Adolescent females on ART increased by 29% and viral load suppression increased by 24%. However, among males (10–14 years) there was a slight decrease in those on ART in 2018 (294) compared to 2015 (298). Similarly, adolescent males on ART decreased by 10 patients, between 2015 and 2018 and viral suppression also decreased by 17 patients.

Discussion

This chapter provides insights into the strategies that can improve retention and viral load outcomes among children and adolescents in an urban setting. Data-driven, facility-based and community-based strategies were identified for implementation. The number of children and adolescents on ART increased by 14% while those who were virally suppressed also increased by 13% in 2018 compared to 2015. ECC and PSS have shown significant association with increased viral load suppression among

ALHIV and not among CLHIV. Clinic support and file audits also showed a similar association in CLHIV and ALHIV although not sustained among CLHIV.

These findings suggest that focused strategies can improve the 3rd 90 outcomes among CLHIV and ALHIV. However, extending the project duration alone is not adequate to achieve the goal. Adherence to the project's core components of quality improvement and technical assistance may have improved results at this level of the cascade. There was a high loss to follow-up rate of 30% among newly enrolled patients, showing a need for better interventions among newly initiated patients to keep them engaged in care. Retention on ART at 12 months remained below the target of 95% for all cohorts, ranging between 64–81% for children and 64–71% for adolescents.

Implementation strategies

The facility-based, community-based and data-driven strategies were implemented, to improve retention and viral suppression. All data-driven approaches were scaled up for implementation in the second phase of the project, which suggested confidence in them, despite the lack of documented outcomes at the strategy level. Facility-based psychosocial support and technical assistance for high viral load were also scaled up while clinic support days and ECC were to be refined in the next phase. None of the community-based approaches were scaled up, however, these were flagged to be refined in the next phase of the project.

Data-driven strategies can be cost-effective and efficacious when implemented correctly. Data-driven strategies used in PASP are easy to implement and do not require highly skilled staff to identify and flag patients with missed appointments and high viral loads. In this study, the number of patients was small, but the outcomes of tracing were promising, with 80% of patients returning to care. These strategies should be integrated into routine practice in public health facilities. Routine review of patient data should be prioritised to identify issues which will inform subsequent interventions. Programmes such as the ACT initiative have shown that the similar "check-flag-act" strategy improved the identification and tracking of patients with missed appointments and those due for viral load testing. The approach was reported to have resulted in

retention rates of 85–90% at 12 months as well as improved the uptake of viral load testing, adherence, psychosocial support, and disclosure (19).

File audits are good for identifying gaps in the viral load management of patients, and other clinical interventions, although they are time-consuming and require a clinical understanding to navigate them. File audits or patient record reviews were done in the PASP project, however, data were not collected to quantify their relative contribution to the 3rd 90 outcomes. Patient record reviews also require an efficient filing system which has been an ongoing challenge in public health facilities. Nonetheless, this approach is important for the clinical management of patients, especially children and adolescents who may not be able to speak up about clinical tests received or due.

The approaches for facility-based strategy included psychosocial support (adherence & disclosure packages), clinic support days and ECC. Psychosocial support (PSS) was scaled-up, based on reported positive results while clinic support days and ECC were to be refined in the second phase of the project. There is no doubt that PSS is an important approach to HIV management among children and adolescents. The quality of delivery for PSS, especially EAC, including the number of adherence sessions and the competencies of counsellors, should be carefully considered. File reviews have been previously used to assess the provision of EAC in a descriptive study in Swaziland(29). The review of 180 records showed that only 20% had received all three adherence sessions according to guidelines, while 20 of the files were unclear on whether EAC was received or not. Overall, 81% had received at least one session of counselling, while 19% did not receive any EAC (29).

There were no data to qualify the scale-up of PSS however there was a high number of individuals reached through adherence and disclosure groups. Improvements among children and adolescents who previously had poor adherence and high viral load were reported anecdotally. It is important that patients attend all or most of the PSS sessions to monitor the clinical outcomes over time. These patients also receive other interventions including ECC, which could also impact the outcomes.

In the project reports and interviews with the project team, psychosocial support was highlighted as the core pillar of paediatric and adolescent HIV care, although the

process data was not available to verify and quantify this. In addition, ECC for high viral load was scaled up in PASP, however, there was no documented data to support the decision and, the contribution of other clinical confounders such as changes in dosing, regimen switching as well as nutritional factors have not been evaluated. Scaling up ECC in this project, is common practice and recommended in guidelines in cases where there is VL non-suppression. Interventions may include adherence counselling and where appropriate an ART regimen switch (122). An observational study that compared 12-month CD4 count and viral load outcomes among 939 prenatally HIV-infected youth with virological failure found that switching to new combination therapy was associated with improved virological outcomes (175).

PSS also included enrolment in Youth Care Clubs (YCCs) which were primarily implemented by the Adolescent Innovations project in Region F. The YCCs were adopted by the Department of Health to improve the 3rd 90 among adolescents. Peer counselling, adherence clubs and short message services are the most widely implemented interventions to improve ART retention and viral suppression in this population (176). Pairing newly diagnosed adolescents and those with adherence issues or high viral loads with a trained peer has been reported to improve viral load testing, adherence, and disclosure in the ACT initiative (19).

Lastly, community-based adherence support has been widely used in different settings but there is no evidence of its effectiveness for children and adolescents (169). In this study, there were very few children who were traced and linked back to care through the Child and Youth Care Workers. Returning defaulting patients to care can be difficult and resource intensive. Approaches such as checking and flagging early missed appointments, reviewing and acting on the laboratory results, psychosocial support, ECC, peer support clubs and AYFS should be strengthened in routine public health practice.

Retention on ART

Cumulative retention for children and adolescents improved after January 2017 when most project activities were in place and was sustained until March 2018 when a slight decline was observed. This decline is attributed to the changes in the funding landscape which affected the staff complement and the handover of the sub-district

operations to new stakeholders. The highest increase in retention was among 0–9 year old children followed by adolescent females. Younger age, being a child older than 60 months, starting treatment at age ≥5 years, and being an older adolescent has been associated with poor retention in other studies (155). The 2020 UNAIDS report on modelled estimates also suggested that in 21 focus countries, two-thirds of HIV-positive children who are not receiving treatment were in the 5–9 and 10–14 year age group (9).

Retention on ART at 12 months among children and adolescents ranged from 64% to 76%, however, below the target of 95%. The shorter duration of ART was highlighted by Abuogi et al. 2016 as a predictor of ART attrition with higher attrition observed in the first 12 months after ART initiation among children (155). In this systematic review of 12 studies, retention at one year of ART initiation ranged from 76–95% and where children were not retained in care, loss to follow-up (LTFU) accounted for 73% (155).

The overall LTFU was highest among adolescents (47%), even though there was an increase among adolescent females on ART. This increase is attributed to the role of peer support groups; however, an unexplained opposite trend was observed among males whose retention declined between 2015 and 2018. Adolescent females are often recipients of other HIV programmes such as DREAMS that could contribute to their engagement in care, compared to males. Programmes such as DREAMS form partnerships to impact lives and improve HIV outcomes for adolescent girls and young women (133,177). DREAMS was implemented in the Region F sub-district and other districts with high HIV incidence and vulnerabilities among adolescent girls and young women. Sexually active adolescent females may also access family planning and antenatal services in the facilities that provide integrated HIV services, increasing their opportunities for engagement in care.

There was a decrease in the number of males aged 10-19 years on ART by the end of the project. It is not unusual for older children and adolescents to be poorly retained in care, given that they do not have routinely scheduled clinic visits for other services, compared to younger children and girls. Those who go to school are at a further disadvantage because health facilities mostly operate during school hours with few facilities that provide weekend services.

Lastly, in hospitals, there was a decline in the number of children on ART at the end of the project. This was expected as hospitals transfer outpatients to primary health facilities upon discharge. The district hospital, however, had a much lower retention compared to the tertiary hospital even though both received only technical assistance. This observation is supported by the findings from Kariminia et al. (152) in a global cohort study where adolescents in care at district hospitals, were reported to have poorer retention.

Viral load suppression

ECC/PSS strategies demonstrated a significant effect in viral load trends among ALHIV although, there was no significant improvement in viral load suppression among CLHIV. ECC/PSS may require additional support or modifications to effectively improve viral load suppression among ALHIV. Both CLHIV and ALHIV benefit from ECC/PSS in terms of reduced viral load suppression trends.

Some studies, including Evans et al. (31), Lejone et al. (154) and Chandiwana et al. (178) have reported poorer ART treatment outcomes among CLHIV including poor virological response and virological failure (31,32,64,154,179). In the City of Johannesburg Chandiwana et al. (178) found that 13% of 114 children had no follow–up viral load in their clinic records, and of those who had viral load results, 4% had virological failure while 18.4% had a high viral load irrespective of ART duration.

The role of caregiver treatment literacy and non-disclosure were prominent in the interviews with the PSS and clinical mentors. Low treatment literacy among caregivers (parents, grandparents, or child carers) was said to affect the adequate dosage and adherence for children. Similar to health care providers, it is important to instil confidence in caregivers, to ensure continuity of care beyond the health service point.

Adolescents had significantly lower viral suppression at 12 months post initiation for the third year of the project, compared to children. Higher viral load suppression rates have been previously reported from a data review in 15 Region F health facilities (Imrie et al. (77) among 195 adolescents with 80% of males and 84% females having a suppressed viral load in August 2016. While the youth care clubs showed promise for patients in clubs, strategies to retain newly initiated adolescents in the first year of ART

need to be explored and implemented at scale. The effect of disclosure sessions and peer support on treatment adherence needs to be explored in future when routine data is available (77). While the youth care clubs showed promise for patients in clubs, strategies to retain newly initiated adolescents in the first year of ART need to be explored and implemented at scale. The effect of disclosure sessions and peer support on treatment adherence needs to be explored in future when routine data is available.

The challenge of viral suppression among adolescents is not unique to PASP. Poor ART adherence has been identified as a risk factor associated with virological and immunological failure among 260 adults and adolescents in one region in Ethiopia (180). Males and those with CD4 cell count <250 were more likely to experience virological failure and among adolescents (15–24 years), VLS rates of less than half (47.7%) were observed. The challenge of viral suppression among adolescents is not unique to PASP. Poor ART adherence has been identified as a risk factor associated with virological and immunological failure among 260 adults and adolescents in one region in Ethiopia (180). Males and those with CD4 cell count <250 were more likely to experience virological failure and among adolescents (15–24 years), VLS rates of less than half (47.7%) were observed.

Lastly, the tertiary hospital had the highest viral suppression overall (86%), while Primary Health Care clinics had the lowest (59%). The lack of confidence among primary health care workers, especially those who are not trained to manage HIV treatment for children can be a barrier in achieving the 3rd 90 goals. The closure of three Primary Health Care clinics may also have affected adherence for patients with higher viral loads.

The major limitation in evaluation the outcomes for the 3rd 90 is that process indicators such as patients receiving disclosure, adherence support or ECC were not routinely monitored or documented. This made it impossible to evaluate the effect of these approaches on the outcomes. Future programmes must collect prospective data on the process indicators to accurately measure implementation outcomes.

6.4 Conclusion

This chapter has highlighted potential strategies for improving the 3rd 90 goals, and challenges that remain. The study's findings suggest that targeted interventions, such as clinic support/file audits could be refined for improved outcomes, while ECC and PSS showed promise for scale up among adolescents.

Achieving the targets for retention and viral suppression among children and adolescents requires holistic care to remove barriers to access. The total number of children and adolescents on ART and virally suppressed increased between 2015 and 2018, however, the increase was below the target of 90%. On the other hand, retention of newly initiated ART patients at 12 months was also below target, target. Refining the strategies in future projects could yield better results. Additional implementation time alone may not always be the solution for improvement.

In this study, facility-based peer support groups such as youth care clubs are promising for retention and viral load suppression among older children and adolescents. Youth Care Clubs are easily scalable as they already have the attention of the health department. Technical assistance for managing high viral loads through ECC was scaled up in this project, although there were no data for this study to evaluate the effect on retention and viral suppression. Nonetheless, the scale-up of this approach suggests that it may hold promise for the 3rd 90.

All data-driven strategies (review of missed appointment lists, file audits, results for action dashboards) were scaled up in this project. However, the study could not obtain data to evaluate the relative contribution of these strategies to the 3rd 90. File audits and missed appointment lists have been used and recommended in other projects. Data-driven strategies are inexpensive and can facilitate the identification and tracking of patients with missed appointments and high viral loads. However, the challenge remains with integrating data-related activities within the scope of existing staff in health facilities such as data clerks and counsellors for adoption and sustainability.

Lastly, community-based strategies were the least implemented and documented in this project. Only 12 children were documented as traced and linked back to care.

Although more than 250 children were referred to community-based organizations, there were no outcomes documented from the referral. This limited data on the outcomes of the community-based activities impacted the evaluation of these strategies. Nonetheless, other programmes recommend community-based interventions for hard-to-reach groups where access to health facilities is a challenge.

CHAPTER 7 – Potential moderators and barriers to implementation

7.1 Introduction

This chapter uses the framework for evaluating implementation fidelity to address research questions for objective three of this study, which aimed to describe the potential moderators and barriers to the PASP implementation.

In implementation science, five classical dimensions measure implementation fidelity: adherence to the program design, dose or frequency and duration of exposure to the program, quality of delivery, participant responsiveness, and program differentiation. While Carrol et al. (40) argue that all five dimensions should be assessed for a comprehensive measure of fidelity, others suggest that any of these dimensions can provide an alternative measure of fidelity (46). Additionally, Pérez et al. (181) argue that fidelity and adaptation co-exist, and adaptation can either enhance or negatively impact the program being implemented. Consequently, some classical fidelity dimensions may lose relevance when adaptation is involved. This study focuses on the participant responsiveness dimension. Figure 7.1 illustrates the framework for evaluating implementation fidelity, highlighting key elements included in this evaluation.

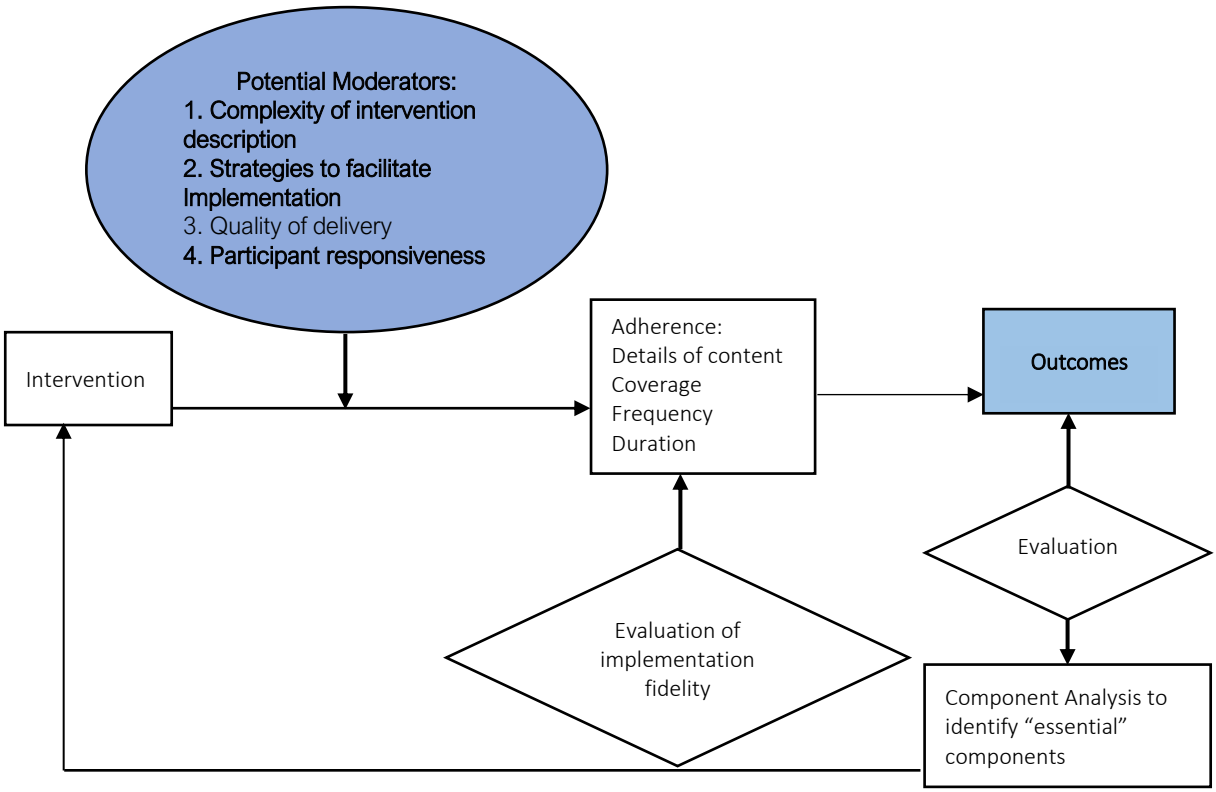

Figure 7. 1 Framework for evaluating implementation fidelity

Source: Carrol et al. (40). A conceptual framework for implementation fidelity

Carroll et al. (40) identify four potential moderators for implementation fidelity: complexity of the intervention, strategies to facilitate implementation, quality of delivery, and participant responsiveness. These elements are interrelated and influence each other (40). This study evaluates participant responsiveness, facilitation strategies, and intervention complexity. Measuring adherence, dose, quality of delivery, or program differentiation was not feasible, as described later in the intervention complexity section.

Complex interventions can pose significant barriers to implementation or adoption, leading to low fidelity implementation. Complex interventions have been criticized for their variation in implementation and potential for omitting essential project elements (40). Complexity includes perceived difficulty, reflected through duration, scope, radicalness, disruptiveness, significance, and implementation steps (182).

Facilitation strategies differ from implementation strategies as they augment, improve, and standardize implementation. These strategies may include manuals, guidelines,

training, incentives, supportive feedback, and mentoring for implementers (95). Early evaluation of facilitation strategies can address variations and achieve high fidelity. However, more strategies do not necessarily translate to better implementation; complex interventions require rigorous assessment of necessary strategies for success.

Participant responsiveness refers to the degree of engagement between implementers, beneficiaries, and the intervention. When participants (e.g., nurses, patients) lack enthusiasm or perceive the intervention as non-essential, they may disengage, hindering adequate implementation. Implementers' and recipients' perceptions of the intervention's value are crucial. This makes participant responsiveness an essential dimension and moderator for implementation fidelity.
A strong relationship exists between facilitation strategies and participant responsiveness, influencing each other on multiple levels. However, this relationship is complex and difficult to measure. For example, implementers may adjust training or mentorship packages based on recipient attendance or engagement.

Roger's diffusion of innovations theory emphasizes the importance of participant responsiveness, arguing that intervention uptake depends on its acceptability to recipients(106). Rogers suggests that self-reported information may be the most accurate measure of participant responsiveness. Participants' perceptions of the intervention's usefulness determine their engagement.

Quality of delivery refers to whether implementers delivered the intervention as intended by designers to achieve objectives. Carrol et al. (40) emphasize the importance of minimum quality standards or benchmarks in measuring quality of delivery. However, quality of delivery could not be evaluated in this study due to PASP being layered on existing projects, key changes in essential elements, and retrospective data collection.

7.2 Methods

Research Team and Reflexivity

The research team consisted of the primary researcher (a doctoral student with a background in public health) and two trained fieldworkers experienced in primary data collection. The primary researcher conducted interviews and oversaw all data collection and analysis processes. Reflexivity was maintained through regular discussions with supervisors and team members to mitigate personal biases and ensure alignment with study objectives.

The primary researcher established rapport with participants by explaining the study's purpose, ensuring confidentiality, and creating a neutral environment during interviews. A reflective journal was maintained to capture insights, observations, and potential influences on data collection.

Participant Selection and Study Setting

Participants were purposively selected from 10 health facilities participating in the Paediatric and Adolescent Scale-Up Plan (PASP). This included seven health facility managers and two PASP project implementers (Clinical and Psychosocial mentors). Participants were chosen based on their roles in implementing or managing PASP activities. Of the initial 10 facilities, three were excluded due to operational closures, and interviews were conducted at the remaining seven facilities.

Data Collection

Data were collected using four approaches: Semi-Structured Interviews. Review of Project Documents, Retrospective Data Analysis, Patient Record Reviews

7.2.1 Semi-Structured Interviews

The researcher conducted virtual interviews with PASP project implementers and health facility managers. Pre-determined themes included implementation strategies, participant responsiveness, and barriers. Interview guides were pilot-tested and refined based on participant feedback. All interviews were conducted in English, lasting between 30–60 minutes, and were audio-recorded with participant consent. Transcripts were anonymized and cross-checked for accuracy.

Data Analysis

Deductive content analysis was used to identify themes aligned with the study objectives. An iterative coding approach ensured clarity and refinement of codes. Nvivo software was employed for data management and thematic analysis. Trustworthiness was ensured through triangulation of data sources (e.g., interview transcripts, project reports, and patient records) and peer debriefing sessions.

7.2.2 Review of Project Documents

Annual project reports, training materials, and monitoring data were reviewed to assess intervention strategies and barriers to implementation. The document review was conducted by the researcher/student. The reviewed documents included: the project proposal, three annual reports submitted to the funder (July 2015 – September 2016, October 2016 – December 2017, January 2018 – September 2018), two project presentations, and three project databases (July 2015 – September 2018). The project documents were obtained from the PASP senior project manager and the Strategic Information Officer.

7.2.3 Retrospective Data Analysis

Patient outcome data from Tier.Net and DHIS databases were analysed to evaluate the impact of facilitation strategies on HIV outcomes. All project databases were reviewed to understand and present the outcomes of the facilitation strategies, including direct service delivery, guidelines, job aids, tools, training, and mentoring. The purpose of the retrospective data analysis was to evaluate the outcomes of PASP in relation to the effect of the two guideline changes (birth PCR and UTT) and direct service delivery as facilitators of implementation. De-identified patient data from Tier.Net and aggregated data from the DHIS were used for this evaluation. Data were obtained from the Region F District Health Information Office as Microsoft Excel export files. To evaluate the impact of earlier infant diagnosis on HIV case finding due to birth PCR guideline implementation, monthly PCR data from the DHIS Microsoft Excel export (July 2015 – September 2018) were summarized to describe key variables:

- Number of HIV-exposed infants
- Number of HIV-exposed infants tested for HIV
- Number of HIV-positive infants (outcome), by health facility type

For UTT guideline implementation evaluation, Tier.Net Microsoft Excel export data on CLHIV and ALHIV initiated on ART (monthly, July 2015 – September 2018) were analysed. PCR and ART linkage data were transformed and exported to STATA for modelling using Prais-Winsten regression to assess:

- The effect of birth PCR testing on HIV case finding
- The effect of UTT on linkage to ART

Finally, to evaluate the impact of DSD hours on HIV case finding, ART linkage, retention on ART, and viral load suppression, routine implementation data (DSD hours) and monthly patient outcome data (CLHIV and ALHIV linked to ART and remaining on ART) from July 2015 to September 2018 were analysed. Implementation data were summarized to highlight total hours spent on each level of the HIV cascade during the implementation period. Patient outcome data were transformed in Microsoft Excel, exported to STATA, and modelled using Prais-Winsten regression to assess the effect of DSD on patient outcomes across the HIV cascade.

7.2.4 Patient Record Review

Fieldworkers reviewed 253 patient records of children and adolescents to assess interventions and outcomes related to retention and viral suppression. Retention and viral suppression longitudinal details were obtained from paper-based patient records, as the electronic Tier.Net database did not consistently capture detailed clinical and psychosocial intervention notes.

A list of records for CLHIV and ALHIV with "loss to follow-up" outcomes or last viral load >400 copies (recorded between July 2015 and September 2018) was generated from the Tier.Net database Microsoft Excel export by the researcher. This list, containing health facility name, folder number, date of birth, sex, and clinical status at last visit, was used to retrieve clinical records from health facilities in August 2020 by two trained field workers experienced in primary data collection.

The following variables were reviewed and documented by field workers from patient records:

- Documented evidence of interventions to re-engage clients in care
- Number of viral loads conducted

- Number of unsuppressed viral loads
- Viral load suppression at last visit
- Documented evidence of interventions to manage high viral load

Patient records were obtained from health facility information officers. By reviewing the files, fieldworkers extracted information on clinical interventions taken to improve retention and viral suppression. Assuming that training and mentoring of health facility staff would enhance patient management, the evaluation focused on the impact of PASP implementation, even though not all patients were directly seen by the implementation team.

7.3 Results and Discussion

PASP was layered on two existing donor funded projects (Health Systems Strengthening and Adolescent Innovations) to provide specific HIV care and treatment for HIV positive children and adolescents in July 2015. These projects which started implementation in October 2013 with a five year duration and an end date of September 2017. They had already established relationships with key stakeholders in the region with resources and infrastructure in place. This section describes the initial project implementation framework and the potential effect of the direct service delivery approach which subsequently diffused the initial framework.

7.3.1 Semi-structured interviews

Participant Demographics and Context

Seven health facility managers participated in interviews, six female and one male, with an average age of 52 years. Four were unit managers, and three were clinicians. All participants demonstrated awareness of PASP's goals and activities but had varying levels of engagement with specific implementation strategies. Table 7.12 shows the basic demographic information of interview participants.

Table 7. 1 Basic demographic information of health facility respondents

Health Facility	Age	Gender	Role
Charlotte Maxeke Hospital	54	Female	Unit manager
South Rand Hospital	54	Female	Clinician
Hillbrow CHC	43	Female	Clinician
Joubert Park Clinic	51	Female	Unit manager
Malvern Clinic	57	Female	Unit manager
Yeoville Clinic	-	Male	Unit manager
Rossettenville Clinic	52	Female	Clinician

Themes and Sub-Themes

Awareness and Understanding of PASP

All participants displayed awareness of PASP's primary goal of improving paediatric and adolescent HIV care. However, perceptions of PASP's components varied. While most participants recognized the psychosocial support and mentoring aspects, the quality improvement (QI) framework was less emphasized.

One participant noted:

"PASP was mainly about helping children and adolescents. It focused on testing, getting them on treatment, and helping them stay on treatment with the right support." (Female clinician, 54 years).

A unit manager highlighted PASP's role in addressing the unique needs of children and adolescents:

"It was different because it focused on a specific age group—children and adolescents—and involved more hands-on strategies." (Female unit manager, 52 years).

However, another participant admitted confusion about the project's distinction from other initiatives:

"I thought PASP was just another part of the adolescent project. I didn't realize it had a specific focus on children as well." (Female unit manager, 43 years).

Facilitation Strategies

Participants consistently acknowledged the value of training and mentoring in building confidence among healthcare providers. The clinical mentor described her approach to mentoring:

"We worked closely with the nurses, guiding them through cases. Initially, they were hesitant to manage children with complex conditions, but over time, they gained confidence."

The psychosocial mentor elaborated on the role of the KidzAlive model:

"KidzAlive helps children understand their treatment and HIV status in a way they can relate to. We also guide caregivers on how to disclose to children at the right time."

However, participants emphasized that training alone was insufficient without ongoing support:

"The training sessions were helpful, but the real impact came from the mentoring. It's one thing to learn in theory, but another to apply it in practice." (Female clinician, 57 years).

Training and mentoring were viewed as key facilitators of success. A participant noted,

"The mentoring gave us confidence to handle children with high viral loads... we now know what to do." (Female unit manager, 51 years).

Participant Responsiveness

Healthcare providers described improved confidence and engagement due to mentoring and technical assistance. However, patient responsiveness varied, with adolescents showing greater resistance to treatment due to stigma and family dynamics. While some healthcare providers embraced the changes introduced by PASP, others relied heavily on external mentors. A unit manager observed:

"The dedicated support helped us a lot. We could call the mentor anytime for guidance, and that made a big difference."

Documentation of viral load monitoring and retention interventions was inconsistent across facilities. One respondent admitted:

“We didn’t always document the viral load results properly. Sometimes the records were incomplete, and this made it hard to track progress.” (Male unit manager, undisclosed age).

Data Quality and Patient Retention

The review of 253 patient records highlighted critical gaps in documentation and retention interventions. Only 23% of records included documentation of tracing efforts, and among these, only 27% of patients were successfully returned to care. Incomplete records and inconsistencies in viral load documentation were recurrent barriers. As one participant stated:

“We struggled to trace patients because the contact details in the system were often outdated or incorrect.” (Clinical mentor).

One participant reflected on the challenges of tracing patients:

“The contact details were often outdated or incorrect. Without accurate information, it’s impossible to bring patients back into care.” (Female unit manager, 51 years).

The psychosocial mentor emphasized the importance of addressing these gaps:

“Tracing is not just about finding the patient; it’s about understanding why they left care in the first place and providing the right support to keep them engaged.”

Barriers to Implementation

Barriers to implementation were categorized into patient-level, health worker-level, and systemic challenges. Barriers: Patient-level challenges included stigma, refusal to consent, and incorrect contact details, which hindered HIV testing and retention. Health worker barriers included reluctance to initiate ART due to lack of confidence and concerns about workload.

- **Patient-Level Barriers**

Participants cited stigma and lack of disclosure as significant barriers. Caregivers often hesitated to test children or initiate ART, fearing social repercussions. For adolescents, lack of autonomy and resistance to disclosure posed additional challenges. One participant explained:

“Some caregivers refused to test their children, fearing that the child’s HIV-positive status would expose their own.” (PASP clinical mentor).

Adolescents were particularly challenging to manage:

“Adolescents often resisted treatment, especially when their siblings were HIV-negative. They felt singled out and blamed their parents.” (PASP psychosocial mentor).

- **Health Worker-Level Barriers**

Health workers expressed concerns about increased workload and insufficient training on paediatric ART initiation. A reliance on external mentors highlighted gaps in confidence and capacity within facilities. Health workers’ reluctance to initiate ART for children due to lack of confidence was a recurrent theme:

“Many nurses were scared to initiate children on ART. They worried about dosing or managing side effects, and this delayed treatment.” (Female clinician, 54 years).

- **Systemic Challenges**

Operational constraints, such as limited after-hours services and inadequate integration of HIV testing in routine school health programmes, impeded access for children and adolescents. Data inaccuracies further complicated patient tracing and retention efforts. Inadequate operating hours for school-going adolescents and poor data quality were significant systemic barriers. A unit manager stated:

“The clinic hours don’t work for school children. They can’t come during school time, and we don’t have resources to follow up after hours.”

Impact of PASP on HIV Outcomes

Despite barriers, participants recognized PASP’s contributions to improving paediatric and adolescent HIV outcomes. The introduction of psychosocial support and targeted mentoring improved adherence and viral suppression among some patients.

A unit manager summarized PASP’s impact:

“We saw improvements in how we manage children with high viral loads. The mentoring sessions were particularly useful for helping us understand what to do differently.”

However, the quantitative analysis indicated no statistically significant association between PASP strategies and HIV outcomes at the population level

Suggestions for Improvement

Participants provided insights for improving PASP and similar projects in the future. Suggestions included enhancing data management systems, increasing community engagement, and expanding psychosocial support resources.

One participant recommended:

“We need better systems for tracking patients. If we can’t track them, we can’t measure our success.” (Female clinician, 52 years).

Another emphasized the importance of integrating HIV testing into schools:

“If we could bring testing to schools, we’d reach more children and reduce stigma.” (Female unit manager, 54 years).

Trustworthiness and Limitations

Triangulation of data sources, including interviews, patient records, and project documents, enhanced the credibility of findings. However, the reliance on retrospective data and operational disruptions, such as facility closures, limited the comprehensiveness of the analysis.

7.3.2 Review of Project Documents

Intervention complexity

PASP can be described as a complex intervention due to different factors including the complexity of the Region F sub-district (chapter 3), multiple implementation strategies at all levels of the HIV cascade (chapters 4 – 6), external changes to clinical guidelines (facilitation strategies), multi-disciplinary implementing teams across projects, project duration and most importantly, the possible effect of co-dependence on other projects that served the same population.

At the time of PASP project inception in Region F, HIV services for adolescents (10 – 24 years) were provided through the adolescent innovations project, while the health systems strengthening project roader services for all children, adolescents and adults living with HIV. In addition, the adolescent innovations project was implemented in partnership with DREAMS, an intervention targeted at adolescent girls and young women which was also implemented in Region F. While these projects were also initially based on the principles of quality improvement and technical assistance, there was a major shift towards direct service delivery from October 2015 in order to achieve patient outcome level targets.

The PASP project duration at inception was thirty months from July 2015 – December 2017. The project was extended by nine months, ending in September 2018 due to delays at start-up, interruptions in the implementation of planned strategies, and complexity of the environment. The total project duration was therefore 39 months.

The Break-Through Series (BTS) was the core implementation framework for PASP (186). The purpose of BTS in this project was to test and refine quality improvement strategies to develop an optimal care package or a collection of “tried and tested” change ideas that could result in improvement across the 90–90–90 cascade for CLHIV and ALHIV. The package could then be used for sharing and facilitating rapid uptake of these change ideas in other health facilities. Figure 7.2 depicts the framework developed for implementing PASP.

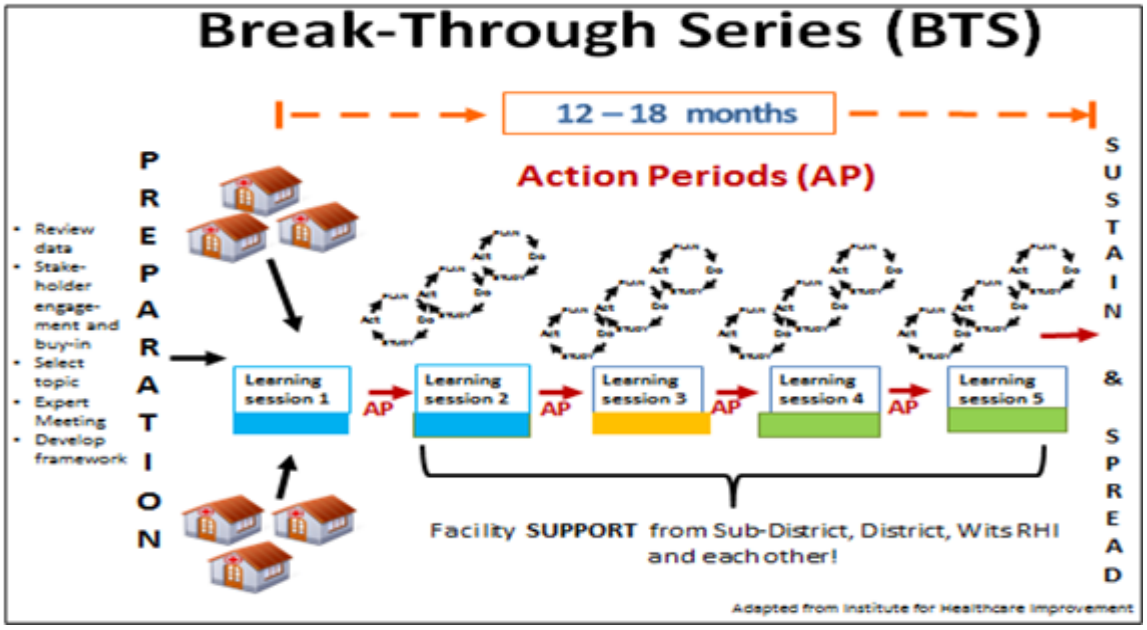

Figure 7. 2 PASP Framework for quality improvement and technical assistance

Source: PASP Proposal document

The BTS model was highlighted as a systematic approach to address the care cascade, encouraging facilities to test and adapt change ideas through Plan-Do-Study-Act cycles. Overall, the goal was to strengthen the health system's ability to identify and manage CLHIV effectively. Four of the ten public health facilities received weekly DSD support visits from the implementation team while the other six received technical assistance only.

Quality Improvement

PASP was designed based on principles of Quality Improvement (QI) and Technical Assistance (TA) as its essential elements. Quality Improvement (QI) Initiatives including change ideas, training sessions and workshops focused on improving paediatric HIV management, with ongoing mentoring and support for healthcare workers were conducted. Quality Improvement (QI) projects aimed at enhancing paediatric HIV testing and care in facilities. Due to the internal and external complexity, influenced by changes in the other two projects and new HIV management guidelines, there was a gradual shift from QI towards direct service delivery. In addition, due to other dynamics such as the closure of health facilities, and staff turnover the independent effect of PASP was not easy to evaluate. The 18-month barometer, paediatric screening tool and hospital forum were key initiatives implemented for quality improvement to improve HIV case finding and linkage to ART.

The 18 - month HIV testing barometer

The 18-month barometer was a quality improvement project implemented from 2016 to improve HIV case finding among children who were missed in the PMTCT cascade. It was developed by estimating and setting targets for children who were eligible for rapid HIV tests during their 18-month immunization visit. The estimate was based on the facility's catchment population, existing headcount at 18-month visits and antenatal HIV prevalence. Health facilities were then allocated targets to improve case finding for this age group.

There were no process data from the project to determine the number of children identified HIV positive through the use of the barometer, or the facility performance against targets. Over three years, the focus shifted from addressing poor performance in 18-month HIV testing to implementing targeted strategies based on immunization visit data. Year 3 showed a rise in 18-month testing coverage from 66% to 78%, despite ongoing challenges.

For health facilities that were reaching targets based on the 18 month visit uptake, a 'step-wise' target setting approach was implemented using each preceding immunization visit. This means that the target was re-calculated using the 12 month visit and then the 9 month visit through to the 6 weeks visit. The outcome data from the step-wise targeting approach were not available to evaluate its effect.

Paediatric screening tool

A screening tool was developed in the second year of the project to identify CLHIV (5-14 years) who had a biological parent or sibling living with HIV, to improve case finding. HIV testing was performed by counsellors or nurses at child entry points and screening outcomes were documented in the child's health record. The tool was important for identifying "at risk" children for testing as opposed to non-targeted testing of all children. Figure 7.6 shows HIV case finding among children screened using the screening tool.

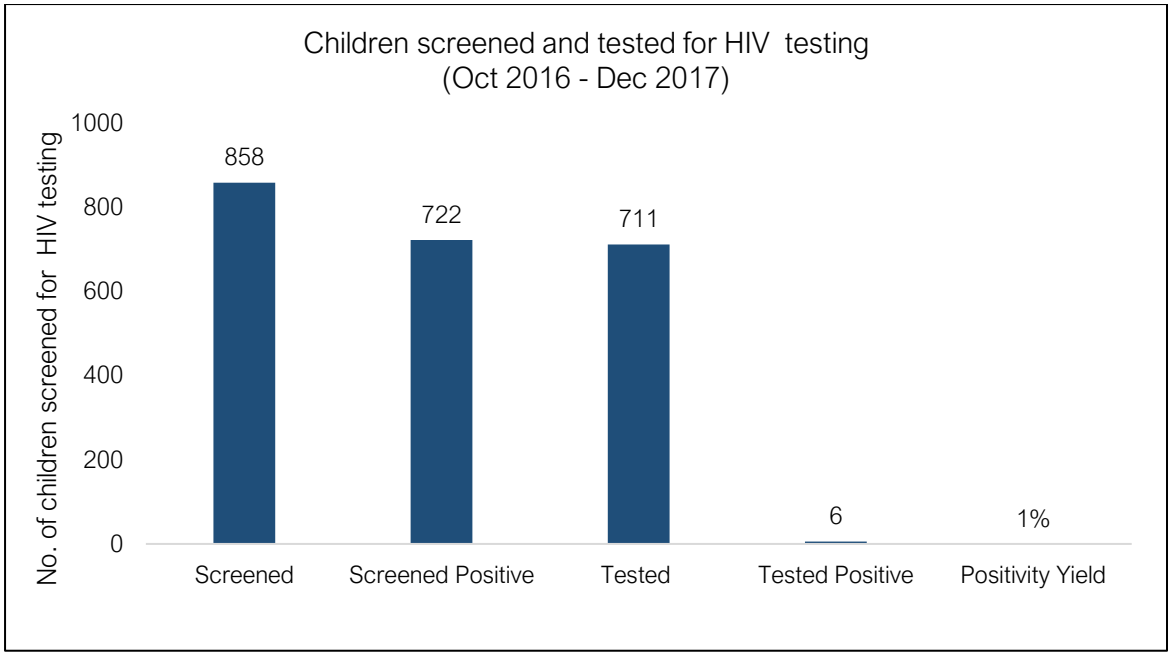

Figure 7. 3. HIV screening cascade for children

Source: PASP project measurement tool

A total of 858 children were screened and 722(84%) of them were eligible for an HIV test and 711 (98%) of them received and HIV test. Only six of the tested children were identified as HIV positive children, a yield of 1%. This yield was similar to the yield observed from community based HIV case finding.

The data shows that 11 children eligible for testing were not tested. Reasons included the absence of a primary caregiver and refusal to provide consent by some caregivers. According to project reports, those who refused cited they were not ready to test their children or did not have the time to wait for the counselling and testing process.

Hospital Forum

The hospital forum was established in the second year of the project with clinicians in the two hospitals to address specific issues in the HIV management of children. During the first year of the project, hospitals were recognised for their key role in HIV services for children and adolescents, including testing, treatment and follow-up, however they were underperforming in certain aspects of HIV care and had not been actively included in the implementation plans. The main gaps identified at hospital level were poor uptake, recording and reporting of birth HIV-PCR testing and linkage to care of HIV-positive infants, and low HIV testing treatment and follow-up reporting, among older children.

The forum's primary focus was to reduce Missed Diagnostic Opportunities (MDOs) for children in hospitals. Raw data were not available to evaluate the effect of the hospital forum, however the Year 2 project report highlighted that MDOs reduced from a baseline median of 25% to 6% over six months, while the recording and reporting of HIV testing data also improved. The willingness and cooperation of clinicians were recognised as the reason for the success. In addition the forum was recognised for creating a platform for engagement, strengthened relationships, and identification of hospital-based champions to support implementation. Overall, the paediatric HIV data reporting was the major improvement area in which hospital teams gained significant understanding.

Technical assistance

Technical assistance was in the form of training, mentoring, as well as the roll-out of the NIMART case workbook, was provided as an enabling environment to facilitate implementation strategies and quality improvement from the first year of the project. These were implemented by the clinical and psychosocial mentors with oversight and coordination from a paediatric technical specialist. Paediatric and adolescent HIV management requires skills to navigate the unique needs and experiences (clinical or psychosocial) related to an HIV diagnosis. In addition, changes in guidelines require system changes including that health providers get trained or mentored to gain competency for implementation.

Training of nurses and linkage officers

Training was an important facilitation strategy for PASP to ensure that health providers have confidence in providing targeted HIV management for CLHIV and ALHIV and could deliberate on and implement change ideas for QI. A lot of time was invested in the training of facility-based Department of Health's professional nurses on paediatric-initiated management of ART. Figure 7.4 shows the programme areas and number of training conducted for health workers during implementation of PASP.

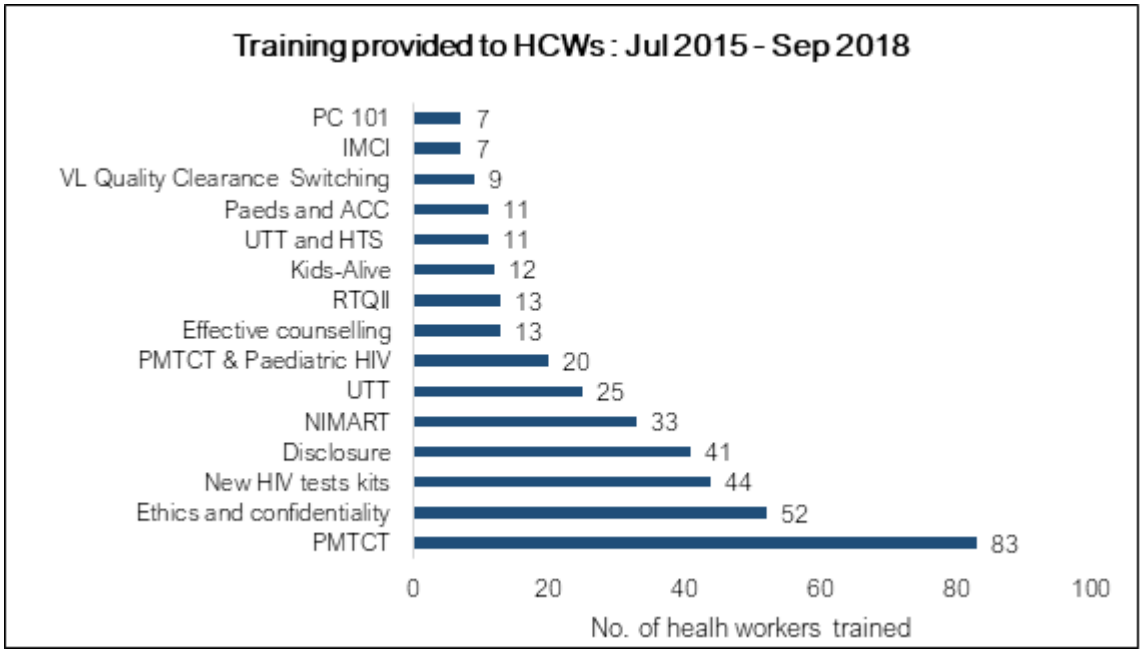

Figure 7. 4 Types of trainings and health worker capacity building during PASP

Source: PASP project measurement tool

The highest number of health workers were trained on PMTCT and ethics and confidentiality, while the lowest were trained on PC 101 and IMCI. All the training in figure 7.4 covered one or more level of the HIV continuum from HIV case finding to viral load suppression. NIMART training was fundamental for PASP as it included advanced paediatric clinical management and competency. In eight of the ten health facilities, 33 nurses from received NIMART training, and 13 of them were declared competent by the end of the project. The certified competent nurses in the eight health facilities were initiating and managing children on treatment independently by the end of the project.

The second fundamental training was KidzAlive, a child-centred, all-inclusive model for finding undiagnosed children with chronic illnesses and those who were abused. KidzAlive "supported primary caregivers with information, care, and disclosure support; capacitated health facilities and communities to provide adherence and psychosocial support to children and their families and help children to understand their illness or abuse using age-appropriate language and fun tools" (http://kidzalive.co.za/v2/). KidzAlive training was implemented from July 2017 to September 2018 and resulted in child-friendly spaces established in 3 health facilities.

Lastly, to improve HIV case finding, linkage to ART and adherence, four linkage officers were employed who fulfilled a comprehensive role of HIV counselling and testing, patient navigation for ART initiation, and post-ART adherence counselling and support. They were also the first point of contact for patients, caregivers and healthcare workers conducting patient navigation. Linkage officers received training and supervision from the PSS mentor on:

- Understanding barriers to linkage to care and implementation of PASP activities
- Testing and accompanying newly diagnosed CLHIV with their caregivers and ALHIV to professional nurses for ART initiation and ensuring continuity of care
- Becoming the initial and ongoing point of contact for CLHIV and ALHIV for ease of navigation to clinical services
- Strengthening routine services for CLHIV and ALHIV in health facilities by fast-tracking clinical consultations

NIMART nurse mentorship

Mentoring was a fundamental element of PASP which was implemented to ensure quality care and sustainability of the strategies. From the first year of the project, case-based ongoing mentoring of medical officers from Hillbrow CHC in the management of difficult paediatric cases was conducted.

Mentoring was done primarily during clinic support days which served to improve overall quality of care and provided support for VL monitoring and management. Selection of files to audit based on the VL RfA reports (i.e. with high VLs) was a particularly useful way to facilitate mentoring on VL management. Use of the tool “Managing High Viral Loads in Children and Adolescents – A checklist” use continuously promoted. Where the tool has been used, the feedback has been incredibly positive as health care staff often feel a lack of confidence when dealing with these issues in children and adolescents.

Nurses based in the labour ward were mentored on EID case management, while others in primary health service facilities received paediatric mentoring support. These mentoring and support activities were conducted to assist nurses with initiating complex cases and delivered either in person or over the phone on a weekly basis. The clinical mentor integrated mentoring with providing direct service delivery support in the form of testing children and initiating those that are positive during in-person mentorship visits. A total of 15 nurses were actively implementing paediatric HIV management and 13 of them were certified competent. Table 7.5 shows the number of NIMART trained nurses who were actively managing CLHIV and ALHIV as well as those who were certified as competent.

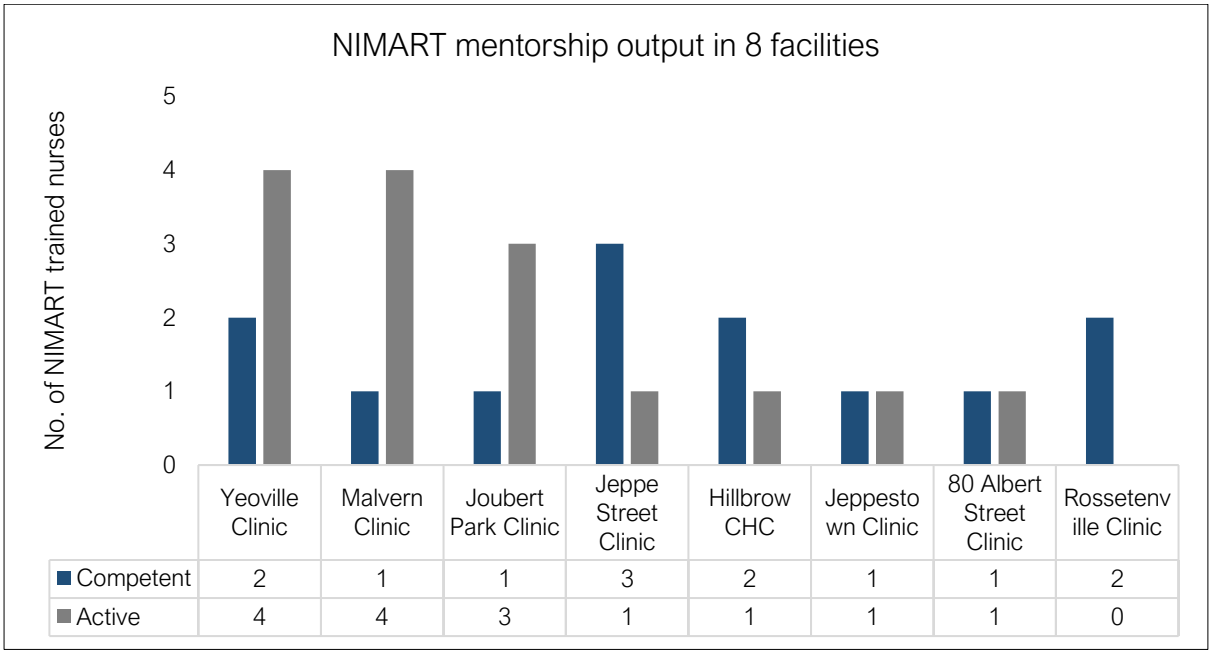

Figure 7. 5 NIMART mentorship in 8 health facilities

Source: PASP annual report, 2018

The mentorship data shows that Yeoville, Malvern and Joubert Park clinics had the highest number of nurses who were actively managing CLHIV and ALHIV, while Jeppe Street has the highest certified competent nurses. Although Rossetenville had two nurses who were competent none of them were active, as they were assigned to other roles within the district. Similarly, in Jeppe street clinic, only one nurse was actively implementing from the three who were certified.

NIMART case workbook

The NIMART case workbook was developed in 2016 as a reference tool for newly trained nurses to facilitate HIV management for CLHIV and ALHIV. This workbook included relevant material from various sources, to assist the nurses with HIV management tools such as guidelines, job aids, charts and case studies with paper-based paediatric and adolescent “cases”. The focus of the workbook was on NIMART, Prevention of Mother to Child Transmission (PMTCT), HIV/AIDS, STIs and TB (HAST), Integrated Management of Childhood Illnesses (IMCI), Tuberculosis (TB), Universal Test and Treat and (UTT). In addition, the workbook included guidance on completing paediatric clinical records, disclosure, as well as emerging problems in paediatric and adolescent HIV care.

7.3.3 Retrospective Data Analysis

HIV management guidelines

The HIV management guidelines in South Africa are developed by the National Department of Health in consultation with key subject matter experts and rolled out to public health facilities. There were two changes in HIV management guidelines which affected outcomes for HIV case finding, linkage to ART and total remaining on ART. While the PASP project did not develop these guidelines they were key in enhancing implementation of the PASP strategies.

Infant PCR testing at birth

The birth PCR and 10 to 18 week rapid testing guidelines were introduced in June 2015, replacing the 6 week PCR testing which was the first antibody test received by HIV exposed infants after birth. The guideline implementation was applied depending on the patient’s risk profile and was a positive enabler for PASP in reducing the possibility of attrition after birth compared to the 6 week PCR testing. As indicated in Chapter 4, through birth PCR 11,078 (≈92%) infants out of 12,099 born to HIV-positive women were tested and 212 (1.9%) of them were HIV-positive. Table 7.2 shows the number and proportion of infants receiving PCR tests in health facilities and the yield.

Table 7. 2 Early infant diagnosis in targeted facilities

	HIV exposed infants (n)	PCR test done (n)	PCR test done (%)	PCR-positive(n)	Yield (%)
TA^{++} sites (n=4)	2,917	2,886	99%	81	2.8%
TA only sites(n=4)	N/A	2,371*	-	32	1.3%
Tertiary Hospital	7,004	6,132	88%	51	0.8%
District Hospital	2,178	2,060	95%	48	2.3%
Total	12,099	11,078	92%†	212	1.9%

**PCR tests conducted at TA only sites (PHCs) represent 6/10-week tests, there are no births at this level of care. †Excludes 6 weeks & and 10-week PCR tests (2371) done in TA only facilities (possibly repeat tests). (Data source: DHIS)*

Table 7.2 shows that the highest HIV case finding yield was in TA++ health facilities (2.8%), followed by the district hospital (2.3%) and the TA only health facilities (1.3%). The tertiary hospital had the lowest yield (0.8%), while having the highest number of infants receiving a PCR test. The highest PCR testing coverage was in the TA^{++} facilities (99%) followed by the district hospital (95%) and the lowest being the tertiary hospital (88%). HIV exposed infants who are missed at birth could receive a PCR test at lower levels of care such as the primary health care centres and the community health centres. Figure 7.3 shows a visual display of the monthly live births and birth PCR testing from July 2015 to September 2018.

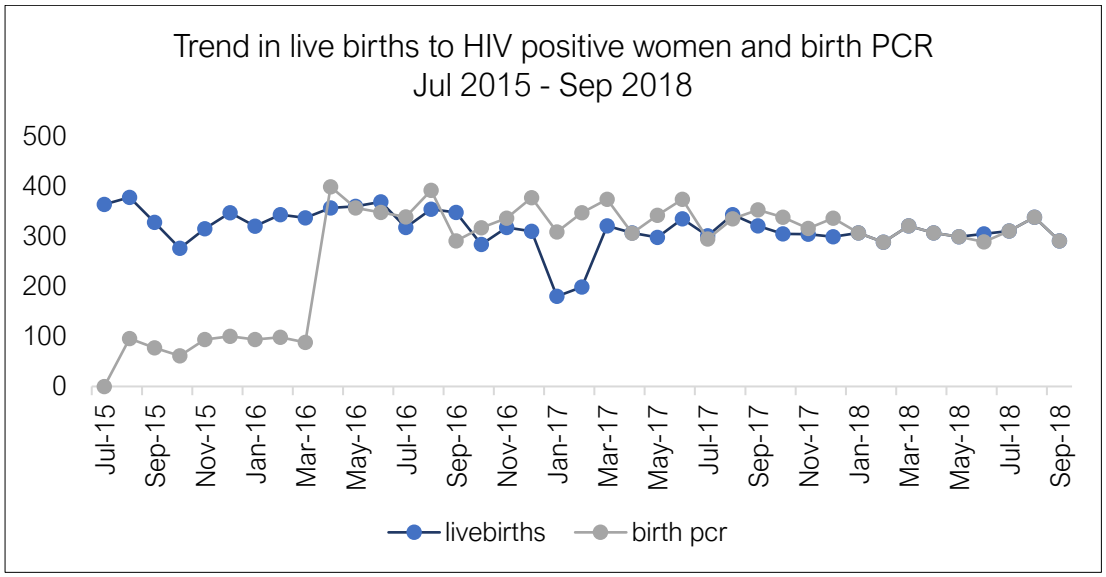

Figure 7. 6 Birth PCR testing and live births to HIV-positive women in three health facilities

Source: DHIS

Figure 7.3 shows that birth PCR tests done were consistent with live births to HIV positive women after April 2016 which suggests that very few HIV exposed infants were missed on a monthly basis. There was a decrease in live births to HIV positive women in February compared to PCR tests done which was attributed to low reporting or poor data quality. Although birth PCR implementation started in June 2015, the hospitals started reporting in April 2016, hence there were no data available for hospitals before this point although the service was provided. For this reason, the number of infants who received a PCR test increased from 88 in March 2016 to 399 in April 2016.

Routine monthly time-series data on birth PCR which is described in Chapter 4 were summarized and analysed for the period July 2015 to September 2018 to describe trends in the HIV positivity among children. The descriptive statistics are presented in Table 7.3.

Table 7. 3 Descriptive statistics of monthly child HIV positive

Variable	Mean	Std. Dev	Variance	Skewness	Kurtosis	Min	Max
CLHIV	14. 615	11.875	141.032	2.284	8.356	2	56

To determine whether HIV case finding among infants (<10 weeks) increased following the reporting of positive PCR tests reported from April 2016, data for HIV positive analysed and modelled using Prais Winsten regression. The dataset was over 39 months starting in July 2015, with April 2016 as the “intervention” month. Table 7.4 shows the results of HIV positivity among infants following improved PCR reporting in April 2016.

Table 7. 4 Association between birth PCR guideline implementation and HIV positivity among infants

	Coef.	Std. error	P - value	95% CI
Birth PCR reporting	-1.157	1.169	0.33	(-3.53 to 1.213)

This analysis revealed no statistically significant association between birth PCR reporting and HIV positivity in infants (p-value = 0.33, 95% CI: [-3.53 to 1.21]). The coefficient estimate indicates a non-significant decrease of 1.157 for PCR-positive infants. Overall there was no conclusive evidence of an association between Birth

PCR guideline implementation and HIV positivity in infants. Further research is needed to explore potential relationships between new infant specific guidelines and HIV outcomes in paediatric populations, using larger sample sizes and more precise measurements.

Universal test and treat

The second fundamental guideline change was Universal Test and Treat (UTT) introduced in September 2016(187). This change enabled HIV testing and offering of ART to all newly diagnosed PLHIV on the same day, provided all other clinical criteria were met and readiness to start ART was assessed. HIV positive patients are initiated on treatment without waiting and those who were previously diagnosed but not yet in the eligible threshold could then be traced and linked to care. This replaced the previous guideline that offered ART to patients from a CD4 count of <500 copies/mL, pregnant women and children.

Children who test HIV positive were already eligible for ART irrespective of their CD4 threshold, however adolescents were not eligible. This universal test and treat guideline was of benefit to adolescents and older children who were missed previously as ART could be initiated as soon as the patient is ready and within 2 weeks of doing a CD4 count. This guideline change was an important facilitation strategy for the 2nd 90, to reduce time to ART initiation, loss to follow-up for newly diagnosed patients and improve ART coverage.

Routine monthly time-series data on linkage to ART which is described in Chapter 5 were summarized and analysed for the period July 2015 to September 2018 to describe trends in linkage to ART among CLHIV and ALHIV. The descriptive statistics for linkage to ART are presented in Table 7.5.

Table 7. 5 Descriptive statistics of monthly CLHIV and ALHIV linked to ART

	Mean	Std. Dev	Variance	Skewness	Kurtosis	Min	Max
CLHIV linked to ART	21.333	5.653	31.964	1.430	8.010	11	44
ALHIV linked to ART	21.410	4.950	24.511	.516	3.734	12	36

To predict the effect of universal test and treat on linkage to ART, among CLHIV and ALHIV compared the pre-UTT period, monthly Tier.Net data on CLHIV and ALHIV linked to ART were analysed. Data were summarised and transformed in Microsoft excel and then exported into STATA. The UTT start period was set at September 2016, which was the 13th month since the start of PASP and data were modelled using Prais Winsten regression. Table 7.6 shows the estimated effect of UTT on linkage to ART.

Table 7. 6 Effect of UTT among CLHIV and ALHIV linked to ART: Prais-Winsten AR (1) regression iterated estimates

	CLHIV linked to ART				ALHIV linked to ART			
	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P-value	95% CI
Universal Test & Treat	-.616	1.535	0.69	(-3.73 to 2.46)	1.339	1.449	0.36	(-1.60 to 4.28)

These results suggest that Universal Test & Treat did not have a significant impact on linkage to ART among CLHIV (p-value = 0.69) or ALHIV (p-value = 0.36), with wide confidence intervals indicating a level of uncertainty around the effect sizes. The implementation of UTT was associated with a non-significant decrease in CLHIV linked to ART, with a coefficient of -0.616 (p-value = 0.69, 95% CI: [-3.73 to 2.46]), suggesting that UTT did not have a substantial impact on reducing HIV prevalence at the cluster level. Among ALHIV the implementation of UTT was associated with a non-significant increase in ALHIV linked to ART, with a coefficient of 1.339 (p-value = 0.36, 95% CI: [-1.60, 4.28]).

Routine monthly time-series data on CLHIV and ALHIV remaining on ART which is described in Chapter 6 were summarized and analysed for the period July 2015 to September 2018 to describe trends in linkage to ART among CLHIV and ALHIV. The descriptive statistics for linkage to ART are presented in Table 7.7.

Table 7. 7 Descriptive statistics of monthly total CLHIV and ALHIV remaining on ART

Variable	Mean	Std. Dev	Variance	Skewness	Kurtosis	Min	Max
CLHIV TROA	1,212	77.215	5962.301	-.339	2.165	1,065	1,333
ALHIV TROA	633	20.417	416.883	.210	1.938	604	684

To predict the effect of universal test and treat on TROA, among CLHIV and ALHIV compared the pre-UTT period, monthly Tier.Net data on CLHIV and ALHIV remaining on ART were analysed. Data were summarised and transformed in Microsoft excel and then exported into STATA. The UTT start period was set at September 2016, which was the 13th month since the start of PASP and data were modelled using Prais Winsten regression. Table 7.8 shows the estimated effect of UTT on linkage to ART.

Table 7. 8 Effect of UTT among CLHIV and ALHIV remaining on ART: Prais-Winsten AR (1) regression iterated estimates

	CLHIV remaining on ART				ALHIV remaining on ART			
	Coef.	Std. error	P-value	95% CI	Coef.	Std. error	P-value	95% CI
Universal Test & Treat	11.312	19.871	0.57	(-28.95 to 51.58)	2.127	7.430	0.78	(-12.93 to 17.18)

The results indicate no statistically significant association between Universal Test & Treat and ART retention for either CLHIV (p-value = 0.57) or ALHIV (p- value = 0.78). The implementation of Universal Test & Treat was associated with a non-significant increase of 11.312 percentage points (p-value = 0.57, 95% CI: [-28.95 to 51.58]) in CLHIV remaining on ART. This suggests that Universal Test & Treat did not have a substantial impact on improving CLHIV remaining on ART. Similarly, among ALHIV, the implementation of UTT was associated with a non-significant increase of 2.127 percentage points (p = 0.78, 95% CI: [-12.93 to 17.18]) in area-level HIV remaining on ART.

In the HIV programme an increase in individuals linked to ART often has an effect on individuals remaining on ART. However in the case of UTT, there was no significant association with increased linkage to ART and therefore no significant increase in individuals remaining on ART.

Direct Service Delivery

DSD was gradually implemented in other projects and PASP also shifted focus to DSD approaches which included enhanced facility-based testing by the project's linkage officers to improve HIV case finding across age groups, and ART initiation by project clinicians to improve linkage to ART. DSD support included staff to provide clinical services, Technical Assistance (TA) in the form of training and mentoring, and Quality Improvement (QI) workshops with learning sessions, while partial implementation included TA only. Table 7.9 shows the documented DSD hours spent towards different elements of the HIV clinical cascade targeted at the 10 – 14 year old children and the 15 – 19 year old adolescents in 8 of the 10 health facilities.

Table 7. 9 Hours of DSD spent on CLHIV (10 – 14 years) and ALHIV (15 – 19 years)

Programme area	No. of hours	Outcome
HIV Testing Services (HTS)	1 538	HIV case finding(1st 90)
ART initiation and management	1 799	Linkage to ART(2nd 90)
Adherence and retention in care	630	Retention & viral load suppression (3rd 90)
Viral load monitoring and management	164	
PSS referral	56	
PSS case management	40	
HIV disclosure	171	
Support groups	150	
Youth Care Clubs (YCC)	388	
AYFS	282	System strengthening (Cross-cutting)
QIP implementation	157	
Health facility assessments	318	
Total	5 693	

Source: Project measurement tool

As shown in table 7.9, a total of 5,693 hours were spent by clinical and psychosocial implementers of PASP on DSD. The highest number of hours of direct service delivery were spent on ART initiation and management (1,799) and HIV testing services (1,538). The least DSD hours were spent on PSS referral and PSS case management. HIV testing services contributed towards the outcomes of first 90 (HIV case finding), while ART initiation and management targeted the second 90 outcomes (linkage to ART). AYFS, QIP implementation and facility assessments were cross-cutting system strengthening approaches with a total of 757 hours of DSD. All other approaches

supported outcomes for the 3rd 90 (retention and viral load suppression) with 1,040 total hours of DSD.
Case management (clinical and psychosocial) was provided and AYFS were established in 8 of the 10 facilities (excluding two hospitals). Through the AYFS healthcare providers were trained and mentored to provide adolescent services which were measured against predetermined standards and criteria. Disaggregated data were not available on the number of adolescents attending AYFS who were retained or virally suppressed.

Through DSD, 11,501 children were tested (0.7% HIV positivity), of which 2,324 were child index contacts. A total of eighty-six HIV-positive children (≈10%) from the 802 children started on ART were initiated through DSD. There were no data on the number of CLHIV and ALHIV reached through DSD for retention and viral load management. DSD for adherence and retention in care was implemented from March 2016 to September 2018. DSD for viral load monitoring and management was implemented from August 2016 to September 2018.

To predict the effect of DSD on the HIV outcomes, monthly data for HIV test positive, linkage to ART, TROA and VLS among CLHIV from July 2015 to September 2018 were used. Raw data were summarised and transformed in Microsoft Excel for analysis and exported into STATA. Outcome data were modelled in STATA using Prais-Winsten for each outcome with DSD starting in January 2017. Table 7.10 shows the results of for DSD effect on HIV case finding, linkage to ART, TROA and viral load suppression.

Table 7. 10 Prais-Winsten AR (1) regression - iterated estimates predicting the effect of DSD on CLHIV and ALHIV outcomes

	CLHIV				ALHIV			
	Coef.	Std. error	P value	95% CI	Coef.	Std. error	P value	95% CI
DSD (HTS Pos)	10.536	8.408	0.22	(-6.50 to 27.57)	.815	3.017	0.79	(-5.30 to 6.93)
DSD (Linked to ART)	-1.587	1.594	0.33	(-4.82 to 1.65)	-.021	1.446	0.99	(-2.91 to 2.91)
DSD (TROA)	18.056	19.759	0.37	(-21.98 to 58.09)	3.670	7.414	0.62	(-11.35 to 18.69)
DSD (VLS)	12.138	9.212	0.20	(-6.55 to 30.82)	3.864	4.363	0.38	(-4.99 to 12.71)

Table 7.10 shows that none of the outcomes were significantly associated with DSD. DSD for HIV case finding had no significant association with number of HIV positive children (p-value = 0.22, 95% CI: [-6.50 to 27.57]) and adolescents (p-value=0.79, 95% CI: [-5.30 to 6.93]) tested HIV positive. Durbin-Watson statistic shows limited auto-correlation among children tested HIV positive (Durbin-Watson (1.976) and among adolescents tested HIV positive (Durbin-Watson (1.932). DSD was also not significantly associated with linkage to ART for CLHIV (p-value= 0.33, 95% CI: [-4.82 to 1.65]) and ALHIV (p-value =0.99, 95% CI: [-2.91 to 2.91]), there was rather a decline of 1.587 among CLHIV and .021 among ALHIV. For total CLHIV and ALHIV remaining on ART there was no significant association with DSD among CLHIV (p-value=0.37, 95% CI: [-21.98 to 58.09]) and ALHIV (p-value =0.62, CI: [-11.35 to 18.69]).

7.3.4 Patient Record Review

The PASP project was a multi-stakeholder collaboration between the implementing team, district health managers, clinicians and counsellors. The nurses, doctors and patients as recipients of the project in the project sites were the critical participants for the success of the project. This section describes the documentation of HIV management in reviewed patient records and interviews with health facility staff and PASP project staff.

Documentation of HIV management

A total of 253 patient records of CLHIV and ALHIV who were documented as no longer on ART in the Tier.Net database in seven facilities were reviewed to evaluate whether interventions were done to retain them in care. CLHIV and ALHIV who were lost to follow-up before July 2015 and after September 2018 were excluded. The main outcome was patient return to care. Table 7.11 shows the sample of records reviewed to evaluate retention interventions in seven health facilities.

Table 7. 11 CLHIV and ALHIV records reviewed to evaluate ART retention interventions

	CLHIV		ALHIV		Total	
	n	%	n	%	n	%
Total remaining on ART	1082	-	631	-	1713	-
Records reviewed for retention	133	12%	120	19%	253	15%
Active patients	64	48%	40	33%	104	41%
Loss to Follow Up (LTFU)	47	35%	62	52%	109	43%
Transferred out	19	14%	16	13%	35	14%
Died	3	2%	2	2%	5	2%
Tracing documented	11	8%	48	40%	59	23%
Patients returned to care	6	55%	10	21%	16	27%

A total of 133 records for CLHIV were reviewed, and among CLHIV who were no longer on ART in the study sites, 47(35%) were lost to follow-up, 19(14%) were transferred out, and three (2%) had died. Only 11(8%) of the records had documentation of tracing outcomes and 6(55%) of these had returned to care. Among adolescents, 120 records were reviewed and 62 (52%) were lost to follow-up, 16 (13%)

were transferred out and two had died (1.6%). Documentation of tracing was found in 48 records (40%) and 10(21%) of these traced and returned to care.

A higher number and percentage of records with documentation tracing was found among ALHIV records. While the proportion of those who transferred out and who died was almost similar among CLHIV and ALHIV, the loss to follow-up was higher among ALHIV (52%) than children (35%). Overall, loss to follow-up accounted for more CLHIV and ALHIV who were no longer on ART (43%), followed by those who were transferred out (14%) while death accounted for the least (2%). In total, only 23% of the records showed documentation of tracing and only 27% of these were returned to care.

A total 342 records of CLHIV and ALHIV remaining on ART who had the last viral load documented between July 2015 and September 2018 were included to evaluate interventions for viral load monitoring and suppression during the project period. The main outcome was evidence of VL intervention. Table 7.12 shows the viral load status and the number of records with documentation of interventions.

Table 7. 12 CLHIV and ALHIV records reviewed to evaluate viral load interventions

	CLHIV		ALHIV		Total	
	n	%	n	%	n	%
Records reviewed for VL monitoring	294	-	171	-	465	-
Last VL documented	243	83	99	58	342	74
Last VL suppressed	151	62	73	74	224	65
Last VL not supressed	91	38	26	26	117	34
Ever had unsuppressed VL	188	64	38	22	226	49
Evidence of VL interventions	58	31	24	63	82	36

A total of 294 records of CLHIV were reviewed for VL monitoring, and 243 (83%) of them had the last VL count documented, of which 151 (62%) had a suppressed viral load and 91 (38%) had an unsuppressed viral load. From the reviewed documents, a total of 188 (64%) had ever had an unsuppressed viral load, and 58(31%) had documented evidence of interventions to manage the viral load. Among ALHIV, 38(22%) records had ever had an unsuppressed viral load, and 24(63%) had evidence of interventions to manage viral load.

The lack of documentation does not mean that the services were not provided, but with viral load, the clinical result from the laboratory, in hard copy, could be found anywhere within the facilities, including in lever arch files. For example, documented viral load on the clinical paper records may be lower than the number of individuals whose viral load tests were processed in the laboratory. The paper-based records can also be incomplete duplicates (referred to as temporary files), missing pages with essential information which may not have been captured on the electronic system.

Professional nurses are responsible for viral load monitoring, including specimen collection from patients in clinics, while in hospital this is often done by doctors. Clinical records provide for documenting the viral load specimen request with a date and bar code, as well as documenting the result once they are received. The record review showed that CLHIV and ALHIV in the tertiary hospital, those who were active on ART and those who were transferred out had better clinical documentation.

Three health facilities that had closed at the time of the record review were also excluded. Esselen street clinic that was temporarily closed for renovations in 2017 showed good documentation of tracing for patients with LTFU outcomes with 17 of the 29 patients traced (59%), but the return to care rate was low (18%) as only three of the 17 patients were returned to care. This clinic also had higher LTFU from the reviewed adolescent records (52.6%).

7.4 Limitations

Three of the implementing sites were closed at different times during project implementation, such that by the end of the project, there were seven sites remaining out of the initial ten selected. The closure of these health facilities, adversely affected record management, making it difficult to account for all patients who were transferred out of these health facilities, as some of them may have not reached the receiving health facilities.

Frameworks can help to identify factors that contribute to or influence implementation outcomes. The main limitation of the framework for evaluating implementation fidelity is that few studies have used the framework for implementation fidelity through

empirical research since its development and none to the researcher's knowledge focussed on paediatric or adolescent HIV programmes, and therefore hard to make a comparison with other studies(41–43,45,46,108). This can also be a strength of this study; despite it not being possible to evaluate all the elements of this framework based on the complexity of the project and the available data.

7.5 Conclusion

Implementation strategies can improve outcomes such as coverage, however, for higher implementation fidelity, potential moderators, especially facilitation strategies are important. Modifications to development projects are inevitable, however describing the why, by whom, what, and whenever modifications are made is important for evaluating implementation fidelity. While collaboration and leveraging existing resources is important within the limited resources, it is critical to identify and maintain the essential components of a project.

The improved clinical guidelines were important enablers for PASP. Implementation of guidelines requires staff to be oriented and mentored. Training and mentoring of staff were essential elements of the project, although challenges were noted in getting participants to attend, and printing of materials. The poor compliance with implementation guidelines from health facility staff remains a significant barrier, especially when there is reliance on project staff to correct these. Other training models, including online self-directed opportunities and remote mentoring, should be considered where possible.

Lastly, there were many barriers to the implementation of PASP at various levels, and weak health systems were frequently highlighted. The patient barriers, especially around incorrect contact details, incorrect dosing and lack of disclosure highlighted poor engagement with the project, and these require effective mechanisms to be in place. Screening in high HIV prevalence settings should be considered a routine practice to maximise testing coverage of undiagnosed CLHIV and ALHIV at the point of care. The use of the screening tool can facilitate targeted testing at adolescent and child health entry points simply and efficiently.

CHAPTER 8 – General discussion and conclusion

This study aimed to evaluate the relative contribution of the Paediatric and Adolescent Scale-up Plan (PASP) to the 90–90–90 HIV goals among children and adolescents. This section discusses the implications of the findings for implementers of similar programmes in the public health sector and highlights unanswered questions for future research. The principal findings, strengths, and weaknesses in relation to other studies have been discussed in detail in the results chapters. Overall, the study highlights progress in paediatric and adolescent HIV care, driven by strategic partnerships, training, and innovative service delivery models.

The findings of this study show that targeted strategies used by PASP contributed to the 90–90–90 goals for children and ALHIV; however, implementation fidelity was unclear. Some implementation approaches from these strategies were incorporated into guidance for other implementing partners in South Africa and widely disseminated through multiple best practice presentations. These approaches formed the foundation of the UB 2.0 programme, which followed the UB 1.0 (PASP) in May 2019. Some PASP strategies were adopted by local departments of health to sustain gains made in paediatric and adolescent HIV programming. However, upon regression analysis, most strategies did not have a significant association with HIV outcomes at a population level.

As financial resources for HIV programmes become limited and remain concentrated on populations with a larger burden of HIV in the general population, targeted and cost-effective strategies for CLHIV and ALHIV are urgent to end AIDS by 2030. The routine health information used in this retrospective study provided a longitudinal and cost-effective dataset to evaluate this project, despite some data quality issues and limitations.

8.1 Relative contribution of PASP strategies to 90-90-90 outcomes among children and adolescents

This study's findings indicate that the interventions may have different effects on CLHIV and ALHIV populations, highlighting the need for tailored interventions and further research.

The data on patient outcomes suggested a marginal improvement in ART coverage and viral load suppression. However, progress towards the target for the 1st 90 was the lowest compared to the 2nd and 3rd 90, suggesting that there were still significant numbers of undiagnosed CLHIV and ALHIV not on ART by the end of the project. Early identification and initiation of children on ART are essential to reduce morbidity and mortality, as well as improve ART coverage (18).

Health facility-based strategies

HIV case finding at health facilities is a feasible and acceptable way of identifying undiagnosed CLHIV and ALHIV using existing resources. In this study, facility-based index testing among children and key entry point testing among adolescents had higher HIV positivity than other strategies, particularly for testing contacts of caregivers/parents attending the adult ART clinic and adherence clubs. Index testing was scaled up to other districts in the second phase of the project. Although index testing shows high potential to identify undiagnosed CLHIV and ALHIV, less than half of eligible individuals were tested. This strategy requires dedicated staff to drive uptake, especially in public health facilities. Index case finding, coupled with home-based testing and tracked follow-up, can facilitate HIV testing and diagnosis. However, there is a need to explore other approaches to improve index testing coverage, especially among adolescent males and older children.

Children who were tested in hospitals had the highest HIV prevalence compared to those tested in primary health facilities and community settings. This high HIV prevalence in hospital wards has been observed in other studies in Uganda, Zambia, and Malawi (73–75). While hospital testing was not a strategy, it is essential to implement Provider-Initiated HIV Testing and Counselling (PICT) in high-prevalence health service points such as hospital wards. Additionally, it is crucial to put in place necessary mechanisms, including:

- Training health providers
- Ensuring availability of test kits
- Facilitating consent from caregivers

The cost of implementing PICT is negligible, considering that many cost components, such as staff time and infrastructure, are already incorporated into the healthcare

system (127). Other approaches, such as prompts for HIV screening and rapid HIV testing in hospitals, should be considered in future iterations of HIV guidelines to reduce missed diagnostic opportunities.

Despite hospitals having a high yield, very few children were tested, and other studies have reported that children diagnosed at this level of care often have decreased chances of survival (20). This highlights the need for better testing opportunities at primary health and community levels to improve early diagnosis and treatment (127).

Point-of-care testing for children and adolescents can reduce missed diagnostic opportunities at service points. The World Health Organization (2016) recommends routine HIV testing for all patients in countries with a generalized HIV epidemic, regardless of physical appearance (137). In this study, HIV prevalence at key entry points ranged from 1.2% to 1.7%, and the strategy was scaled up to other districts in the second phase.

Targeted testing at child health entry points like immunization is feasible and effective in improving HIV diagnosis for CLHIV and ALHIV, as shown in higher HIV prevalence found in immunization clinics (72), in South Africa. While PASP had very few children tested in TB clinics, and thus none were HIV positive, the low HIV prevalence of 1% was also observed among a large cohort of 25,282 children from 25 health facilities in Tanzania (19). Irrespective of the HIV prevalence, all entry points remain the most affordable and accessible alternatives to reach undiagnosed CLHIV and ALHIV.

Linkage to ART at the facility level was not a challenge, with over 100% of CLHIV and ALHIV initiated on ART. However, the importance of facilitation strategies like training and mentoring health workers in paediatric and adolescent ART cannot be underrated. Linkage officers played a key role in navigating newly diagnosed patients within health facilities.

Despite high linkage, the target for newly diagnosed patients enrolled on ART was not achieved due to limited new diagnoses. Denial and lack of disclosure among adolescents remain challenges for psychosocial support teams. Interventions like Youth Care Clubs and clinic support days are crucial for retention and viral load

management. Facility-based strategies like psychosocial support and ECC were implemented, but data on dosage and duration are lacking. Youth Care Clubs implemented through the Adolescent Innovations project show promise, with 75% retention and 81% viral suppression

Data-driven strategies

The data-driven strategies were implemented to improve linkage to ART, retention, and viral load suppression. However, there were no data-related strategies for improving HIV case finding.

The tracing of HIV-positive infants from the Results for Action dashboards was a promising approach, with 65% ART initiation among previously HIV-diagnosed infants. Although the NHLS Results for Action (RFA) dashboards are readily available online for public health providers, their use remained low, as providers relied on the project clinical mentor to access, share, and act on them. Barriers to implementing this strategy may include high workload, lack of capacity or skill to use the NHLS platform, or perception that this is not a role of the healthcare worker. Addressing these barriers and putting mechanisms in place can improve the use of this cost-efficient approach and linkage of infants to ART.

While there were no data on the number of children and adolescents identified through the Tier.Net database and those successfully linked to ART, this approach is easy to implement as routine practice at the facility level and should be institutionalized through health facility staff such as data clerks, counsellors, and nurses.

Missed appointment lists can be easily generated routinely from the Tier.Net database by data clerks and shared with community outreach teams for contacting and tracing patients who require intervention.

Access to viral load results action dashboards is limited to clinicians, similar to that of HIV-positive infants with PCR tests. The same barriers apply to clinicians acting on flagged patients with high viral load, and alternative mechanisms to address them should be explored.

File audits assist in improving the quality of care for patients by identifying gaps in patient management, correcting any clinical or psychosocial errors in recording, and mentoring those who provide services. However, the feasibility of this approach in the absence of project-funded staff should be explored.

Early identification helps trigger psycho-social or peer support and enhances viral load management for patients. Adolescent non-disclosure of HIV status and lack of structured transition from childhood to adulthood are not unique to this setting. (82, 85,125,127,128,188).

Lastly, data quality in this project and in public health facilities in general has been a constant challenge. Alternative data management models for public health facilities should be investigated and documented to improve the use of data-driven strategies. Reliable data sources are crucial in guiding the provision of care for children, allocating resources, and evaluating implementation.

Community-based strategies

Community-based testing provides an opportunity for first-time testers who otherwise are missed. In comparison to facility-based testing, community-based linkage was incredibly low (21%), despite follow-up and tracing efforts. Very few children were tested through this strategy, and the prevalence was much lower. Nonetheless, same-day escort to health facilities for patients diagnosed through community-based testing was scaled up for phase two of PASP.

Family health day campaigns were the primary modality used in Region F. While there were no details on the framework behind the selection of community-based testing modalities, the complexity of access to communities in Region F, with a densely populated and mostly migrant population, cannot be underrated. Thus, not all modalities would be possible to implement in this setting. Other testing modalities, such as community-based index contact elicitation and distribution of HIV self-testing kits, should be explored, especially for adolescents. A review of community-based testing approaches and modalities for children and adolescents within urban migrant settings is needed alongside safer access through mechanisms such as peer

mobilization and incentives. Community-based immunization services and catch-up campaigns may also provide an opportunity to identify and initiate CLHIV on ART.

While linkage officers have been described as an important cadre throughout the HIV cascade, the shortage of NIMART-trained nurses for community outreach remains a challenge. Some patients may not have the time to be escorted to a health facility or are afraid of stigma. Mechanisms to address these barriers at the community level should be explored to reduce loss to initiation. Expanding the role of traditional lay counsellors to include patient navigation and case management, especially at the community level, will not only improve the 90–90–90 outcomes but also give counsellors recognition for the key role that they play. An in-depth review of community-based testing approaches and modalities for children and adolescents within urban migrant settings is needed.

Strategies for improving retention and viral load suppression at the community level included strengthening referral pathways and integrating care of OVCAY within Child and Youth care work. While there were no outcome data to link the effect of these approaches to coverage, peer support, disclosure counselling, and referral for community support for other enabling services such as food parcels and social care grants are known to have a positive impact on adherence. Better recording of patients who receive community-based interventions is important for evaluating their clinical outcomes, despite poor human resourcing of community-based services, especially for supportive functions such as data capturing.

8.2 Potential moderators, adaptation and barriers to implementation

Multiple component interventions like PASP can be complex to evaluate. However, implementing several strategies at each level of the cascade was necessary for PASP to align with existing projects and achieve maximum impact. Without a clear understanding of which strategies had the most effect, selecting a single strategy at each level at project inception was not possible.

Direct service delivery activities implemented through other projects were useful in achieving the 90–90–90 goals. However, DSD shifted away from PASP's essential

components of QI and TA, reducing the potential for adoption and sustainability of project gains. Collaboration with other projects is important to reduce duplication, especially when resources are limited. However, collaboration can also negatively affect a project's essential components. Collaborative projects should identify these essential components at project inception and put risk mitigation plans in place in case of major changes to implementation or funding reduction.

Improvements in clinical guidelines can impact the quality of delivery and coverage. The PCR and UTT guidelines were significant and important changes for the 1st 90. Trained NIMART staff and psychosocial support from the project team were crucial in providing supportive clinical management. NIMART training and mentoring were essential for implementing new guidelines, building confidence in clinical management, and achieving the 2nd 90 and 3rd 90 goals. This laid the foundation for DoH staff to continue care and treatment beyond the project. Although there were no data to evaluate the individual contribution of trained clinicians, all supported health facilities were initiating and managing children on treatment independently at the end of the project according to guidelines.

Supportive tools like the 18-month barometer and screening tool were important for the 1st 90. The NIMART handbook was a cross-cutting supportive tool that could be adapted to improve other programmes like immunization coverage. Despite improvements in testing rates, challenges like poor 18-month testing coverage persisted.

Lastly, several internal and external changes and adaptations during PASP's implementation made evaluating implementation fidelity difficult. Some implementation researchers such as Squires et al. (189) have argued that there is no compelling evidence demonstrating an improved effect of multiple-component interventions compared to single-component interventions. This is primarily because the responsibility for implementation is often verbose and in practice the strategies may be applied with adaptations as barriers and changes occur.

8.3 Limitations of the study

This study had several limitations. Firstly, it could not assess the time from HIV diagnosis to ART initiation and other important clinical variables such as CD4 count and viral load at ART start due to limited and incomplete data. This is an important consideration for other retrospective studies looking into the HIV cascade for children and adolescents.

The major limitation of the project was the lack of documentation for process indicators such as characteristics and numbers of patients receiving psychosocial and clinical interventions, patients reached by NIMART-trained nurses and linkage officers. Outcomes for patients reached through data-driven approaches such as file audits, and review of missed appointments and high viral load were also not documented.

As previously indicated, this study also could not assess the time from HIV diagnosis to ART initiation and other clinical variables such as viral load at ART start due to incomplete data and major changes to information systems.

Due to these limitations, the study could not evaluate adherence to the implementation design. Additionally, there were many significant internal and external changes during the implementation of PASP, which made the evaluation of implementation fidelity complex. The limited data on the core elements of PASP, which were Quality Improvement and Technical Assistance, made it impossible to assess the quality of delivery retrospectively. Conclusive evidence of implementation fidelity for the project could therefore not be ascertained.

8.4 General conclusion and recommendations

Contribution to Knowledge

This thesis makes an important contribution to advancing knowledge on implementation strategies for improving child and adolescent HIV outcomes across the HIV cascade in public health facilities. It highlights the gap in implementation fidelity in complex projects where leveraging resources from existing projects is a funding prerequisite.

HIV Case Finding (1st 90)

The study highlights that targeted and deliberate strategies can contribute to HIV diagnosis, particularly at the facility level. Testing children in hospital entry points and index case identification through adult clients (caregivers) on ART should be considered for routine public health practice. Testing at key child entry points is feasible, although lower prevalence was observed. The effect and implementation fidelity of community-based testing (e.g., HIV-self testing, index) and school-based testing should be evaluated in future projects.

Linkage to ART (2nd 90)

Linkage to ART was facilitated through data-driven strategies and direct service delivery, contributing to paediatric ART coverage. However, no significant changes were observed after each strategy. The low HIV positivity compared to higher proxy linkage to ART potentially conceals the actual gap in ART initiation. Community-based linkage to ART was the lowest for children and adolescents, requiring further refinement to reduce loss to initiation.

Retention and Viral Load Suppression (3rd 90)

Coverage for the 3rd 90 was still below target at the end of the project, and process data was inadequate to assess the effect of each strategy or implementation duration. Clinic support days, file audits, peer support, disclosure counselling, adherence clubs, EAC, and ECC are crucial strategies for achieving the 3rd 90. Better documentation and routine analysis of these approaches are essential to identify what works and the characteristics of patients receiving these interventions for targeted care.

Moderators and Future Directions

Potential moderators, such as guidelines on optimal treatment formulations for children and mentoring of health providers on managing treatment regimens, have received more attention in recent years. The availability of easy-to-follow guidelines, training and mentoring of providers, tools and job aids, inter-sectoral collaboration, and participant responsiveness (patients and health providers) are crucial. Achieving the 95–95–95 goals by 2030 requires commitment at health system, provider, patient, and community levels.

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10. Appendices

Appendix **1 Study Protocol**

Implementation evaluation of the Paediatric and Adolescent Scale-up Plan for 90-90-90 HIV outcomes in the inner-city of Johannesburg, South Africa

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Contents

1. INTRODUCTION

Worldwide, 1.4 million new HIV infections among children (<15 years) have been averted since 2010, however in 2017 only about half of the 1.8 million HIV-positive children were receiving antiretroviral treatment (ART) (1). On the other hand, commitments such as the Global Plan Towards the "Elimination of New HIV Infections Among Children by 2015", Universal Test and Treat(UTT), and the Joint United Nations Program 90-90-90 goals on HIV and AIDS have given renewed hope for paediatric and adolescent HIV prevention and treatment(2– 4).

The ambitious "90-90-90" targets introduced in 2014 assert that 90% of people living with HIV must be diagnosed, 90% of those diagnosed should be on ART and 90% of those on ART should be retained with suppressed viral load by 2020(4).

In South Africa, HIV incidence among children (< 15 years) was estimated at 0, 48% and the prevalence was 2, 4% with ART coverage at only 50% in 2017 (5). Among adolescents (15 – 24 years), the HIV incidence was 1.51% and prevalence of 26, 3%. While adolescents accounted for 38% of all new HIV infections, ART coverage was poor, at only 39.9%. HIV - positive adolescents (15 – 24 years) have poorer ART treatment outcomes (virological response, high Loss to Follow Up, and virological failure) than adults receiving ART (6).

There are improvements in the paediatric and adolescent 90-90-90 HIV goals in South Africa but gaps still exist (7). Without ART, almost half of HIV - positive children die before the age of two and of those who survive, a further one third die before their fifth birthday (8).

HIV testing and case finding

Over the past 15 years of the Prevention of Mother to Child Transmission (PMTCT) program, vertical HIV transmission reduced remarkably from transmission rates of up to 30 - 45% in the early 2000s to < 2% in 2018 among new-born infants (9)[3]. Revisions in HIV testing guidelines for exposed infants in 2015 have also led to early identification of HIV - positive infants through birth HIV polymerase chain reaction (PCR) testing.

[3] National Health Laboratory Services (NHLS) PCR results data, 2018

However, there are still missed opportunities particularly for children (5 – 14 years) born at a time when HIV testing was not rigorously implemented. The implementation challenges with HIV testing in older children are described in studies by Kranzer et al. (2014), Bemelmans et al. (2016) and Bandason et al. (2013) and include: perceived unsuitability of caregivers to give consent by Health Care Workers (HCWs), staff shortages, poor integration of lay counsellors into the health-care system, and parent's fear of stigma (10–12). In Kranzer et al.'s mixed-method study conducted in Zimbabwe, male caregivers and guardians were less likely to consent for HIV testing of sick and older children. Chamla et al. (2015) as well as Davies and Pinto (2015) also point to poor integration of childhood programs as a major challenge in diagnosing HIV- positive children (13, 14). The challenge for adolescents relates to limited opportunities for HIV testing outside health facilities, especially since generally Sexual and Reproductive Health (SRH) services are poorly implemented in schools.

Linkage to care

Linkage to care is a major challenge in achieving 90-90-90 goals with only 43% of the estimated 18 548 children <15 years and 25 % of the estimated 69 781 adolescents living with HIV(ALHIV) aged 15 – 24 years on ART in the City of Johannesburg (CoJ) in 2018 , . The implementation challenges around prompt linkage to care are in part due to the lack of a unique identifier and inability to track children and adolescents through current data systems, if children relocate, or are followed up in a different facility to where their testing is done. Initiation of HIV- positive children on ART is a challenge outside of hospital - based specialised care, largely due to the lack of confidence among health workers to initiate children on ART, while adolescent challenges are around non-disclosure of HIV status as described by Phelps et al. (2013), Vreeman et al. (2013) and Okawa et al. (2017) and lack of structured transition programs from childhood to adulthood (15–21).

Retention on ART and loss to follow-up

Retention of children and adolescents in care remains a challenge. In 2017, children (<15 years) in South Africa had a cumulative loss to follow - up (LTFU) rate of more than 50% (5). In a study among 135 children in CoJ, Chandiwana et al. (2018) found a 10.8 per 100 person-years overall rate of LTFU. Older children (≥ 60 months), those with more than one year on ART, those with a better staging (1 and 2) as per World

Health Organization (WHO), and children who had missed an ART visit were most likely to be lost to follow-up (LTFU). However, children who once presented with high viral load were less likely to be LTFU, possibly due to increased intervention and more frequent visits as a result (22).

Adolescent specific HIV treatment outcome data are limited as routine government data reporting historically included the broader 15 – 49 year age group. Nonetheless, in a retrospective cohort study on 2 251 adolescents (10–24 years) from 5 clinics in Gauteng and 2 clinics in Mpumalanga provinces, South Africa, Evans et al. (2013) found that by 12 months on ART, 11.1% of adolescents were lost to follow-up, with young adolescents less likely to be lost at any time period after ART initiation compared to older adolescents (6).

Similarly, Nglazi et al. (2012) found that among 883 adolescents (9–28 years) in a community ART program in Cape Town, South Africa, LTFU rate was 10.0 per 100 person-years, higher than the LTFU outcomes among young and older adolescents were the same. The key findings in this study were that virological failure rates were higher in adolescents than adults but mortality and LTFU were similar (23).

Contrary to the findings from Nglazi et al. (2012), but in support of Evans et al. (2013), in a Johannesburg study that enrolled 126 adolescents (12 –20 years), Maskew et al. (2016) found that older adolescents (18–20 years) were more likely to miss a visit compared to younger adolescents and that 38% of all adolescents missed a scheduled visit within 24 months of enrolment (24, 25).

Lastly, Kariminia et al. (2018) reported a 30% LTFU from a global cohort collaboration of 61,242 ALHIV (10–19 years) from 270 clinics in 34 countries. Higher LTFU rates were observed among females, patients starting treatment at age ≥5, those in care at district hospitals or in rural settings and patients starting triple-ART after 2006. Although the adolescent age definition differs across these studies, all of them point to the challenge of retention in this group.

Implementation challenges with retention in care for children and adolescents vary. Chamla et al. (2015) reports that children with HIV and TB co-infection in particular

are poorly retained in care as health providers find it difficult to monitor dosing and manage symptoms in this group (26). The undesirable physical and psychological effects of the drug regimens as described by Vreeman et al. (2015) also affect retention of children on ART (22). Non-disclosure among adolescents, due to difficulty in approaching this conversation, guilt, possible unresolved grief and fear of stigma from peers and the community also affect retention (16).

Viral load done and suppression

Viral load done and suppression in children and adolescents remains poor. In 2017, children (<15 years) on ART who had a viral load done (VLD) in South Africa had a viral load suppression (VLS) rate of 81% but this is likely to be much lower (51.9%) if all children who are estimated to be living with HIV were considered, due to “leaking” at each point of the 90-90-90 cascade (5). Similarly, among adolescents (15 – 24 years) VLS rates of 47.7% were observed among those estimated to be living with HIV.

In the CoJ, Chandiwana et al. (2018) found that 13% of 114 children had no follow-up viral load in their clinic records, and of those who had viral load results, 4% had virological failure while 18.4% had a high viral load irrespective of the time period post ART initiation (22). A 2017 cohort data analysis in 10 health facilities (8 in Johannesburg, 2 in Mpumalanga) also reported that adolescents (10–24 years) are at a greater risk of unsuppressed viral load than adults (21).

Challenges related to viral load are primarily around poor viral load monitoring and documentation by clinicians, and poor adherence on ART by patients. Fixed Dose Combinations (FDC) are recommended as they reduce pill burden and improve adherence (27). However, the lack of child-friendly ART drug formulations and delayed approval of new and alternative drugs for children remain a concern as noted by Okawa et al. (2017) and others(20,28). Children on second or third line drugs have a much greater pill burden, which may in turn affect adherence. In addition, poor adherence and viral suppression among adolescents is mostly related to lack of disclosure, lack of Adolescent and Youth Friendly services and lack of tailored transition programs into adulthood.

Strategies for improving paediatric HIV outcomes

Proctor et al. (2013), defines implementation strategies as techniques used to improve the adoption, operation, and sustainability of a clinical program or practice (29). We reviewed some of the strategies implemented to improve HIV outcomes for children and adolescents in other African countries. The Zimbabwe study for Enhancing Testing and Improving Treatment of HIV in Children (ZENITH) randomised control trial showed that using Community Health Workers (CHWs) in facilities and communities improved HIV treatment outcomes in children (30). In this trial, intensive supervision and mentoring was associated with CHWs' long-term satisfaction as well as provision of job aids, standardized manuals, refresher training and formalized links between clinics and CHWs, thus improving HIV case finding and retention (24).

The Accelerating Children's HIV/AIDS Treatment (ACT) initiative, although also not implemented in South Africa showed promising strategies to improve HIV outcomes among children and adolescents(31). The ACT Initiative was implemented in 9 priority African countries (Cameroon, the Democratic Republic of Congo (DRC), Kenya, Lesotho, Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe).

Implementation strategies from the ACT initiative were: HIV testing for HIV-exposed infants through index cases, testing at TB clinics, malnutrition services, paediatric ward, screening all orphans and vulnerable children (OVC) for HIV risk and HIV testing in high-prevalence settings. Testing mothers and infants attending under-five clinics and integrating paediatric testing in all entry points were also successful case finding strategies.

The ACT initiative improved ART coverage for children by more than 10% in 6 countries, with Zimbabwe reaching 80% coverage compared to 49% globally. Using communication technology for referral; involving volunteers and peers with intensive monitoring; and deploying specialized human resources to link children to HIV care improved ART coverage.

Viral load monitoring and suppression were improved by pairing newly diagnosed adolescents and those with adherence issues or high viral loads with a trained mentor to ensure personalized support. The "*check-flag-act*" approach to identify missed opportunities from clinical records, ensure timely initiation on ART, and improve the

uptake of viral load testing, adherence, psychosocial support, viral load and disclosure was also found effective. Overall, the strategies from the ACT Initiative were shown to be effective in the African countries with lowest HIV treatment coverage for children.

Lastly in a pre-post evaluation of the Red Carpet Program (RCP) on the timing and outcomes of linkage to care among adolescents (15–19 years) and youth (20–21 years) in Homa Bay County, Kenya, linkage to ART improved from 56.5% pre-implementation to 95.7% within 6 months. Retention on ART increased from 66.0 to 90.0% at 3 months, and from 54.4 to 98.6% at 6 months. The key strategies used in this program were stakeholder and peer involvement, training and roll-out of adolescent friendly SRH curricula and the “fast-track” peer-navigated services. These improved linkage to care and treatment (32).

2. RATIONALE FOR THE EVALUATION OF PASP

The Paediatric and Adolescent Scale-up Plan (PASP), known as “Unfinished Business” (UB 1.0) targeted HIV exposed children (<15 years) and adolescents (15 – 19 years) to improve coverage for HIV testing, linkage to ART and retention with viral load suppression in the City of Johannesburg (CoJ), South Africa from July 2015 to September 2018. Figure 1: PASP theory of change below summarises the strategies planned by PASP and the targeted outcomes set by the project. HIV testing strategies were selected by based on literature related to ways to get the most yield as opposed to non-targeted testing. Linkage to ART strategies were also based on experience from the HSS and AIP, other similar interventions in other settings as well as practical issues such as resources available to maximise outcomes.

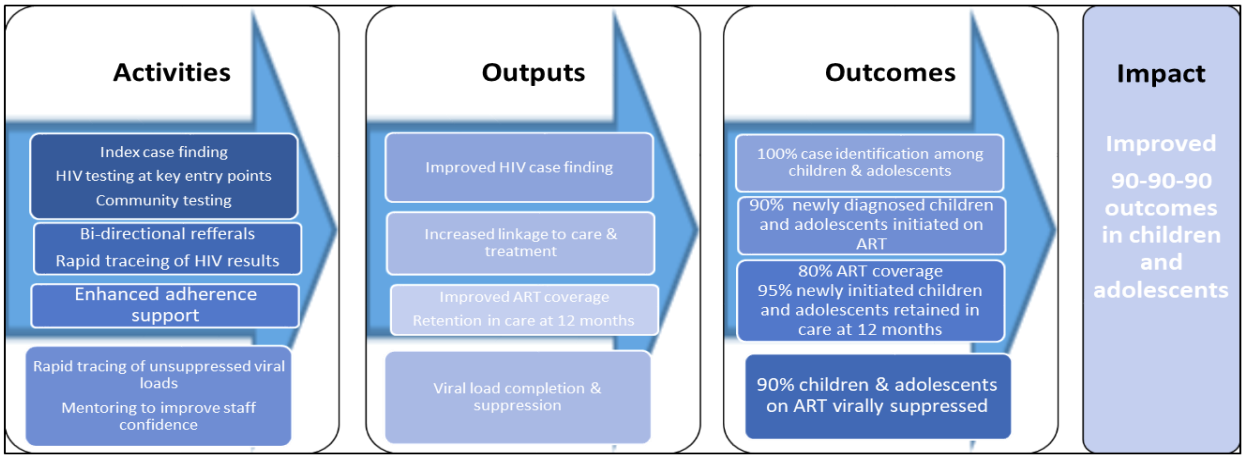

Figure 1: PASP Theory of change (implementation package of care)

PASP is unique because it leveraged other donor funded interventions - Health System Strengthening(HSS) Programme and the Adolescent Innovations Project(AIP) in CoJ, it was ELMA foundation funded as an adjunct to address paediatric (<15 years) and adolescent (15–19 years) 90-90-90 goals and was implemented over a longer period (3 years) in complex health settings. PASP only leverages existing funding as opposed to being implemented as a Project on its own where there is no comprehensive program. This was based on donor requirements since ELMA only co-funds with existing donors, and practical programme integration considerations, since both HSS and AIP had deliverables related to paediatric and adolescent 90-90-90. Therefore, PASP provided an extra layer of services on top of AIP and HSS. Another unique feature of PASP was the tracking and tracing of previously diagnosed children and adolescents for ART initiation.

This implementation science study will focus on the CoJ inner city (Region F). Initiatives such as the ZENITH trial, ACT Initiative and the RCP have shown promising strategies in other countries, however the question remains whether similar strategies (PASP) are effective for children and adolescents within routine health service delivery and this densely populated, high HIV burden urban in South Africa. By evaluating PASP, we will establish whether its strategies were effective, in what contexts and to what extent, as these can be scaled up in similar settings.

Relevance of this study

This study will identify potential moderators and essential components of PASP that will inform future paediatric and adolescent HIV programming for the South African government, development partners and private practitioners. This information is useful to direct limited resources to the most effective and essential strategies for scale up.

3. STUDY OBJECTIVES

Aim: This implementation science study aims to assess the **effectiveness** and **implementation fidelity** of the Paediatric and Adolescent Scale-up Plan (PASP) in improving 90-90-90 HIV outcomes, in the inner City of Johannesburg (Region F), South Africa. The study has two phases:

PHASE I: a retrospective **outcome evaluation** to assess paediatric and adolescent HIV outcomes (HIV case finding, linkage to ART, retention in care and viral load suppression) in facilities that received intensive Quality Improvement (QI), Technical Assistance (TA) & Direct Service Delivery (DSD) and those that only received TA.

Objectives

2. To evaluate the effectiveness of the PASP implementation strategies in improving paediatric and adolescent HIV case finding, linkage to ART, retention and viral load suppression in region F sub-district, City of Johannesburg.
3. To describe which strategies implemented by the Paediatric and Adolescent Scale-up Plan in the City of Johannesburg were effective to improve 90-90-90 HIV paediatric and adolescent outcomes.

PHASE II: a **process evaluation** to explore explanatory factors (potential moderators) that can be associated with the PASP outcomes.

Objective

4. To describe the potential moderators (barriers and facilitators) in PASP implementing sites

4. CONCEPTUAL FRAMEWORK

There are several frameworks for evaluating implementation science studies such as the RE-AIM framework, Implementation Outcomes Framework, COM-B framework and others (29, 33, and 34). This implementation science evaluation is based on Carrol et al.'s (2007) conceptual framework (figure2) for evaluation of implementation fidelity (35). This framework has been chosen because it enables both the evaluation of effectiveness and fidelity as well as takes into account the potential moderators that impact on intervention success and barriers that could lead to failure. Intervention effectiveness and achievement of high implementation fidelity are important considerations for replicating success. A description of how these components will be assessed is summarised in Table 2: Summary of the study approach and methods (see appendix A).

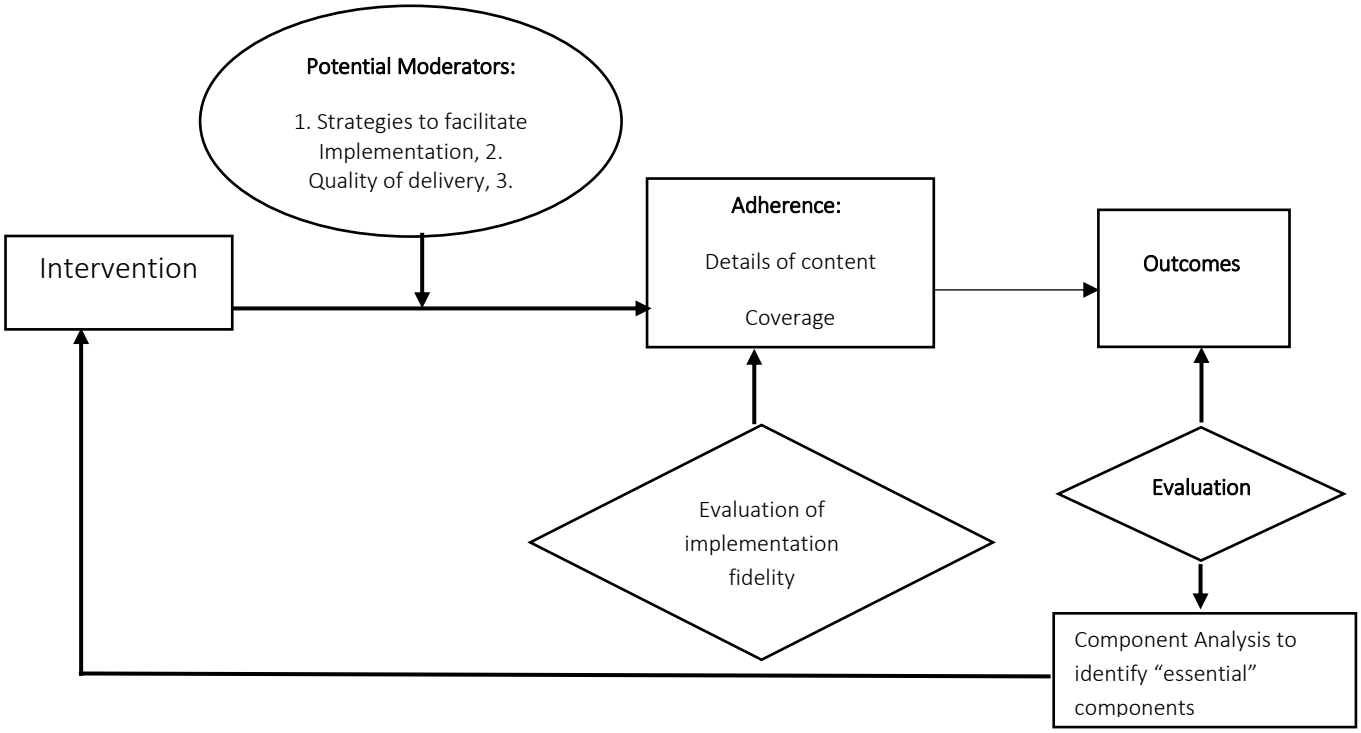

Figure 2: Conceptual Framework for implementation fidelity

Source: *Carrol et al. (2007)*

5. STUDY DESIGN

Using the Interrupted Time Series (ITS) with a 6 month before (January – June 2015), project implementation phase (July 2015 – September 2018) and a 6 months after (October 2018 – March 2019) we will conduct a retrospective **outcome evaluation** to assess effectiveness of PASP (**Phase I**) in improving HIV case finding, linkage to ART, retention in care and viral load suppression in 10 health facilities (36). To assess Implementation Fidelity (**Phase II**) we will conduct a **process evaluation** of potential moderators (barriers and facilitators) and adherence to the intervention (coverage, frequency and duration)

6. METHODS

This implementation science evaluation will use quantitative and qualitative approaches. Retrospective clinical outcome data for **Phase I** (quantitative) will be obtained from the District Health Information System (DHIS), Tier.Net (ART patient management system), National Health Laboratory System (NHLS) and project reports. For **Phase II** (qualitative) we will conduct key informant interviews, review project narrative reports, clinical record reviews, and assess adherence to guidelines as well

as evidence of technical assistance training and mentoring (done prior to September 2018) using a check-list. Considering that the second phase of PASP (UB 2.0) started in May 2019, the availability of guidelines will be presented descriptively as opposed to attribution to the effectiveness of the first phase (UB 1.0) roll-out.

6.1 STUDY SETTING

This study will be conducted in the Johannesburg inner city (Region F sub-district), in 10 facilities: four where PASP was intensively implemented (TA, QI & DSD also referred to as TA++) and six where partial implementation (TA only) was provided (see appendix A - Table 1: Brief description of study sites). These sites consist of two hospitals, one Community Health Centre (CHC) and seven Primary Health Care (PHC) facilities.

All sites were prioritized by assessing the following criteria: high Primary Health Care (PHC) <5 Headcount, high volume of adults receiving ART, with a cut-off of > 2,000 adult HIV cases per facility, high volumes of children receiving HIV care where siblings would be high risk and, some or no volume of children on ART but where there are > 2000 adults receiving care (Low number of children on ART (<20 cases). Based on these criteria, the four TA++ sites were selected where maximal impact was anticipated because of the numbers of exposed children (based on adult head count), numbers of children with HIV and numbers of children under 5, of which those acutely ill or with suspected HIV. Also based on available resources within the project, prioritisation was necessary and was conducted based on these variables.

All 10 facilities were also receiving support from the donor funded Health Systems Strengthening (HSS)[4] program and Adolescent Innovation Project (AIP)[5] with multi-disciplinary teams. The Region F sub-district is densely populated, and estimated to have about 15% of the 4 million people who live in CoJ. The inner-city is a uniquely complex and dynamic environment that has undergone major demographic, social and

[4] The objective of HSS was to provide direct service delivery (DSD) and technical assistance (TA) to the South African Department of Health (DoH) to improve Health Systems and avert the TB/HIV epidemics by supporting implementation of the 90-90-90 strategy

[5] The goal of AIP was to develop and implement a replicable model of targeted and linked interventions to improve the screening, diagnosis, quality of care, adherence, retention and transition of adolescents living with HIV

economic shifts. It is important to find strategies that are effective, specifically in this kind of an environment in order to link and retain children and adolescents in care.

6.2 STUDY POPULATION AND SAMPLING

This study will involve two groups according to the two phases described above.

i) Phase I: PASP primary beneficiaries (all children <15 years and adolescents 15–19 years) documented as receiving HIV services between January 2015 and March 2019 in the 10 health facilities. For record reviews for quality of care assessment, we will sample 30% of patient records from 77 113 children and 7 513 adolescents who were tested for HIV, and all patient records for children and adolescents who tested HIV positive, were linked to care, defaulted treatment or had unsuppressed viral loads between January 2015 and March 2019.

ii) Phase II: PASP stakeholders - designated paediatric and adolescent staff (at-least one professional nurse from each paediatric and adolescent service point) and four PASP project team members (one program manager, one data manager and two project officers) from Wits RHI (implementing institution). While most facilities usually have one designated professional nurse at each service point, all relevant facility based staff who are based in the paediatric or adolescent service point will be interviewed (where there is more than one) until saturation is reached and no new information is obtained. The higher level interviews (District and Provincial Managers) were conducted in 2018 as part of a country level UB 1.0 external evaluation commissioned by the funder. Findings from this external evaluation will complement this evaluation.

All the 10 '*high volume*' study sites that received PASP (UB1.0), intensive and partial implementation will be included, therefore, sampling will not be required. These facilities had a better ART patient caseload, as opposed to the other 8 smaller facilities that were not included in PASP (UB1.0).

6.3 DATA COLLECTION

The study will be directed by this protocol and data will be collected in different ways: **PHASE I**: a) HIV testing data will be obtained from the DHIS, NHLS (PCR) as well as the routine project database; b) linkage to ART, retention and viral load data will come

from Tier.net and NHLS (VL); c) descriptive data on PASP strategies (e.g. index and key entry points) will be obtained from PASP routine reports and the project database. **PHASE II:** Face to face individual interviews will be conducted to obtain information on potential moderators (barriers and enablers) by trained research assistants and the principal investigator. Service provider interviews will be conducted in health facilities at a convenient and quiet space as identified by the participants, while project team member interviews will be conducted in the offices where they currently operate. Project team interviews will explore PASP implementation strategies, planning and service delivery activities, while facility staff interviews will explore management and leadership activities, data management and use of information. Interview findings will provide context to the outcomes observed in PHASE I. Interviews will audio-taped and notes will be written to highlight key points and as a back-up. Routine data quality monitoring will be done by the student (primary researcher) and research assistants. Close coordination with supervisors will be maintained and a statistician will be consulted as needed.

6.4 DATA ANALYSIS

In **Phase I**, we will be comparing 2 groups of patients (children and adolescents) in 4 types of settings (4 intensive sites, 4 partial sites, and 1 tertiary and 1 district hospital). Hospitals often manage complex cases although some patients are retained in care even after being stable. We will separate the analysis for the two hospitals as they are unique from each other and because patient characteristics are often different from other levels of care. The data cleaning on Tier.Net and DHIS will primarily include verifying missing and erroneously recorded information from paper based patient records and registers. A decision will be made on excluding records that have too little data for the variables of interest and this will be explicitly reported in the results. A qualified statistician will be consulted during the cleaning and analysis of Tier.Net and NHLS data. Data cleaning and data quality checks for missing values, data range, duplicates and outliers and analysis will be done using STATA by the principal investigator.

A summary of variables (Table 3: Variables for analysis – Phase Me) to be included in the analysis is provided in appendix A. We will use the Interrupted Time Series (ITS)

comparing key 90-90-90 outcomes (HIV case finding, linked to ART; retained in care at 12, 24 and 36 months; viral load done and viral load suppressed) for children (0–14 years) and adolescents (15–19 years) between full intervention, partial intervention and hospital sites. Normality tests will be conducted on independent and dependent variables. The normality tests assess the distribution of data - whether it follows a normal distribution pattern or not. If data are normally distributed, ANOVA, a parametric method will be used to conduct univariate and multivariate analyses. However, if data are not normally distributed, a non-parametric method, Kruskal-Wallis, will be used for the univariate and multivariate analysis, with adjusted odds ratios and 95% confidence interval.

While other similar evaluation studies (such as RCP and ACT initiative) used mainly the before-and-after approach, the ITS will enable us to observe specific points where change occurred (if any) and to describe factors that can be attributed to those changes.

In **Phase II** the following themes will be deduced from interviews: systems for paediatric and adolescent HIV service provision and delivery, documentation, site management and use of performance data for decision making. Data will be organised using NVIVO. Descriptive and interpretive thematic analysis for qualitative data will be done using a deductive approach based on these themes (see appendix A - table 4 for themes).

7. ETHICAL AND OPERATIONAL CONSIDERATIONS

An ethics application will be submitted to the University of Witwatersrand Human Research Ethics Committee and the National Health and Research Development (NHRD). An existing data use agreement is in between the Wits RHI Health Systems Strengthening Program and the City of Johannesburg which covers the PASP and this evaluation study.

In **Phase I**, personal identifiers (name, surname, ID number) will be removed and data will remain anonymous throughout the study. A waiver will be requested for record review since this component will be retrospective and it will not be possible to obtain informed consent. Patient record data will be de-identified and kept confidential with anonymised extracted clinical information and the relevant approvals will be obtained from the provincial and district research committees. An application to access the NHLS database will also be submitted, once ethics approval is obtained.

In **Phase II**, a signed informed consent will be obtained from each participant for both the interview and recording, and district approval will be obtained for the study. Participants will be informed of their rights, including the right to withdraw from the interview at any point without fear of penalties. All interview records will be secured with password-protected access.

8. TIMELINES

The anticipated start date for data collection is December 2019 with the following timelines for the study completion:

Activities	2019		2020		2021		2022		2023	
	Jan-Jun 2019	Jul-Dec 2019	Jan-Jun 2020	Jul-Dec 2020	Jan-Jun 2021	Jul-Dec 2021	Jan-Jun 2022	Jul-Dec 2022	Jan-Jun 2023	Jul-Dec 2023
Registration, protocol development and review										
Post graduate assessment and ethics										
NHRD application and approval										
Recruitment and training of research assistants										
Phase 1 data review and cleaning										
Phase 1 PASP project report and document review										
Phase 2 participant recruitment and site consultation										
Phase 2 interviews and transcription										
Phase 1 data analysis and interpretation										
Joint Advanced Seminar 3 and Phase 2 data analysis										
Manuscript writing (Phase 1 results)										
Manuscript submission, revision and publication										
Manuscript writing (Phase 2 results)										
Manuscript submission, revision and publication										
Research report writing and submission										
External examination										
Revisions and final research report submitted										

9. FUNDING

Wits RHI was awarded a 3 year ELMA's unfinished business grant to support the CoJ district to implement and evaluate PASP (UB 1.0). The data collection, analysis, training and conference attendance costs for this PhD will be funded through the Welcome Trust CARTA Fellowship Programme ($10 000) which will become available upon ethics approval. Additional funding will be sought from the National Research Foundation (NRF) and the South African Medical Research Council (SAMRC) PhD funding streams.

BUDGET ITEMS	Secured funds= USD10 000	@1USD=ZAR12.0	Year 1	Year 2	Year 3
PERSONNEL COSTS	Annual Salary	% Effort	2020	2021	2022
Principal Investigator	R 15,000	100%	R 15,000	R 15,000	R 15,000
Research Assistant 1	R 30,000	50%	R 15,000	R 0	R 0
Research Assistant 2	R 30,000	50%	R 15,000	R 0	R 0
Total - Personnel Costs			**R 45,000**	**R 15,000**	**R 15,000**
TRAINING COSTS	Unit Cost	No.of Units			
Venue	R 300.00	1	R 300	R 300	R 300
Audio-visual equipment	R 300.00	1	R 300	R 300	R 300
Meals	R 150.00	3	R 450	R 450	R 450
Stationary	R 100.00	2	R 200	R 200	R 200
Total - Laboratory Costs			**R 1,250**	**R 1,250**	**R 1,250**
TRAVEL COSTS	Unit Cost	No.of Units			
Local Airfares	R 0.00	0	R 0	R 0	R 0
Local Ground Travel	R 3,000.00	1	R 3,000	R 3,000	R 3,000
Local Accommodation	R 0.00	0	R 0	R 0	R 0
Local S&T	R 1,200.00	3	R 1,200	R 1,200	R 1,200
Total - Travel Costs			**R 4,200**	**R 4,200**	**R 4,200**
OTHER DIRECT COSTS:	Unit Cost	No.of Units			
Printing	R 1,500.00	1	R 1,500	R 1,000	R 750
Telephone	R 750.00	1	R 750	R 750	R 750
Internet	R 2,500.00	1	R 2,500	R 2,500	R 2,500
Editing	R 2,500.00	1	R 0	R 2,500	R 2,500
Publication	R 2,500.00	1	R 0	R 2,500	R 0
Total - Other Direct Costs			**R 4,750**	**R 9,250**	**R 6,500**
CAPITAL ITEMS					
Tape recording equipment	R 1,600.00	2	R 1,600	R 0	R 0
Total - Capital Costs			**R 1,600**	**R 0**	**R 0**
TOTAL: DIRECT COSTS			**R 56,800**	**R 29,700**	**R 26,950**
INSTITUTIONAL LEVY	5%		R 2,760	R 1,485	R 1,348
TOTAL COST PER ANNUM			**R 59,560**	**R 31,185**	**R 28,298**
			TOTAL COST		**R 119,043**

10. STRENGTHS & LIMITATIONS

Changes in clinical guidelines: Clinical guidelines for HIV care and management change frequently. While paediatric guidelines have historically permitted ART initiation, irrespective of CD4 count, we anticipate that changes such as the Universal Test and Treat (UTT), may have positively impacted on uptake for paediatric and adolescent HIV services. The implementation of birth PCR testing in 2015 might also positively influence the observed outcomes for paediatric HIV testing. Through interviews and document reviews, we will describe and where possible quantify the impact of these changes.

Study design: While similar studies often use a before-and-after evaluation design, the use of the interrupted time-series in this study provides a more detailed view of the changes that occur in a project, and contextual reasons for the observed changes without making general assumptions about success or failure of the entire project.

Political commitment: There is increased focus and commitment from many levels of the department of health and other stakeholders (e.g. Department of Basic Education, donors) on the child and adolescent health and the findings of this study will be pertinent in the paediatric and adolescent HIV management efforts. In addition, this study will be supervised by senior experts in maternal and child health and implementation science who are actively involved in national task teams that endeavour to find new ways to improve paediatric and adolescent health outcomes.

Adherence to the project design: Since PASP implementation leveraged on the HSS and the AIP, we anticipate that any changes in these two programs would have impacted on adherence to the original PASP project design. To mitigate for this, we will document all changes reported through interviews and project documents in the results and interpretation.

Comparability and data quality: The facilities are unique which makes comparing outcomes difficult. While hospitals see mainly patients with more complex issues, the Hillbrow CHC has a very large case load of ART patients from different nationalities. The 7 PHCs also differed with regards to case-load, patient profiles and management. Phase I of this study relies on retrospective data which was routinely collected for service delivery. We anticipate this data may not be of best quality which could impact on the analysis. Triangulation of data from NHLS, patient records and interviews with the project staff will assist with explaining some of the missing and inaccurate data. We will report primarily on patients with documented outcomes and characteristics. Records with missing variables will be described and excluded from the analysis.

Recall bias: This study is conducted after the end of the first phase of the project and we anticipate that some interviewees may not be able to accurately recall all the project activities, particularly individuals who have moved on to work in other projects. We will triangulate data from multiple sources to mitigate against this limitation. In light of the second phase of PASP (UB 2.0) being implemented in the study sites, there is a potential for dilution of findings observed. Where this is observed, we will include it in interpretation and presentation of our results.

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Appendix 2 Participant information sheet

Study Title: Implementation evaluation of the Paediatric and Adolescent Scale-up Plan for 90-90-90 HIV outcomes in the inner-city of Johannesburg, South Africa

Principal Investigator: Lindiwe Farlane |Student No. 724733 |Programme Code: MDA00|Course: CMID9000A

This PhD study is funded by the Welcome Trust through the Consortium for Advanced Research Training in Africa (CARTA)

Institution: University of the Witwatersrand

Introduction: Hello, my name is Lindiwe Farlane, Principal Investigator for this study. I am recruiting service providers /project implementation team members to participate in an in-depth interview (IDI) to discuss your experience, and recommendations regarding the implementation of the Paediatric and Adolescent Scale-up Plan(PASP) which was implemented between July 2015 and September 2018 at _____ (name of facility/Region F). Because of your experience as a service provider/project implementer from this facility/sub-district, I would like to invite you to participate in an in-depth interview for the study titled - Implementation evaluation of the Paediatric and Adolescent Scale-up Plan for 90-90-90 HIV outcomes in the inner-city of Johannesburg, South Africa

This information form is to help you decide if you would like to participate. You should fully understand what is involved before you decide to take part in this study. If you have any questions, do not hesitate to ask me. **You should not agree to take part unless you are satisfied about all the procedures involved.** If you decide to take part in this study, you will be asked to sign this document to confirm that you understand the study form and you will also receive a copy to take with you.

This research is conducted to evaluate the PASP and fulfil PhD purposes and is conducted by Lindiwe Farlane who is the PhD Candidate, the Principal Investigator and an employee of Wits Reproductive Health and HIV Institute (Wits RHI). The PASP was implemented by Wits RHI and four other organizations within the City of Johannesburg.

Purpose of The Study: This implementation science study aims to assess the effectiveness and implementation fidelity of the Paediatric and Adolescent Scale-up Plan (PASP) in improving 90-90-90 HIV outcomes, in the inner City of Johannesburg (Region F), South Africa. You will be one of approximately 14 participants who will be invited to participate in an in-depth interview. The information gathered from these interviews will help us to

understand the processes, including barriers and enablers and areas of improvement of the PASP (UB 1.0) and inform future paediatric and adolescent HIV management efforts.

Procedure: During the in-depth interview, we will cover the following questions over a period of 60 minutes or less: PASP implementation strategies, planning and service delivery activities, management and leadership activities, data management and use of information. Only you and the interviewer will be present during the in-depth interview. With your permission, we will tape the recordings during the discussion. If any questions, make you feel upset either you or the interviewer may stop the interview at any time. When the interview is over, we will transcribe (write out) what you have said during the interview in order to analyse it. Your name will not be recorded during analysis so there will be no way of linking what you say in this discussion to who you are.

Confidentiality: All information discussed during the interview will be kept strictly confidential; at no point will your personal details be disclosed. The interview will take place in a private area where possible and any data reported in scientific journals and any other platform will not include information that identifies you.
Your consent form will be kept separately from all other research documents. Only investigators to this study will have access to the tape recordings; you will not be identified in any of the transcribed data or research and programme related discussions or outcomes. The research team will have primary access to the transcribed data, and any quotations from this data will be anonymised and therefore will not contain your name. If needed, we will use pseudo names to present quotes from your transcribed interview. This study protocol has been approved by the **WITS HEALTH ETHICS REVIEW COMITTEE**.

Benefits: I believe that you may NOT benefit directly by participating in this interview, however the information that you share will assist future implementation or scale up of these strategies for children and adolescents. I believe that the information you provide will help District Support Partners and Department of Health better understand and strengthen the HIV related paediatric and adolescent cervices at this facility/sub-district and other similar settings.

Risk, costs and re-imbursements: There are no foreseen risks for participating in this study as information that you provide will be kept confidential and anonymised. However,

should you feel that you may experience by participating in this interview, please contact the Principal Investigator. Please not that there will be no penalties for refusing to participate or not competing the interview. Besides your time, there will be no financial costs to you for participating in this interview as the interviewer will come to you, at a time that is convenient to you. There will be no re-imbursement for participation in this interview.

Rights of the Participant: You may find it uncomfortable to express your personal opinions in front of the interviewer. We want you to feel comfortable, therefore the interview will take place in a location that the study staff have determined will provide you with privacy and confidentiality such as the clinic, or another appropriate place. The study team will talk with you about this, so you know where to go for the interview]. If any questions, make you feel upset either you or the interviewer may stop the interview at any time. You don't have to answer any questions that you don't want to discuss, and you can leave the interview at any time.

What do I do if I have questions or problems?

For questions about this study or a research-contact:

Lindiwe Farlane, Principal Investigator, on telephone no. 0826047802, or by email at lindiwefarlane@gmail.com

Dr Lee Fairlie, Supervisor, on telephone no. 011 358 5300, or by e-mail at lfairlie@wrhi.ac.za

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.

Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

English Participant Information Sheet & Informed Consent Form version …… and dated_____

Participant Initials: ____ ____

Approved by **WITS HEALTH ETHICS REVIEW COMITTEE** on _____

Appendix 3 Participant informed consent form

Study Title: Implementation evaluation of the Paediatric and Adolescent Scale-up Plan for 90-90-90 HIV outcomes in the inner-city of Johannesburg, South Africa

Principal Investigator: Lindiwe Farlane | Student #: 724733| Programme Code: MDA00| Course: CMID9000A

This PhD study is funded by the Welcome Trust through the Consortium for Advanced Research Training in Africa (CARTA)

Institution: University of the Witwatersrand

Please tick the applicable block (Yes/No)

1. ☐ **Yes** I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto;

_____ Participant Initials

OR

☐ **No** I have not been given a Participant Information Sheet, which explains the nature and processes involved in this study, which is attached hereto;

._____ Participant Initials

2. ☐ **Yes** I was given time to read it, or had it read to me, in the language I best understand

_____ Participant Initials

OR

☐ **No** I was not given time to read it, or had it read to me, in the language I best understand

._____ Participant Initials

3 ☐ **Yes** I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;

_____ Participant Initials

OR

☐ **No** I was not given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;

._____ Participant Initials

4. ☐ **Yes** I believe I fully understand why the study is being conducted and what the intended outcomes will be

_____ Participant Initials

☐ **No** I do not believe I fully understand why the study is being conducted and what the intended outcomes will be

._____ Participant Initials

OR

5. ☐ **Yes** I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;

_____ Participant Initials

OR

☐ **No** I do not understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;

._____ Participant Initials

6.☐ **Yes** I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained

_____ Participant Initials

OR

☐ **No** I do not understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained

._____ Participant Initials

7. ☐ **Yes** I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study I am free to speak to any of these contacts.

_____ Participant Initials

OR

☐ **No** I have not been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study I am free to speak to any of these contacts.

._____ Participant Initials

CONSENT FORM FOR AUDIO RECORDING OF STUDY PARTICIPATION

You do not give up any rights by signing this form.

Please indicate below, whether you allow to take part in the audio – recordings.

☐ **Yes** I agree to take part in the audio – recordings

_____ Participant Initials/Mark

OR

☐ **No** I do not agree to take part in the audio – recordings

._____ Participant Initials/Mark

I hereby consent to audio recording of the interview

I understand that:

- The recording will be stored in a secure location (a locked cupboard or password protected computer) with restricted access to the researcher and the research supervisor.
- The recording will be transcribed and any information that could identify me will be removed,
- The recordings will be destroyed within either (a) two (2) years of the publication of the research findings, or (b) six (6) years, if no publications arise from this research
- Anyone wishing to access this information in the future will first have to obtain the approval of the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg
- Direct quotes from my interview, without any information that could identify me, may be cited in the research report or other write-ups of research.

Who to contact should the participant have questions or problems?

For questions about this study contact:

Lindiwe Farlane, Principal Investigator, on telephone no. 0826047802, or by email at lindiwefarlane@gmail.com

Dr Lee Fairlie, Supervisor, on telephone no. 011 358 5300, or by e-mail at lfairlie@wrhi.ac.za

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.

Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

Participant (Print Name & Surname)	**Participant Signature/Mark**	**Date**	**Time**

Study Staff conducting interview **(Print Name & Surname)**	**Signature**	**Date**	**Time**
***Witness** **(Print Name & Surname)**	**Signature/ Mark**	**Date**	**Time**

*For participants who are unable to read or write, a witness will also complete the signature section above at the end of the consent process

Appendix 4 Interview guide – Health providers

Title: Implementation evaluation of the Paediatric and Adolescent Scale-up Plan for 90-90-90 HIV outcomes in the inner-city of Johannesburg, South Africa

Lindiwe Farlane **|Student #: 724733** **|Programme Code:MDA00** **|Course: CMID9000A**

Name of facility:_____ **Date of review:**_____

Name of reviewer:_____ **Title of interviewee:**_____

Interview Guide (Service Provider)

1. Pediatric and Adolescent HIV services

All service delivery points offering pediatric and adolescent HIV services (e.g. education, counseling, care and treatment provision) should have systems in place to ensure the quality of care. All clients should have access to high quality HIV counseling and ART services		
	1.1 Systems for Pediatric and Adolescent HIV services Provision	
	Question	**Response**
Q1	Are there at least two counsellors onsite who currently provide pediatric and adolescent HIV counselling & testing services ?	0 = No 1 = Yes
	Is there at least one linkage officer onsite who currently links children and adolescents to ART ?	0 = No 1 = Yes
	Is there at least one professional nurse onsite who currently provides pediatric and adolescent HIV testing and treatment ?	0 = No 1 = Yes
Q2	Are caregivers informed about pediatric and adolescent HIV testing services, including the right to accept or decline these services ?	0 = No 1 = Yes
Q3	Are pediatric and adolescent quality assurance activities conducted at least once per quarter? (*Quality assurance activities can include supportive supervision, monitoring visits, and/or client satisfaction assessments?*)	0 = No 1 = Yes
Comments		

	1.2 Pediatric and adolescent HIV Service Delivery	
	Question	**Response**
Q1	Do caregivers and clients receive pediatric and adolescent HIV education and an assessment or screening as part of the routine care at each service delivery point?	0 = No 1 = Yes
Q2	Is pediatric and adolescent HIV counseling and testing routinely offered onsite to caregivers and clients?	0 = No 1 = Yes
Q5	Does each service delivery point have a private space for providing	0 = No

	pediatric and adolescent HIV services?	1 = Yes
	Stock-outs	
Q1	Has there been a stock-out of pediatric and adolescent HIV test kits or ART drugs in the past 24 months?	0 = No 1 = Yes
Q2	In the past 24 months, have children or adolescents been given appointments to return back to the facility due to decreased ART drug supply?	0 = No 1 = Yes
Q3	In the past 24 months, have children or adolescents been given an alternative ART drug due to unavailability of their normal ART drug?	0 = No 1 = Yes
Q4	Are comprehensible HIV related education materials (IEC) on display or available to caregivers and adolescents (e.g. pamphlets, posters, brochures, inserts, etc.) accessing this service delivery point?	0 = No 1 = Yes
Comments		

2. Documentation

Each site should maintain accurate and complete standard data collection and reporting tools for all nationally required HIV related indicators.

	Question	Response
Q1	Is there an HIV testing register in use at the service delivery point?	0 = No 1 = Yes
Q2	Is there a PCR register in use at pediatric entry points	0 = No 1 = Yes
Q3	Are registers reviewed at least monthly and used to inform pediatric and adolescent HIV services?	0 = No 1 = Yes
Comments		

3. Site Management—QM/QI (Quality Management/ Quality Improvement)

3.1 Quality Improvement (QI) System

Each site should have a QI system, with routine monitoring of processes and quality of services.

	Question	Response
Q1	Are any Quality Improvement (QI) activities or plans in place to improve pediatric and adolescent HIV services?	0 = No 1 = Yes
Q2	Is there a staff person responsible for /QI?	0 = No 1 = Yes
Q3	Does a functional QI committee/team exist that does at least one of the following? 1) Convene regular (e.g. monthly, weekly) QI team meetings at the facility 2) Follows a site QI plan and/or 3) Routinely reviews performance and service delivery standards	0 = No 1 = Yes
Q4	Is there a *written* site QI plan being implemented with defined staff roles and responsibilities?	0 = No 1 = Yes
Comments		

3.2 Assessment and Utilization of Performance Data in QI activities

Each service delivery site should have a system for review and use of performance data to inform implementation of QI activities.

	Question	Response
Q1	Does the site perform any review of performance data to identify gaps and initiate QI activities?	0 = No 1 = Yes
Q2	Are performance data collected and reviewed amongst staff on a routine basis (e.g. weekly, monthly)?	0 = No 1 = Yes
Q3	Is there documentation (e.g. run charts of plotted indicators, QI team meeting minutes of tested changes, QI team improvement journals) of active and completed QI initiatives?	0 = No 1 = Yes
Q4	Is there a system for recognition of excellent performance?	0 = No 1 = Yes
Comments		

Appendix 5 Data Dictionary Codebook – facility interviews

5/14/2020

Implementation evaluation of the Paediatric and Adolescent Scale-up Plan

Codebook

14-05-2020 15:58

Data Dictionary Codebook

	#	Variable / Field Name	Field Label *Field Note*	Field Attributes (Field Type, Validation, Choices, Calculations, etc.)
Instrument: **Demographic Information** (demographic_information)				
	1	participant_id	Participant ID	text
	2	rst_name	Section Header: *Basic Demographics* First Name	text, Identifier
	3	last_name	Last Name	text, Identifier
	4	interview_date	Interview Date	text (date_dmy)
	5	date_of_birth	Date of Birth	text (date_dmy), Identifier
	6	primary_phone_number	Primary phone number	text (phone_za)
	7	gender	Gender	radio 1 Female 2 Male 3 Other
	8	title	Title	dropdown 1 Proffessional nurse 2 Enrolled nurse 3 Unit manager
	9	employment_years	Employment duration	Radio 1 <3 years 2 3 – 5 years 3 > 5 years

Instrument: **Systems for Pediatric and Adolescent HIV services Provision** (systems_for_pediatric_and_adolescent_hiv_services_provision)				
	10	counsellor_cadre	Section Header: *Staff complemnet* Are there at least two counsellors onsite who currently provide pediatric and adolescent HIV counselling & testing services ?	yesno 1 Yes 0 No
	11	linkage_officer_cadre	Is there at least one linkage officer onsite who currently links children and adolescents to ART ?	yesno 1 Yes 0 No
	12	nurse_cadre	Is there at least one professional nurse onsite who currently provides pediatric and adolescent HIV testing and treatment ?	yesno 1 Yes 0 No
	13	informed_caregiver	Are caregivers informed about pediatric and adolescent HIV testing services, including the right to accept or decline these services ?	yesno 1 Yes 0 No
	14	Quality_assurance	Are pediatric and adolescent quality assurance activities conducted at least once per quarter? (Quality assurance activities can include supportive supervision, monitoring visits, and/or client satisfaction assessments?)	yesno 1 Yes 0 No
	15	comments	Comments	text

Instrument: **Pediatric and adolescent HIV Service Delivery** (pediatric_and_adolescent_hiv_service_delivery)				
	16	education_assessment_screening	Section Header: *HIV services* Do caregivers and clients receive pediatric and adolescent HIV education and an assessment or screening as part of the routine care at each service delivery point?	yesno 1 Yes 0 No
	17	Counselling_testing_offered	Is pediatric and adolescent HIV counseling and testing routinely offered onsite to caregivers and clients?	yesno 1 Yes 0 No
	18	privacy	Does each service delivery point have a private space for providing pediatric and adolescent HIV services?	yesno 1 Yes 0 No

	19	comments	Comments	text
Instrument: **Stock-outs** (stock_outs)				
	20	stock_out	Has there been a stock-out of pediatric and adolescent HIV test kits or ART drugs in the past 24 months?	yesno 1 Yes 0 No
	21	re_scheduling	In the past 24 months, have children or adolescents been given appointments to return to the facility due to decreased ART drug supply?	yesno 1 Yes 0 No
	22	alternative_drugs	In the past 24 months, have children or adolescents been given an alternative ART drug due to unavailability of their normal ART drug?	yesno 1 Yes 0 No
	23	iec_material	Are comprehensible HIV related education materials (IEC) on display or available to caregivers and adolescents (e.g. pamphlets, posters, brochures, inserts, etc.) accessing this service delivery point?	yesno 1 Yes 0 No
	24	comments	Comments	text
Instrument: **Documentation** (documentation)				
	23	testing_register	Is there an HIV testing register in use at the service delivery point?	yesno 1 Yes 0 No
	24	pcr_register	Is there a PCR register in use at pediatric entry points	yesno 1 Yes 0 No
	25	review_of_registers	Are registers reviewed at least monthly and used to inform pediatric and adolescent HIV services?	yesno 1 Yes 0 No
	26	comments	Comments	text
Instrument: **Quality Improvement System** (quality_improvement_system)				
	27	qi_activities	Are any Quality Improvement (QI) activities or plans in place to improve pediatric and adolescent HIV services?	yesno 1 Yes 0 No

	28		Is there a staff person responsible for /QI?	yesno 1 Yes 0 No
	29	qi_committee	Does a functional QI committee/team exist that does at least one of the following? 1) Convene regular (e.g. monthly, weekly) QI team meetings at the facility 2) Follows a site QI plan and/or 3) Routinely reviews performance and service delivery standards	yesno 1 Yes 0 No
	30	qi_plan	Is there a written site QI plan being implemented with defined staff roles and responsibilities?	yesno 1 Yes 0 No
	31	comments	Comments	text
Instrument: **Assessment and Utilization of Performance Data in QI activities** (assessment_and_utilization_of_performance_data_in_qi_activities)				
	32	performance_review	Does the site perform any review of performance data to identify gaps and initiate QI activities?	yesno 1 Yes 0 No
	33	routine_data_review	Are performance data collected and reviewed amongst staff on a routine basis (e.g. weekly, monthly)?	yesno 1 Yes 0 No
	34	tracking_monitoring	Is there documentation (e.g. run charts of plotted indicators, QI team meeting minutes of tested changes, QI team improvement journals) of active and completed QI initiatives?	yesno 1 Yes 0 No
	35	reward_recognition	Is there a system for recognition of excellent performance?	yesno 1 Yes 0 No
	36	comments	Comments	text

Appendix 6 Interview guide – Project staff

Title: Implementation evaluation of the Paediatric and Adolescent Scale-up Plan for 90-90-90 HIV outcomes in the inner-city of Johannesburg, South Africa

Lindiwe Farlane

Student #: 724733 **Programme Code:** MD000 **Course:** CMID9000A

Date of interview: _____

Name of interviewer: _____

Position/ designation of interviewee: _____

Sub-district: _____

Facility (ies) assigned: _____

Interview Guide

Hello, my name is _____ (Insert name here) from the University of the Witwatersrand.

I would like to ask you a few questions that will help the Department of Health and the District Support Partner to understand what gaps exist in the implementation of the Paediatric and Adolescent Scale-up Plan (PASP) including strategic leadership, supply, demand, quality of service delivery and elements of an enabling environment (barriers and enablers) that fosters or hinders the paediatric and adolescent 90-90-90 HIV goals (i.e. HIV testing, linkage to care, retention, viral load done and viral load suppression. I will ask you questions, to guide the discussion. This key informant interview will take approximately 60 minutes.

All personal identifiers will be removed when writing down your responses. The responses you provide will be reported together with responses provided by other individuals participating in this evaluation.

This will be recorded using this tape recorder (show tape recorder). This is to help me remember all what we discussed.

Do you have any questions before we start?

Implementation Strategies, Essential Components of PASP, Planning and service delivery, Management and Leadership, Data Management & Strategic

Theme: [Do not ask questions on this column during the interview.]	**Interview questions**	*Probes: [**ONLY** ask questions on this column if the interviewee needs clarity about the question or more detail is needed]*
INTERVENTION		
Implementation Strategies	What HIV testing and case-finding strategies were implemented by the PASP? How did these differ for children and adolescents?	- Were all these strategies implemented across the 10 targeted facilities in CoJ Region F? - Were they implemented in the same way? How did they differ in each facility? - What was unique about facilities that implemented most of the strategies?
	Which linkage to care strategies were implemented by the PASP? How did these differ for children and adolescents?	
	What retention strategies of PASP were implemented by the PASP? How did these differ for children and adolescents?	
	What viral load uptake and retention strategies were implemented by the PASP? How did these differ for children and adolescents?	
Essential Components of PASP	In your experience, what were the essential components that made PASP a success?	- Were these components unique to PASP? In what ways? - How would PASP look like without these specific strategies?
	How did the PASP strategies differ from those implemented by HSS?	
	In what ways did HSS strategies enable or become barriers to the success of PASP	
	In facilities where most PASP strategies were successfully implemented, what were the dynamics?	
POTENTIAL MODERATORS		
Planning and service delivery	What training and mentoring was provided to health service providers at the PASP facilities by your unit or position?	- Were all health service providers trained/mentored (counsellors, linkage officers, nurses)
	Which guidelines, tools, Standard Operating Procedures (SOPs)	

	and/or manuals were put in place for the implementation of PASP? Who used these guidelines and tools?	- Did all facilities receive these guidelines and tools?
	In your opinion, what were some of the challenges (barriers) and enablers in implementing the PASP strategies of PASP	
	What are some on the health systems challenges in reaching the 90-90-90 goals for children and adolescents?	- What was the coverage in PASP supported facilities at the end of the project?
	In your opinion what are the community level challenges that impact on the 90-90-90 goals for children and adolescents?	- How were these challenges overcome by PASP?
Management and Leadership	What technical assistance (TA) and/or supportive supervision was provided to health service providers at the PASP facilities by yourself/your team unit?	- Where and how was this TA documented? (Check if available for review)
	How was feedback provided to the facilities supported by you? How did you assess that action has been taken to address the gaps identified during your technical support visits?	- How was the need determined and assessment done?
	How often was PASP performance reviewed and who led these reviews? Who formed part of the reviews? What were the key actions from the reviews?	- At what level were the reviews done?
ADHERENCE		
Coverage	What proportions of staff (DoH health service providers) received training and mentoring on the PASP strategies?	- Who did the training mentoring sessions and how was the need determined?
	What proportion of health service providers (per cadre) was competent in providing paediatric and adolescent HIV services (per strategy) at the end of the project?	- Where certification/ completion of Portfolios of Evidence (POEs) was applicable, what proportion of service providers (in each

		cadre) completed their mentoring
	Were there any staff involved in Direct Service Delivery (DSD) from the project team? How many (per cadre if applicable)? How often	- Did all facilities have DSD staff? What were the variations? What/who determined these
Duration	How long were the training sessions (per cadre if applicable)?	- (*Document # of hours spent and number of days throughout the project period and variations in each facility, per cadre if applicable*)
	How long were the mentoring sessions (per cadre if applicable)?	
	How long did the DSD staff spend in each facility (per cadre if applicable)	
Frequency	How often were the training sessions (per cadre if applicable) conducted?	- (*Document # of sessions throughout the project period and variations in each facility if applicable*)
	How often were the mentoring sessions (per cadre if applicable) conducted?	
	How many days did DSD staff (per cadre) spend in each facility?	- (*Document # of days throughout the project period and variations in each facility, per cadre if applicable, using* timeline)
Quality of services	How many Quality Improvement (QI) projects were implemented during PASP (per strategy if applicable)	- Who was the custodian of the QIPs? (*Check if documentation of QIPS is available*)
	In your opinion what were some of the QI strategies that were successful across the paediatric and adolescent HIV cascade?	- Were these QI project done across facilities? What were the challenges and enablers in implementing QI projects
	In the PASP supported facilities, how confident are you that health service providers are implementing the services according to the paediatric and adolescent HIV guidelines	- How did you assess quality of services across the cadres and facilities?
	What staff capacity challenges do you think still exist in the PASP supported facilities?	- What were the challenges in addressing the capacity needs during PASP?

Data Management & Strategic Information	In your opinion how well do clinical staff record and understand the paediatric and adolescent 90-90-90 HIV indicators and data element definitions?	- How was clinical recording and reporting assessed and how often?
	How did PASP ensure that recording and reporting of data is accurate from the point of collection?	- Was data triangulated, e.g. PCR results from NHLS compared to DHIS?
	What are the gaps in collecting important information such as HIV testing results for infants and viral load documentation?	- Were there programme tools in place to document PASP specific data? Was data reviewed and quality assured?
Closing questions	We have come to the end of the interview. Do you have any additional comments or questions?	

Appendix 7 Ethics clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Ms L Farlane

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M1911110

NAME: (Principal Investigator)	Ms L Farlane
DEPARTMENT:	Wits Reproductive Health and HIV Research Institute
PROJECT TITLE:	Implementation evaluation of the Paediatric and Adolescent Scale-up Plan for 90-90-90 HIV outcomes in the inner City of Johannesburg, South Africa
DATE CONSIDERED:	2019/11/29
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Drs L Fairlie and S Mullick
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2020/07/09

This clearance certificate is valid for 5 years from the date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the 3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **November** and will therefore reports and re-certification will be due early in the month of **November** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

2020/07/13
Date

Appendix 8 Ethical declaration by researcher and supervisor

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

DECLARATION:

Adherence to HREC (Medical) Ethics Application Terms and Conditions

I, the undersigned, hereby declare that I have not collected data/ done secondary data analysis or any other form of research, prior to obtaining clearance certificate from the HREC (Medical) for study no: M1911110.

I have read and understood the terms and conditions on section 9 of HREC (Medical) application form. I confirm that it is my responsibility to ensure that I have received final HREC (Medical) Clearance before commencing any research.

LINDIWE FARLANE

Name, Surname and Signature

Student/Staff no if applicable: 724733

Date: 16 JANUARY 2020

Lee Fairlie

Name, Surname and Signature

Supervisor (if applicable)

Date: 24/03/2020.

Appendix 9 Letter of approval – Tertiary hospital

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

FACULTY OF HEALTH SCIENCES

Department of Paediatrics and Child Health
Charlotte Maxeke Johannesburg Academic Hospital (CMJAH)

ENQUIRIES : **Prof MC Mulaudzi**
TEL : **011 488 4246/ 4637**
EMAIL : **Mphelekedzeni.Mulaudzi@wits.ac.za**

Date: 20 March 2020

To: Human Research Ethics Committee (HREC)-WITS

Dear Madam/Sir

Permission to conduct research in Paediatrics and Child Health Department at CMJAH

The Department of Paediatrics and Child Health at Charlotte Maxeke Johannesburg Academic hospital give permission the researcher/s to conduct research in the department as stated below:

Research Title: "Implementation evaluation of the Paediatric and Adolscent Scale-up Plan for 90-90-90 HIV outcomes in the inncer-city of Johannesburg, South Africa".

Principal Investigator: **Miss Lindiwe Farlane**
Co-investigator/s: **Drs. L. Fairlie and S. Mullick**

This permission is given in support to your application to the WITS-HREC. The researcher/s cannot start collecting data without the clearance certificate from the HREC.

.....
Mphelekedzeni Caroline Mulaudzi
Adjunct Professor
Head of Department, CMJAH

23/03/2020
Date

GAUTENG PROVINCE

HEALTH
REPUBLIC OF SOUTH AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Enquiries:
Ms. N. Mzila
Office of the Clinical Director
Email: Nolwazi.Mzila@gauteng.gov.za
Tell: (011): 488-4812
30th March 2020

GP_202001_024

Dear Mrs. L. Farlane

STUDY TITLE: Implementation evaluation of the Paediatric and adolescent scale-up plan for 90-90-90 HIV outcomes in the inner-city of Johannesburg, South Africa.

Permission to review patient file for conduction of the above mentioned study is provisional approved. Your study can only commence once Ethics approval is obtained. Please forward a copy of your Ethics Clearance Certificate as soon as the study is approved by the Ethics Committee for the CEO's office to give you the final approval to conduct the study.

Supported / not supported

Dr. P. Africa
Acting - Clinical Director
DATE: 01/04/2020

Approved/ not approved

Ms. G. Bogoshi
Chief Executive Officer
DATE: 01.04.2020

Appendix 10 Letter of approval – District hospital

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

SOUTH RAND HOSPITAL
1 Friars Hill Road, Rosettenville, 2149

ENQUIRIES:
Office of the CEO
T: 011 681 2004
M: 071 872 6649
E: Nobantu.Maleka@gauteng.gov.za

To: Ms Lindiwe Farlane

RE: IMPLEMENTATION EVALUATION OF THE PEADIATRIC AND ADOLESCENT SCAL-UP PLAN FOR 90-90-90 HIV OUTCOMES IN THE INNER-CITY OF JOHANNESBURG,SOUTH AFRICA

The above noted study has been reviewed and permission granted. The research may be undertaken at South Rand Hospital. South Rand Hospital pledges to provide the required support in terms of access as well as guidance should it be required.

Regards.

Dr M.N. Maleka
CEO: South Rand Hospital
Date: 30 January 2020

South Rand Hospital
Friars Hill Rd

Appendix 11 Letter of Approval – Region F sub-district, City of Johannesburg

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Joburg
a world class African city

JOHANNESBURG HEALTH DISTRICT

Enquiries: Dr EM Ohaju
Tel: 011 694 3888 Cell: 076 8831659
Email: Elizabeth.Ohaju@gauteng.gov.za
Hillbrow CHC: Administration Building
Cr Smith Str. & Klein Street
Private Bag X21, Johannesburg
South Africa, 2017

Wits
Human Research Ethics Committee(Medical),
University of The Witwatersrand
Johannesburg, South Africa
LINDIWEFARLANE@GMAIL.COM

DRC Ref: 2020-01-003

NHRD Ref no: GP_202001_024

Dear: Ms Lindiwe Farlane

TITLE: ***Implementation evaluation of the Paediatric and Adolescent Scale-up Plan for 90-90-90 HIV outcomes in the inner-city of Johannesburg, South Africa***

Your application for research approval refers.

The District Research Committee has reviewed your application. This letter serves as an in-principle approval to access the Districts Health facilities (mentioned below) for the above project subject to following conditions:

- The facility to be visited: **17 ESSELEN STREET CLINIC, 80 ALBERT STREET CLINIC, HILLBROW CHC, JEPPE STREET CLINIC, MALVERN CLINIC, ROSETTENVILLE CLINIC, SOUTH RAND HOSPITAL, YEOVILLE CLINIC**
- This facility will be visited from **11/02/2020 to 11/02/2021**
- The research can only commence after you submit an ethics clearance certificate from a recognized institution.
- You will report to the Facility Manager before initiating the study.

Sub District	Sub District Manager/ Area Manager	Contact No.	Cell phone
ABCEF	Ms Matlala	011 440 1259	082 307 0267
F(LA)	Oupa Montsioa	011 681 8130	082 467 9423
Southrand	Dr N Maleka	011 681 2002	071 872 6649

The following conditions must be observed:

- Participants' rights and confidentiality will be maintained all the time.

Appendix 12 Plagiarism declaration form

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I LINDIWE FARLANE (Student number: 724733) am a student registered for the degree of DOCTOR OF PHILOSOPHY in the academic year 2023.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature: Lindiwe Farlane Date: 26 / 02 / 2024

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Appendix 13 Turn-it-in report

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Ann M Starrs, Alex C Ezeh, Gary Barker, Alaka Basu et al. "Accelerate progress—sexual and reproductive health and rights for all: report of the Guttmacher– Lancet Commission", The Lancet, 2018

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CHAPTER 1 – Introduction Chapter One introduces the contextual background and justification for the study. The purpose and objectives of the study are also described in this chapter. Progress towards the 90–90–90 HIV goals by 2020 (replaced by 95–95–95 goals by 2030) among children and adolescents that formed the basis for the purpose and evaluation has been explored. 1.1 Background There have been remarkable scientific successes in paediatric and adolescent focussed HIV clinical research to optimise treatment availability and formulations since the roll-out of anti-retroviral therapy. The neglected "right to science" for children living with HIV (CLHIV) and adolescents living with HIV (ALHIV) has been previously highlighted by Scanlon et al., (4) and Chaudhury et al., (5), however, the progress made for this population over the past three decades, since the 1990s is notable. Despite these improvements, there are still pertinent questions around implementation strategies to get treatment to those who need it and for children and adolescents, this requires a focus on priority interventions and strategies to ensure that all ALHIV and CLHIV access lifesaving anti-retroviral treatment and high-quality care. In 2014, the ambitious UNAIDS 90–90–90 targets asserted that to control the HIV epidemic, 90% of people living with HIV should know their status, 90% of these should receive Antiretroviral Therapy (ART) and 90% of those on ART should be retained with a suppressed viral load by 2020 (2). Beyond 2020, the goals were to achieve 95–95– 95 across the HIV cascade by 2030(6). Treatment coverage among children and adolescents remains lower than that of adults, despite some improvements in clinical research in recent years. Sadly, studies have estimated that without ART, almost half of HIV-positive children will die before the age of two and of those who survive, a further one-third will die before their fifth birthday (3,7). In more than two decades of the Vertical Transmission Prevention (VTP), transmission reduced remarkably from rates of up to 30–45% in the early 2000s to < 2% in 2018 among new-born infants (8). New HIV infections among children have also declined by 58% in 2022 compared to 2010, and more children who are on Antiretroviral Therapy (ART) are ageing into adolescence (9). AIDS-related deaths have declined significantly among children, although slower among adolescents aged 15–24 years. Regrettably, in 2022, an estimated 4000 adolescent girls and young women aged 15– 24 years were newly infected with HIV globally (10,11). Commitments such as the Global Plan Towards the "Elimination of New HIV Infections Among Children by 2015", Universal Test and Treat (UTT), and the UNAIDS Accelerating Action to end the AIDS Epidemic by 2030 have given renewed hope for paediatric and adolescent HIV prevention and treatment programs (6,12). However, as resources towards HIV care and treatment continue dwindling, effective ART implementation strategies should be refined and scaled-up promptly, to take the ongoing evidence-based and improved HIV treatment to those who need it. Despite successful efforts in the VTP, some HIV–infected children remain undiagnosed. According to the UNAIDS estimates, in 2022 only 63% of the 1.5 million CLHIV (0–14 years), knew their HIV status globally, and 57% of CLHIV were on treatment, compared to 77% of adults (13). Moreover, 81% of those known to be HIV- positive on ART were virally suppressed. Viral load suppression rates are typically lower among children and adolescents compared to those of adults. Traditional viral load monitoring and adherence options may not necessarily work for infants and children on ART. With the already limited treatment regimens for this population, tailored viral load monitoring and adherence strategies are needed. Reporting on HIV data for adolescents is a global challenge. While the global target was to provide ART to one million adolescents by 2020, data to assess the progress were lacking. About 1.7 million adolescents (10–19 years) were estimated to be HIV-positive in 2019 (14). There are several reasons for the slow progress toward 90–90–90 targets for children and adolescents (15–18). The evidence on strategies that improve these targets for children and adolescents in public health settings is inadequate. In addition, most donor-funded programs have been centred around the general HIV response, not focused on these populations that make up small numbers in the epidemic (19). The PEPFAR program and the Global Fund have made some of the major investments to the South African HIV response for almost two decades, however, targeted funding to address the gaps for children only began receiving attention in recent years. In South Africa, age-specific modelled estimates highlight the gap towards ART coverage and viral load suppression among

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Mee, P, Fearon, E, Hassan, S, Hensen, B, Acharya, Y, Rice, BD, Hargreaves, JR. "The association between being currently in school and HIV prevalence among young women in nine eastern and southern African countries.", Public Library of Science, 2018

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Arthi Vasantharoopan, Hendramoorthy Maheswaran, Victoria Simms, Chido Dziva Chikwari et al. "A costing analysis of B-GAP: index-linked HIV testing

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CHAPTER 8 – General discussion and conclusion This study aimed to evaluate the relative contribution of the Paediatric and Adolescent Scale-up Plan (PASP) to the 90–90–90 HIV goals among children and adolescents. This section describes the implications of the findings for implementers of similar programs in the public health sector, as well as unanswered questions for future research. The principal findings, strengths and weaknesses in relation to other studies have been discussed in detail in the results chapters. The findings of this study show that targeted strategies used by PASP contributed positively and if implemented with fidelity, they can improve 90–90–90 goals for children and adolescents. Some of the implementation approaches from these strategies were further incorporated into guidance for other implementing partners in South Africa and widely disseminated through multiple best practice presentations and formed the foundation of the UB 2,0 program, which followed the UB 1,0 (PASP) in May 2019, As financial resources for HIV programs become limited and concentrated on the larger burden of HIV in the general population, targeted and cost-effective strategies for CLHIV and ALHIV are urgent to end AIDS by 2030. The overall results of the project suggest that PASP was implemented with adequate fidelity and that the adaptations made were acceptable. The routine health information used in the retrospective analysis provided a longitudinal and cost-effective dataset to evaluate this project, despite some data quality issues and limitations. 8.1 Relative contribution of PASP strategies to 90-90-90 outcomes among children and adolescents In this study, the data on patient outcomes suggested a marginal improvement in ART coverage and viral load suppression. Progress towards the target for the 1st 90 was the lowest compared to the 2nd and 3rd 90, suggesting that there were still significant numbers of undiagnosed CLHIV and ALHIV not on ART by the end of the project. Early identification and initiation of children on ART is essential to reduce morbidity and mortality, as well as improve ART coverage (18). Some of the PASP strategies were adopted by the local departments of health to sustain the gains made in paediatric and adolescent HIV programming. Health facility-based strategies HIV case finding at health facilities is a feasible and acceptable way of identifying undiagnosed CLHIV and ALHIV using existing resources. In this study, facility-based index testing had higher HIV prevalence than other

Appendix 14 Editor's/ Proof-reader's note

JML

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14 December 2023

To whom it may concern:

RE: Confirmation of proofreading and editing

This letter serves to confirm that the document detailed below has been proofread and edited by Dr Justina Amakali. The editor has focused on the following: spelling, grammar, accuracy, consistency, tone, structure, cohesion, and referencing style.

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STUDENT NAME: LINDIWE FARLANE

STUDENT NO.: 724733

Regards,

Dr Justina Amakali

Justina Amakali, PhD (English Studies) UNAM; MPhil (Second Language Studies) Stellenbosch University; B. Hons (ETD)UJ; Further Diploma (English Language Teaching) UJ; Diploma (Proofreading & Copy-editing) Black Ford Centre, UK.