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ABSTRACT

Stacey Adjei

HIV Care Retention and Attainment of Viral Suppression among Georgia Women during Pregnancy and Postpartum Period

Background: Rates of care retention and maintenance of viral suppression differ by location in the United States due to the varying public health policies and infrastructures. As a result, it is imperative to determine the rates of retention and viral suppression as well as factors associated with these changes during the prenatal and postpartum period in the state of Georgia

Methods: Data on 161 HIV infected women was collected from birth certificate records and the enhanced HIV/AIDS Reporting System (eHARS). Multivariate logistic regression was used to determine the association between sociodemographic as well as clinical variables and outcome variables of retention, viral suppression and care engagement during and after pregnancy.

Results: Women were more likely to be retained in care during pregnancy (79.50%) than during the postpartum period (55.28%). Women were also more likely to achieve viral suppression during pregnancy (68.94%) than during the postpartum period (49.69%). Approximately 43% of women engaged in HIV care within 90 days of giving birth. Women who were retained in HIV Care prior to pregnancy were more likely to be retained during pregnancy (95%) and the postpartum period (76%) than women diagnosed during pregnancy or not retained in care prior to pregnancy.

Conclusion: Women face a myriad of challenges that make retention and viral suppression difficult. It is important that we utilize technology to help improve treatment received in the postpartum period.

HIV Prenatal & Postpartum Care Retention & Viral Suppression
Stacey Adjei

HIV CARE RETENTION AND ATTAINMENT OF VIRAL SUPPRESSION AMONG
GEORGIA WOMEN DURING PREGNANCY AND POSTPARTUM PERIOD

By

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B.A., CASE WESTERN RESERVE UNIVERSITY

A Thesis Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
of the
Requirements for the Degree

MASTER OF PUBLIC HEALTH

ATLANTA, GEORGIA
30303

APPROVAL PAGE

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Author's Statement Page

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I

INTRODUCTION

Background

Advancements in medical science have significantly reduced HIV/AIDS related morbidity and mortality as well as perinatal HIV/AIDS infections. As a result, more HIV/AIDS infected women pursue motherhood. In fact approximately 8500 women living with HIV give birth annually (CDC, 2016b). Raising a family, particularly young infants and children place unique challenges on women that make adherence and retention in care much more difficult. This is especially dangerous because of the increased risk of morbidity and mortality associated with immune suppression during the postpartum period (Louis et al., 2006).

Study Rationale & Purpose

Rates of care retention and maintenance of viral suppression may differ by location in the United States due to the varying public health policies and infrastructure that exist in different states. For instance, in contrast to the low levels of postpartum retention in the first year found in Mississippi, 37%, (Rana et al., 2010) and in Philadelphia, 39%, (Adams et al., 2015), a study in the state of New York found a 70% retention rate in the first year postpartum with 50% of these women achieving viral suppression (Swain et al., 2016). As a result, it is imperative to determine the rates of retention and viral suppression as well as factors associated with these changes during the prenatal and postpartum period in the state of Georgia.

The current study seeks to describe and assess rates of care engagement, retention in care, and viral suppression achieved by HIV infected women in Georgia during pregnancy and up to one year postpartum. The study will assess differences in sociodemographic factors such as race/ethnicity, education, number of children and age that may affect these outcome variables

during pregnancy and the postpartum period. We will also examine clinical variables such as stage of disease at delivery, adequacy of prenatal care received, and HIV care received prior to pregnancy (diagnosed during pregnancy, retained in care prior to pregnancy, and not retained in care prior to pregnancy) to determine the effects of these factors on viral suppression, care engagement and retention. Examination of sociodemographic and clinical variables will enable us to evaluate specific factors associated with achievement of viral suppression and retention during pregnancy and one year postpartum in the state of Georgia. We hypothesize that rates of retention and viral suppression will be greater during pregnancy than during the postpartum period as has been determined in other studies. Our aim is to get an idea of the percentage of HIV-infected women in Georgia who fall out of care during the postpartum period and to try to understand factors that may contribute to it.

II

LITERATURE REVIEW

Facts

Approximately 1 in every 4 people living with HIV in the United States today is a woman. By the end of 2014, women made up 19% of the estimated new HIV diagnoses and 25% of the estimated AIDS diagnoses among adults and adolescents in the United States. Eighty-four percent of the women diagnosed with HIV in 2013 were linked to care within 3 months but only 55% were able to be retained in care. Thirty-nine percent of women living with HIV were prescribed antiretroviral therapy by the end of 2012 and only 30% were able to achieve viral suppression (CDC, 2016a).

HIV Care Continuum

The goal of the HIV care continuum is to achieve viral suppression, thus increasing life expectancy and dramatically reducing the transmission of HIV to others. The continuum consists of several steps to achieve the desired outcome of viral suppression. These include HIV diagnosis, linkage to care, engagement and retention in care, and prescription of antiretroviral therapy (The HIV/AIDS Bureau, 2014). Unfortunately, many HIV infected women fail to be retained in care particularly during the postpartum period (Adams et al., 2015; Siddiqui et al., 2014; Rana et al., 2010) thus increasing their risk of opportunistic infections and rapid advancement of disease (Bardeguet et al., 2008; Vitalis, 2013, Phillips et al., 2014). Socioeconomic status, race, young age, education and the challenges of coping with a new born have all been associated with gaps in care continuum for these women (Adams et al., 2015; Siddiqui et al., 2014; Rana et al., 2010; Boehme et al., 2014). A change in providers has also

been attributed to barriers in the care continuum for these women, particularly for those diagnosed during pregnancy (Turner et al., 2000).

Adherence, Retention in Care & Viral Suppression

Evidence from several studies show that women are more likely to be engaged and retained in care during pregnancy than during the postpartum period. One study found a desire to stay healthy for the child and prevent mother to child transmission as the primary reason for adherence during pregnancy, a motivation that dissipates during the postpartum period (Mellins et al., 2008). As a result, viral suppression achieved during pregnancy is not maintained during the postpartum period. In fact, a majority of women who achieved viral suppression during pregnancy have been found to experience virologic rebound during the postpartum period (Sha et al., 2011). A New York state study also found that while 75% of women achieved viral suppression by delivery, only about 67% of these women were virally suppressed by their first VL test during the postpartum period. About 24% had rebounded to VL levels greater 1000 copies/ml by their first postpartum test (Swain et al., 2016). HIV viral suppression is crucial not only for the prevention of mother to child transmission during pregnancy and delivery, it is also crucial to maintaining optimum health during the postpartum period. Maintaining viral suppression reduces the risk of HIV related morbidity, development of viral resistance to treatment, advancing to AIDS and reduces the risk of spreading the virus to others.

Optimal follow-up rates with HIV care providers during the postpartum period have been found to be as low as 37% in the state of Mississippi (Rana et al., 2010). In that study, 18% of women had only one visit and 29% of women had no documented visits to an HIV care provider during 1 year postpartum (Rana et al.,). A South African study on loss to follow up in HIV positive women found that postpartum women were more likely to be lost to follow up when

compared to their non-pregnant counterparts. Specifically, 32% of postpartum women in their study became lost to follow up compared to 13% among non-pregnant individuals (Kaplan et al, 2008). A study in Philadelphia on postpartum engagement in HIV care also found women were less likely to be engaged in HIV care during the postpartum period (Adams et al., 2015). Specifically, 92% of women were engaged in care during pregnancy compared to 38% within 90 days of the postpartum period. They also found low rates of retention for up to 2 years in postpartum women (Adams et al., 2015).

Barriers to Adherence & Retention

Several studies have examined barriers to adherence and retention in order to try to understand the significant difference in care during pregnancy and the postpartum period. The risk of care discontinuation has been found to be particularly high among postpartum women (Mellins et al., 2008) due to the challenges of caring for a newborn. A busy schedule has been reported as one of the barriers to adherence and retention. More specifically, many women reported that having a new born child disrupted their medication intake routines (Boehme et al., 2014). A majority also reported scheduling conflicts and lack of childcare as barriers to clinic visits. Having multiple children was also reported as contributing to a busy schedule making it more difficult to attend clinic visits and take medications as prescribed (Boehme et al., 2014).

Other factors associated with barriers to retention and adherence includes transportation, clinic and copay expenses and long length of time between appointments (Boehme et al., 2014). Feeling depressed or overwhelmed and having other health related symptoms (Mellins et al, 2008) as well as substance abuse and lack of self-efficacy (Vitalis, 2013) has been reported as a barrier to adherence. Lack of social support outside of immediate family and past experience

with stigma has also been identified as barriers during the postpartum period (Buchberg et al., 2015).

III

METHODS

Data Source

This was a retrospective cohort study that used data collected between July 2014 and June of 2015 by two data sources: birth certificate records in the state of Georgia and the enhanced HIV/AIDS Reporting System (eHARS), both of which are managed by the Georgia Department of Public Health (GDPH). Georgia birth certificate records collect information regarding the health status as well as sociodemographic information of newborns and their parents. eHARS is a surveillance database that collects information on all HIV related labs including CD4 cell counts and viral load (VL) results.

For this study, HIV infected women who gave birth during the study period were identified by the presence of a check mark in the maternal HIV infection field on Georgia birth certificates. These women were then matched to existing data in eHARS using the link plus software. After matching was complete maternal HIV laboratory data was manually extracted for the nine months preceding the infants date of birth and up to one year after giving birth. We also collected information on whether or not women had been retained in HIV care and virally suppressed for up to the year preceding the pregnancy period to determine if they were aware of their diagnosis in care or not or had been diagnosed during pregnancy.

This study was approved by the IRBs of Georgia State University and the Georgia Department of Public Health.

Study Population

Our study included HIV-infected women who gave birth in the state of Georgia between July 2014 and June 2015. Participants were excluded if there were not found in eHARS. We included women who did not receive care during the pregnancy or postpartum period because

part of our analysis focuses on rates of care retention and achievement of viral suppression during both periods. Including them reflects the true rates of people who fall out of care or are not properly reported in the state of Georgia.

Primary Outcome

Five binary outcomes which include retention in care and viral suppression during both the pregnancy and the postpartum periods and engagement in care within 90 days of the postpartum period were assessed for this study. We defined retention in HIV care as having 2 or more laboratory tests (CD4 or Viral load test) at least 90 days apart during the pre-pregnancy (up to 12 months before pregnancy), pregnancy and the postpartum period (up to 12 months after delivery) (Office of AIDS policy, 2010). Achievement of viral suppression, defined as having a quantitative viral load test of 200 copies/mL or less was evaluated using the last VL test before or during delivery and in the 1-year pre-pregnancy and postpartum period. Postpartum care engagement was defined as having one or more laboratory tests (CD4 or VL test) within 90 days after delivery. Laboratory tests performed within 5 days of delivery were excluded because patients are likely to still be admitted in the hospital and not actually out seeking HIV care. Persons missing viral load tests were assumed to be out of care and not virally suppressed.

Sociodemographic and Clinical Variables

Sociodemographic data on maternal age at delivery (18-24, 25-34, ≥ 35), education (< high school, high school graduate, some college, bachelors or higher), race/ethnicity (black, white, other), and parity (≤ 1 , ≥ 2) were abstracted from Georgia birth certificate records. Other race includes Hispanic/Latino, Asian, American Indian/Alaskan Native and unknown. Clinical data on stage of disease at delivery (HIV, AIDS) and HIV care received (i.e. labs) before pregnancy were abstracted from eHARS. For HIV care received before pregnancy, women were

considered retained in care prior to pregnancy if they had 2 or more HIV labs that are at least 90 days apart and virally suppressed if they had a last VL less than 200 copies/ml on record 1 year preceding the pregnancy period. Women without any lab records before pregnancy were considered to have been diagnosed during pregnancy. Number of prenatal visits was abstracted from Georgia birth certificate records. The number of prenatal visits used to determine the adequacy of prenatal care was based on the Kessner index, a validated measure of the quality of prenatal care (Stringer, 1997). The Kessner index accounts for the trimester at which prenatal care begins, gestational age at delivery and number of prenatal visits. Adequacy was determined using the number of visits appropriate for 34 or more weeks because the trimester in which prenatal care began could not be determined from our data sources. Women missing number of prenatal visits were considered to have had intermediate care.

Statistical Analysis

Data were analyzed in SAS 9.3. The chi-squared (X^2) test was used to characterize the distribution of and determine differences in retention in care and achievement of viral suppression during the prenatal and postpartum periods. The chi-squared (X^2) was also be used to determine the relationship between HIV care received the year prior to pregnancy and HIV care engagement as well as retention and viral suppression during the postpartum period. Multivariate logistic regression was used to determine the association between all variables (with the exception of number of children) and engagement in care within 90 days of the postpartum period. Multivariate logistic regression was also used to measure the associations between all variables and achievement of viral suppression and retention in care during pregnancy and the postpartum period with the exception of number of children. A sub analysis of the 75% of women for whom we had data on the number of children they had before the pregnancy under

study was carried out. Multivariate logistic regression examining associations between all variables and achievement of viral suppression, retention in care and HIV care engagement within 90 was carried out for this subset with the inclusion of number of children in the model. Statistical significance for all tests was based on a P value <0.05 using a 2 tailed test or an odds ratio that doesn't include the null value of 1 in the 95% confidence interval.

IV

RESULTS

We identified 185 women with maternal HIV checked on their infant's birth certificates for children born between July 2014 and June 2015. One hundred and sixty one of these women were successfully matched to eHARS for abstraction of lab data.

Table 1 describes the sociodemographic and clinical variables of the participants (N=161) in our study. Approximately 82% of the women were non-Hispanic Black, 60% were between the age of 25 and 34 and 69% had a high school diploma or less. Seventy four percent of the women had a diagnosis of HIV before pregnancy and about 25% were diagnosed during pregnancy. Of those who were diagnosed before pregnancy, 57% were retained in care during the pre-pregnancy period. Sixty-two percent of the women received adequate prenatal care and 50 % of women had an average of 2 children before the pregnancy under study. Forty-three percent of the women in our study engaged in HIV care within 90 days of the postpartum period, 49% achieved viral suppression by the end of the postpartum period and 55% were retained in HIV care 1 year postpartum.

HIV care received before pregnancy

Bivariate analysis comparing postpartum retention, HIV care engagement within 90 days and postpartum viral suppression among women diagnosed prior to pregnancy was conducted to examine the association between HIV care before pregnancy and postpartum retention as well as postpartum viral suppression. We found that women who were retained in care during the year before pregnancy (80.4 %) were more likely to engage in care within 90 days postpartum than women who were not retained in care (19.61%) $X^2(1, N=120) = 19.02, p < 0.0001$. Women who were retained in care before pregnancy (75.7 %) were more likely to be retained in care

postpartum than women who were not retained before pregnancy (24.29%) $X^2 (1, N=120) = 22.81, p < 0.0001$. Women retained before pregnancy (72.9 %) were also more likely to achieve viral suppression during the postpartum period than women who were not retained (27.1 %) $X^2 (1, N=120) = 11.24, p=0.0008$. A similar pattern was also found with achievement of viral suppression before pregnancy. Women who were virally suppressed during pregnancy were more likely engage in care within 90 days of the postpartum period (72.6% vs. 31.9% $X^2 (1, N=120) = 19.40, p < 0.0001$), be retained for 1 year postpartum (62.9% vs. 30.0% $X^2 (1, N=120) = 12.60, p=0.0004$) and achieve viral suppression during the postpartum period (69.5% vs. 29.5% $X^2 (1, N=120) = 19.18, p < 0.0001$).

A look at the rates of retention and viral suppression during the pre-pregnancy, prenatal and postpartum period among women diagnosed before pregnancy reveal that there is an increase in retention and viral suppression during the prenatal period and decrease back to pre-pregnancy levels during the postpartum period (Figure 1). However only 80% of women who were retained the year before pregnancy were also retained 1 year postpartum and only 69% of women who achieved viral suppression one year before pregnancy achieved viral suppression 1 year postpartum.

Retention in Care

Bivariate analysis comparing the prenatal to the postpartum period showed that women were more likely to be retained in care during pregnancy (79.5 %) than during the postpartum period (55.28%), $X^2 (1, N=161) = 10.47, p = 0.001$. Retention in care during the prenatal period was associated with HIV care received before pregnancy and adequacy of prenatal care, in multivariable logistic regression (Table 2). Women who had intermediate prenatal care (60%) were less likely than women with adequate prenatal care (89%) to be retained during pregnancy

(AOR, 0.17 [95% CI, 0.07-0.46]). Women who were diagnosed during pregnancy (71%) and those not retained in care before pregnancy (65%) were also less likely to be retained in care during pregnancy than those who retained in care before pregnancy (95%) {(AOR, 0.08 [95% CI, 0.02-0.34]) and (AOR, 0.08 [95% CI, 0.02-0.31]) respectively}. Multivariable logistic regression revealed that HIV care received before pregnancy and engagement in HIV care within 90 days were associated with postpartum retention (Table 2). Particularly, women who were diagnosed during pregnancy (46%) and women who were not retained in care before pregnancy (33%) were both less likely to be retained in postpartum care than women who were retained 1 year before pregnancy (81%) {(AOR, 0.24 [95% CI, 0.08-0.75]) and (AOR, 0.28 [95% CI, 0.10-0.80]) respectively}. We also found that women who engaged in care within 90 days postpartum (86%) were more likely to be retained for 1 year postpartum (AOR, 14.57 [95% CI, 5.55-38.27]).

Viral Suppression

Bivariate analysis also showed that women were also more likely to achieve viral suppression during pregnancy (68.9 %) than during the postpartum period (49.7 %), $X^2(1, N=161) = 25.57, p < 0.0001$. Table 3 summarizes the results of the multivariable logistic regression for viral suppression during pregnancy and the postpartum period. Prenatal viral suppression was associated with educational attainment, maternal age and retention in care during the prenatal period. Particularly high school graduates (65.0 %) and those with less than a high school education (61.5 %) were less likely to achieve viral suppression in the prenatal period when compared to those who had some college education or higher (82.0%) {(AOR, 0.19 [95% CI, 0.06-0.61]) and (AOR, 0.18 [95% CI, 0.05-0.61]) respectively}. Younger women, those between the ages of 18 and 24 (69%) and those between the ages of 25 to 34 (63%) were

both less likely to be virally suppressed during the prenatal period than older women, 35 years and older (81%) {(AOR, 0.15 [95% CI, 0.02-0.96]} and (AOR, 0.09 [95% CI, 0.02-0.52]) respectively} Women who were not retained in care during the prenatal period (33%) were also less likely to achieve viral suppression during the prenatal period than women who were retained (78%) (AOR, 0.11 [95% CI, 0.03-0.35]). Achieving viral suppression during the postpartum period was associated viral suppression during pregnancy, retention in care during the postpartum period and maternal age. Women who did not achieved viral suppression (20%) during the prenatal period were likely to be virally suppressed during the postpartum period (AOR, 0.16 [95% CI, 0.05-0.48]). Women who were not retained during the postpartum period (22%) were also 8 times less likely to be virally suppressed at one year (AOR, 0.12 [95% CI, 0.06-0.49]). We found that women between the ages of 25 and 34 (52%) were more likely to achieve viral suppression during the postpartum period than those between 18 and 24 (36%) years of age (AOR, 3.03 [95% CI, 1.05-8.76]).

Postpartum Care Engagement

Postpartum care engagement in our study population was low, approximately 43% of women engaged in HIV care within 90 days of giving birth. We found that HIV care received before pregnancy was associated with care engagement within 90 days. Specifically, women who were retained in care the year prior to their pregnancy were more likely to be engaged in HIV care within 90 days of the postpartum period than women who were not in care the year prior to pregnancy (AOR, 7.02 [95% CI, 2.68-18.42]). Women who were diagnosed during pregnancy were also more likely to be retained in postpartum care than women who were not retained in care 1 year prior to pregnancy (AOR, 4.34 [95% CI, 1.54-12.27]). Achievement of viral suppression during pregnancy was also found to be associated with engaging in care within 90

days after giving birth. Women who were not virally suppressed by the end of their pregnancy were less likely to engage in HIV care within 90 days of giving birth (AOR, 0.27 [95% CI, 0.08-0.58]).

A second multivariate analysis was performed to determine whether engagement during the first 90 days of the postpartum period is associated with retention in care and viral suppression. We found that when race, education, and age are accounted for, care engagement within 90 days of the postpartum period is predictive of retention in care (AOR, 14.76 [95% CI, 6.34-34.39] $p < 0.0001$) and achievement of viral suppression (AOR, 6.52 [95% CI, 3.19-13.35] $p < 0.0001$) during the postpartum period. Specifically, women were more likely to achieve viral suppression and be retained in care 1 year postpartum if they engaged in HIV care within 90 days of the postpartum period.

Sub analysis with number of children

The multivariate sub analysis including number of children in each of the models for a subset of the women (75%, N=122) was conducted to examine the effects of including number of previous children on retention, care engagement and viral suppression. Previous number of children was not found to be significantly associated with any of the outcome variables. We found that including previous number of children did not change the variables that were significantly associated with care engagement within 90 days, retention and viral suppression. Tables five through seven summarizes our findings of factors associated with retention, viral suppression and postpartum engagement when previous number of children is included in the model.

V

DISCUSSION

As expected we found that women in Georgia are more likely to be retained in care and achieve viral suppression during pregnancy than during the postpartum period. This finding is consistent with previous studies (Adams et al., 2015; Rana et al., 2010; Onen et al., 2008) and highlights the importance of linkage to care to an HIV care provider outside the obstetrics field for these women. It may be important for linkage to a non-obstetrics HIV provider to occur during the pregnancy period to allow for optimum engagement in care during the postpartum period as a change in providers may contribute to delays in care engagement (Turner et al., 2000) due to lack of familiarity. Our study found women who engaged in HIV care within 90 days of the postpartum period were more likely to be retained and to be virally suppressed 1 year postpartum. Early linkage to care to a non-obstetric HIV care provider particularly for women diagnosed during pregnancy may contribute long-term retention and viral suppression.

Our study found that women were more likely to achieve viral suppression during the postpartum period if they were virally suppressed during pregnancy. This finding emphasizes the importance of education on adherence to medication and care during the pregnancy period where good adherence habits are likely to be formed. Cavallo et al., 2010 found that women with poor adherence to ART during pregnancy (which predicts low likelihood of viral suppression) are less likely to be adherent postpartum. To increase rates of viral suppression in the postpartum period, it may be important for healthcare providers to educate women on the importance of continued adherence during the postpartum period. We also found that women were likely to achieve viral suppression postpartum if they were retained in care in the postpartum period. Retention in care

is likely to lead to higher adherence rates and thus contribute to achieving viral suppression during the postpartum period.

To our knowledge, our study is the first to examine the relationship between pre-pregnancy HIV care and postpartum retention and viral suppression. We found that care received prior to pregnancy was the most consistent factor associated with postpartum retention and engagement in care within 90 days. Women who were retained in care before pregnancy were more likely to engage in care within 90 days of giving birth and to be retained during the postpartum period than women who were diagnosed during pregnancy and women who were not retained in care before pregnancy. Bivariate analysis looking at just women who were diagnosed before pregnancy shows that those retained in care were more likely to be engaged in care with 90 days, be retained 1 year postpartum and achieve viral suppression than women who were not retained before pregnancy. We found pre-pregnancy rates of retention and viral suppression to be similar to rates of retention and viral suppression during the postpartum period. This finding suggests that women may not just be falling out of care during the postpartum period but simply returning to their pre-pregnancy care pattern. If so, it may be important to educate women on the importance of adherence to HIV care to their overall health and wellbeing and that of their families, for instance in prevention of HIV/AIDS related orphaning. However, we also found that only about 80% of women who were retained before pregnancy are also retained postpartum and only about 70% of women who achieve viral suppression pre-pregnancy were also virally suppressed during the postpartum period. This finding reflects findings from previous studies about the unique challenges during the postpartum period such having to care for a newborn (Boehme et al., 2014) and lack of social support (Buchberg et al., 2015) that may contribute to failure to be retained in care and achieve viral suppression.

Our sub analysis that included number of children in the model did not cause significant changes to our results. However including it in the models emphasized the importance of postpartum viral suppression and care engagement within 90 days on postpartum retention. It also emphasized the importance of HIV care before pregnancy on early care engagement and postpartum viral suppression and retention. Boehme et al., 2014 found that having multiple children made it difficult for women to attend clinic visits. A larger sample may be able to properly detect the true effects of having multiple children on postpartum viral suppression.

There are several limitations to our study. First of all, we relied on surveillance records which are dependent on the quality and completeness of the records reviewed. We were therefore unable to collect information of insurance status and social support which may play a role in retention in care and achievement of viral suppression. We used HIV viral load and CD4 count labs as proxy for medical visits because studies based on chart abstraction have shown a high correlation between medical visits and lab reports (CDC, 2014). However, retention could be under-ascertained if laboratory reporting is incomplete

Our study highlights the importance of establishing quality HIV care throughout the life span of a woman. Sustained HIV care engagement should be made a priority because it predicts long term retention and continued viral suppression. Women who are diagnosed during pregnancy, those who are unable to achieve viral suppression during pregnancy and those who receive inadequate HIV care before pregnancy should be considered as high risk for not engaging in early postpartum care or being retained postpartum. These women may benefit from strong interventions to overcome barriers to care during pregnancy than any other time because they are likely to be motivated to stay in care during that period.

Barriers to care during the postpartum period may be overcome by ensuring that women who need a different HIV provider after delivery are linked to one while still pregnant. For these women, we recommend that linkage occur by providing them assistance with making an appointment within 90 days of the postpartum period with their new HIV provider. We also recommend case management for HIV infected pregnancy women so they may be better retained during the pregnancy and postpartum periods to reduce harm associated with non-adherence and failure to attend necessary clinic appointments. Case managers may be more aware of the unique challenges each individual woman faces and thus be better able to provide the support needed for continued care during the postpartum period.

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Table 1. Demographic and Clinical Variables of Cases.

Characteristics	Total Study Population (N=161)	
	No.	%
Race/Ethnicity		
Black	133	82.61
White	16	9.94
Other	12	7.45
Maternal age at delivery		
18-24	39	24.22
25-34	98	60.87
≥35	24	14.91
Education		
< High school	52	32.30
High school graduate	60	37.27
≥Some college education	49	30.43
HIV care received before Pregnancy		
Diagnosed during pregnancy	41	25.47
Retained in care before pregnancy	69	42.86
Not retained in care before pregnancy	51	31.68
Stage of disease at delivery		
HIV	117	72.67
AIDS	44	27.33
Adequacy of prenatal care		
Adequate	100	62.11
Intermediate	48	28.81
Inadequate	13	8.07
Parity		
≤ 1 child	42	26.09
≥ 2 children	80	49.69
Retention		
Retained during pregnancy	128	79.50
Retained postpartum	89	55.28
Viral Suppression		
Achieved prenatal Viral Suppression	111	68.94
Achieved postpartum Viral Suppression	80	49.69
Engaged in care within 90 days	70	43.48

Table 2. Factors Associated with Retention in HIV Care during Pregnancy and the Postpartum Period in Multivariable Logistic Regression Models.

CHARACTERISTICS	Prenatal retention			Postpartum retention		
	%	AOR	CI	%	AOR	CI
Race/Ethnicity						
Black	78.95	0.92	0.17-4.85	53.38	2.25	0.43-11.76
White	81.25	1	NA	50.00	1	NA
Other	83.33	1.70	0.16-18.60	83.33	26.77	2.03-353.2
Maternal age at delivery						
18-24	87.18	3.11	0.84-11.52	53.85	1.60	0.54-4.75
25-34	76.53	1	NA	56.12	1	NA
≥35	79.17	1.15	0.31-4.28	54.17	0.72	0.21-2.41
Education						
<High school	76.92	0.41	0.13-1.31	55.77	0.88	0.28-2.83
High school graduate	85.00	1	NA	53.33	0.76	0.27-2.17
≥Some college	75.51	0.46	0.14-1.50	57.14	1	NA
HIV care before pregnancy						
Dx during pregnancy	70.73	0.08	0.02-0.34	46.34	0.24	0.08-0.75
Retained in care before pregnancy	95.65	1	NA	76.81	1	NA
Not retained in care before pregnancy	64.71	0.08	0.02-0.31	33.33	0.28	0.10-0.80
Stage of disease at delivery						
HIV	81.20	1.55	0.55-4.23	53.85	0.75	0.28-2.03
AIDS	75.00	1	NA	59.09	1	NA
Adequacy of prenatal care						
Adequate	89.00	1	NA	65.00	1	NA
Intermediate	60.42	0.17	0.07-0.46	37.50	0.40	0.15-1.17
Inadequate	76.92	0.22	0.04-1.14	46.15	0.50	0.10-2.41
Care engagement within 90 days						
Engaged	NA	NA	NA	85.71	14.57	5.55-38.27
Not engaged	NA	NA	NA	31.87	1	NA
Retained during pregnancy						
Retained	NA	NA	NA	61.72	1	NA
Not retained	NA	NA	NA	30.30	0.41	0.12-1.39

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; HIV human immunodeficiency virus; AIDS, acquired immune deficiency syndrome; Dx, diagnosis; NA, not applicable; Confidence intervals that don't overlap the null value of 1 are shown in bold. Multivariate logistic regression for each outcome included all of the demographic and clinical variables listed in the table.

Table 3. Factors Associated with Viral Suppression during Pregnancy and the Postpartum Period in Multivariable Logistic Regression Models.

Characteristics	Prenatal Viral Suppression			Postpartum Viral Suppression		
	%	AOR	95%CI	%	AOR	95%CI
Race/Ethnicity						
Black	66.92	0.35	0.08-1.52	48.87	1.80	0.40-8.02
White	75.00	1	NA	43.75	1	NA
Other	83.33	1.94	0.22-17.36	66.67	1.90	0.24-15.23
Maternal age at delivery						
18-24	69.23	0.15	0.02-0.96	35.90	1	NA
25-34	63.27	0.09	0.02-0.52	52.04	3.03	1.05-8.76
≥35	91.67	1	NA	62.50	2.61	0.62-11.09
Education						
<High school	61.54	0.18	0.05-0.61	46.15	0.98	0.30-3.18
High school graduate	65.00	0.19	0.06-0.61	46.67	0.69	0.24-2.00
≥Some college	81.63	1	NA	57.14	1	NA
HIV care before pregnancy						
Dx during pregnancy	68.29	2.196	0.76-6.37	51.22	2.42	0.72-8.16
Retained before pregnancy	79.71	2.08	0.76-5.66	62.32	1.14	0.39-3.34
Not retained before pregnancy*	54.90	1	NA	31.37	1	NA
Stage of disease at delivery						
HIV	70.09	1.11	0.43-2.86	45.30	0.41	0.15-1.13
AIDS	65.91	1	NA	61.36	1	NA
Adequacy of prenatal care						
Adequate	76.00	1	NA	58.00	1	NA
Intermediate	58.33	0.69	0.27-1.75	31.25	0.49	0.18-1.32
Inadequate	53.85	0.45	0.11-1.89	53.85	1.96	0.38-10.11
Prenatal retention in care						
Retained	78.13	1	NA	54.69	1	NA
Not retained	33.33	0.11	0.03-0.35	30.30	1.06	0.28-3.94
Postpartum retention in care						
Retained	NA	NA	NA	71.91	1	NA
Not retained	NA	NA	NA	22.22	0.12	0.06-0.49
Prenatal viral suppression						
Suppressed	NA	NA	NA	63.06	1	NA
Not suppressed	NA	NA	NA	20	0.16	0.05-0.48
Care engagement within 90 days						
Engaged	NA	NA	NA	74.29	1	NA
Not engaged	NA	NA	NA	30.77	0.42	0.16-1.08

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; HIV human immunodeficiency virus; AIDS, acquired immune deficiency syndrome; Dx, diagnosis; NA, not applicable; Confidence intervals that don't overlap the null value of 1 are shown in bold. Multivariate logistic regression for each outcome included all of the demographic and clinical variables listed in the table.

Table 4. Factors that Predict HIV Care Engagement within 90 days of the Postpartum Period in Multivariable Logistic Regression Models.

Characteristics	%	AOR	95%CI
Race/Ethnicity			
Black	42.11	0.90	0.27-2.96
White	50.00	1	NA
Other	50.00	0.97	0.18-5.25
Maternal age at delivery			
18-24	35.90	1	NA
25-34	44.90	1.53	0.60-3.88
≥35	50.00	0.77	0.26-2.26
Education			
<High school	40.38	0.69	0.28-1.74
High school	43.33	1	NA
≥Some college	46.94	0.86	0.34-2.20
Stage of disease at delivery			
HIV	41.03	0.62	0.27-1.42
AIDS	50.00	1	NA
HIV care before pregnancy			
Dx during pregnancy	46.34	4.34	1.54-12.27
Retained before pregnancy	53.85	7.02	2.68-18.42
Not retained before pregnancy	6.90	1	NA
Adequacy of prenatal care			
Adequate	49.00	1	NA
Intermediate	33.33	0.50	0.21-1.19
Inadequate	38.46	0.54	0.13-4.92
Stage of disease at delivery			
HIV	41.03	0.62	0.27-1.42
AIDS	50.00	1	NA
Prenatal Viral Suppression			
Suppressed	52.25	1	NA
Not suppressed	24.00	0.27	0.08-0.58
Prenatal retention in care			
Retained	45.31	1	NA
Not retained	54.69	2.79	0.89-8.73

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; HIV human immunodeficiency virus; AIDS, acquired immune deficiency syndrome; Dx, diagnosis; NA, not applicable;
Confidence intervals that don't overlap the null value of 1 are shown in bold.
Multivariate logistic regression for each outcome included all of the demographic and clinical variables listed in the table.

Table 5. Factors Associated with Retention in HIV Care during Pregnancy and during the Postpartum Period in Multivariable Logistic Regression Models when Number of Children are Included.

CHARACTERISTICS	Prenatal retention			Postpartum retention		
	%	AOR	CI	%	AOR	CI
Race/Ethnicity						
Black	79.21	0.40	0.03-4.84	46.53	1.39	0.19-10.11
White	83.33	1	NA	58.33	1	NA
Other	88.89	2.0	0.10-5.87	88.89	21.80	0.97-489.3
Maternal age at delivery						
18-24	86.36	1.70	0.29-9.91	50.00	1.14	0.28-4.73
25-34	78.21	1	NA	51.28	1	NA
≥35	81.82	1.01	0.24-4.37	50.00	0.63	0.15-2.71
Education						
<High school	78.57	0.45	0.12-1.72	54.76	0.86	0.23-3.26
High school graduate	86.36	1	NA	52.27	1	NA
≥Some college	75.00	0.42	0.11-1.67	44.44	0.76	0.21-2.74
HIV care before pregnancy						
Dx during pregnancy	72.00	0.11	0.02-0.55	40.00	0.27	0.07-1.09
Retained during pregnancy	94.74	1	NA	75.44	1	NA
Not retained during pregnancy	65.00	0.12	0.03-0.49	22.50	0.20	0.06-0.68
Stage of disease at delivery						
HIV	81.40	1.23	0.40-3.81	48.84	0.62	0.19-2.01
AIDS	77.78	1	NA	55.56	1	NA
Adequacy of prenatal care						
Adequate	89.47	1	NA	60.53	1	NA
Intermediate	63.89	0.31	0.10-0.95	36.11	0.39	0.12-1.30
Inadequate	70.00	0.17	0.03-1.02	30.00	0.34	0.04-2.61
Number of Children						
>1	75.00	0.30	0.07-1.23	51.25	1.61	0.52-4.95
≤1	90.48	1	NA	50.00	1	NA
Care engagement within 90 days						
Engaged	NA	NA	NA	82.35	12.50	4.06-38.45
Not engaged	NA	NA	NA	28.17	1	NA
Retained during pregnancy						
Retained	NA	NA	NA	58.16	1	NA
Not retained	NA	NA	NA	20.83	0.05	0.05-1.21

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; HIV human immunodeficiency virus; AIDS, acquired immune deficiency syndrome; Dx, diagnosis; NA, not applicable; Confidence intervals that don't overlap the null value of 1 are shown in bold. Multivariate logistic regression for each outcome included all of the demographic and clinical variables listed in the table.

Table 6. Factors Associated with Viral Suppression during Pregnancy and during the Postpartum Period when number of children is included in Multivariable Logistic Regression Models.

Characteristics	Prenatal Viral Suppression			Postpartum Viral Suppression		
	%	AOR	95%CI	%	AOR	95%CI
Race/Ethnicity						
Black	65.35	0.46	0.10-2.19	46.53	1.51	0.30-7.69
White	66.67	1	NA	50.00	1	NA
Other	88.89	4.09	0.28-59.73	77.78	1.74	0.15-19.70
Maternal age at delivery						
18-24	68.18	0.22	0.03-1.53	40.91	1	NA
25-34	60.26	0.10	0.02-0.55	48.72	2.45	0.59-10.13
≥35	90.91	1	NA	59.09	1.91	0.35-10.54
Education						
<High school	59.52	0.23	0.06-0.87	50.00	0.98	0.24-3.90
High school graduate	65.91	0.28	0.08-1.02	47.73	0.73	0.22-2.45
≥Some college	77.78	1	NA	50.00	1	NA
HIV care before pregnancy						
Dx during pregnancy	68.00	1.35	0.35-5.19	48.00	2.26	0.47-11.02
Retained before pregnancy	75.44	1.44	0.48-4.32	63.16	1.23	0.34-4.39
Not retained before pregnancy*	55.00	1	NA	30.00	1	NA
Stage of disease at delivery						
HIV	69.77	1.38	0.50-3.83	45.35	0.43	0.14-1.31
AIDS	61.11	1	NA	58.33	1	NA
Adequacy of prenatal care						
Adequate	73.68	1	NA	56.58	1	NA
Intermediate	61.11	0.92	0.31-2.73	33.33	0.47	0.15-1.48
Inadequate	40.00	0.27	0.05-1.45	50.00	2.76	0.46-16.51
Prenatal retention in care						
Retained	75.51	1	NA	54.08	1	NA
Not retained	33.33	0.15	0.04-0.54	29.17	1.29	0.31-5.43
Number of Children						
>1	62.50	0.62	0.22-1.76	47.50	1.26	0.43-3.73
≤1	76.19	1	NA	52.38	1	NA
Postpartum retention in care						
Retained	NA	NA	NA	74.19	1	NA
Not retained	NA	NA	NA	23.33	0.12	0.03-0.48
Prenatal viral suppression						
Suppressed	NA	NA	NA	62.20	1	NA
Not suppressed	NA	NA	NA	22.50	0.14	0.05-0.48
Care engagement within 90 days						
Engaged	NA	NA	NA	70.59	1	NA
Not engaged	NA	NA	NA	33.80	0.68	0.22-2.06

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; HIV human immunodeficiency virus; AIDS, acquired immune deficiency syndrome; Dx, diagnosis; NA, not applicable; Confidence intervals that don't overlap the null value of 1 are shown in bold. Multivariate logistic regression for each outcome included all of the demographic and clinical variables listed in the table.

Table 7. Factors that Predict HIV Care Engagement within the first 90 days of the Postpartum Period when children are included when number of children is included in Multivariable Logistic Regression Models.

Characteristics	%	AOR	95%CI
Race/Ethnicity			
Black	38.61	0.58	0.14-2.41
White	58.33	1	NA
Other	55.56	0.57	0.07-4.53
Maternal age at delivery			
18-24	36.36	1	NA
25-34	42.31	2.24	0.63-8.01
≥35	45.45	1.21	0.26-5.65
Education			
<High school	42.86	0.75	0.24-2.33
High school	43.18	1	NA
≥Some college	38.89	0.62	0.20-1.88
Stage of disease at delivery			
HIV	40.70	0.71	0.27-1.84
AIDS	44.44	1	NA
HIV care before pregnancy			
Dx during pregnancy	44.00	7.06	1.71-29.22
Retained before pregnancy	59.65	11.21	3.44-36.54
Not retained before pregnancy	15.00	1	NA
Number of children			
>1	41.25	1.32	0.49-3.53
≤1	42.86	1	NA
Adequacy of prenatal care			
Adequate	46.05	1	NA
Intermediate	36.11	0.77	0.28-2.14
Inadequate	30.00	0.65	0.12-3.52
Prenatal Viral Suppression			
Suppressed	50.00	1	NA
Not suppressed	25.00	0.25	0.08-0.79
Prenatal retention in care			
Retained	43.88	1	NA
Not retained	33.33	2.54	0.69-9.34

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Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; HIV human immunodeficiency virus; AIDS, acquired immune deficiency syndrome; Dx, diagnosis; NA, not applicable;
Confidence intervals that don't overlap the null value of 1 are shown in bold.
Multivariate logistic regression for each outcome included all of the demographic and clinical variables listed in the table.

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