Motivational interviewing retention counseling and adherence to early infant diagnostic HIV testing schedule in South Africa

The PAEDLINK randomized trial

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Abstract

Introduction: We report the PAEDLINK randomized trial results on the effect of motivational interviewing (MI) retention counseling on the adherence of postpartum women to the early infant diagnostic human immunodeficiency virus (HIV) testing schedule.

Methods: HIV positive women and their babies were enrolled 3 to 6 days after delivery at 4 midwife obstetric units in the Gauteng province of South Africa and randomized into (A) MI retention counseling and telephonic tracing, (B) biannual telephonic tracing, and (C) standard care. Mother-baby pairs were followed up for 18 months via medical records. The uptake of child HIV tests and maternal retention in the 0 to 6 and 7 to 18-month periods were modeled using Log-binomial regression.

Results: Overall, 501/711 enrolled mother-baby pairs received a second HIV polymerase chain reaction test by 6 months (70.0%, 70.5%, and 70.0% in groups A, B, and C, respectively). A higher proportion of intervention children (60.9%) were tested at 7 to 90 days than group B (48.1%, adjusted risk ratio [aRR] 0.8 for B vs A, 95% confidence interval [CI]: 0.7–0.9) and group C children (52.7%, aRR 0.9 for C vs A, 95% CI: 0.9–1.0). Child testing between 7 and 18-months was also higher in group A than C (10.7% A, vs 5.5% C, RR 2.0, 95% CI: 1.0–3.7). However, maternal retention was similar across groups, with 41.6% and 16.3% retained during the 0 to 6 and the 7 to 18-month periods, respectively.

Conclusion: MI retention counseling can reduce delays in the early infant diagnosis testing schedule for HIV-exposed infants. However, further support is necessary to maximize later HIV tests and maternal retention.

Abbreviations: ANC = antenatal care, ART = antiretroviral therapy, CI = confidence interval, CONSORT = Consolidated Standards of Reporting Trials, EID = early infant diagnosis, HIV = human immunodeficiency virus, IQR = inter quartile range, MI = motivational interviewing, MOU = midwife obstetric unit, PCR = polymerase chain reaction, RR = risk ratio, SA = South Africa.

Keywords: early infant diagnosis, human immunodeficiency virus, motivational interviewing counseling, South Africa
1. Introduction

The risk of vertical transmission of the human immunodeficiency virus (HIV) in South Africa (SA) gradually declined from 25% to 30% by 6-week, before 2001, to 1.5% in 2016, and 0.7% by 10 weeks in 2019.\textsuperscript{[1–5]} However, more efforts are required to maximize the survival of HIV infected children by reducing delays in HIV diagnosis and antiretroviral therapy (ART) initiation.\textsuperscript{[6,7]} Non-adherence to the early infant HIV diagnostic (EID) HIV test schedule delay HIV diagnosis and ART initiation of HIV infected children and the accuracy of vertical HIV transmission estimates in South Africa.\textsuperscript{[6,8–10]}

In 2015, the SA EID testing schedule for HIV-exposed infants included an HIV polymerase chain reaction (PCR) at birth and 10 weeks of age and a rapid antibody test at 6 weeks post-cesarean section for breastfeeding and/or at 18 months.\textsuperscript{[4]} The proportion of babies tested at birth to over 90% in 2016.\textsuperscript{[11]} The median ART initiation age in South Africa also gradually declined from 68 days in the 2006 to 2009 period to 45 days in 2013 to 2017.\textsuperscript{[7]} The EID guidelines were updated in 2019 to include an HIV PCR test at 6 months and an antibody test at 18 months for all children regardless of known HIV exposure.\textsuperscript{[12–14]} However, the uptake of the 10-week PCR and the 18-month antibody tests remains unclear.

Losses of HIV exposed infants from the EID schedule is systemic in Sub-Saharan Africa, with up to 50% lost by 6 months.\textsuperscript{[15]} However, prevention of mother to child transmission interventions focus primarily on increasing early maternal attendance of antenatal care (ANC) services with limited messaging and evidence of their effect on maternal adherence to the EID schedule.\textsuperscript{[16,17]}

Patient-centered counseling interventions are essential to improve prevention of mother to child transmission outcomes, considering the unique trajectory of each mother–child pair in the postpartum period.\textsuperscript{[18]} There is increasing evidence to support the beneficial effect of brief behavior change interventions, including motivation interviewing (MI) techniques in preventing risky sexual behaviour, HIV, and unintended pregnancies in low and middle-income settings.\textsuperscript{[19–21]} However, very little data exists on its use in improving adherence to the EID testing schedule.\textsuperscript{[22]} This study aimed to test the effect of an MI-based brief retention counseling on maternal retention for their own health and the adherence to the EID testing schedule for HIV exposed infants in the Gauteng province of South Africa.

2. Materials and methods

2.1. Study design and population

This was a randomized controlled trial conducted among adult (≥18 years) HIV positive mothers, and their HIV uninfected babies enrolled at 4 midwife obstetric units (MOUs) in Tshwane and Ekurhuleni districts of the Gauteng province of South Africa (Pan African Clinical Trials Registry https://pactr.samrc.ac.za/ Ref: PACTR201809886446171). Mother and baby dyads were recruited consecutively via referrals from MOU midwives and interviewed immediately after the postnatal consultation (scheduled 3 to 6 days after delivery). We included mothers who were well enough to complete a questionnaire, willing to consent to the telephonic tracing of mother and baby, as well as medical records reviews at 6, 12, and 18 months postpartum. We excluded women with babies over 2 months old. Participants were screened and interviewed in English, Sotho, and Zulu with written consent secured before randomization.

Study enrollment was conducted from October 2016 to January 2018. Follow-up activities continued until the end of June 2019. Participants randomized to receive telephonic followup received R30 airtime vouchers after telephonic follow-up interviews as an incentive for accepting phone calls from study interviewers.

2.1.1. Sample size. This study was a prospective extension of a retrospective cohort study aiming to determine the rate of early ANC initiation among HIV positive women enrolled 3 to 6 days postpartum. The sample was determined based on the fact that 30% of South Africa pregnant women who test HIV positive during antenatal care had a previous HIV positive diagnosis, and only 40% of South African women attend ANC before the recommended 14 weeks gestation.\textsuperscript{[17,19,20]} Beyond the aims of the retrospective cohort study, we sought as a total sample of 920 HIV positive women to detect a 20% difference in the uptake of the child HIV PCR test between the intervention (A) and the standard care arm of the study using an alpha (α) of 0.05, 80% power, and a 1:1:1 allocation ratio.

2.2. Randomization procedure

Participants were randomized in a 1:1:1 ratio using balanced block randomization\textsuperscript{[23]} (block size 20) to either (A) MI retention counseling with telephonic counseling and tracing, (B) telephonic tracing, or (C) passive tracing (standard of care). Randomization was un-blinded for all groups. While all participants consented to receive counseling sessions and telephone calls, participants were aware when these did not occur. Participants study number were issued consecutively and pre-allocated to the study arms. Randomization occurred after the completion of the baseline interview by the study assistant at participating sites. While participants were assigned study IDs after consenting to participate, the allocation was only revealed after the questionnaire was administered.

2.2.1. (A) MI retention counseling with active telephonic tracing. The intervention was based on the information motivational and behavioral skills model.\textsuperscript{[21]} The information motivation and behavior theory model depends on adequately skilled and motivated patients to overcome behavioral challenges and exploit opportunities to follow HIV-specific recommendations. Lay counsellors were trained on MI techniques using the brief negotiated interviewing online training tools before the study started and again before the 6- and 12-months follow-up telephonic counseling sessions.\textsuperscript{[24]} Mothers received the brief face-to-face baseline MI-based counseling immediately after the clinic consultation and the telephonic counseling at 6 and 12 months postpartum. Counseling took about 15 to 30 minutes and was conducted in Sotho, Zulu, or English. The counseling messages centered on strengthening mothers’ intentions and selfefficacy to remain in HIV care and adhere to the EID testing schedule for their HIV exposed infants. The telephonic counseling sessions were audio-recorded for training and fidelity management purposes.

2.2.2. (B) Active telephonic tracing. Group B women were interviewed in person at baseline and telephonically at 6 and 12-months. No counseling or advice was offered to this group.
2.2.3. (C) Passive tracing (standard of care). There was no further direct contact with group C participants after the baseline interview.

2.3. Data collection

2.3.1. Baseline. Female interviewers administered the questionnaire, collecting data on demographic, socio-economic factors, and postpartum mobility plans. HIV knowledge was measured using a 12 item index, with the total knowledge scores categorised as “Low to medium” (score ≤8) or “Medium to high” (score >8). Perceived social support (PSS) was measured using a 6-item scale in which participants indicated their overall level of satisfaction with available support given in each area. Postpartum depression was measured using the Center for Epidemiologic Studies Depression scale, a 10-question 4-point scale (scores range 0–3) that measures general depression up to 7 days before the interview date (Cronbach α= 0.83, range: 0–3). [24–26] Categorized into no depression (Center for Epidemiologic Studies Depression scale total score <5), low to medium (total score ≥ 5 and <10), and major depression (total score ≥10). [27,28] Additionally, antenatal and obstetric data were collected from mothers’ records at birthing sites.

2.3.2. Follow-up. The follow-up questionnaire collected information on linkage to and retention of mother–child pairs in postpartum HIV care. Mother–baby pairs were further followed up via medical records at 6, 12, and 18 months at up to 25 primary healthcare clinics (Figs. 1 and 2). We searched for HIV PCR, viral load test, and patient visit data in the Three Interlinked Electronic Registers for Tuberculosis & HIV (TIER.Net) and the National Health Laboratory Service databases. The final dataset was de-identified before the statistical analysis. This study was approved by the ethics committee of the University of the Witwatersrand Human Research Ethics Committee (Medical) (HREC No. M151041).

2.4. Analytic variables

2.4.1. Primary outcome. The overall median time from delivery to study enrolment was 4 days (interquartile range [IQR]: 3–6). The secondary study outcome was the uptake of the second infant HIV PCR test from 7 days to 6 months of life and also determined if an exit antibody test was conducted between 7 and 18 months.

2.4.2. Secondary outcome. The primary outcome was maternal retention (evidence of clinic attendance) in HIV care for her
own health, up to 6 months postpartum and in the 7 to 18 months postpartum period.

2.5. Statistical analysis
Categorical variables were summarized using frequencies, percentages with 95% confidence intervals (95% CI). Continuous variables were described using medians and IQR. Adjusted Log-binomial regression model was used to estimate risk ratio (RR) and predictors for maternal retention (7 days to 6 months postpartum), overall 10-weeks (7 days to 6 months) infant HIV PCR test uptake and on-time second PCR uptake (7–90 days). Data analysis was conducted using STATA version 14 (StataCorp, College Station, TX).

3. Results
We enrolled 711/848 mother–baby pairs randomly assigned to 1 of 3 study arms as per the Consolidated Standards of Reporting Trials (CONSORT) flow diagram Fig. 1 (233, 241, and 237 in groups A, B, and C, respectively). A total of 137 (16.1% of screened) mother–child pairs were excluded: 8 women (5.8% of excluded) were underage, 42 (30.6%) refused to participate, and 87 (63.5%) were unwell on the day of screening. The overall median age at enrolment was 30 years (IQR: 25–34). Only 17.7% of the women were over 35 years old. About a third (34.5%) of women had completed high school, and 40.3% were employed (Table 1). There were no significant differences in the sociodemographic characteristics of women by randomization arms.

Although 50.1% of the women screened positive for some level of postpartum depression, 56.1% reported high expectations of general social support. Most women (93.6%) received inpregnancy support from the baby’s father, but fewer (63.1%) also expected childcare support from the father.

Over half of the women (58.1%) lived in secondary homes, with 50.8% having a primary home in another SA province or another country. Among those with planned postpartum moves, 30.9% changed their primary healthcare clinic for the child HIV PCR, while 17% of those who did not plan to move eventually changed clinics. Overall, 74.7% of children who received a second PCR test were tested at the mother’s ANC clinic, and 6.4% accessed care outside Gauteng (Fig. 2). Although all mothers knew about the blood sample taken for the birth HIV PCR, only 22.9% received their baby’s birth HIV results during the first postnatal visit at the MOU.

3.1. Completion of the second child HIV PCR test by 6 months
Overall, 526/711 (74.0%) babies were retained in the first 6 months, 174 (74.6%) in the intervention group versus 175 (72.6%) and 177 (74.7%) in control groups B and C, respectively. Overall, 501/711 (70.5%) babies had a second HIV PCR test result by 6 months, 70.8% in the intervention arm (A), 70.5% in group B, and 70.3% in group C (Fig. 3) (Table 2).

Overall, child testing in the first 6 months was higher among older mothers (>35 years) (aRR 1.1, vs mothers 18–25 years old 95% CI: 1.0–1.3) and unemployed mothers who were not job hunting (aRR 1.2 vs employed mothers, 95% CI: 1.0–1.3). Child testing was lower when mothers lived in non-primary homes (aRR 0.9 for the primary home in other SA provinces vs current, 95% CI: 0.9–1.0) and having planned postpartum moves (aRR 0.8, 95% CI: 0.7–1.0). However, among children who were retained at 6 months, PCR testing was higher when clinic changes occurred within Gauteng (aRR 1.2, 95% CI: 1.1–1.3) or elsewhere in SA (aRR 1.3, 95% CI: 1.2–1.4) compared with accessing PCR tests at the site of ANC.

3.2. Completion of the second child HIV PCR test by 90 days
While the overall proportion of babies tested was similar across randomization groups, timely PCR (7–90 days) was highest in the intervention arm (60.9%) compared with group B (48.1%,
### Table 1
Characteristics of HIV positive women by randomization attending postpartum care in Gauteng, South Africa.

| Age             | MI retention counseling and phone tracing (A) | Standard care with phone tracing (B) | Standard care (C) | Total |
|-----------------|---------------------------------------------|-------------------------------------|-------------------|-------|
| N=233           | N=241                                       | N=237                               | N=711             |
| Median, IQR     | 30.0 (25.9–34.0)                            | 30.0 (25.9–34.0)                    | 30.0 (25.9–34.0)  |       |
| N=233           | N=241                                       | N=237                               | N=711             |
| 18–25           | 63                                           | 63                                   | 63                 | 63    |
| 26–30           | 66                                           | 69                                   | 73                 | 73    |
| 31–35           | 69                                           | 69                                   | 73                 | 73    |
| >35             | 35                                           | 35                                   | 35                 | 35    |
| Time to enrollment, d | 4.0 (2.0–4.0)                             | 4.0 (2.0–4.0)                        | 4.0 (2.0–4.0)     | 4.0 (2.0–4.0) |
| Median, IQR     |                                              |                                      |                   |       |
| Highest level of education |                                              |                                      |                   |       |
| ≤ Grade 7       | 13                                           | 20                                   | 20                 | 20    |
| Grades 8–11      | 138                                          | 145                                  | 151               | 151   |
| Completed Grade 12 | 53                                           | 58                                   | 60                 | 60    |
| Tertiary education | 29                                           | 33                                   | 36                 | 36    |
| Employment       |                                              |                                      |                   |       |
| Employed        | 99                                           | 101                                  | 98                | 98    |
| Unemployed       |                                              |                                      |                   |       |
| Unemployed (job hunting) | 99                                           | 108                                  | 96                | 96    |
| Unemployed (not job hunting) | 35                                           | 32                                   | 33                | 33    |
| Primary source of income |                                              |                                      |                   |       |
| Paid job or business | 72                                           | 74                                   | 71                | 71    |
| Government grant | 22                                           | 15                                   | 17                | 17    |
| Spouse/partner   | 115                                          | 124                                  | 121               | 121   |
| Parents/relatives| 17                                           | 20                                   | 22                | 22    |
| Missing          | 72                                           | 74                                   | 74                | 74    |
| Marital status   |                                              |                                      |                   |       |
| Not in a relationship | 44                                           | 36                                   | 43                | 43    |
| In a relationship | 181                                          | 193                                  | 198               | 198   |
| Married          | 8                                            | 12                                   | 12                | 12    |
| Participant lives with |                                              |                                      |                   |       |
| Alone/ main adult with child | 21                                           | 14                                   | 16                | 16    |
| With partner/spouse | 145                                          | 147                                  | 150               | 150   |
| Parents/relatives| 67                                           | 80                                   | 75                | 75    |
| Location of primary house |                                              |                                      |                   |       |
| Current house    | 97                                           | 104                                  | 98                | 98    |
| Same province    | 12                                           | 17                                   | 17                | 17    |
| Another province/rural area | 78                                           | 79                                   | 79                | 79    |
| Another country  | 40                                           | 53                                   | 50                | 50    |
| Planned postpartum mobility |                                              |                                      |                   |       |
| No              | 205                                          | 221                                  | 212               | 212   |
| HIV knowledge    |                                              |                                      |                   |       |
| Low/medium      | 17                                           | 21                                   | 24                | 24    |
| High            | 216                                          | 220                                  | 219               | 219   |
| Number of older children |                                              |                                      |                   |       |
| None            | 49                                           | 38                                   | 50                | 50    |
| 1–2 children    | 153                                          | 174                                  | 191               | 191   |
| >2 children     | 31                                           | 29                                   | 31                | 31    |
| Birth HIV PCR results received |                                              |                                      |                   |       |
| Yes             | 175                                          | 191                                  | 182               | 182   |
| Latest pregnancy planned |                                              |                                      |                   |       |
| No              | 128                                          | 132                                  | 136               | 136   |
| ANC attendance  |                                              |                                      |                   |       |
| No              | 5                                            | 4                                    | 8                 | 8     |
| Yes             | 105                                          | 108                                  | 113               | 113   |
| Province of antenatal care (ANC) |                                              |                                      |                   |       |
| ANC out of Gauteng | 7                                             | 2                                    | 9                 | 9     |
| ANC in Gauteng  | 220                                          | 235                                  | 238               | 238   |

(continued)
and CI: 0.7–0.9) and group C (52.7%, aRR 0.9 C vs A, 95% CI: 0.7–1.0) (Table 2). The likelihood of a timely child HIV PCR test was higher when mothers were older (aRR 1.2 for 31–35 vs 18–25 years old, 95% CI: 1.0–1.4) and clinic changes occurred within Gauteng (aRR 1.2 vs no clinic change, 95% CI: 1.0–1.4). However, child testing was delayed when mothers lived with a partner/spouse (aRR 0.8 vs being the only household adult, 95% CI: 0.7–0.9) or with

| Table 1 (continued). |
|----------------------|
| MI retention counseling and phone tracing (A) | Standard care with phone tracing (B) | Standard care (C) | Total |
|----------------------|----------------------------------|------------------|------|
| N=233 | % (95% CI) | N=241 | % (95% CI) | N=237 | % (95% CI) | N=711 | % (95% CI) |
| Same as ANC PHC | | | | | | | |
| 176 | 75.5 (69.6–80.7) | 162 | 67.2 (61.0–72.9) | 147 | 62.0 (55.6–68.8) | 485 | 68.2 (64.7–71.5) |
| Changed PHC in Gauteng | | | | | | | |
| 18 | 7.7 (4.9–12.0) | 22 | 9.1 (6.1–13.5) | 35 | 14.8 (10.8–19.9) | 75 | 10.5 (8.5–13.0) |
| Inter-province PHC change | | | | | | | |
| 11 | 4.7 (2.6–8.4) | 11 | 4.6 (2.5–8.1) | 12 | 5.1 (2.9–8.7) | 34 | 4.8 (3.4–6.6) |

CI = confidence intervals, HIV = human immunodeficiency virus, IQR = interquartile range, MI = motivational interviewing, PCR = polymerase chain reaction.

Figure 3. Uptake and timing of the second infant HIV PCR and 7 to 18 months HIV antibody test among HIV-exposed children by randomization group. HIV = human immunodeficiency virus, PCR = polymerase chain reaction.
## Table 2

### Adjusted log binomial regression to assess the timing of the second infant HIV PCR test.

|                                | HIV PCR done (N=711) | HIV PCR 7–90 days (N=711) |
|--------------------------------|----------------------|---------------------------|
|                                | n (%) RR (95% CI) aRR (95% CI) | n (%) RR (95% CI) aRR (95% CI) |
| Randomization                  |                      |                           |
| MI counselling and phone tracing (A) | 165 (70.8) 1 | 142 (60.9) 1 |
| Standard care with phone tracing (B) | 170 (70.5) 1.0 (0.9–1.1) 1.1 (0.9–1.2) | 116 (48.1) 0.8 (0.7–0.9) 0.8 (0.7–0.9) |
| Standard care (C)              | 166 (70.3) 1.0 (0.9–1.1) 1.0 (0.9–1.1) | 125 (52.7) 0.9 (0.7–1.0) 0.9 (0.7–1.0) |
| Age, y                         |                      |                           |
| 15–25                          | 118 (63.8) 1 | 86 (46.7) 1 |
| 26–30                          | 146 (70.5) 1.1 (1.0–1.3) 1.0 (0.9–1.1) | 110 (53.4) 1.2 (0.9–1.4) 1.0 (0.8–1.3) |
| 31–35                          | 149 (72.2) 1.2 (1.1–1.4) 1.1 (0.9–1.2) | 118 (61.1) 1.3 (1.1–1.6) 1.2 (1.0–1.4) |
| >35                            | 88 (69.6) 1.1 (0.9–1.3) 1.1 (1.0–1.3) | 69 (54.8) 1.2 (0.9–1.5) 1.1 (0.9–1.4) |
| Highest level of education     |                      |                           |
| High school or less            | 323 (69.3) 1 | 247 (53.1) 1 |
| Matric                         | 117 (73.6) 1.1 (0.9–1.2) | 85 (53.5) 1.0 (0.9–1.2) |
| Tertiary level                 | 61 (70.9) 1.0 (0.9–1.2) | 51 (59.3) 1.1 (0.9–1.4) |
| Employment                     |                      |                           |
| Employed                       |                      |                           |
| Unemployed (not job hunting)   | 80 (80.5) 1.2 (1.0–1.3) 1.2 (1.0–1.3) | 57 (57.6) 1.1 (0.9–1.4) |
| Unemployed (job hunting)       | 224 (68.9) 1.0 (0.9–1.1) 1.0 (0.9–1.1) | 178 (54.8) 1.1 (0.9–1.4) |
| Primary source of income       |                      |                           |
| Paid job, salary or business   | 151 (72.9) 1 | 117 (56.5) 1 |
| Spouse/partner                 | 266 (72.3) 1.0 (0.9–1.1) | 204 (55.4) 1.0 (0.8–1.1) |
| Parents/relatives/government grant | 80 (70.9) 1.0 (0.8–1.1) | 59 (52.7) 0.9 (0.7–1.2) |
| Maternal status                |                      |                           |
| Married                        | 97 (78.9) 1 | 71 (57.7) 1 |
| In a relationship              | 381 (68.5) 0.9 (0.8–1.0) 1.0 (0.9–1.1) | 294 (62.9) 0.9 (0.8–1.1) |
| Not in a relationship          | 23 (74.2) 0.9 (0.7–1.2) 0.9 (0.7–1.1) | 18 (58.1) 1.0 (0.7–1.4) |
| Participant lives with         |                      |                           |
| Alone/only adult with children  | 39 (76.5) 1 | 240 (53.3) 1 |
| With partner/spouse            | 320 (71.0) 0.9 (0.8–1.1) | 108 (51.7) 0.8 (0.6–0.9) 0.8 (0.7–0.9) |
| Parents/relatives              | 142 (67.9) 0.9 (0.7–1.1) | 35 (68.6) 0.7 (0.6–0.9) 0.9 (0.7–1.0) |
| Location of primary house      |                      |                           |
| Current house                  | 215 (74.4) 1 | 161 (55.7) 1 |
| Somewhere in Gauteng           | 39 (78.0) 1.0 (0.9–1.2) 1.1 (0.9–1.2) | 31 (62) 1.1 (0.9–1.4) |
| Another SA province            | 146 (70.5) 0.9 (0.8–1.1) 0.9 (0.9–1.0) | 111 (53.6) 1.0 (0.8–1.1) |
| Another country                | 98 (68.5) 0.9 (0.8–1.0) 0.9 (0.8–1.0) | 78 (54.5) 1.0 (0.8–1.2) |
| Planned postpartum mobility    |                      |                           |
| No                             | 458 (71.7) 1 | 351 (54.9) 1 |
| Yes                            | 43 (60.6) 0.8 (0.7–1.0) 0.8 (0.7–1.0) | 32 (45.1) 0.8 (0.6–1.1) |
| HIV knowledge                  |                      |                           |
| Low/medium                     | 39 (62.9) 1 | 27 (43.5) 1 |
| High                           | 462 (71.3) 1.1 (0.9–1.4) | 356 (54.9) 1.3 (0.9–1.7) |
| Birth HIV PCR results received |                      |                           |
| No                             | 387 (70.8) 1 | 302 (55.1) 1 |
| Yes                            | 114 (69.9) 1.0 (0.9–1.1) | 81 (49.7) 0.9 (0.8–1.1) |
| Number of older children       |                      |                           |
| 0 children                     | 74 (60.2) 1 | 55 (44.7) 1 |
| 1–2 children                   | 353 (72.3) 1.2 (1.0–1.4) 1.0 (0.9–1.2) | 273 (55.9) 1.3 (1.0–1.5) 1.0 (0.2–1.3) |
| ≥2 children                    | 74 (74.8) 1.2 (1.0–1.5) 1.0 (0.8–1.1) | 55 (55.6) 1.2 (1.0–1.6) 1.0 (0.7–1.3) |
| Latest pregnancy planned       |                      |                           |
| No                             | 278 (71.5) 1 | 216 (55.5) 1 |
| Yes                            | 223 (69.5) 1.0 (0.9–1.0) | 167 (52) 0.9 (0.8–1.1) |
| ANC and postpartum care facility (including 10-weeks PCR test) |                      |                           |
| Same as ANC PHC                | 389 (80.4) 1 | 301 (62.1) 1 |
| Changed PHC in Gauteng         | 71 (94.7) 1.2 (1.1–1.3) 1.2 (1.1–1.3) | 55 (73.3) 1.2 (1.0–1.4) 1.2 (1.0–1.4) |
| Inter-province PHC change      | 33 (97.1) 1.2 (1.1–1.3) 1.3 (1.2–1.4) | 21 (68.1) 1.0 (0.8–1.3) 1.0 (0.8–1.3) |
| Missing ANC or postpartum care attendance | 8 (6.6) 0.1 (0.04–0.2) 0.1 (0.1–0.2) | 6 (5.1) 0.1 (0.04–0.2) 0.1 (0.04–0.2) |
| Baby’s father’s involvement during pregnancy |                      |                           |
| Involved                       | 469 (70.7) 1 | 358 (54) 1 |
| Not involved                   | 32 (68.1) 1.0 (0.8–1.2) | 25 (55.6) 1.0 (0.8–1.3) |
| Perceived primary in-pregnancy supporter |          |                           |
| Partner                        | 281 (72.1) 1 | 202 (51.8) 1 |

(continued)
parents/relatives (aRR 0.9 vs being the only household adult, 95% CI: 0.7–1.0). Furthermore, women who had any level of postpartum depression delayed the second child PCR test (aRR 0.8, 95% CI: 0.7–1.0).

In a model restricted to children who accessed PCR tests, receiving a timely HIV PCR test was also lower when mothers were unaware of the babies’ birth HIV status (aRR 0.9, 95% CI: 0.8–1.0) and higher when mothers perceived high in-pregnancy support from the baby’s father (not a partner) (aRR 1.2 vs a sexual partner, 95% CI: 1.0–1.4) or family members (aRR 1.1 vs a sexual partner, 95% CI: 1.0–1.3).

3.3. Uptake of the child HIV test (rapid/ PCR) in the 7 to 18-month period

Overall, 47.7% of children were retained (in care) at 7 to 18 months, slightly more in the intervention group (53.2%, 95% CI: 46.6–59.8) compared with 46.5% (95% CI: 40.0–53.0) and 43.4% (95% CI: 37.1–50.0) in groups B and C, respectively. However, only 58/711 82% of babies (17.1% of those retained) had an HIV test result at 7 to 18 months. A higher proportion of babies in the intervention group (10.7%) were tested compared with 8.3% in group B (RR 0.8, 95% CI: 0.4–1.4) and 5.5% in group C (RR 0.5, 95% CI: 0.3–1.0) with a final 18-month vertical transmission rate of 0.7%.

3.4. Maternal retention (clinic attendance for their health) and viral suppression

Overall maternal retention (41.6%) in the first 6 postpartum months was a little higher in the intervention (A) group compared with control groups B (RR 0.9, 95% CI: 0.7–1.0) and C (0.9, 95% CI: 0.7–1.0). Retention was much lower in the 7 to 18-month period at 24.2%. Overall, 25.7% of retained (1–6 months) mothers had no viral load measurements. Group C women had a higher missing viral load measurement (32.3%, RR 1.6 for group C vs A, 95% CI: 1.0–2.7) followed by group B (28.4%, RR 1.8 for group C vs A, 95% CI: 1.1–3.0) and then the intervention group (17.6%) (Tables 3 and 4).

Overall, 146 (20.5%) women were virally suppressed at 6 months (49.3% of those retained). Six-month viral suppression was not significantly higher in group A (24.5%) compared with 19.1% for group B (RR 0.8 vs A, 95% CI: 0.6–1.1) and 18.1% for group C (RR 0.7 vs A, 95% CI: 0.5–1.1).

In the multivariate log-binomial model for maternal retention in the first 6 months, there was no difference between the intervention group and the controls. Predictors of maternal retention were receiving financial support from the family (aRR 1.2 vs a sexual partner, 95% CI: 1.0–1.6), living in a temporary home (aRR 1.3 primary home in other SA province vs current, 95% CI: 1.1–1.5), having planned postpartum moves (RR 1.4, 95% CI: 1.1–1.7) and medium perceived social support (aRR 1.4 vs high social support, 95% CI: 1.1–1.9). Similarly, postpartum depression increased the likelihood of 6-month retention (aRR 1.4, 95% CI: 1.1–1.9).

4. Discussion

We sought to determine the effect of a brief MI counseling intervention on the retention of HIV positive postpartum women and their adherence to the early infant HIV diagnostic testing schedule. To the best of our knowledge, this is also one of the first

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### Table 2

(continued).

|     | HIV PCR done (N = 711) | HIV PCR 7–90 days (N = 711) |
|-----|------------------------|-----------------------------|
|     | n (%)                  | RR (95% CI) | aRR (95% CI) | n (%)                  | RR (95% CI) | aRR (95% CI) |
| Baby’s father (if not partner) | 118 (67.8) | 0.9 (0.8–1.1) | 1           | 98 (66.3) | 1.1 (0.9–1.3) |
| Family members                 | 102 (69.9) | 1.0 (0.9–1.1) |             | 83 (57.2) | 1.1 (0.9–1.3) |
| Expected primary childcare supporter |     |               |             |             |               |
| Partner                         | 211 (73.8) | 1             |             | 157 (64.9) | 1             |
| Baby’s father (if not partner)  | 116 (71.6) | 1.0 (0.9–1.1) |             | 95 (58.6) | 1.1 (0.9–1.3) |
| Family members                  | 173 (71.2) | 1.0 (0.9–1.1) |             | 131 (53.9) | 1.0 (0.8–1.1) |
| Perceived social support        |     |               |             |             |               |
| High PSS                        | 279 (70.1) | 1             |             | 215 (54) | 1             |
| Medium PSS                      | 222 (71.2) | 1.0 (0.9–1.1) |             | 168 (53.8) | 1.0 (0.9–1.1) |
| Postpartum depression           |     |               |             |             |               |
| No depression                   | 259 (75.1) | 1             |             | 305 (75.7) | 1             |
| Any depression                  | 241 (69.5) | 0.9 (0.8–1.0) | 1.0 (0.9–1.0) | 78 (48.1) | 0.8 (0.7–0.9) | 0.8 (0.7–1.0) |

**ANC** = antenatal care, **CI** = confidence intervals, **HIV** = human immunodeficiency virus, **IQR** = interquartile range, **MI** = motivational interviewing, **PCR** = polymerase chain reaction.

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### Table 3

Maternal retention and viral suppression during the 1–6 and 7–18 months postpartum periods.

| Study group | Period 1–6 months postpartum | Period 7–18 months postpartum |
|-------------|------------------------------|------------------------------|
|             | Maternal retention/total     | Viral suppression/total       | Maternal retention/total | Viral suppression/total |
|             | n (%) RR (95% CI)            | n (%) RR (95% CI)            | n (%) RR (95% CI)        | n (%) RR (95% CI)        |
| A           | 108 46.4) 1.0 (0.7–1.0)      | 57 24.5) 1.0 (0.6–1.1)       | 50 21.5) 1.0 (0.7–1.0)   | 66 27.4) 1.3 (0.9–1.8)   |
| B           | 95 39.4) 0.9 (0.7–1.0)       | 46 19.1) 0.8 (0.6–1.1)       | 66 27.4) 1.3 (0.9–1.8)   | 57 23.7) 1.2 (0.8–1.7)   |
| C           | 93 39.2) 0.9 (0.7–1.0)       | 43 18.1) 0.7 (0.5–1.1)       | 56 23.6) 1.1 (0.8–1.5)   | 8 20.3) 1.0 (0.7–1.5)    |

**CI** = confidence intervals, **RR** = risk ratio.
| Predictors of maternal retention during the 1–6 months postpartum periods. | n (%) | RR (95% CI) | aRR (95% CI) |
|---|---|---|---|
| **Maternal retention by 6 months postpartum (N = 711)** | | | |
| **Randomization** | | | |
| MI retention counselling and phone tracing (A) | 108 (46.4) | 1 | |
| Standard care with phone tracing (B) | 95 (39.4) | 0.9 (0.7–1.0) | 0.9 (0.7–1.1) |
| Standard care (C) | 93 (39.2) | 0.8 (0.7–1.0) | 0.9 (0.7–1.1) |
| **Age** | | | |
| 18–25 | 77 (41.6) | 1 | |
| 26–30 | 87 (42.2) | 1.0 (0.8–1.3) | |
| 31–35 | 82 (42.5) | 1.0 (0.8–1.3) | |
| >35 | 50 (39.7) | 1.0 (0.7–1.3) | |
| **Highest level of education** | | | |
| High school or less | 188 (40.4) | 1 | |
| Matric | 66 (41.5) | 1.0 (0.8–1.3) | |
| Tertiary level | 42 (48.8) | 1.2 (0.9–1.5) | |
| **Employment** | | | |
| Employed | 119 (41.6) | 1 | |
| Unemployed (not job hunting) | 44 (44.4) | 1.1 (0.8–1.4) | |
| Unemployed (job hunting) | 133 (40.9) | 1.0 (0.8–1.2) | |
| **Primary source of income** | | | |
| Paid job, salary or business | 89 (43.0) | 1 | |
| Spouse/partner | 140 (38.3) | 0.9 (0.7–1.1) | 0.9 (0.7–1.1) |
| Parents/relatives/government grant | 59 (52.7) | 1.2 (1.0–1.6) | 1.2 (1.0–1.6) |
| **Marital status** | | | |
| Married | 44 (35.8) | 1 | |
| In a relationship | 238 (42.8) | 1.2 (0.9–1.5) | |
| Not in a relationship | 14 (45.2) | 1.3 (0.8–2.0) | |
| **Participant lives with** | | | |
| Alone/only adult with children | 180 (40.0) | 1 | |
| With partner/spouse | 98 (46.9) | 1.1 (0.8–1.7) | |
| Parents/relatives | 18 (35.3) | 1.3 (0.9–2.0) | |
| **Location of primary house** | | | |
| Current house | 116 (40.1) | 1 | |
| Somewhere in Gauteng | 20 (40.0) | 1.0 (0.7–1.4) | 1.0 (0.7–1.5) |
| Another SA province | 99 (47.8) | 1.2 (1.0–1.5) | 1.3 (1.1–1.5) |
| Another country | 55 (38.5) | 1.0 (0.7–1.2) | 1.0 (0.8–1.3) |
| **Planned postpartum mobility** | | | |
| No | 257 (40.2) | 1 | |
| Yes | 39 (54.9) | 1.4 (1.1–1.7) | |
| **HIV knowledge** | | | |
| Low | 84 (39.6) | 1 | |
| Medium to high | 205 (43.2) | 1.0 (0.9–1.1) | |
| **Birth HIV PCR results received** | | | |
| Yes | 232 (42.3) | 1 | |
| No | 64 (39.3) | 0.9 (0.7–1.1) | |
| **Number of older children** | | | |
| 0 children | 56 (45.5) | 1 | |
| 1–2 children | 206 (42.2) | 0.9 (0.7–1.2) | |
| ≥2 children | 34 (34.3) | 0.8 (0.5–1.1) | |
| **Latest pregnancy planned** | | | |
| No | 164 (42.2) | 1 | |
| Yes | 132 (41.1) | 1.0 (0.8–1.2) | |
| **ANC and postpartum care facility (including 10-weeks PCR test)** | | | |
| Same as ANC PHC | 216 (44.5) | 1 | |
| Changed PHC in Gauteng | 37 (49.3) | 1.1 (0.9–1.4) | |
| Inter-province PHC change | 14 (41.2) | 0.9 (0.6–1.4) | |
| Missing ANC or postpartum care attendance | 29 (24.8) | 0.6 (0.4–0.8) | |
| Baby’s father’s involvement during pregnancy | | | |
| Involved | 276 (41.6) | 1 | |
| Not involved | 20 (44.4) | 1.1 (0.8–1.5) | |
| **Perceived primary in-pregnancy supporter** | | | |
| Partner | 152 (39.0) | 1 | |

(continued)
studies to accurately determine the second child HIV PCR test uptake in a cohort of HIV exposed infants in the Gauteng province of South Africa. HIV exposed children who receive two HIV PCR tests have higher survival, especially when at least 75% receive both tests, and the results are returned to the parent.[25–27]

4.1. Intervention effect on child HIV testing and maternal retention

Postpartum MI retention counseling did not affect the overall maternal retention or improve the overall uptake of the second child HIV PCR test, which was estimated at 70.1%. However, children in the intervention group received the second HIV PCR test earlier than the control groups. Furthermore, the intervention group had higher uptake of the child HIV test in the 7 to 18-month age period than both control groups. The low testing at 18-months may reflect insufficient data on children’s rapid tests but suggests that a vast majority of HIV exposed infants do not complete the later HIV tests and possibly remain undiagnosed until later in life. While the intervention showed little effect on maternal postpartum retention, retained women in the intervention group were more likely to have received a viral load test in the first 6 postpartum months than the controls.

The lower maternal retention at 6 months compared with child retention and HIV PCR test uptake (74.0%) is consistent with previously reported declines in women’s need to protect children from HIV acquisition after pregnancy.[17,29–34] Maternal retention in our study was also much lower compared with a similar population in the Western Cape Province,[32,33] probably associated with data management differences between the Gauteng and the Western Cape provincial health care systems. The follow-up HIV PCR estimate is similar to the 67.4% reported in the same period in the Western Cape province.[35] However, a cohort study in the Free state province reported a 36.7% follow-up PCR uptake after birth,[28] highlighting missed opportunities to maximize maternal retention and the need for more data to identify regions that need strengthening to close the child testing gap.

4.2. Predictors of timely adherence to child HIV PCR testing and maternal retention by 6 months

While previous studies found that a birth HIV PCR result could reduce the adherence to follow-up tests, we found that non receipt of the birth HIV PCR result resulted in delayed uptake of the second HIV PCR test.[35] The value of this first PCR test is reduced if mothers leave obstetric care without the baby’s birth HIV results, as child tracing is often complicated by postpartum migration and inaccurate contact information.[2,6,17,36]

While living in temporary homes and postpartum migration can create linkage challenges for both mother and child, our results suggest that participants who moved accessed HIV PCR testing more timely. Pre-planned postpartum mobility may be accompanied by pre-planned clinic attendance and better access to alternative child caregivers than unplanned migration.[13]

We found that women who were not job hunting had higher child HIV PCR uptake than employed women. The absence of paid leave benefits possibly limits access to child PCR tests, but employed women may also have the means to seek private healthcare for their children and therefore appear lost from the public health sector.[37,38]

Similar to previous reports, high in-pregnancy social support was associated with high follow-up HIV PCR uptake.[39] Also, timely HIV PCR tests were higher when mothers had high decision-making power (primary household adult/older) than when decision-making was shared with a partner/family member.[17,31,40,41]

Maternal postpartum depression was associated with higher maternal retention but lower PCR uptake. These findings on depression contrast the results of previous studies[34,42,43] and require further investigation.

4.3. Limitations

While the results of this study are encouraging, they are specific to the Gauteng province and settings from which participants were drawn. Additionally, retention estimates may be underestimated because although the determination of patient retention included a national search of laboratory results, the clinic visit record review was limited to the Gauteng province. Also, patient management data in South Africa is not networked, and searches for clinic visit records were informed by patient interviews and did not capture unplanned clinic changes. Finally, data capturing of rapid HIV tests for both adults and children is generally poor, resulting in underestimated uptake of child testing in the 7 to 18-months period.

Table 4 (continued).

| Maternal retention by 6 months postpartum (N = 711) | n (%) | RR (95% CI) | aRR (95% CI) |
|--------------------------------------------------|-------|-------------|--------------|
| Baby father (if not partner)                     | 75 (43.1) | 1.1 (0.9–1.4) | 1.3 (0.9–2.2) |
| Family members                                   | 69 (47.6) | 1.2 (1.0–1.5) | 1.2 (0.9–1.6) |
| Expected primary childcare supporter            |       |             |              |
| Partner                                          | 111 (38.8) | 1 |              |
| Baby father (if not partner)                     | 68 (42.0) | 1.1 (0.9–1.4) | 0.8 (0.5–1.2) |
| Family members                                   | 112 (46.1) | 1.2 (1.0–1.4) | 1.0 (0.7–1.3) |
| Perceived social support (PSS)                   |       |             |              |
| High PSS                                         | 146 (36.7) | 1 |              |
| Medium PSS                                       | 150 (48.1) | 1.3 (1.1–1.6) | 1.4 (1.1–1.9) |
| Postpartum depression (PPD)                      |       |             |              |
| No depression                                    | 121 (35.1) | 1 |              |
| Any depression                                   | 170 (49.1) | 1.4 (1.2–1.7) | 1.4 (1.1–1.9) |

CI = confidence intervals, HIV = human immunodeficiency virus, IQR = interquartile range, MI = motivational interviewing, PCR = polymerase chain reaction, RR = risk ratio.
5. Conclusions
MI retention counseling provided early in the postpartum period resulted in some improvement in the timing of the second child HIV PCR and the adherence to the exit antibody test but had no impact on maternal retention in care. The estimated 70% follow-up HIV PCR of HIV exposed infants is encouraging, considering the postpartum trajectories of HIV positive mothers and their children. However, almost 30% of postpartum women who returned to the clinic lacked viral load tests demonstrating room for improved postpartum maternal care. The results also highlight the critical need to ensure that mothers receive the birth results of their babies at the postnatal visit to improve child testing.

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