Maternal and Infant Option B+ Outcomes in Zambézia Province, Mozambique: Retrospective Cohort Analysis (2013-2021)

Final Report

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Acronyms

3MDD	Three-monthly medication dispensation (i.e., quarterly dispensation)
AIDS	Acquired Immunodeficiency Syndrome
ADS	Associate Director of Science
ANC	Antenatal care
ART	Antiretroviral therapy
CDC	Centers for Disease Control and Prevention
CI	Confidence Intervals
CQI	Continuous quality improvement
DMC	Differentiated models of care
DPS-Z	Direcção Provincial de Saúde de Zambézia (*English: Zambézia Provincial Health Directorate*
EID	Early Infant Diagnosis
FGH	Friends in Global Health
GLMM	Generalized linear mixed-effect models
GRM	Government of the Republic of Mozambique
HF	Health Facility(ies)
HEI	HIV-exposed infant(s)
HIV	Human Immunodeficiency Virus
IIT	Interruption in treatment
IRB	Institutional Review Board
ITSA	Interrupted time series analysis
MOH	Ministry of Health
MTCT	Mother-to-child transmission
Non-PW	Non-pregnant women
OR	Odds ratio
PCR	Polymerase chain reaction
PEPFAR	U.S. President's Emergency Plan for AIDS Relief
PLWH	Persons living with HIV
PMTCT	Prevention of mother-to-child (i.e., vertical) transmission
PW	Pregnant women
SSA	Sub-Saharan Africa
T&S	Test and Start
UNAIDS	United Nations Joint Program on HIV & AIDS
WHO	World Health Organization
VL	Viral load
VS	Viral suppression
VT	Vertical transmission
VUMC	Vanderbilt University Medical Center

Evaluation Summary

Background
Following the introduction of the PMTCT Option B+ strategy in Mozambique beginning in July 2013, universal antiretroviral therapy (ART) for all persons living with HIV (PLWH) regardless of immune status (CD4 cell count) (commonly referred to as the "Test & Start" [T&S] strategy) was introduced in 2016. Now with approximately 10 years of comprehensive program data following program implementation, expansion and maturation, the objective of this evaluation was to look in-depth at the impact the rollout and full implementation of Option B+ has had on the PMTCT cascade. We compared these PMTCT Option B+ outcomes for pregnant women (PW) living with HIV and their infants exposed to HIV pre- and post-implementation of the T&S strategy. We also planned to compare the results of key programmatic outcomes (including retention in care, viral suppression (VS), and treatment interruptions) for PW living with HIV to outcomes of age-matched non-pregnant women (non-PW, including any lactating women) and men living with HIV, in all supported districts pre- and post-implementation of T&S strategy.

Methods
Retrospective cohort study was conducted involving adult (≥15 years of age) PLWH who initiated ART between July 2013 and September 2021, and infants exposed to HIV (HEI) born to women living with HIV during the same period in 173 health facilities in Zambézia Province. Routine data were used to summarize temporal trends in proportions for PW, non-PW, men, and HEI. Outcomes of interest included proportions for: ART coverage among PW and HEI, early infant diagnosis (EID) testing coverage and EID positivity at < 2 and < 9 months of age (as a proxy for vertical transmission), retention in care at 1-, 3-, 6-, and 12-months, VS and interruptions in treatment (IIT). Generalized mixed-effect logistic models built with district as random effect (nine districts included) and splines on time variable were used to compare trends over time for PW living with HIV and age-matched non-PW and men. Generalized linear mixed-effect models were used to compare trends pre- and within-COVID-19 pandemic and mitigation measures periods.

Results
Trends for ART coverage among PW improved over time in Zambézia Province, almost always nearing 100% in all districts from 2018 onward. Trends for HEI EID testing by 2 months and 9 months, as well as trends for HEI EID positivity rates by 2 months and 9 months of age also improved over time. Trends in all retention outcomes (1-, 3-, 6-, and 12-months) showed improvement over time, with monthly proportions for all adult groups (PW, non-PW, and men) increasing over time. There was not an observable trend change in proportions of persons in care with VS for any of the three groups (PW living with HIV, age-matched non-PW living with HIV, and age-matched men living with HIV) in any district from early 2019 to early 2020, with the exception of a slow trend of improvement seen among PW in two districts: Alto Molócuè and Ile. However, there trends of decline in VS proportions seen across all adult groups in almost all districts after COVID-19 mitigation measures were put in place, and there was a great deal of variability seen for monthly proportions across all age categories.

Overall, monthly proportions for IIT within 3 months ("IIT<3m") for each group decreased from approximately 55% to 20%. Trends of decreasing proportions of IIT<3m were more pronounced for PW (i.e., PW had greater improvement in IIT<3m over the period). Men and non-PW showed consistently higher proportions of early IIT, though improvements were seen from 2019 on for these two groups. Similarly, monthly IIT 3-5m proportions for all groups decreased from 2013-2021 (~65% to ~18% for PW, ~50-55% to ~20-25% for non-PW and men), with variations among groups: higher proportions of PW experienced an IIT3-5m from 2013 to early 2016, while non-PW and men had biennial increases in IIT 3-5m from 2013-2018. After 2018, IIT 3-5m trends consistently decreased for all groups.

The odds of PW being retained at 3-months decreased significantly to 56.6% in April 2020 (OR 0.57 [95%CI:0.44–0.74], p<0.001). During COVID-19 period, the odds of being retained at 3-months increased ~3.9% per month (OR 0.57 [1.06-1.10], p<0.001). Directly after COVID-19 began, there was an unexpected 2-fold increase in odds of PW being retained at 6-months (OR 2.16 [1.50–3.10], p<0.001).Though it was seen in the during-COVID-19 period that the odds of being retained at 6-months decreased (OR 0.91 [0.88–0.93], p<0.001), the 6-month retention proportion remained higher than the pre-pandemic period. EID coverage experienced an increase immediately after April 2020 (OR 1.94 [1.26-2.98], p=0.003) and had a sustained effect, with odds of HEI undergoing EID increasing ~4.7% per month. There were no significant differences in proportion of HEI testing positive, decreasing 2.7% per month, over time regardless of period.

Limitations

Causal inference was limited by concurrent programmatic changes.

Conclusions

In Zambézia Province, trend analysis showed improvements in several key maternal and infant outcomes over time. There was also prominent decrease in treatment interruptions in Zambézia Province for all adult groups included in the evaluation (PW, non-PW and men). Men and non-PW had overall slightly higher proportions of IIT, with significant improvements among these groups after T&S was introduced, while the established PMTCT Option B+ strategy showed continued positive effects. Though trends are reassuring on early retention, continued efforts are needed to ensure sustained effect.

1. Project Background

In 2010, the World Health Organization (WHO) released a strategic vision statement to aggressively scale-up access to combination antiretroviral therapy (ART) among HIV-positive pregnant women for the purposes of prevention of mother-to-child transmission (PMTCT) of HIV. The main objectives were to strengthen and expand comprehensive PMTCT services in resource-constrained settings and to demonstrate the public health benefits of such services.[1, 2] The successful scale-up and implementation of national PMTCT programs can reduce the rates of vertical transmission of HIV to <2% among non-breastfeeding women and <5% among breastfeeding women, while at the same time significantly reducing mother and infant morbidity and mortality.[3-5]

Previous strategies (referred to as Options A and B) have been dependent on CD4+ cell count testing to determine women's eligibility for lifelong ART, which has been identified as a major barrier to PMTCT enrollment in prior studies.[6, 7] In 2011, the Malawian Ministry of Health adopted a pragmatic public health approach to improve its low PMTCT coverage, and implemented a PMTCT strategy now referred to as Option B+, which allows for the initiation of lifelong ART among all HIV-positive pregnant and breastfeeding women, regardless of CD4 cell count and/or WHO clinical stage.[8] Option B+ was designed for countries such as Malawi and Mozambique that have limited laboratory capacity, low levels of trained healthcare workers, high HIV prevalence, short birth intervals, and extended breastfeeding.[9] The Government of the Republic of Mozambique (GRM) began formal discussions for adopting this approach in 2012, with implementation in collaboration with U.S. President's Emergency Plan for AIDS Relief (PEPFAR) clinical implementing partners commencing in July 2013.

Based on results from two large randomized controlled trials (START and TEMPRANO trials) showing the significant benefits (reductions in AIDS and non-AIDS associated morbidity and mortality) of immediate ART initiation compared to deferred ART initiation (e.g., when a person's CD4 cell count is < 500 cells/mm3),[10, 11] in 2015 the WHO updated its ART guidelines with recommendations to treat all persons with HIV as soon as possible after diagnosis, regardless of immune status.[12] This strategy, commonly referred to as "Test-and-Start" (T&S, a.k.a. "Treat All") has the potential for significant public health benefits, because the early initiation of ART has been shown to decrease the rates of HIV transmission, as encapsulated by the mantra "treatment as prevention". In addition, this "Treat All" approach was anticipated to significantly accelerate progress towards achieving the Joint United Nations Programme on HIV & AIDS (UNAIDS) fast-track 95-95-95 targets by 2030.[13] Several sub-Saharan African (SSA) countries, including Mozambique, began implementing the T&S strategy in 2016. Zambézia Province began implementing the national T&S strategy at the beginning of September 2016 in Quelimane district, and in March 2017 implementation began in Namacurra, Nicoadala, and Mocuba districts. The T&S strategy was expanded to the districts of Maganja da Costa, Pebane, Mocubela, Alto Molócuè, Gilé, Inhassunge, Lugela, Namarroi, Milange, Gurué, and Molumbo in October 2017, and then in the remaining supported districts of Ile and Mulevala in February 2018.

With the introduction of the T&S strategy, viral load (VL) testing has become part of routine care for all patients receiving ART for more than six months (and for pregnant or breastfeeding women who have been on ART for more than three months). As such, all patients, should receive routine VL testing to determine their VL and the effectiveness of their treatment.

Friends in Global Health (FGH) is a not-for-profit wholly owned subsidiary of Vanderbilt University Medical Center (VUMC) (a Vanderbilt Health Services entity) that has been registered with the Mozambican government since 2006 for the implementation of the U.S. Centers for Disease Control (CDC)'s U.S. President's Emergency Plan for AIDS Relief (PEPFAR)-funded HIV technical assistance initiatives. The FGH team works closely with the GRM officials at national, provincial, and district levels to implement sustainable models of community-based and facility-based services that cover the spectrum of the HIV response. "Avante: Towards Epidemic Control" is the flagship program which supports the provincial and district health authorities to develop, establish, rollout, and scale-up effective and sustainable comprehensive HIV services, including Option B+ and T&S.

Preliminary Option B+ outcomes data, with the majority of publications largely being from Malawi, have shown impressive results in terms of ART uptake/coverage and reductions in vertical transmission,[14-16] as well as evidence that it is more effective for maternal and infant health and more cost-effective compared to other strategies.[17] However, there is a paucity of data from Mozambique and no data detailing long-term (5+ year)outcomes of this important HIV prevention intervention within SSA, thus providing the impetus for this comprehensive evaluation. In addition, now with over eight years of comprehensive data, we identified the opportunity and the need to look in-depth at the impact the rollout and full implementation of Option B+ has had on the PMTCT cascade. In particular, the aim of this evaluation was to investigate the effect of Option B+ on ART coverage, vertical transmission rates, and maternal retention in care.

Evaluation costs were limited to the personnel time required for extraction and analysis of routine secondary data, results review and discussion, and report preparation, with estimated expenditures equal to $47,166.00 for the FGH personnel effort and $30,608.35 for the VUMC personnel effort, for an estimated total of $77,774.35 (which includes salary and benefits).

2. Evaluation Purpose and Questions

The concept note for this program evaluation was developed in collaboration with the Ministry of Health (MOH), and this evaluation was a collaborative partnership between the MOH, the Provincial Health Directorate of Zambézia (*Direcção Provincial de Saúde de Zambézia*, DPS-Z), and VUMC/FGH investigators. The primary objective of this evaluation was to describe the 8+ year maternal and infant Option B+ outcomes in Zambézia Province, Mozambique.

Specifically, our primary objectives were to:

1. Describe the proportion of HIV-positive, ART-eligible pregnant women (PW) enrolling in ART services (i.e., ART coverage; the absolute number and proportion of PW initiating ART within antenatal care (ANC) and maternity settings) over time.
    a. ART coverage among HIV-positive, ART-eligible PW beginning June 1, 2013, through September 20, 2019.

2. Describe the proportion of HIV-exposed infants (HEI) receiving early infant diagnosis (EID) testing (by 2 months of age and by 9 months of age) over time.
    a. EID testing rates among HIV-exposed infants beginning June 1, 2013, through September 20, 2019.

3. Describe the rates of mother-to-child/vertical transmission of HIV (i.e., using first infant HIV DNA polymerase chain reaction (PCR) positivity rate as a proxy for vertical transmission) over time.
    a. HIV DNA PCR positivity rates beginning June 1, 2013 through September 20, 2019.

4. Describe 1-month*, 3-month, 6-month and 12-month retention in care rates among HIV-positive PW that received Option B+ services, compared to age-matched non-pregnant women as well as age-matched men, over time.
    a. Maternal retention beginning June 1, 2013 through September 20, 2019.
    b. *NOTE*: We will treat age continuously and age-match by the following age brackets; 15-24 years of age vs. 25-34 years of age vs. 35-49 years of age.
    c. **NOTE*: The indicator of 1-month retention was added to the analysis based on input from the technical team as it continues to be an important measure used internally for monitoring early retention.

5. Describe the proportion of HIV-positive pregnant women achieving VS (i.e., undetectable HIV RNA PCR/viral load) among those having VL data, compared to age-matched non-pregnant women and age-matched men having VL data, over time.
    a. Maternal viral suppression beginning August 1, 2015 through September 20, 2020.
    b. *NOTE*: We will treat age continuously and age-match by the following age brackets; 15-24 years of age vs. 25-34 years of age vs. 35-49 years of age.

For comparison purposes as well as to test our hypotheses (see below), we compared these Option B+, or PMTCT, outcomes pre- and post-implementation of the T&S strategy which began in August 2016.

Specifically, we compared Option B+ outcomes among PW to non-pregnant women (non-PW; which includes all non-pregnant women and any lactating women) and to men in all supported districts before and after T&S. We chose to do this comparison at the district level supported by the fact that T&S roll-out was implemented in phases at the district level, as outlined above.

Hypotheses

1. Maternal (ART coverage, retention in care, and viral suppression) and infant (EID testing coverage and HEI HIV DNA PCR positivity rate) outcomes will improve over time with program expansion and maturation (as ascertained via program year).

2. With the evolution of ART initiation guidelines – from CD4 cell count-based ART initiation thresholds (e.g., < 350 or < 500 cells/mm^3) to T&S (i.e., starting all HIV-positive persons regardless of immune status) – disparities in ART coverage, retention in care, and viral suppression between PW living with HIV and concurrent, age-matched, non-pregnant adults (non-PW and men) living with HIV will at first be prominent but will diminish over time.

In summary, we aimed to achieve these primary objectives by describing ART coverage, EID testing rates, HEI HIV DNA PCR positivity rates, 3-, 6, and 12-month retention rates, and viral suppression rates since Option B+ was rolled-out/implemented in all VUMC/FGH-supported sites (beginning June 1, 2013, through September 20, 2019). We also described these outcomes stratified by PW, age-matched non-PW, and age-matched men. Finally, we wished to show aggregate and stratified trends in these outcomes over the 10+ years (June 1, 2013, through September 20, 2019) since implementation of Option B+ and while adjusting for important covariates, including district-level implementation of the T&S strategy.

Secondary objectives

In addition to the comparisons described above, we planned for additional comparisons, stratified/adjusted by:

- Age; continuously and by groups/strata (i.e., age brackets), namely younger vs. older adults: 15-24 years of age vs. 25-34 years of age vs. 35-49 years of age;
- District;
- Regional HIV prevalence (e.g., districts can be categorized as low-prevalence [<5%], medium-prevalence [5-10%], and high-prevalence [>10%]);
- Health facility (HF) size/volume (e.g., HF with <2,000 patients currently on ART vs. HF with ≥2,000 patients currently on ART; being a district headquarters site (*sede*, in Portuguese) vs. non-district headquarters site (non-*sede*); HF located in Quelimane (urban area) vs. others (peri-urban or rural area), etc.).

There were two subsequent modifications to the analysis plan based on adoption of new very-relevant PEPFAR indicators (interruption in treatment (IIT)) and major public health crisis (COVID-19 pandemic) impacting programmatic operations:

a) IIT: During discussions with technical team members and collaborators of this evaluation, it was suggested and requested to add an additional sub-analysis to assess the IIT indicators, as a

proxy measure of ARV medication adherence outcome. Whereas retention indicators are used primarily to monitor patients' continuation in care and services, IIT indicators are used primarily to monitor patients' adherence to ART. As such, it was deemed important to include both indicators in this analysis to more comprehensively assess trends in patient outcomes over this period. This sub-analysis was performed in line with the same methods used for retention in care (Objective 4) outcomes, describing IIT outcomes among PW, non-PW and men, treating age continuously and stratifying by age category. Specifically, this analysis assessed trends in proportions of patients without an IIT, as well as trends in proportions of patients experiencing an IIT, at various time intervals following ART initiation. We include in this report the findings of this additional sub-analysis.

b) COVID-19 pandemic: The MOH initiated COVID-19 prevention/mitigation measures in April 2020, including the expansion of various differentiated models of care (DMC), including offering three-monthly drug dispensation (3MDD) to PW from April to August 2020. During the analysis phase, the evaluation team became interested to also investigate if there were any obvious changes in MCH outcomes after COVID-19 restrictions were put in place. We performed a sub-analysis looking at several of the maternal and infant HIV outcomes (ART coverage among PW, EID testing coverage, HEI DNA PCR positivity, 1-month, 3-month, 6-month and 12-month retention in care among PW) in the periods pre- (April 2019 – March 2020) and during-COVID-19 (April 2020 to March 2021) restrictions implementation. We include in this report the findings of this additional sub-analysis. To assess whether the COVID-19 mitigation/prevention measures put in place by the MOH had an obvious (i.e., visually observable) potential effect on all outcomes of interest in this evaluation, a dashed line representing the start of COVID-19 mitigation/prevention measures was shown in each plot for reference. Based on MOH bulletin release dates for national COVID-19 response guidelines, it was decided to use April 1, 2020 as the start date of these measures.

3. Evaluation Design, Methods, and Limitations

3.1 Evaluation Type

To meet the above objectives, we conducted an internal outcome evaluation, in which routine programmatic data were analyzed to evaluate the outcomes of interest.

3.2 Evaluation Design

This was a retrospective evaluation of routinely collected programmatic (i.e., deidentified patient) data.

Inclusion Criteria (for patient-level data):

- Adults (with individual, patient-level data available);
- Reproductive-age (15-49 years of age [*for the purposes of this evaluation*]);

- Initiated on ART;
- Pregnant women, non-pregnant women (including lactating women), and men receiving care at FGH-supported health facilities in Zambézia Province.

Exclusion Criteria (for patient-level data):

- Age < 15 years or > 49 years;
- Pre-ART adults (15-49 years of age);
- Data related to subsequent pregnancies for pregnant adolescents/women (15-49 years of age) who had multiple pregnancies during the observation period (i.e., we only included the first pregnancy period).

Study Definitions of Outcomes

ART coverage for all HIV-positive PW (known and newly tested at first ANC visit): proportion was calculated by: [# of PW who received ART (ART experienced + ART naïve)] / [# of PW who were identified as HIV-positive at first ANC (previously known + newly tested)] * 100%.

- *NOTE for all percentages of ART coverage*: During this calculation, percentages greater than 100% (possibly due to data fidelity issues) were simply capped to 100%.

***HEI EID coverage (i.e., HIV DNA PCR testing coverage)*:**

- HEI EID coverage by **2 months of age**: proportion of HEI receiving EID testing (by 2 months of age; this percentage was calculated by: [# of PCR collected (<2 months)] / [# of HIV-positive PW registered at the 1st ANC 6-month earlier] * 100%.
- HEI EID coverage by **9 months of age**: proportion of HEI receiving EID testing (by 9 months of age; this percentage was calculated by: [# of PCR tested (<9 months)] / [# of HIV-positive PW registered at the 1st ANC 6-month earlier] * 100%.
- *NOTE for all HEI EID coverage outcomes:* percentages greater than 100% (possibly due to data fidelity issue and/or using an approximate denominator) were simply capped to 100%. Since the indicator "number of HIV-positive PW registered at the 1st ANC 6-month earlier" was used as the denominator, the start time in this analysis lagged 6 months accordingly because the denominator for the first 6 months is not available. Thus, the start time for this indicator was April 2017 for Quelimane district, April 2019 for Gurué, Lugela, Milange, Mocuba, Molumbo, and Nicoadala districts, and April 2016 for all other districts; the end of evaluation period was September 2021 for all districts.
- *NOTE for HIV EID coverage <2 months of age:* At the time of data extraction for this evaluation, data for the "number of PCR tested (<2 months)" was not available in the DHIS database. With the assumption that all collected PCR samples were tested, it was decided to use "number of PCR collected (<2 months)" as a proxy for estimating HEI EID coverage for children less than 2 months.

HIV DNA PCR positivity rate was used as a proxy for vertical transmission among HEI.

- HEI HIV PCR positivity rate by **2 months of age**: defined as the proportion of positive DNA PCR results among all DNA PCR tests performed by 2 months of age; the proportion was represented in percentage which was calculated by: [# of PCR test positive (<2 months)] / [# of PCR results (<2 months)] * 100%.
- HEI HIV PCR positivity rate by **9 months of age**: defined as the proportion of positive DNA PCR results among all DNA PCR tests performed by 9 months of age; the proportion was represented in percentage which was calculated by: [# of PCR test positive (<2 months)] / [# of PCR results (<9 months)] * 100%.
- *NOTE for all DNA PCR positivity rates*: During this calculation, percentages greater than 100% (possibly due to data fidelity issues) were simply capped to 100%.
- The DNA PCR positivity rate for each district were calculated using the aggregated district-level numbers.

Retention among individuals was defined relative to time from ART initiation; we determined the proportion of individuals per month who were still in care at 1-month, 3-months, 6-months, and 12-months after ART initiation. Retention proportions for each district were calculated using the aggregated district-level numbers. Specifically, retention at the various timepoints was defined as follows:

- **1-month retention**: patients were considered retained at 1 month if they had at least one ART pick-up within the 33 days post-ART initiation. (*NOTE*: This is a PEPFAR definition and is used internally by FGH for program reporting.) The aggregation for 1-month retention came from patients who initiated ART between "the first day of that month - 33 days" and "the last day of that month - 33 days".
- **3-month retention**: patients were considered retained at 3 months if they had at least three ART pick-ups within the 99 days post-ART initiation. (*NOTE*: This is a PEPFAR definition and is used internally by FGH for program reporting.) The aggregation for 3-month retention came from patients who initiated ART between "the first day of that month - 99 days" and "the last day of that month - 99 days".
- **6-month retention**: patients were considered retained at 6 months if they had an ART pick-up within 59 days after last scheduled pick-up date, 6 months post-ART initiation, as per the MOH definition. The aggregation for 6-month retention came from patients who initiated ART between "the first day of that month - 6 months" and "the last day of that month - 6 months".
- **12-month retention**: patients were considered retained at 12 months if they had an ART pick-up within 59 days after last scheduled pick-up date, 12 months post-ART initiation, as per the MOH definition. The aggregation came from patients who initiated ART between "the first day of that month - 12 months" and "the last day of that month - 12 months".

Viral suppression was defined as the number of routine VL (HIV RNA PCR) results documented in the medical or laboratory records between 3 and 12 months of ART initiation with a result of less than 1,000 copies/ml. If more than one VL result record was available in that time frame, the most recent one was used.

- For this analysis, we determined the proportion of individuals per month per HF with VS among all available VL results during the period of observation. The VS proportion for each district were calculated using the aggregated district-level numbers.
- Based on the definition of VS used, theoretically, a 12-month cutoff after ART initiation was needed to accurately define the VS status, thus all plots for VS only show VS status for patients who initiated ART by the end of September 2020.

***Interruption in treatment (IIT)*:** the patient was considered to have experienced an IIT if they had no clinical contact (including no ART pick up) for 28 days after the last scheduled appointment or expected clinical contact. The IIT were disaggregated in three separate time frames:

- < 3 months: experiencing any IIT after being on treatment for less than 3 months (i.e., any IIT < 3m after ART initiation)
- 3-5 months: experiencing any IIT after being on treatment for 3-5 months (i.e., any IIT ⩾ 3m and < 6m after ART initiation)
- >= 6 months: experiencing any IIT after being on treatment for more than 6 months (i.e., any IIT ⩾ 6m after ART initiation)
- *NOTE:* IIT status was determined based on both the ART pick-up AND clinical visit within each respective time frame (i.e., by 3 months after ART initiation, between 3-5 months after ART initiation, or 6 months or more after ART initiation) but not a fixed time point (such as what is used for retention).

3.3 Evaluation Settings

We evaluated PMTCT Option B+ and other clinical outcomes in 173 FGH-supported health facility sites offering comprehensive HIV services (including PMTCT) in 15 districts in Zambézia Province (see **Appendix 1** for list of all HF included). Each selected HF offers comprehensive HIV services, including clinical care, laboratory testing, and pharmacy services. Each district-level health system consists of one large central (i.e., *sede*) HF/referral center and smaller peripheral health facilities.

While the originally intended evaluation period for analysis for all sites was July 2013 to September 2019, related to programmatic and operational transitions (i.e., FGH as indicated clinical implementation partner) during this period, as well as the availability and functionality of the DHIS database (which was not in use by FGH until October 2015), it was necessary to adjust the inclusion of district/HF sites related to these temporal changes (see **Table 1** and notes below).

Table 1. FGH-supported districts included in the evaluation and the respective evaluation period for each.

		DHIS data		OpenMRS data	
	District Name	**Time period included in analysis**	**Years included**	**Time period included in analysis**	**Years included**
1	Alto Molócuè	October 1, 2015, to September 30, 2021	6	July 1, 2013, to September 30, 2021	8
2	Gilé				
3	Ile				
4	Inhassunge				
5	Maganja da Costa				
6	Mocubela				
7	Namacurra				
8	Pebane				
9	Quelimane	October 1, 2016, to September 30, 2021	5		
10	Gurué	October 1, 2018, to September 30, 2021	3	October 1, 2018, to September 30, 2021	3
11	Lugela				
12	Milange				
13	Mocuba				
14	Molumbo				
15	Nicoadala				

As indicated in **Table 1** above, for six districts included in this evaluation, Lugela, Mocuba, Milange, Gurué, Nicoadala, and Molumbo, FGH began supporting these districts on October 1, 2018. Thus, it was decided to only include in the analysis the programmatic data from October 1, 2018, to September 30, 2021 for these districts, and exclude all data from patients who initiated ART prior to October 1, 2018 in these districts.

NOTE: Health facility sites in the five districts of Chinde, Luabo, Morrumbala, Derre, and Mopeia were supported by a different CDC/PEPFAR-funded implementing partner, fhi360/CHASS, from June 1, 2013 to September 20, 2019. As the sites in these five districts were not supported by FGH for most of the evaluation period (and thus scant data were accessible to FGH for the indicated evaluation period), data from all sites in these districts were excluded from the analysis.

3.4 Data collection

Routinely collected, de-identified patient-level clinical data were collected for the evaluation on access to ART services, retention, VS, and IIT rates (see **Table 2** below). We included data from all adult patients (PW, non-PW, and men) who attended PMTCT and/or HIV services during the period of July 1, 2013, to September 30, 2021 (i.e., just over eight years).

Health facility-level programmatic data on infant HIV testing and HIV test results were collected and included in the analysis for EID outcomes (see **Table 2** below). We included data from all infants born who were exposed to HIV between October 1, 2015, to September 30, 2021. (*Note:* This period was used as these EID outcomes data came from the DHIS database (see below), which only had data available starting in October 2015.)

Table 2. Variables and data sources.

Variables	**Data source**
Health Facility (Name) District (Name) Sex Date of birth Date of enrollment in HIV care Age at enrollment in HIV care Marital status at enrollment in HIV care Pregnancy status at enrollment in HIV care (females) Educational level at enrollment in HIV care Occupation at enrollment in HIV care Partner HIV+ status at enrollment in HIV care WHO clinical stage at enrollment in HIV care Weight at enrollment in HIV care Height at enrollment in HIV care ART initiation date ART regimen Viral load copies/ml (all values) Viral load test data (all dates) CD4 result (absolute + percentage) (all) CD4 test dates (all) Clinic visit dates (all) ART pick up dates (all) Next scheduled ART pick up dates (all) Patient status in ART services (as defined by MoH) Patient status in ART services TB screening done at enrollment TB co-infected at enrollment Access to a cell phone SMS phone reminder consent date Entry dates PMTCT program Exit dates PMTCT program	OpenMRS
# of women registered in ANC # of women receiving HIV counseling and testing # of women testing positive for HIV in ANC (including those newly testing positive as well as those with known positive status) # of women initiating ART # of women already on ART at time of ANC registration # of women eligible for ART # of HIV-exposed infants undergoing infant DNA PCR testing # of HIV-exposed infants testing positive 3-, 6- and 12-month aggregate retention in care rates (for all included individuals) 3-, 6- and 12-month aggregate viral suppression rates (for all included individuals)	DHIS

3.5 Data Sources

Patient-level data for individual adults were extracted from the electronic Open Medical Record System (OpenMRS)™ database, and aggregate health facility-level programmatic data for HEI were extracted from FGH-DHIS2 database (see **Table 2** above).

Related to the availability of data from the two different datasets, there was some difference in the number of HFs for which data was included between the two sources. Data was extracted from the DHIS database for all 173 HFs intended for inclusion. Data was extracted from the OpenMRS database for 166 HFs. In total, there were 139 HFs from which data was available in both DHIS and OpenMRS (with 34 HFs in DHIS dataset were not available in the OpenMRS dataset, and 27 HFs in OpenMRS dataset were not available in the DHIS dataset).

A copy of the limited, de-identified data extracted and exported from the secure OpenMRS or DHIS database was encrypted and electronically transferred via secure file transfer to relevant key personnel (e.g., the biostatistician(s) and investigator at VUMC) using encryption protected folders via internally used internet (Google) drive share. Each recipient received an email containing a unique download URL, along with a second follow-up email with the password (for greater security) for downloading the file. De-identified data sent to biostatisticians was stored on a secure and encrypted computer.

All raw data were in the ".xls /.xlsx" format. Each excel file was loaded into R using read.xls function in gdata package and cleaned, the variables used for defining aforementioned outcomes were extracted, and the monthly HF-level data were aggregated to district-level data. All processed data from different Excel files were integrated by district and month for statistical analyses.

3.6 Statistical Analyses

For the five primary objectives set out in the concept note, descriptive analyses were done for each outcome of interest (specifically, maternal ART coverage in ANC, EID testing rates, infant HIV DNA PCR positivity rates, maternal retention rates, and VS rates) in the format of absolute number and corresponding proportion at the district level. We described ART coverage in ANC, EID testing rates, vertical transmission rates, retention rates, viral suppression rates, and IIT rates during the period of evaluation via tables and trend plots. For the last three outcomes, we also performed the descriptive analysis comparatively among the three patient groups: PW, non-PW, and men living with HIV.

For the purposes of comparing key evaluation outcomes (i.e. retention in care, viral suppression, and the IIT [see Section 3.10 below]) among the three patient groups (PW, non-PW, men) across the evaluation period (July 2013 to September 2021), generalized linear mixed-effect models (GLMM) were built, with logit link function for the logistic models, *time* and *group* as fixed-effect and *district* as random effect for intercept and the slope of *group*. Since the sample size was large, we fitted a complex model with non-linear terms and interactions. Natural splines with 6 knots equally spaced were used to model calendar time, the *time* variable, to account for potential

nonlinear effect. The high number of knots was used to capture the possible complex nonlinear relationship, hopefully capturing closer what is seen in reality; an interaction term of *time* and *group* was also included in the GLMM to account for different trends for different group. For all compared outcomes, temporal (monthly) trends in proportions of PW, non-PW, and men are reported. Specifically, the model can be expressed as (in R syntax):

$$outcome \sim \text{ns}(time, 6) * group + (group \mid district)$$

where: *outcome* is a proportion ranging from 0 to 1 which represents the outcome of retention in care, viral suppression, and the IIT; *time* is an integer representing the number of months with respect to the start time of current study period (i.e. July 2013), and the natural spline with six knots were applied to *time* by using the ns() function; *group* is a three-category variable representing the patient cohort of PW, non-PW, and Men; The operator of "*" indicates that the interaction term between *time* and *group* was considered during the modeling, in addition to the main variables; the portion within parentheses assigned *district* as cluster variable and the random effect on both intercept and the slope of *group* variable.

For the additional sub-analysis (see Section 3.10 below) comparing trends in maternal and infant HIV outcomes (ART coverage among PW, HEI EID coverage, HEI positivity via DNA PCR, and retention in care among PW) prior to (April 2019 – March 2020) and within (April 2020 – March 2021) the COVID-19 mitigation measures being in place, interrupted time series analysis (ITSA) with generalized linear mixed-effect models were built to study the trend/change of each outcome before and after the COVID-19 pandemic mitigation measures were in place. Trend comparison of the outcome prior to and within the COVID-19 was embedded in the ITSA models by evaluating the statistical significance of the *Time*COVID-19* interaction term.

All statistical analyses were conducted using R statistical software 4.1.0.[18]

3.7 Limitations of design

We acknowledge several limitations for this analysis and evaluation.

Our evaluation design does not allow us to establish a causal relationship between implementation of the Option B+ program and the maternal and infant outcomes of interest, or the T&S strategy and the outcomes of interest for adult non-PW and men. We acknowledge that there are many documented and undocumented programmatic changes over time, and there is also expected improvement with program maturation, and our evaluation design is not able to control for these potential confounders.

We utilized aggregate outcomes and exposures (district- and/or HF-level). As such, we were not able to adjust for any individual characteristics in this analysis.

It was unfortunate to have to exclude the five districts (Chinde, Luabo, Morrumbala, Derre, Mopeia) that were not supported by FGH for most of the evaluation period, however, we

determined that there were not enough data available (during the time frame of FGH support to these districts) to meaningfully interpret analysis results if included.

For each of the three outcomes for which data from the OpenMRS database were used, namely retention, viral suppression, and IIT, to calculate the percentages, it was necessary to restrict the dataset to data from individual patients (adults): i) who had an ART initiation date within the established evaluation period, and ii) who had a definitive status (i.e., a calculable status) for each outcome of interest. In other words, if it was not feasible to calculate an outcome of interest (either retention, viral suppression, or IIT) for an individual due to lack of availability of their ART pick-up and/or clinic visit data, those data were excluded when analyzing that outcome.

Upon data extraction, it was discovered that VL records within 3-12 months of ART initiation were not available for most patients in the electronic medical record, especially before VL was routinely examined. Due to the high level of missingness of VL data prior to 2019, to enable meaningful interpretation of viral suppression results, it was decided to include in the analysis for viral suppression only those data from January 2019 to September 2021 (the end of the data extraction period), as during the calendar year of 2019 VL testing became much more routinely available throughout the province. Though this restriction limited the time period of the viral suppression analysis, related to the GLMM of VS outcome, this attenuated the limitation of having few data points for the regression and decreased the width of the 95% confidence intervals (CI).

3.8 Ethical considerations

This secondary data analysis is covered under the approved blanket protocol for program evaluations, titled "*Quality Improvement for HIV Care and Treatment in Zambézia province of the Republic of Mozambique under the President´s Emergency Plan for AIDS Relief (PEPFAR)*." The data use and evaluation plan were approved the VUMC Institutional Review Board (IRB) (#201887), the Institutional Research Ethics Committee for Health of Zambézia Province (*Comité Institucional de Bioética para Saúde – Zambézia*; 01/CIBS-Z/22), and was reviewed in accordance with the CDC human research protection procedures and was determined to be research, but CDC investigators did not interact with human subjects or have access to identifiable data or specimens for research purposes.

All data included in this analysis were de-identified programmatic data and aggregated data. The electronic databases outlined in the *Methods* section were stored on password-protected and encrypted servers at FGH offices. De-identified data were extracted from these secure databases and sent via secure file transfer to relevant key FGH and VUMC personnel (i.e., the principal investigator and the biostatisticians) to conduct analyses and interpret results.

3.9 Stakeholder engagement

FGH technical teams have ongoing collaborations with key stakeholders working in the health facilities and the surrounding communities in which we are supporting and engaged. The concept note and analysis plan for this evaluation of secondary programmatic data were elaborated with

support from the provincial- and district-level authorities, and approved by the sponsoring institution CDC-Mozambique.

3.10 Deviations from scope of work/ protocol

As noted above, the evaluation period was altered for specific variables related to data availability and site inclusion/exclusion was adjusted to account for FGH support transitions during this period. For the descriptive analysis, all 173 HF from 15 districts were included in the dataset from DHIS, and 166 HFs from 15 districts were included in the dataset from OpenMRS. For the GLMM analyses, only 107 HF in nine districts (Alto Molócuè, Gilé, Ile, Inhassunge, Maganja da Costa, Mocubela, Namacurra, Pebane and Quelimane) were included, as the other six districts (Gurué, Lugela, Milange, Mocuba, Molumbo and Nicoadala) had data available only starting in October 2018 related to transition to FGH support of these districts.

Since no indicator variable could be used to identify/define the "lactating status" in both the extracted DHIS and OpenMRS data sets, it was not possible to identify lactating women and form a subgroup of "pregnant and lactating women" as originally outlined in the concept note. Thus, for all maternal outcomes evaluated, they represent only pregnant women and not pregnant and lactating women. Women who were either lactating or not pregnant were included in the category of "non-pregnant women" (non-PW) adults.

There were two subsequent modifications to the analysis plan outlined in the original concept note. These modifications were based on adoption of new very relevant PEPFAR indicators related to IIT and the major public health crisis caused by the COVID-19 pandemic which impacted programmatic operations; these modifications to the analysis plan are described above, and results are presented in this report.

3.11 Data Quality Assurance

Programmatic data used in this evaluation were subject to routine data verification processes conducted by trained members of FGH's Monitoring and Evaluation team. All data were stored securely on password-protected databases at district- and provincial level FGH offices. The performance of the program indicators was continuously monitored by HF staff. All subsequent indicators were collected and internally reported on a monthly frequency by the FGH Health Information Systems team, following the regular reporting period for program data.

Upon receipt of the requested extracted dataset for this evaluation/analysis, data were cleaned and reviewed to ensure they were consistent and appropriate with the evaluation inclusion and exclusion criteria.

4. Findings

[*NOTE*: For all plots in this section (unless otherwise noted), the x-axis is calendar year/month, and the plots show the aggregated status for each respective outcome in that month.]

Objective 1. ART Coverage for all PW living with HIV

Table 3. Proportion of PW living with HIV who received ART within ANC, overall, and per district, over time.

District	HIV+ diagnosis	Min	Q1	Median	Q3	Max	Mean	SD
Alto Molócuè	Previously known HIV+ [a]	87.5	96.3	100	100	100	97.8	3.4
	Newly tested HIV+ [b]	80	96.8	100	100	100	97.8	4.4
	Known + newly tested [c]	89.1	97	100	100	100	98.3	2.8
Gilé	Previously known HIV+ [a]	59.1	90.9	99.3	100	100	94.3	8.7
	Newly tested HIV+ [b]	95.5	100	100	100	100	99.9	0.6
	Known + newly tested [c]	89.3	100	100	100	100	99.3	1.9
Gurué	Previously known HIV+ [a]	91.3	100	100	100	100	99.1	2.4
	Newly tested HIV+ [b]	92.3	100	100	100	100	99.3	2.1
	Known + newly tested [c]	96.8	100	100	100	100	99.7	0.8
Ile	Previously known HIV+ [a]	55.6	93.7	100	100	100	95.0	9.3
	Newly tested HIV+ [b]	66.7	100	100	100	100	97.9	6.0
	Known + newly tested [c]	69.7	98.1	100	100	100	97.4	6.2
Inhassunge	Previously known HIV+ [a]	53.3	89	97.1	100	100	92.7	10.1
	Newly tested HIV+ [b]	73.1	100	100	100	100	99.0	3.9
	Known + newly tested [c]	69.5	98	100	100	100	97.5	5.0
Lugela	Previously known HIV+ [a]	92.3	100	100	100	100	99.7	1.4
	Newly tested HIV+ [b]	92.3	100	100	100	100	99.8	1.3
	Known + newly tested [c]	96.8	100	100	100	100	99.9	0.6
Maganja da Costa	Previously known HIV+ [a]	44.2	92.8	100	100	100	93.3	12.3
	Newly tested HIV+ [b]	94.9	100	100	100	100	99.9	0.7
	Known + newly tested [c]	93.4	98.7	100	100	100	99.1	1.6
Milange	Previously known HIV+ [a]	98.5	100	100	100	100	99.9	0.4
	Newly tested HIV+ [b]	95.9	100	100	100	100	99.8	0.7
	Known + newly tested [c]	98.3	100	100	100	100	99.9	0.3
Mocuba	Previously known HIV+ [a]	96.4	99.4	100	100	100	99.7	0.7
	Newly tested HIV+ [b]	90.4	98.5	100	100	100	99.0	2.0
	Known + newly tested [c]	96.5	99	99.5	100	100	99.4	0.8
Mocubela	Previously known HIV+ [a]	60	95.2	100	100	100	95.9	8.5
	Newly tested HIV+ [b]	84.6	96.7	100	100	100	97.5	4.1
	Known + newly tested [c]	87.5	96.7	99	100	100	97.8	3.1
Molumbo	Previously known HIV+ [a]	67.6	100	100	100	100	99.1	5.4
	Newly tested HIV+ [b]	100	100	100	100	100	100.0	0.0
	Known + newly tested [c]	100	100	100	100	100	100.0	0.0
Namacurra	Previously known HIV+ [a]	68	91.4	100	100	100	94.2	8.6
	Newly tested HIV+ [b]	77.5	99.8	100	100	100	98.4	4.0
	Known + newly tested [c]	73.8	96.8	99.5	100	100	97.3	4.9
Nicoadala	Previously known HIV+ [a]	97.7	99.3	100	100	100	99.7	0.5
	Newly tested HIV+ [b]	93.9	100	100	100	100	99.5	1.3
	Known + newly tested [c]	95.7	99.4	100	100	100	99.6	0.8
Pebane	Previously known HIV+ [a]	60	94.5	99.3	100	100	96.0	7.5
	Newly tested HIV+ [b]	40.2	74.8	97	100	100	88.6	15.4
	Known + newly tested [c]	46.5	83.8	98.5	100	100	91.9	11.9

Quelimane	Previously known HIV+ [a]	82.1	95.2	99.3	100	100	97.3	3.8
	Newly tested HIV+ [b]	80.4	94.4	98.8	100	100	97.0	4.1
	Known + newly tested [c]	83.9	96.2	98.2	99.6	100	97.1	3.5
All districts	Previously known HIV+ [a]	44.2	95.9	100.0	100	100	96.2	7.8
	Newly tested HIV+ [b]	40.2	100.0	100.0	100	100	97.9	6.3
	Known + newly tested [c]	46.5	98.3	100.0	100.0	100	97.9	5.1

[a] This percentage was calculated by: [(# of PW who received ART previously) / (# of PW with known HIV+ at 1st ANC visit) * 100%]. During this calculation, percentages being greater than 100% (possibly due to data fidelity issue) were simply capped to 100%.
[b] This percentage was calculated by: [(# of PW who started ART) / (# of PW tested HIV+ at 1st ANC visit) * 100%]. This calculation assumed that PW started ART were only from those who were tested HIV+ at 1st ANC. This assumption may not be completely true, but the calculated percentage should be a good approximation for ART coverage for PW tested HIV+ at 1st ANC visit. During this calculation, percentages being greater than 100% (possibly due to data fidelity issue) were simply capped to 100%.
[c] This percentage was calculated by: [(# of PW who received ART (previously + started)) / (# of PW who were HIV+ at 1st ANC (known + tested)) * 100%]. During this calculation, percentages being greater than 100% (possibly due to data fidelity issue) were simply capped to 100%.

There was an observable trend of improvement seen in the percentage of ART coverage for all PW living with HIV (known and tested positive at 1st ANC visit) across all districts over time (see **Figure 1** below). While some districts had <80% ART coverage in early 2016 (namely Pebane, Inhassunge, Ile and Namacurra), some districts (Gurué, Lugela, Milange, Mocuba, Molumbo and Nicoadala) which only had data available starting in 2018 were performing consistently very well (>95%) on this indicator throughout the evaluation period. By approximately mid-2018 and thereafter, ART coverage almost always approached 100% in each district. There was no observable difference seen in wake of COVID-19 restrictions.

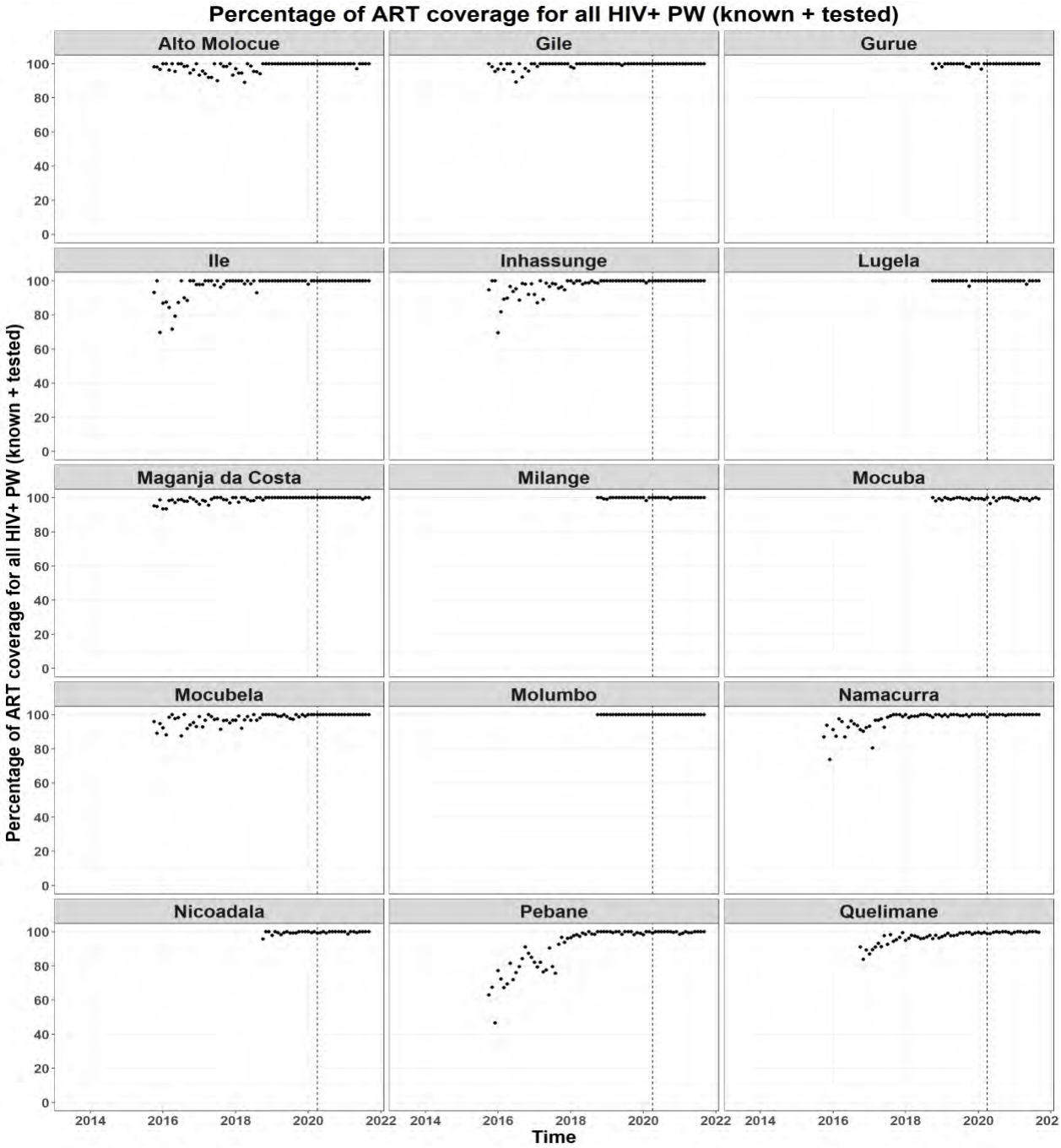

Figure 1. Proportion of PW who received ART in ANC (previously known as HIV-positive and newly diagnosed at 1st ANC visit), over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Objective 2. EID Coverage for all HEI

Table 4. Percentage of EID coverage (via HIV DNA PCR testing) for HEI, by 2 and 9 months of age, over time.

District	PCR test [a, b]	Min	Q1	Median	Q3	Max	Mean	SD
Alto Molócuè	< 2 months	35.7	53.7	67.2	84.1	100	69.0	18.5
	< 9 months	44.3	72.2	89.1	100.0	100	85.2	14.6
Gilé	< 2 months	30.0	49.8	64.0	80.6	100	66.1	21.1
	< 9 months	45.1	74.1	86.9	99.6	100	83.3	15.5
Gurué	< 2 months	35.1	54.7	64.0	97.0	100	71.7	22.6
	< 9 months	44.6	65.7	85.2	100.0	100	81.3	19.1
Ile	< 2 months	27.3	48.0	62.7	78.4	100	65.1	20.5
	< 9 months	30.3	63.8	82.9	100.0	100	80.6	18.2
Inhassunge	< 2 months	32.4	62.2	78.0	93.9	100	76.7	19.5
	< 9 months	52.3	78.7	91.0	100.0	100	87.6	13.3
Lugela	< 2 months	43.1	59.9	70.4	100.0	100	74.6	19.9
	< 9 months	50.0	69.8	83.2	100.0	100	82.9	16.9
Maganja da Costa	< 2 months	35.0	61.4	84.0	100.0	100	77.9	20.6
	< 9 months	67.6	84.9	100.0	100.0	100	92.9	10.1
Milange	< 2 months	42.9	84.5	97.5	100.0	100	89.2	16.1
	< 9 months	60.4	91.3	98.6	100.0	100	92.2	12.2
Mocuba	< 2 months	56.7	71.5	78.3	87.2	100	79.2	11.6
	< 9 months	66.7	82.9	89.2	98.0	100	88.5	10.2
Mocubela	< 2 months	10.9	79.5	94.0	100.0	100	83.8	23.5
	< 9 months	37.0	95.7	100.0	100.0	100	95.1	11.7
Molumbo	< 2 months	32.7	67.1	93.2	100.0	100	82.7	20.0
	< 9 months	53.1	79.5	100.0	100.0	100	90.3	13.2
Namacurra	< 2 months	21.0	57.4	74.8	89.5	100	73.2	20.6
	< 9 months	54.8	82.7	91.7	100.0	100	88.6	11.2
Nicoadala	< 2 months	67.1	80.6	88.8	100.0	100	88.8	10.6
	< 9 months	75.0	89.1	100.0	100.0	100	94.5	7.6
Pebane	< 2 months	29.1	53.6	72.8	84.0	100	69.6	20.3
	< 9 months	51.0	77.2	89.9	100.0	100	86.4	13.2
Quelimane	< 2 months	41.4	68.2	74.7	87.5	100	77.0	15.1
	< 9 months	58.4	79.1	86.8	91.6	100	85.3	10.9
All districts	< 2 months	10.9	59.4	76.7	95.8	100	74.9	20.6
	< 9 months	30.3	78.6	91.8	100.0	100	87.5	14.1

[a] This percentage was calculated by: [(# of PCR collected (<2 months)) / (# of HIV+ PW registered at the 1st ANC 6-month earlier) * 100%] (which was used to estimate the HEI EID coverage). During this calculation, percentages being greater than 100% (possibly due to data fidelity issue and using an approximate denominator) were simply capped to 100%.

[b] This percentage was calculated by: [(# of PCR tested (<9 months)) / (# of HIV+ PW registered at the 1st ANC 6-month earlier) * 100%] (which was used to estimate the HEI EID coverage). During this calculation, percentages being greater than 100% (possibly due to data fidelity issue and using an approximate denominator) were simply capped to 100%.

[c] Since "# of HIV+ PW registered at the 1st ANC 6-month earlier" was used as denominator, the start time in this analysis lagged 6 months accordingly since the denominator for the first 6 months is not available.

There was a discernible trend of improvement in the percentage of HEI who had a PCR test collected by 2 months of age (proxy for PCR testing), across all districts over time. There was a more robust trend of improvement specifically seen for the districts of Mocubela, Milange, Molumbo, Maganja da Costa, Gurué, Namacurra, Pebane and Quelimane. Within several districts, there was rapid and maintained improvement in this indicator seen after COVID-19 measures were put in place, namely in Gurué, Milange, Quelimane, and especially in Molumbo (see **Figure 2a** below).

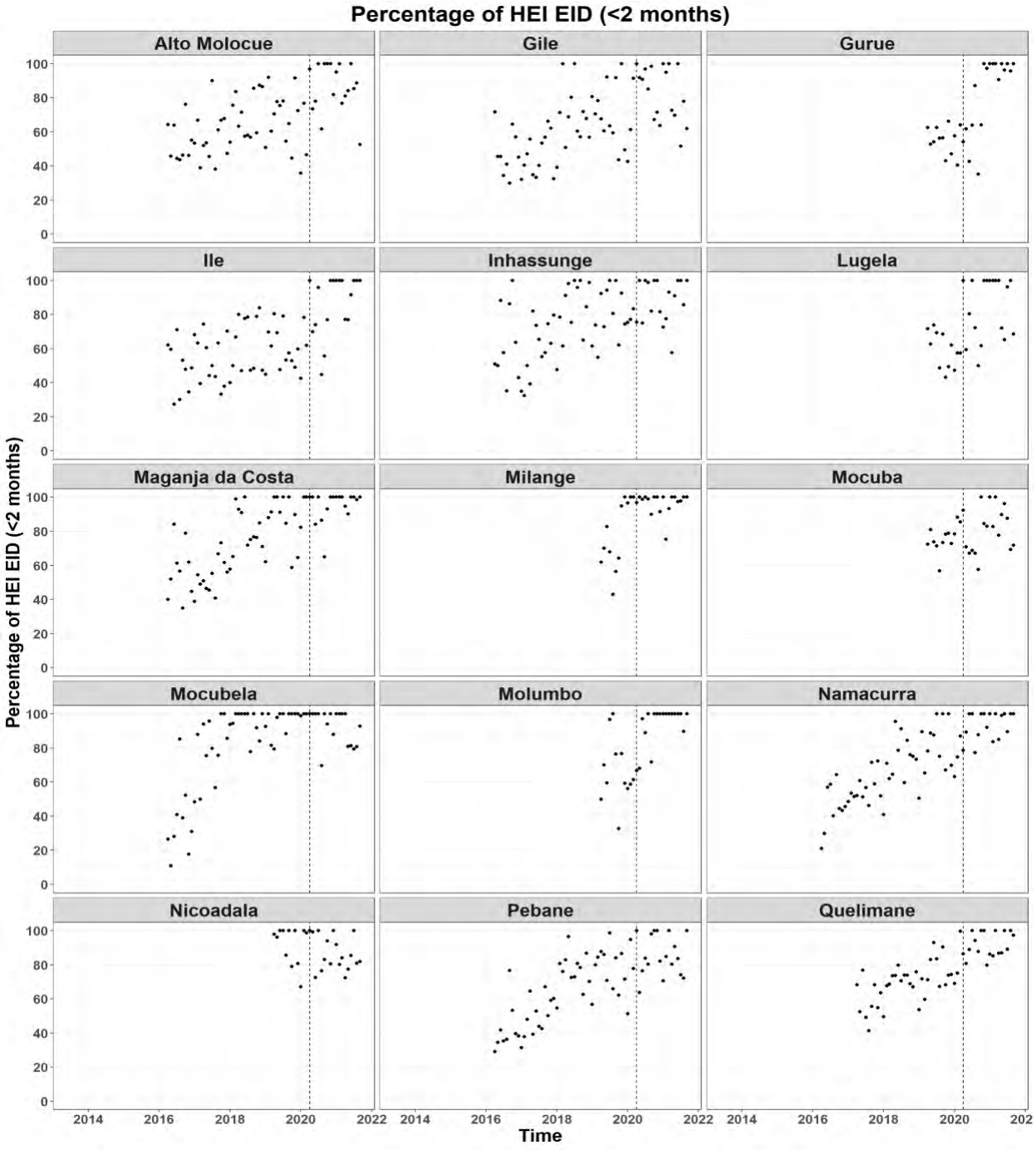

Figure 2a. Percentage of HEI who had a PCR test collected by < 2 months of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

For the percentage of HEI who had EID testing by < 9 months of age, similar to EID testing by 2 months of age, there was an observable trend of improvement across all districts over time. That said, certain districts performed consistently well over the evaluation period even pre-COVID-19 mitigation measures, including Mocubela, Milange, Maganja da Costa, Molumbo, and Nicoadala. There were also notable improvements seen in many districts after COVID-19 pandemic began, especially in Alto Molócuè, Namacurra, and Quelimane (see **Figure 2b** below).

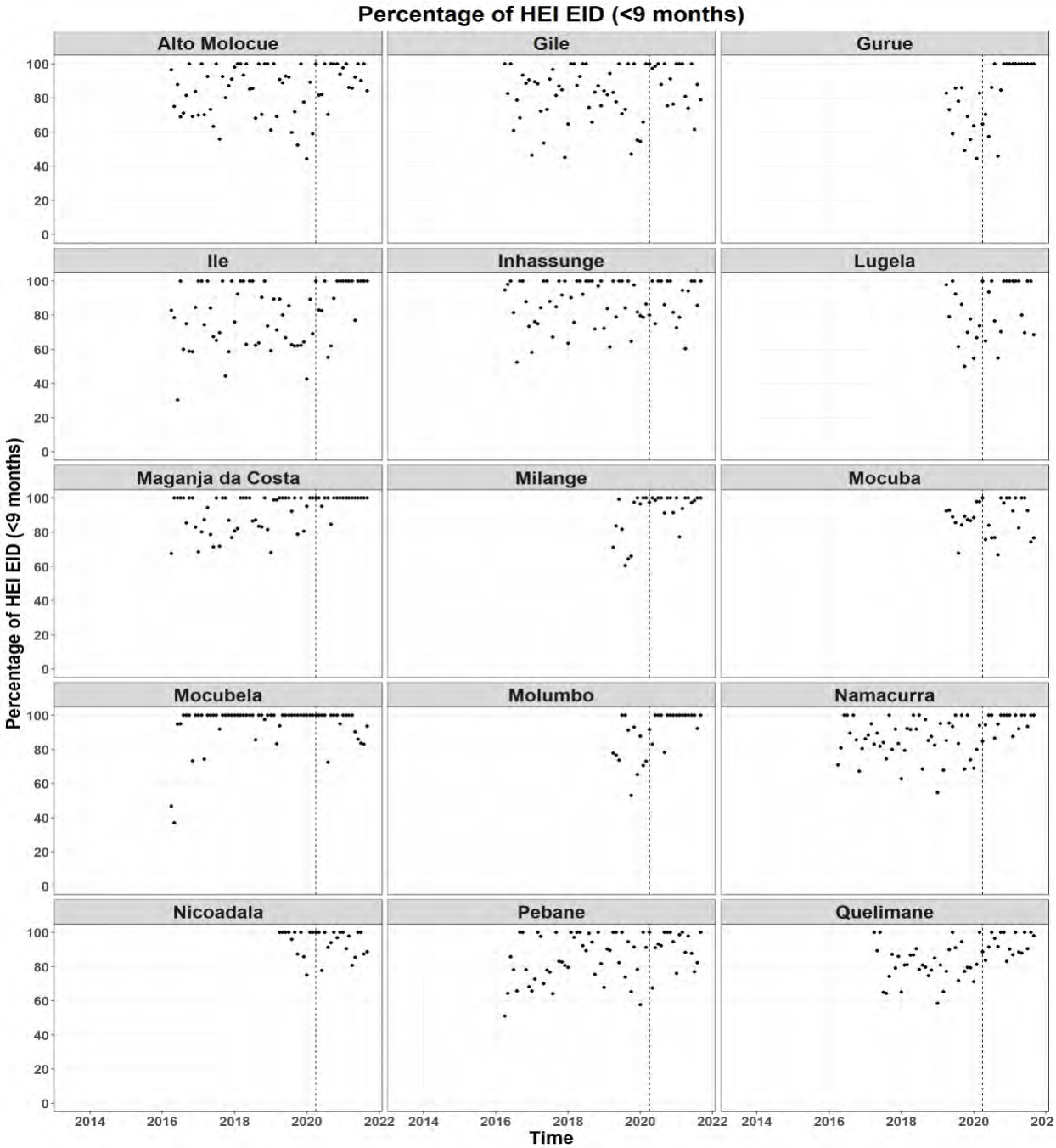

Figure 2b. Percentage of HEI who had a PCR test collected by < 9 months of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Objective 3. Infant HIV DNA PCR Positivity Rate (proxy for vertical transmission)

Table 5. Proportion of HEI testing positive via HIV DNA PCR, by 2 months and 9 months of age, respectively, over time.

District	Positive PCR	Min	Q1	Median	Q3	Max	Mean	SD
Alto Molócuè	< 2 months	0.0	2.2	5.2	10.8	50.0	8.1	9.6
	< 9 months	0.0	3.7	6.5	10.6	29.0	8.3	7.2
Gilé	< 2 months	0.0	4.7	8.0	13.6	100.0	11.4	14.5
	< 9 months	0.0	5.6	10.0	17.3	40.0	11.8	9.2
Gurué	< 2 months	0.0	0.0	2.5	4.1	8.6	2.6	2.8
	< 9 months	0.0	0.0	3.8	6.2	12.3	3.9	3.3
Ile	< 2 months	0.0	3.1	7.7	13.4	55.6	9.3	9.8
	< 9 months	0.0	4.3	7.8	16.3	46.2	11.0	9.7
Inhassunge	< 2 months	0.0	2.6	5.8	8.1	100.0	8.8	13.3
	< 9 months	0.0	3.0	7.5	13.3	81.8	10.5	12.1
Lugela	< 2 months	0.0	3.3	4.7	11.3	33.3	8.0	7.8
	< 9 months	0.0	3.7	6.0	12.8	24.3	8.5	6.8
Maganja da Costa	< 2 months	0.0	3.6	5.6	8.3	43.8	6.9	6.3
	< 9 months	0.9	5.2	8.1	12.4	100.0	10.3	12.0
Milange	< 2 months	0.0	0.8	1.6	2.5	6.5	2.0	1.8
	< 9 months	0.0	1.4	2.1	3.3	16.7	3.2	3.5
Mocuba	< 2 months	1.2	2.7	4.6	6.2	15.0	4.9	2.9
	< 9 months	1.1	4.2	6.2	7.8	20.7	6.5	3.6
Mocubela	< 2 months	0.0	1.7	3.5	5.9	100.0	7.7	17.4
	< 9 months	0.0	2.3	4.7	9.1	100.0	9.7	17.2
Molumbo	< 2 months	0.0	0.0	1.0	4.8	25.0	3.5	6.0
	< 9 months	0.0	0.0	3.8	6.5	20.0	4.8	5.1
Namacurra	< 2 months	0.6	3.1	6.9	10.2	92.0	11.3	15.7
	< 9 months	1.1	3.5	8.6	14.7	75.0	12.9	15.1
Nicoadala	< 2 months	0.0	2.6	3.9	5.2	11.5	4.1	2.3
	< 9 months	1.4	3.5	4.7	5.5	12.7	5.0	2.7
Pebane	< 2 months	0.0	3.2	5.4	8.5	40.0	7.3	7.2
	< 9 months	0.0	4.1	7.3	13.4	100.0	10.6	13.2
Quelimane	< 2 months	0.0	2.2	3.1	4.6	14.0	3.8	2.7
	< 9 months	0.4	2.9	4.0	5.5	25.2	5.3	4.6
All districts	< 2 months	0.0	2.2	4.6	8.3	100.0	7.3	10.6
	< 9 months	0.0	3.1	6.0	11.1	100.0	8.9	10.7

For positivity rates (via HIV DNA PCR test) by < 2 months of age, there was an observable trend of improvement across all districts over time. This improving trend was more distinct in certain districts, namely Maganja da Costa, Mocubela, Molumbo, Namacurra, and Pebane, while there was somewhat fainter improvement seen in the districts of Ile, Gilé, Inhassunge, Alto Molócuè and Lugela. Notably, the districts of Milange, Mocuba, Nicoadala and Quelimane performed consistently well in this indicator from 2019 onward (see **Figure 3a** below).

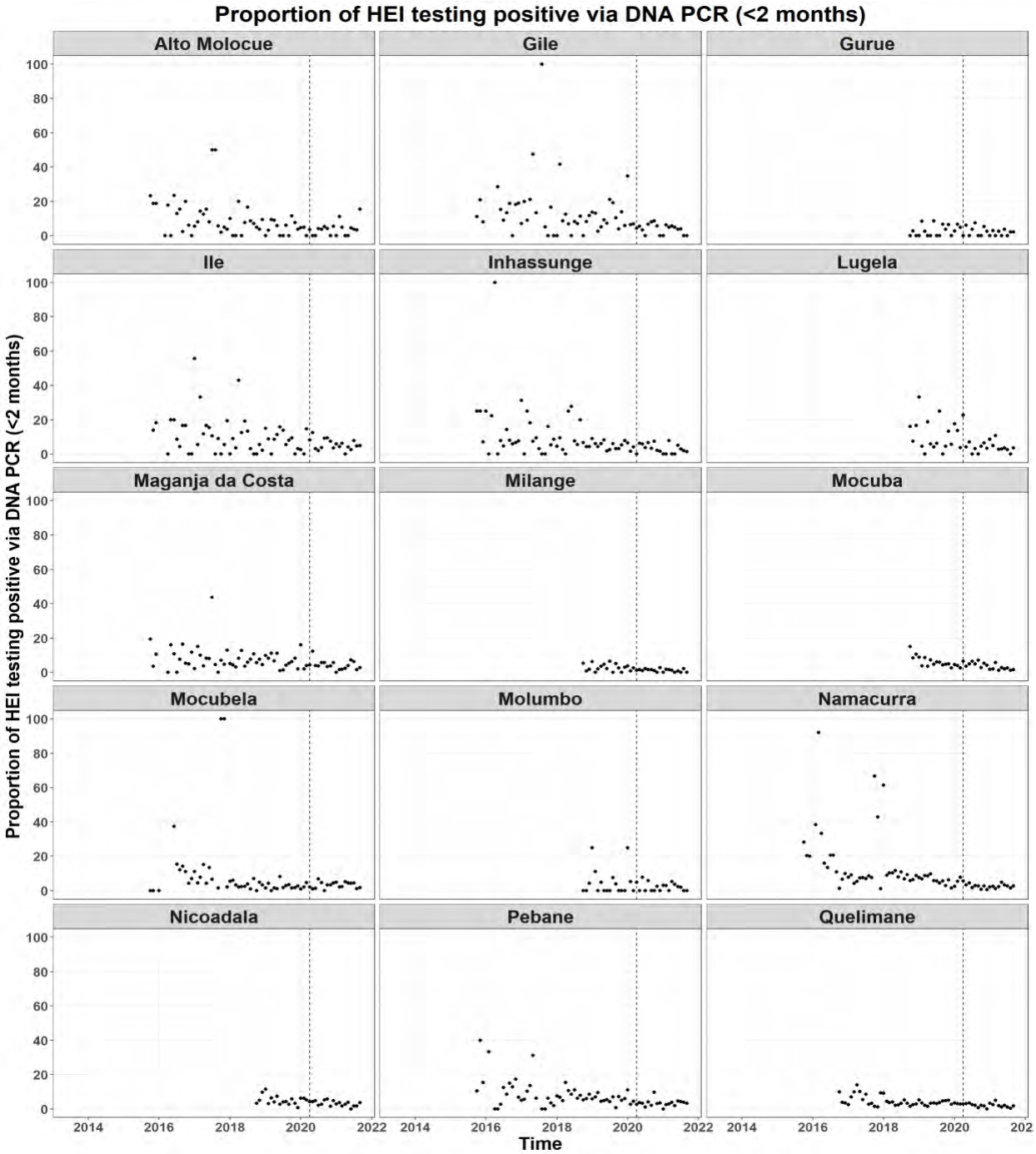

Figure 3a. Percentage of HEI testing HIV-positive (via DNA PCR) by < 2 months of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

For positivity rates (via HIV DNA PCR test) by < 9 months of age, there was an observable trend of improvement seen for all districts over time. These trends were similar to those seen for the positivity rate by < 2 months of age, with certain districts performing strongly since prior to 2019, namely Quelimane, Nicoadala, Mocuba, Milange and Namacurra (see **Figure 3b** below).

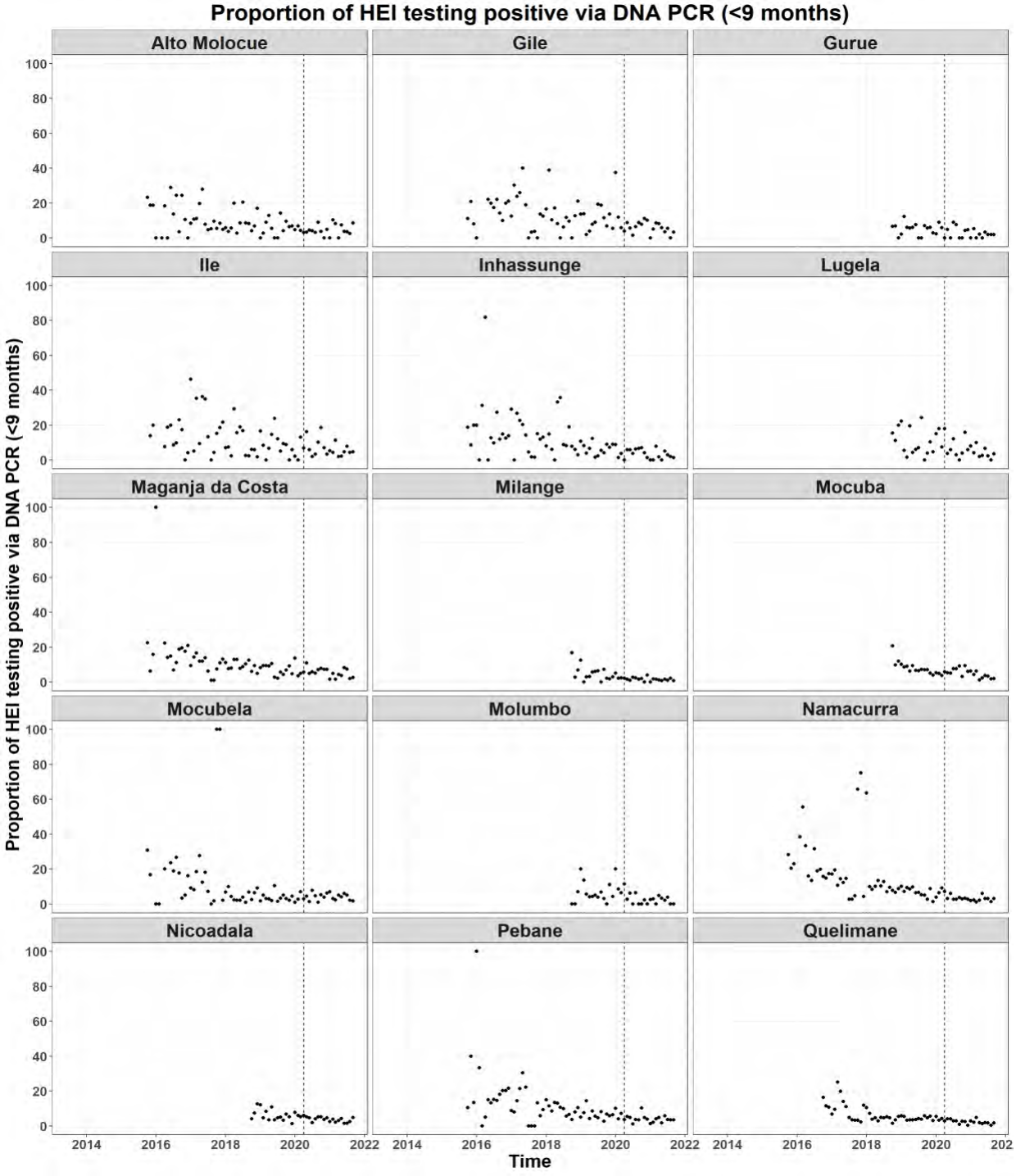

Figure 3b. Percentage of HEI testing HIV-positive (via DNA PCR) by < 9 months of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Objective 4. Retention in care rates

1-month Retention

Table 6. 1-month retention percentages, overall for entire cohort and by group, per district, and for all districts, over time.

District	Group	Min	Q1	Median	Q3	Max	Mean	SD
Alto Molócuè	Overall	14.7	47.2	58.1	81.1	93	62	19.2
	PW	11.8	47.8	64.5	79.7	100	63.8	22.1
	Non PW	12.5	50	66.7	80.8	92.1	63.6	19.7
	Men	12.5	44.1	60	79.8	100	61.3	22.5
Gilé	Overall	19.7	42.1	49.1	79.7	92.7	57.4	20.5
	PW	14.3	45.7	58.8	78	100	60.7	21.3
	Non PW	29.4	40	53.4	79.3	100	58.5	21.5
	Men	11.1	33.9	44.2	78.6	94.8	53.9	23.9
Gurué	Overall	46.3	77	82.6	89.3	97.2	81.8	10.4
	PW	55.6	78.9	87.5	93.7	100	85	11.1
	Non PW	44.4	71.4	82.4	91.1	100	80.7	12.9
	Men	33.3	76	85	89.8	100	81.7	13.5
Ile	Overall	34.8	47.7	54.9	67.8	96.8	58.8	14.5
	PW	10.5	47.2	56.9	68.7	100	58.9	17.9
	Non PW	24.3	47.5	56.6	68	100	59.1	15.3
	Men	31.2	44.8	53.6	72.2	100	58.7	17.3
Inhassunge	Overall	5.6	39.2	50	72.1	91	52.1	21
	PW	5.4	43	58.3	74.3	95.8	57.1	22.2
	Non PW	13.3	36.4	52.5	69.8	100	53.4	20
	Men	4.3	35.3	47.5	69.3	91.4	50.5	21.2
Lugela	Overall	44.3	61.4	72.7	80.2	94.7	69.9	13.7
	PW	43.8	71.4	78.3	85.4	100	75.5	15.6
	Non PW	35.3	56.3	71.1	82.9	93.3	68.3	16
	Men	35	58.1	71	83	96.9	69	17.4
Maganja da Costa	Overall	15.4	39.3	45.5	68.1	90.7	52.8	18.3
	PW	18.6	42.6	51.8	71.6	91.8	56.1	18.8
	Non PW	15	37.7	45.7	64.7	94.5	51.8	18.4
	Men	7.7	37.8	47	67.8	91	52	20.7
Milange	Overall	67.8	81.9	87.8	90.4	95.4	85.6	6.9
	PW	62	84	88.7	92.3	100	87.9	7.2
	Non PW	65	78.3	84.7	90	95.2	83.8	8.4
	Men	72.3	81.9	88.2	90.7	96.8	86.1	6.8
Mocuba	Overall	56.3	69.8	78.9	85.2	91.6	77.2	9.6
	PW	60.4	74.4	81.2	87.3	92.6	80.1	8.6
	Non PW	50.8	67.7	82.2	84.2	89	76.2	10.6
	Men	53.6	68	75.9	84.6	93.7	76.3	11
Mocubela	Overall	15.7	43.7	55.5	66.8	85.9	55.2	15.3
	PW	19.1	44.8	59.5	71.2	100	58.4	18.7
	Non PW	14.6	43.4	54.8	67.6	86.1	55.3	15.4
	Men	8	43.9	54.4	64.7	83.6	54.2	15.8
Molumbo	Overall	50.6	65.6	72.1	79.2	87.8	71.8	10
	PW	41.7	59.1	73.3	88.2	100	73.9	16.6

	Non PW	31.6	66.3	72.7	79	95.7	71	12.3
	Men	43.2	65	71.1	80.6	95.5	72.3	11.8
Namacurra	Overall	33	45.8	52.1	64.6	85	55.3	12.8
	PW	29.4	46.4	55.2	66.7	87.3	57.1	13.9
	Non PW	27.6	47	55.2	64.4	88	56.4	12.6
	Men	26.1	43.2	49.6	63.9	90.3	53.3	14.8
Nicoadala	Overall	46.7	69.2	76.9	84.6	94.2	76.2	11.7
	PW	61.1	73.7	82.8	88	98.5	80.8	10.1
	Non PW	42.4	68.7	76.4	86.7	94.4	75.6	12.4
	Men	50	66.4	75.4	83.4	94.9	75.1	12.3
Pebane	Overall	31.5	47.2	54	62.4	81.2	54.7	11.1
	PW	23.7	47.1	57.2	65.9	90.9	56.2	13.3
	Non PW	28.1	49.1	55.9	64	82.3	56.3	11.3
	Men	24	44	51.3	61.3	79.4	52.6	12.2
Quelimane	Overall	29.5	46.2	56.5	64.9	85.3	57.7	13.7
	PW	26.1	41.8	63	78.4	96.7	61	19.5
	Non PW	34	49.5	58.8	67.6	86.6	59.3	12.9
	Men	28.6	46.7	54.3	63.7	83.7	55.7	13.8
All districts	Overall	5.6	46.3	58.0	76.3	97.2	60.2	17.9
	PW	5.4	47.7	63.0	79.6	100.0	63.0	19.9
	Non PW	12.5	47.0	59.3	75.9	100.0	60.7	17.9
	Men	4.3	43.1	58.3	75.0	100.0	58.9	19.8

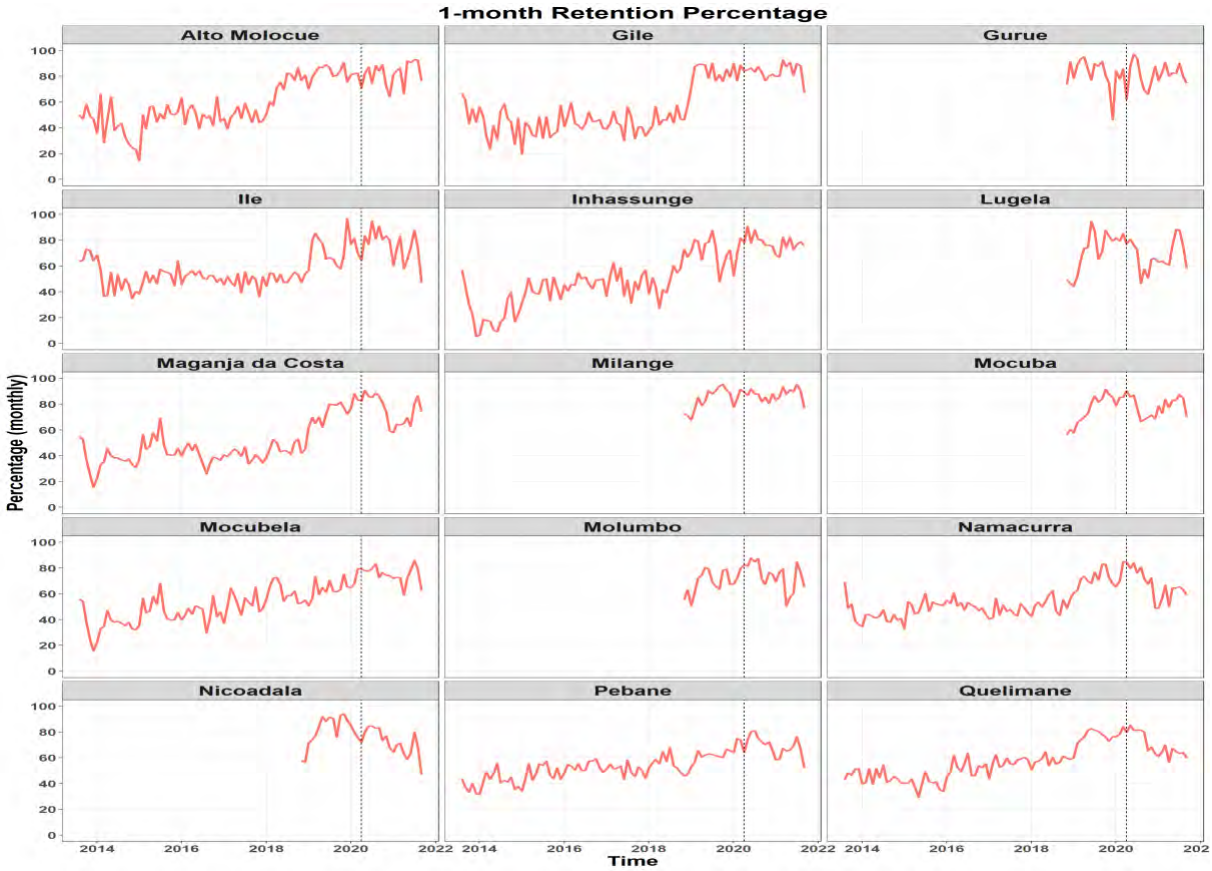

Figure 4. Percentage of patients retained at 1-month, for entire cohort, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

For 1-month retention, there was a modest observable trend of improvement for all three groups, in all districts, till the start of COVID-19 mitigation measures (see **Figure 5** below). After April 2020, improvement seemed to stagnate in some districts (Alto Molócuè, Gilé, Gurué, Milange) and in others there was worse performance among all three groups (Maganja da Costa, Namacurra, Nicoadala, Pebane and Quelimane) through the end of the evaluation period. The three groups had similar 1-month outcomes throughout the period in Milange, Mocuba, Mocubela, Namacurra, Nicoadala, Pebane and Quelimane districts, with slightly more variability seen among the groups in Alto Molócuè, Gilé, Ile and Inhassunge.

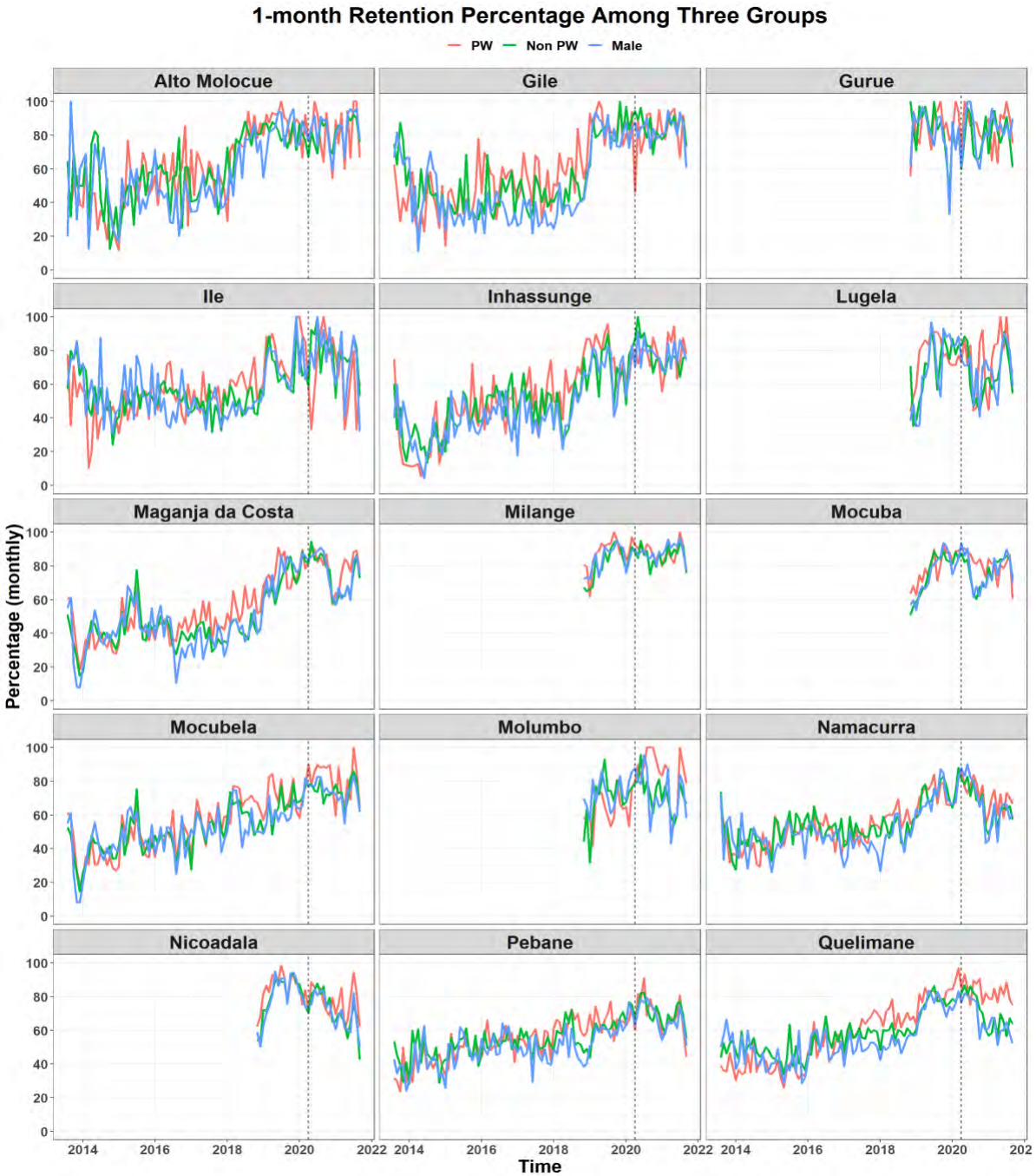

Figure 5. Percentage of patients retained at 1-month, by group (PW, non-PW, men), over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Further disaggregating to look at 1-month retention percentages among individuals 15-24 years of age, there was a very modest trend of improvement across all three groups, in almost all districts, over time (see **Figure 6a** below). In Nicoadala district, there was a short-term trend of improvement seen, but this was not sustained. Generally speaking, over the period, PW seemed to perform slightly better non-PW and men in 1-month retention in this age category, and men had the greatest variability of the three groups. (Please see **Table S5** in **Appendices** below for 1-month retention percentages among all three groups by age.)

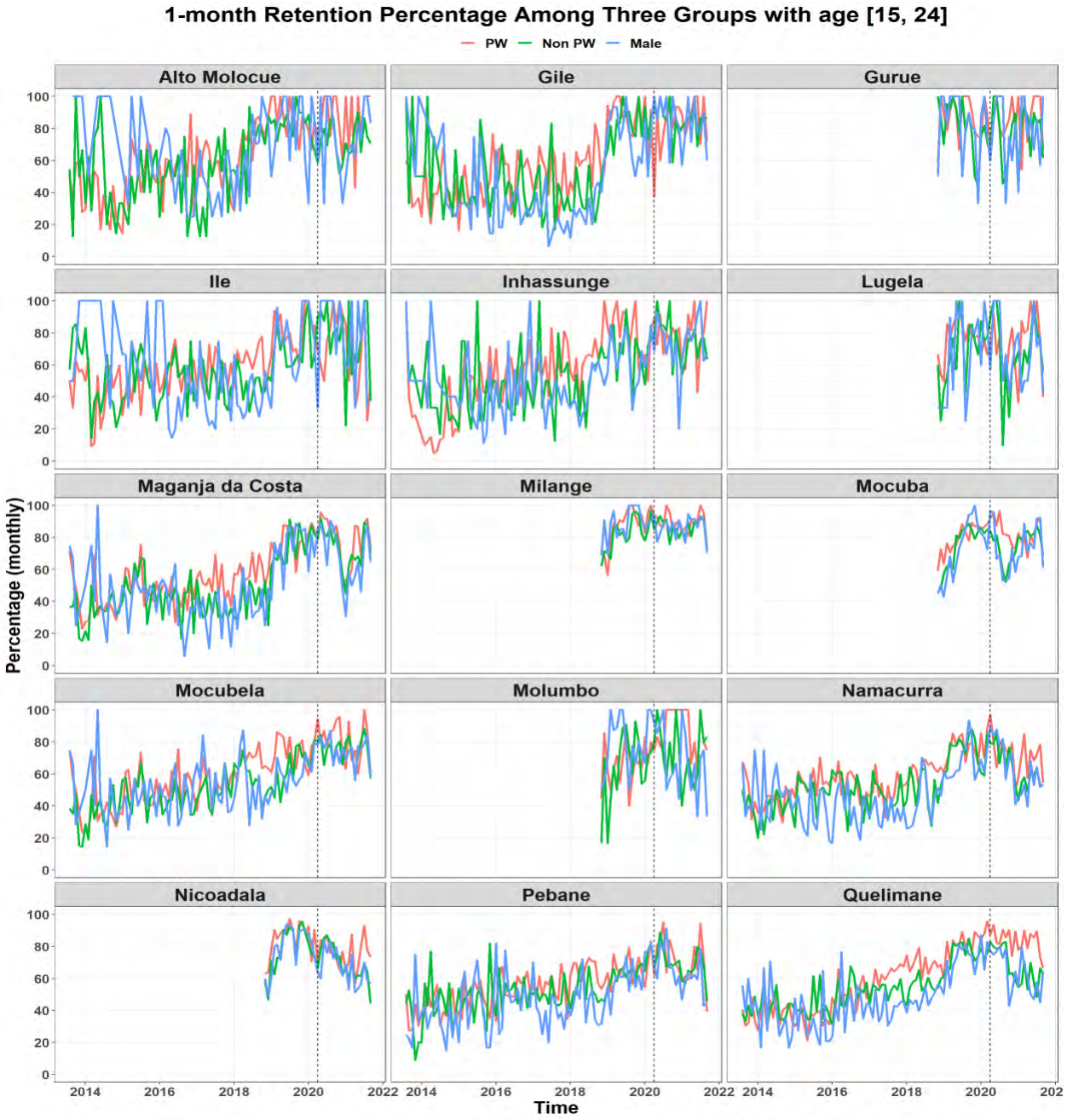

Figure 6a. Percentage of patients retained at 1-month, by group (PW, non-PW, men), among those 15-24 years of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

With regard to 1-month retention percentages among individuals 25-34 years of age (see **Figure 6b** below), there was a modest observable trend of improvement across all three groups, in all districts, over time, however after COVID-19 mitigation measures were put in place the improvement trend slowed or reversed in several districts, namely Maganja da Costa, Mocuba, Namacurra, Nicoadala, Pebane and Quelimane. Notably, there was much less variability (i.e., greater similarity) seen in 1-month retention proportions among the three groups in the districts of Milange, Mocuba, Namacurra, Nicoadala, Pebane, and Quelimane.

Figure 6b. Percentage of patients retained at 1-month, by group (PW, non-PW, men), among those 25-34 years of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Looking at 1-month retention percentages among individuals 35-49 years of age, there was a modest trend of improvement seen across all three groups, in all districts, through the start of the COVID-19 mitigation measures (see **Figure 6c** below). After April 2020, most districts saw stagnating 1-month outcomes for all groups, and in Nicoadala, Namacurra and Quelimane districts non-PW and men had trends of decreasing 1-month retention outcomes after this time. There was much variability seen in indicator performance for all groups, however this was especially true among PW.

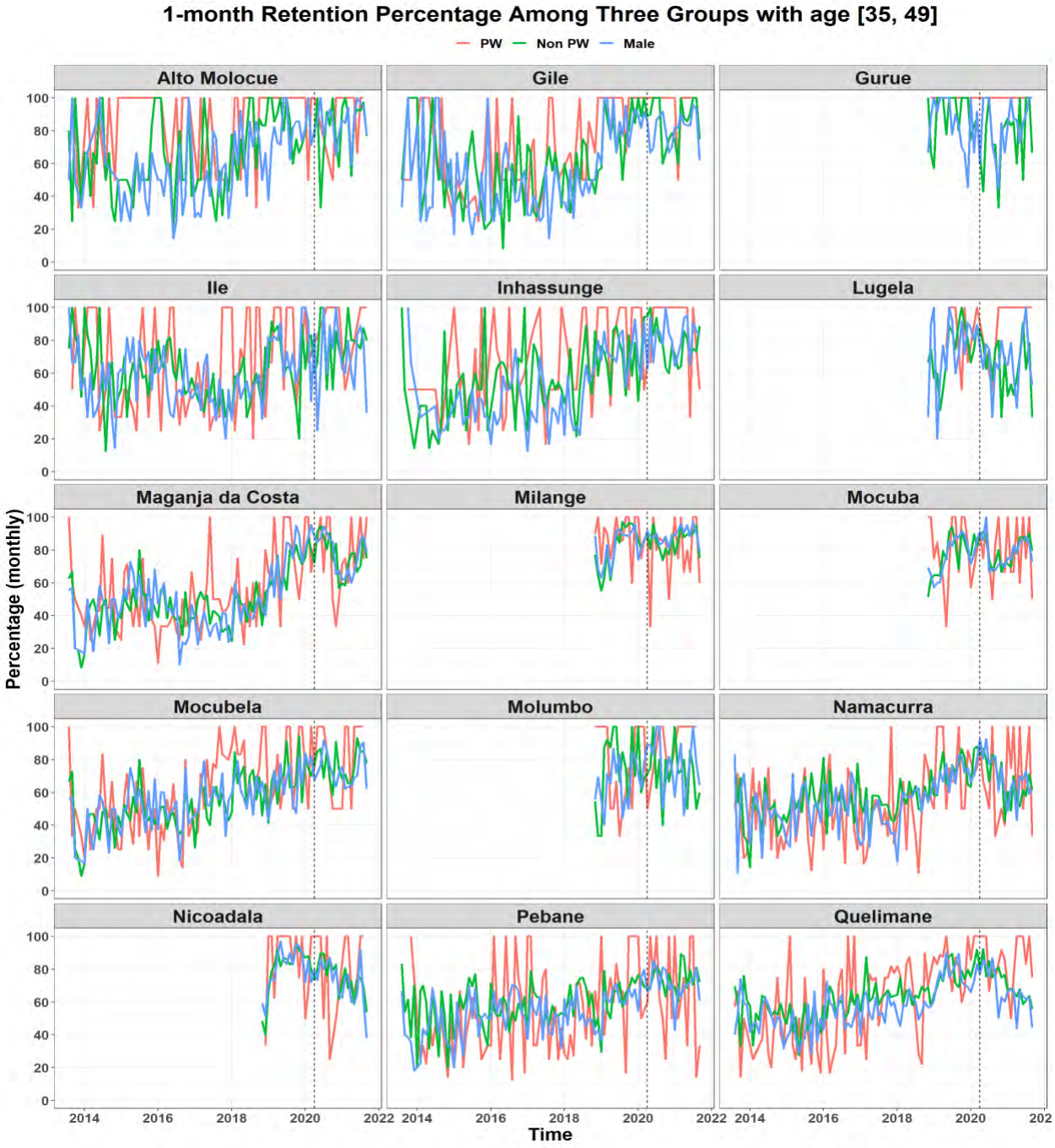

Figure 6c. Percentage of patients retained at 1-month, by group (PW, non-PW, men), among those 35-49 years of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Model results comparing 1-month retention across groups

Overall, the monthly 1-month retention proportions for each group increased along time till April 2020 (from approximately 40% to 80% for PW, from approximately 48% to 78% for non-PW, and from approximately 51% to 78% for men) (**Figure 7**). From then on there was a downward trend till the endpoint of the evaluation period (September 2021), potentially related to the COVID-19 outbreak and mitigation measures in place starting April 2020 in Mozambique.

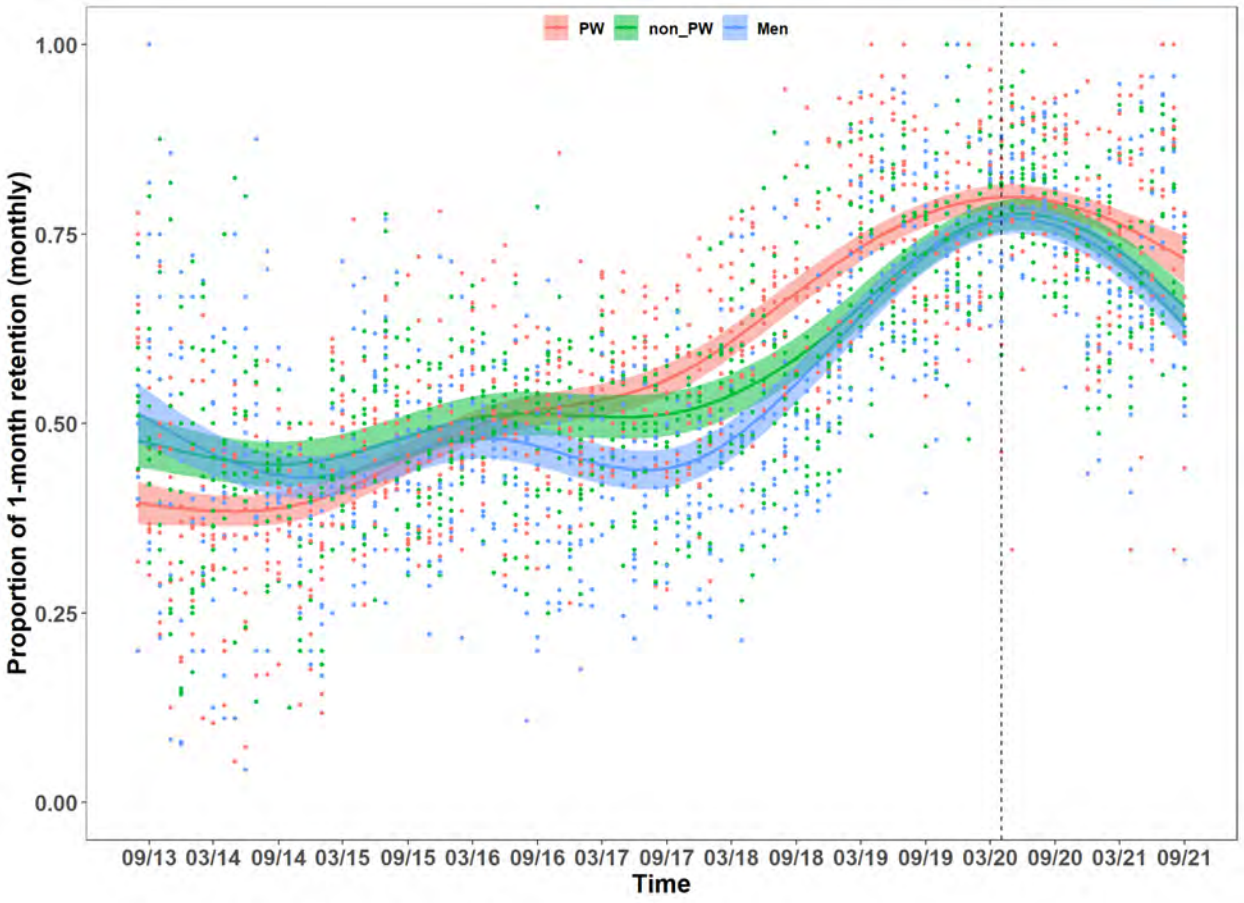

Figure 7. Comparison of 1-month retention proportions among the three groups. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

3-month Retention

Table 7. 3-month retention percentages, overall for entire cohort, and by group, per district, and for all districts, over time.

District	Group	Min	Q1	Median	Q3	Max	Mean	SD
Alto Molócuè	Overall	5.1	20.2	30.6	49.6	85	35.5	19.5
	PW	4.8	19	31.3	51.7	83.3	35.9	21
	Non PW	5.3	19.4	35.6	50.8	85.9	37.7	20.8
	Men	5	18.8	34	53.6	86.2	37.4	21.2
Gilé	Overall	9.1	19.1	26.5	53.9	69.9	33.8	18.5
	PW	2.4	20.4	30	45	81.8	34.8	19.8
	Non PW	5.9	19.7	28.6	58.2	80.6	35.7	20.6
	Men	4.2	16.7	27.3	50.7	73.9	32.5	19.3
Gurué	Overall	34.4	46.7	62	71.7	90.4	60.3	15.3
	PW	33.3	46.7	62.5	75	100	62.2	17.6
	Non PW	27.8	42.4	60	73.3	100	60.7	19.1
	Men	28	46.4	57.1	76	94.7	60.2	19.3
Ile	Overall	15.5	26.1	32.1	40.7	64.4	34.2	10.9
	PW	6.9	21.2	33.3	45.5	100	35.4	17.9
	Non PW	9.1	28.6	34	40.5	72.7	35.6	13.1
	Men	8.1	23.5	31.8	41	70.6	33.4	13.3
Inhassunge	Overall	1.9	24.3	31.1	43.5	68	32.2	14.7
	PW	2.7	21.9	36.7	50	86.7	37.2	20.1
	Non PW	5.3	24.6	33.9	44.4	65.3	33.9	14.7
	Men	3.7	20.9	28.1	40.9	73.6	30.9	13.8
Lugela	Overall	11.5	33.3	44.4	54.8	89.3	44.9	16.4
	PW	10	35.3	42.9	63.2	85	48.1	19.6
	Non PW	11.5	36.2	45	55.6	91.7	46.3	18.3
	Men	12.5	30.2	42.9	50	93.5	42.1	17.6
Maganja da Costa	Overall	5.8	19.4	26.7	38.6	80.1	31.4	17.2
	PW	6.3	20	27.5	46.5	85	34.5	18.4
	Non PW	2.9	18.8	26.5	40.8	75.9	31	17.7
	Men	4.8	19.5	27.1	39	82.1	31.4	18.4
Milange	Overall	28.8	47.3	55.8	70.1	81.7	57	15.7
	PW	26.3	53.5	64.3	70.7	89.7	62.4	14.4
	Non PW	25.2	42.7	56.7	68.4	83.5	56	16.2
	Men	26.8	40.7	55.1	68.2	81.9	55.7	16.6
Mocuba	Overall	33.7	39.2	46.5	54.7	63.2	47.3	9.3
	PW	19.4	49.3	56.8	60.6	73.8	53.9	11.3
	Non PW	28.3	39.7	45.6	55.2	63.2	46.5	9.7
	Men	27.2	37.2	44.1	51.8	61.8	44.6	9.6
Mocubela	Overall	5.8	21.3	32.1	45.1	61.9	33.1	14.2
	PW	5.5	22.4	36.2	53.3	79.2	37.4	18.4
	Non PW	3.2	20	33.7	47.1	65.6	33.7	15.9
	Men	5	22.8	31.2	40.7	62.2	31.9	12.8
Molumbo	Overall	35.1	45.7	53.3	61.9	71.9	53.3	9.7
	PW	7.1	34.8	51.9	75	100	54.6	22.9

	Non PW	27.3	42.5	53.6	61.9	85.7	53.9	14
	Men	34.8	41.9	50	62.1	87.2	52.6	13.1
Namacurra	Overall	11	26.4	31.5	37.5	55.1	31.6	9
	PW	7	23.8	31.5	42.1	62.5	32.8	13.5
	Non PW	13.6	29	34.5	40.5	56.9	34.4	9.1
	Men	12.5	23.6	30.2	34.5	52.9	29.4	8.3
Nicoadala	Overall	16	30.9	39.3	54.9	71	42.2	13.7
	PW	12.9	41.2	51.4	59.2	81.2	51.2	14.8
	Non PW	17.6	31.2	38	52.7	71.1	41.7	13.9
	Men	15.2	29.7	36.5	48.1	66.2	39.3	13.6
Pebane	Overall	11	28.1	35	42.3	55.1	34.6	10.1
	PW	4.8	23.6	35.5	46.7	60	35.1	14
	Non PW	11.1	30.3	37.2	43.7	58.5	37	10.2
	Men	3.1	26.6	33.1	40	53.7	32.9	10.4
Quelimane	Overall	13.9	26.9	38.5	43.3	67.1	36.5	12.4
	PW	11	22.9	42.6	58	76.6	41.3	20
	Non PW	17	29.8	38.6	45.4	68.4	38.2	11.7
	Men	8.7	27.3	33.7	38.7	64.7	33.5	11.3
All districts	Overall	1.9	25.3	34.9	46.9	90.4	36.9	16.1
	PW	5.4	47.7	63.0	79.6	100.0	63.0	19.9
	Non PW	12.5	47.0	59.3	75.9	100.0	60.7	17.9
	Men	4.3	43.1	58.3	75.0	100.0	58.9	19.8

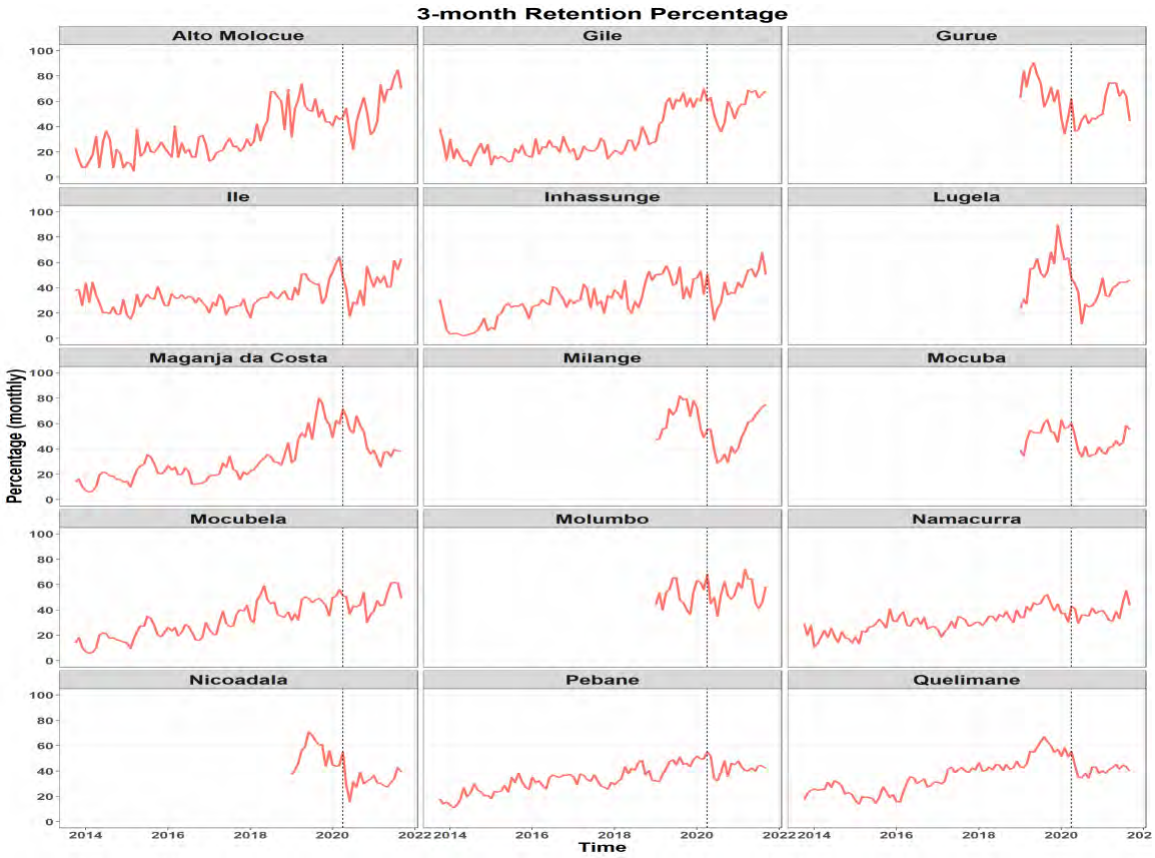

Figure 8. Percentage of patients retained at 3-months, for entire cohort, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

For 3-month retention, there was a modest observable trend of improvement for all three groups, in most districts, till the start of COVID-19 mitigation measures (see **Figure 9** below). At the start of 2020, improvement seemed to stagnate in more than half the districts (including Gilé, Ile, Mocuba, Mocubela, Molumbo, Namacurra, Pebane) and in other districts there was worse performance among all three groups seen directly after the start of COVID-19 (Alto Molócuè, Gurué, Inhassunge, Lugela, Maganja da Costa, Milange, Nicoadala, and Quelimane), though in a few districts there were signs of rebounding improvement near the end of the evaluation period. The three groups had similar 3-month outcomes throughout the period, with slightly more variability seen among the groups in Alto Molócuè, Gilé, Ile, Inhassunge, Mocubela, Molumbo and Quelimane.

Figure 9. Percentage of patients retained at 3-months, by group (PW, non-PW, men), over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Further disaggregating to look at 3-month retention percentages among individuals 15-24 years of age, there was an observable trend of improvement across all three groups, for most districts (with the exception of Gurué, Molumbo and Nicoadala), over time, for all groups. Improving trends seemed to be impacted by COVID-19. relatively consistent finding across groups, with greatest variability seen for men in this age category (see **Figure 10a** below). (Please see **Table S6** in **Appendices** below for 3-month retention percentages among all three groups by age.)

Figure 10a. Percentage of patients retained at 3-months, by group (PW, non-PW, men), among those 15-24 years of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

With regard to 3-month retention percentages among individuals 25-34 years of age (see **Figure 10b** below), there was a modest observable trend of improvement across all three groups, for most districts (with the exception of Gurué and Nicoadala), over time. Improving trends seemed to be impacted by COVID-19. relatively consistent finding across groups, with greatest variability seen in this age category for non-PW (and PW following COVID-19 pandemic start).

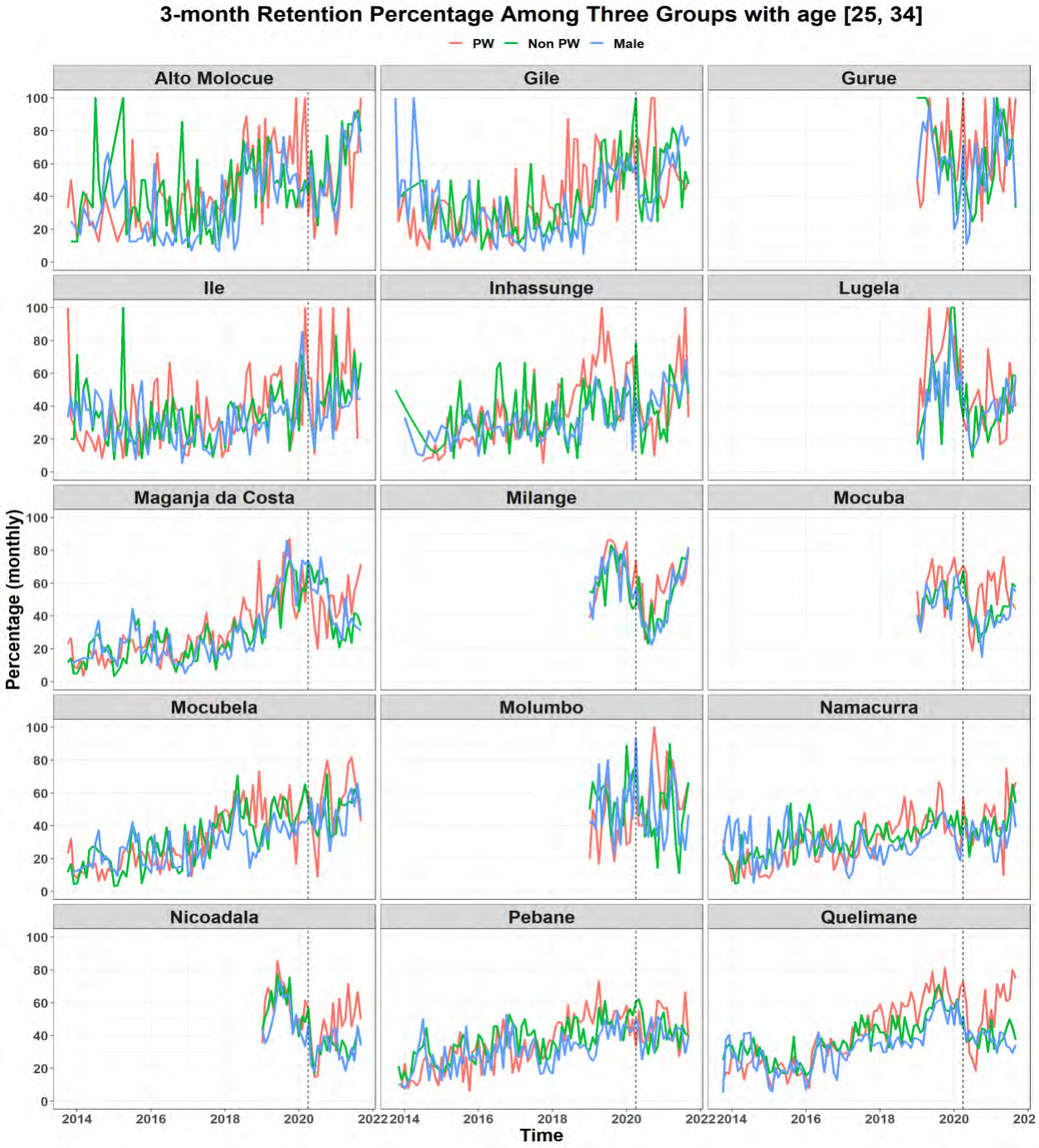

Figure 10b. Percentage of patients retained at 3-months, by group (PW, non-PW, men), among those 25-34 years of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Looking at 3-month retention percentages among individuals 35-49 years of age, there was a modest trend of improvement seen across all three groups (especially non-PW and men), in all districts (with the exception of Gurué and Nicoadala), over time (see **Figure 10c** below). Improving trends seemed to be impacted by COVID-19. Relatively consistent finding across groups, with greatest variability seen in this age category for PW.

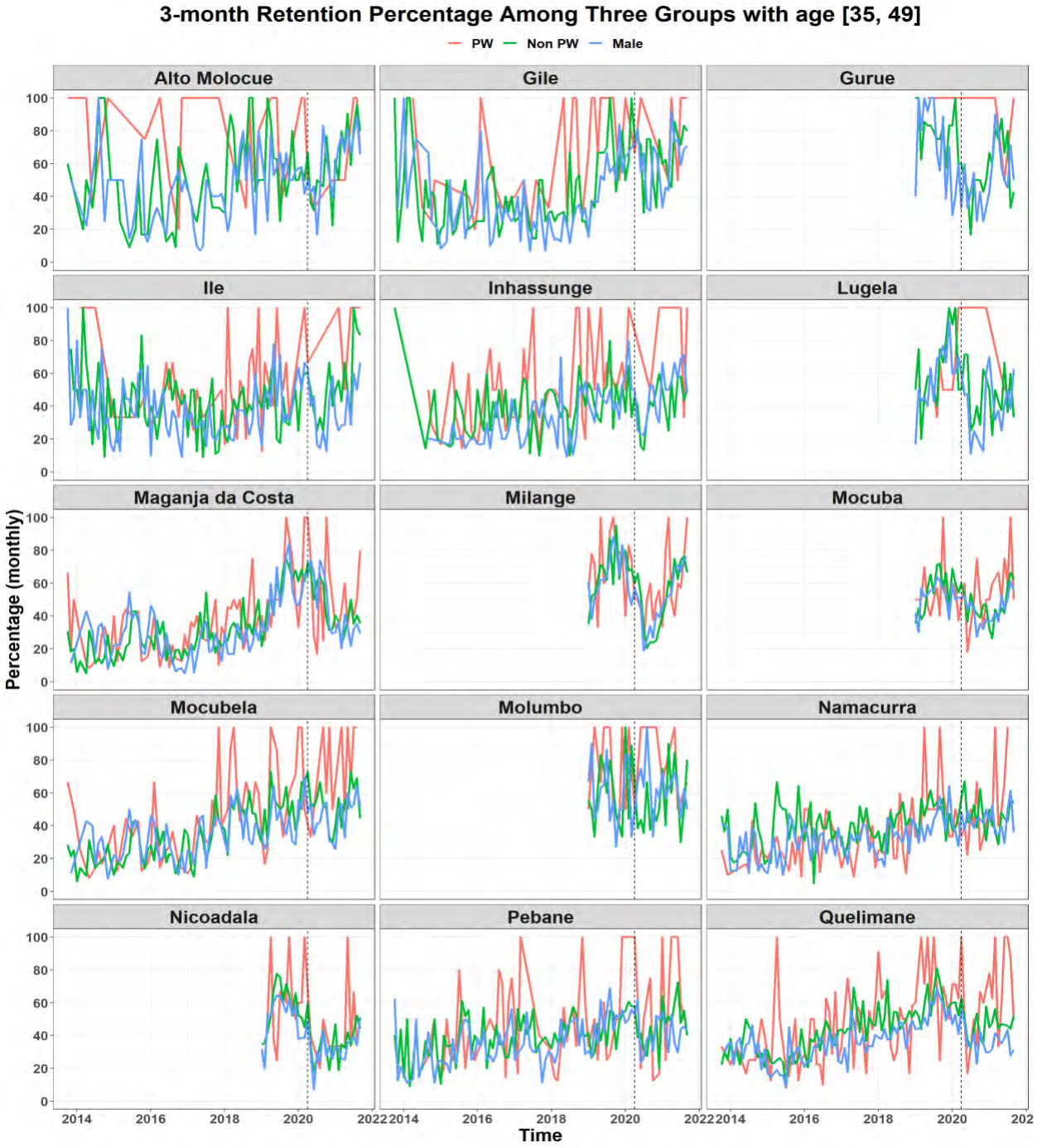

Figure 10c. Percentage of patients retained at 3-months, by group (PW, non-PW, men), among those 35-49 years of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Model results comparing 3-month retention across groups

Overall, the monthly 3-month retention proportions for each group increased along time (from approximately 15% to 60% for PW, from approximately 23% to 46% for non-PW, and from approximately 28% to 42% for men). The 3-month retention proportion for PW was lower than that for non-PW and men before 2016. It gradually caught up and was comparable with that for non-PW and men till later 2017 and became greater than that for non-PW and men from 2018.

From this plot (see **Figure 11** below), it appears that 3-month retention proportions for non-PW and men did not show noticeable trend and level change before and after COVID-19 mitigation measures were in place, but the proportion for PW changed from a downward trend to an upward trend around April 2020 when the COVID-19 measures began in Mozambique.

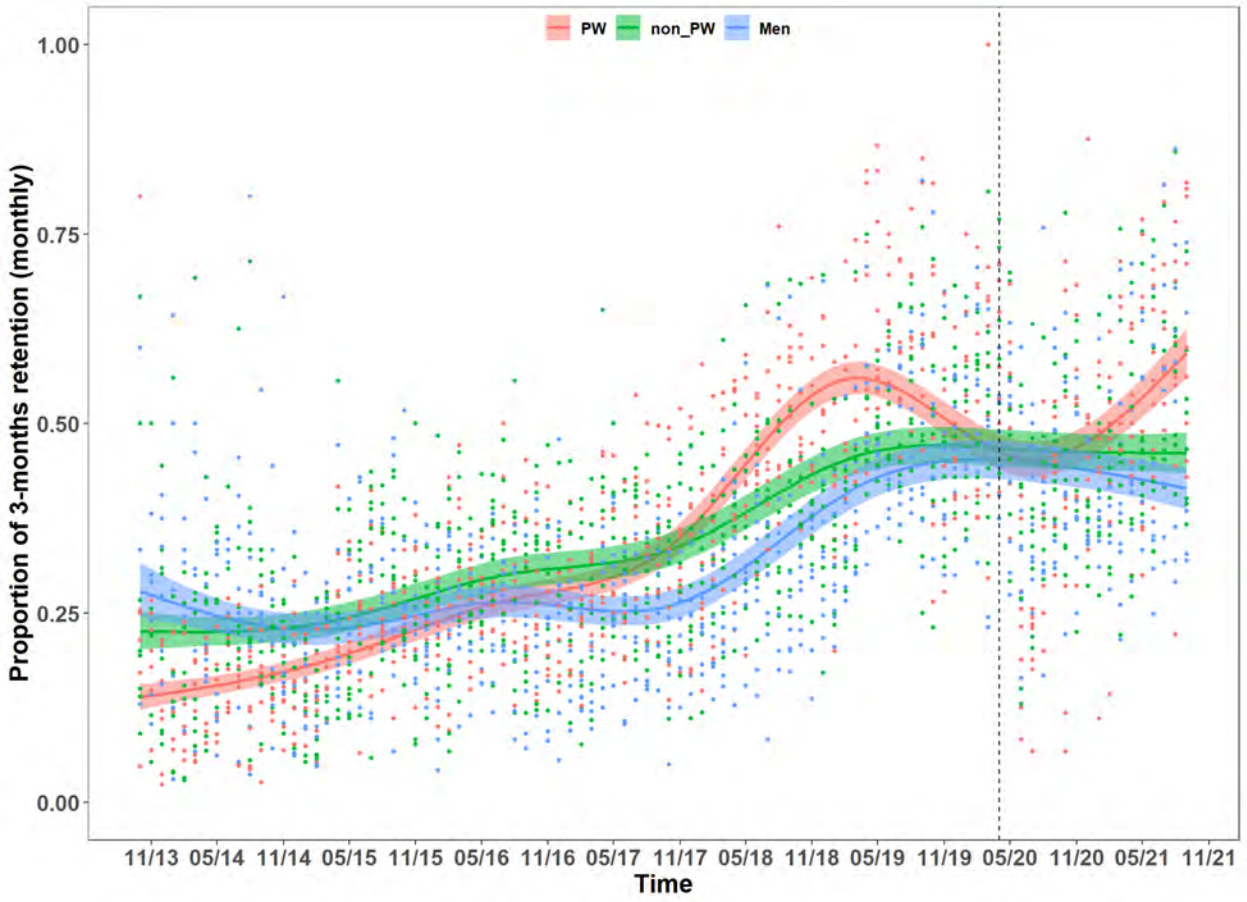

Figure 11. Comparison of 3-month retention proportions among the three groups. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

6-month Retention

Table 8. 6-month retention percentages, overall for entire cohort, and by group, per district, and for all districts, over time.

District	Group	Min	Q1	Median	Q3	Max	Mean	SD
Alto Molócuè	Overall	17.4	57.3	69	87.1	100	69.3	18.5
	PW	10	53.8	72.2	88.9	100	71.5	21.5
	Non PW	10	60	74.1	87	100	71.3	19.9
	Men	16.7	48.4	65.4	84.6	100	65.3	21.4
Gilé	Overall	33.3	60.5	66	81.3	99	70	15.4
	PW	35.3	60.5	75	88	100	73.2	17.6
	Non PW	37.5	60	70.5	83.8	100	72.4	15.1
	Men	22.2	53.6	64.7	78.1	97.9	66.3	18.1
Gurué	Overall	79.2	87.6	92.2	95.9	97.2	91	5.5
	PW	66.7	85.7	91.1	94.4	100	89.8	8.6
	Non PW	80	86.8	92.4	96.1	100	91	6.4
	Men	78.8	87.8	91.8	96.3	100	91.9	6
Ile	Overall	37.4	56.2	64.6	80.1	96.9	67.5	15.3
	PW	11.1	52.3	66.7	85.7	100	67.9	19.5
	Non PW	31.2	60	70.6	82.4	100	70.6	15.9
	Men	29.2	54	62.5	77.8	100	64.8	16.5
Inhassunge	Overall	5.9	58.9	69.5	79.2	98.9	67.3	20.5
	PW	5.3	65.5	80	90.9	100	74.6	22.5
	Non PW	9.1	58.5	72	82.6	100	68.9	20
	Men	14.3	47.7	64.2	76	100	62.2	21.7
Lugela	Overall	59.7	74.7	78.1	81.6	90.5	77.1	7.7
	PW	50	71.7	83.3	88.2	100	80.6	13.1
	Non PW	60.7	77.1	81.6	86.8	96.4	81.2	8.4
	Men	46.4	62.6	72.4	79.9	90	71.4	11.2
Maganja da Costa	Overall	29.6	55.6	67.9	84.9	98.2	68.8	19
	PW	29.9	55.5	74.1	91	100	72.2	21.5
	Non PW	27.9	58.6	69	83.3	98.6	69.6	18.7
	Men	25	53.5	66.1	83.8	99.2	66.4	20.3
Milange	Overall	68.7	88.2	90.6	94.6	97.4	90.5	6
	PW	66.7	90.6	93.2	96.3	100	92.5	6.6
	Non PW	66.7	86.7	90.2	95	98.1	89.9	6.8
	Men	71.8	87.6	92	94.3	96.8	90	6.1
Mocuba	Overall	64	80.2	84.3	91.1	94.9	84.6	7.4
	PW	71.8	85.8	89.6	91.7	97	88.2	6
	Non PW	65.4	80.7	85.4	90.8	95.1	84.4	8.1
	Men	58.2	78.1	82.7	89.9	94.3	82.6	9.1
Mocubela	Overall	32.5	57.7	73.9	85.5	97.2	70.9	18.5
	PW	29.9	53.3	79.1	90.6	100	72.8	22
	Non PW	26.8	61.4	75.4	88.4	96.9	72.9	17.4
	Men	26.1	58	71.5	82.7	96.4	69	18.6
Molumbo	Overall	66.7	84.1	93.3	97.1	100	89.6	9.8
	PW	50	81	96.2	100	100	88.9	14
	Non PW	70	84.3	95.4	97.4	100	90.6	9.4
	Men	67.9	81.3	93.1	96.9	100	90	9.6
Namacurra	Overall	35	61.8	67.1	77.2	94.1	67.9	13.6
	PW	31.4	58.8	72.7	83.9	98.2	70.8	16.8
	Non PW	33.3	63.7	71.1	78.8	94.6	70.6	12.4

	Men	30.4	53.3	61.3	74.1	94.2	63.5	14.7
Nicoadala	Overall	67.9	77.3	85.2	92.3	98.6	84.5	9.4
	PW	80	85.7	90.8	94.5	100	90.6	5.3
	Non PW	64.9	76.6	85.4	91.8	99.5	84.3	9.5
	Men	62.3	75.6	83.7	92.9	98.1	82.4	11.3
Pebane	Overall	37.1	63.8	71.6	77.8	92.6	69.8	12.8
	PW	28	62.5	74.2	83.3	97.1	72.1	15.4
	Non PW	34.4	67.4	75.3	81	95.3	73.3	13
	Men	11.1	57.9	66.2	73.8	89.9	64.8	13.9
Quelimane	Overall	41.2	54.2	68	77.9	89	66.9	13.8
	PW	29.9	50.9	77.2	86.7	98.8	70	19.3
	Non PW	43.2	58.5	70	77.5	89.3	68.5	12.5
	Men	35.7	54.7	66	74.9	87.9	64.3	13.3
All districts	Overall	5.9	61.2	72.2	86.1	100.0	71.8	16.9
	PW	5.3	60.7	79.7	90.2	100.0	74.6	19.4
	Non PW	9.1	64.3	75.0	86.7	100.0	73.7	16.5
	Men	11.1	55.7	67.9	84.1	100.0	68.6	18.5

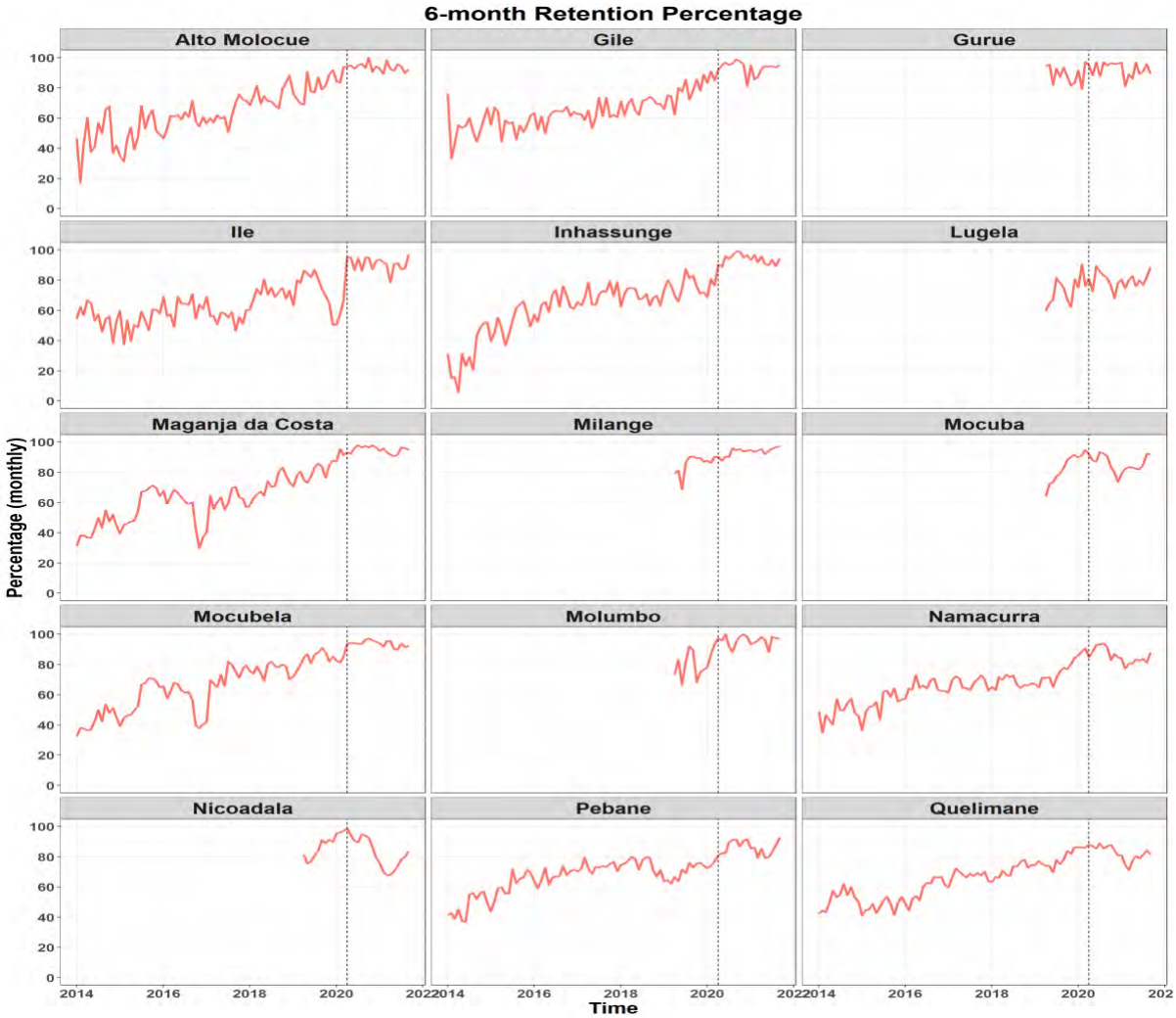

Figure 12. Percentage of patients retained at 6-months, for entire cohort, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

There was an observable trend of improvement in 6-month retention for all three groups, in all districts, over time (see **Figure 13** below). Across the evaluation period, PW continued with higher 6-month retention proportions than non-PW or men, despite some variability seen after COVID-19 pandemic began. Men consistently performed worse in this period, having lower 6-month retention compared to PW or non-PW, however their 6-month retention rates have been improving and approaching those of non-PW, especially since early 2020 and after COVID-19 mitigation measures were put in place.

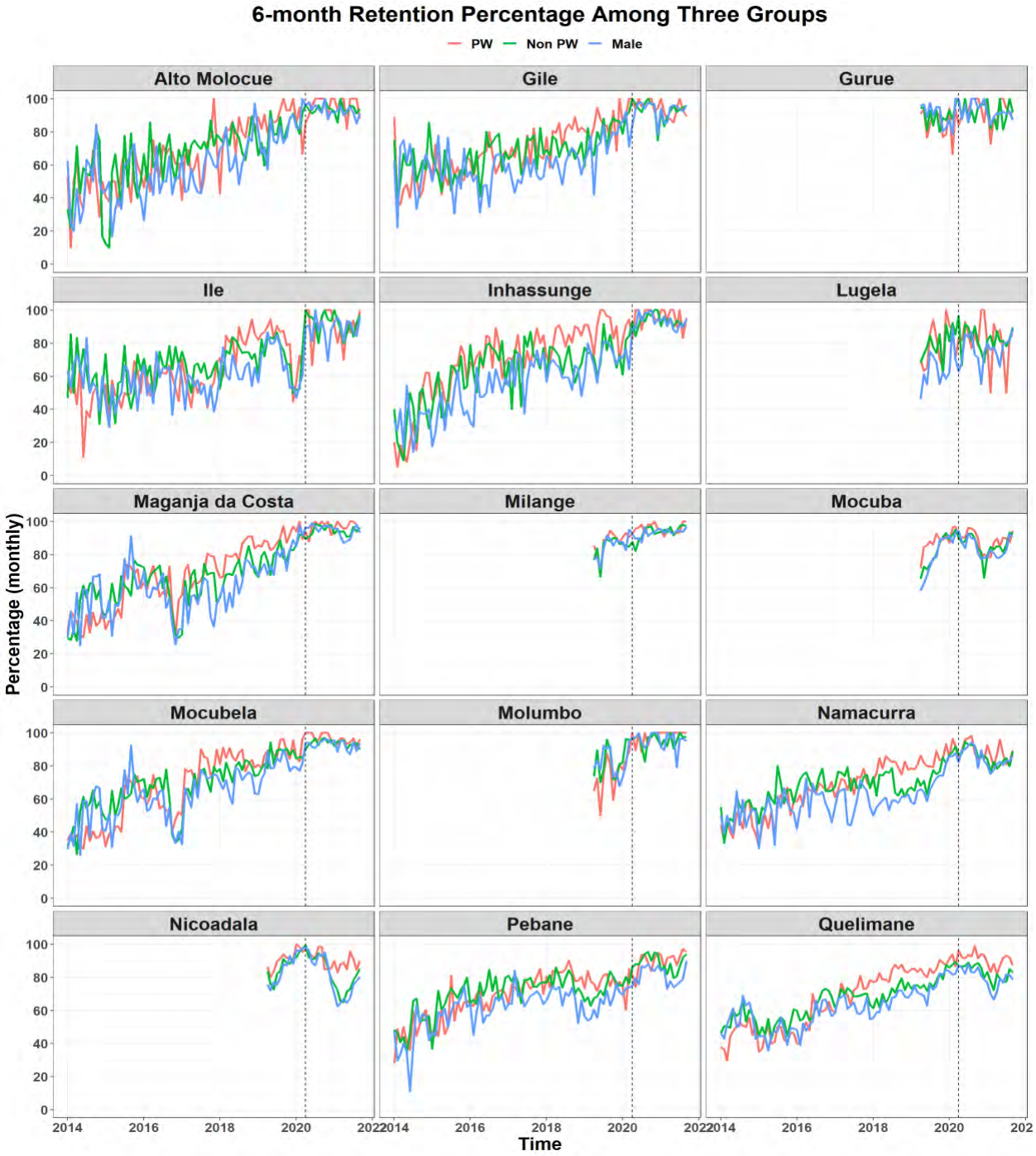

Figure 13. Percentage of patients retained at 6-months, by group (PW, non-PW, men), over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Further disaggregating to look at 6-month retention percentages among individuals 15-24 years of age (see **Figure 14a** below). (Please see **Table S7** in **Appendices** below for 6-month retention percentages among all three groups by age.)

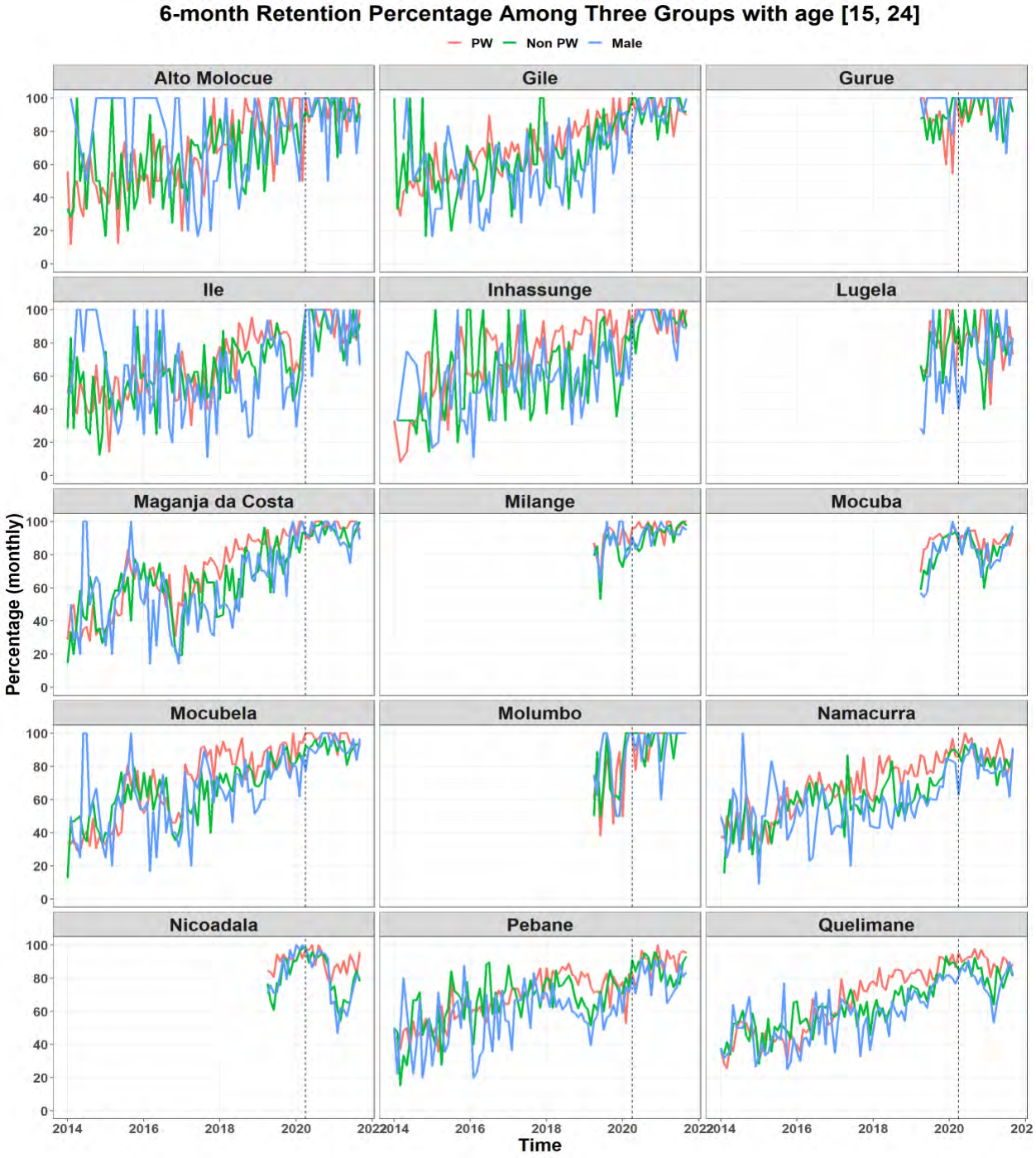

Figure 14a. Percentage of patients retained at 6-months, by group (PW, non-PW, men), among those 15-24 years of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

In relation to 6-month retention percentages among individuals 25-34 years of age (see **Figure 14b** below), there was also an observable trend of improvement across all three groups, in all districts, over time, with a great deal of variability among the groups in most districts, with the exception of Milange, Mocuba, and Nicoadala (prior to COVID-19).

Figure 14b. Percentage of patients retained at 6-months, by group (PW, non-PW, men), among those 25-34 years of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

With regard to 6-month retention percentages among individuals 35-49 years of age, there was a modest trend of improvement seen across all three groups, in all districts, over time (see **Figure 14c** below). It appeared that PW in this age category consistently performed better compared to non-PW and men in almost all districts over time, and particularly so in Alto Molócuè, Gurué, Inhassunge and Maganja da Costa. There was a great deal of variability seen in indicator performance for all groups over time, with notably much greater variability seen for PW in Ile, Mocuba, Namacurra, Pebane and Quelimane districts, and notably more variability seen for men in Gurué, Ile and Lugela districts, with non-PW showing the least variability.

Figure 14c. Percentage of patients retained at 6-months, by group (PW, non-PW, men), among those 35-49 years of age, over time. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)

Model results comparing 6-month retention across groups

Overall, the monthly 6-month retention proportions for each group increased along time (from approximately 38% to 93% for PW, from approximately 47% to 88% for non-PW, and from approximately 47% to 85% for men). The 6-month retention proportions for PW were lower than that for non-PW and men before June 2015. Then it exceeded that for men but was still lower than that for non-PW till early 2017 and became greater than that for both non-PW and men from the latter half of 2017 to the end of the evaluation period.

From this plot (see **Figure 15** below), it appears the upward trend for non-PW and men were slowed down a bit after COVID-19 mitigation measures went into effect, but there was no obvious trend change for PW.

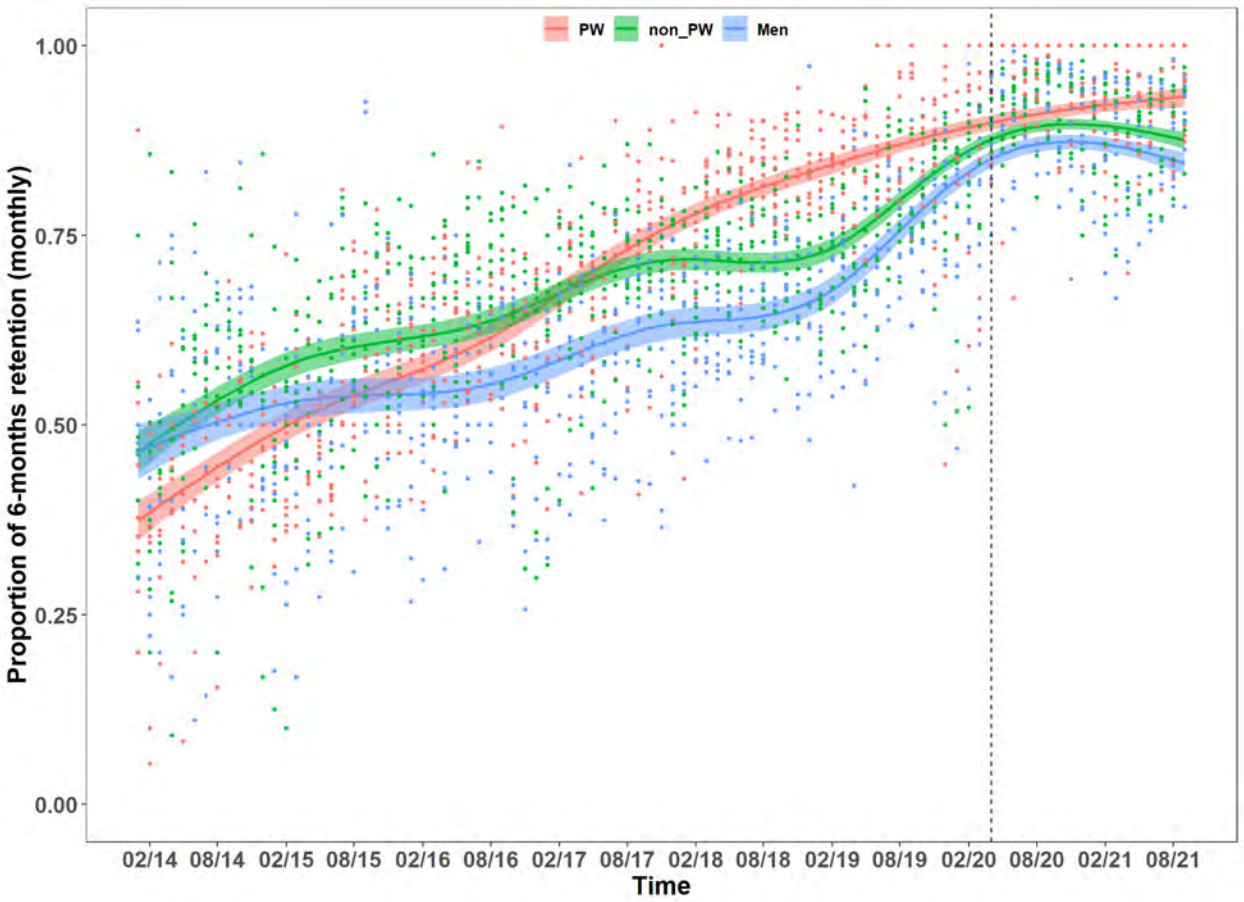

Figure 15. Comparison of 6-month retention proportions among the three groups. (Dotted line: time point when COVID-19 mitigations were put in place in Mozambique.)