A Systematic Review of Barriers and Interventions towards Eliminating Mother-to-Child HIV Transmission in the United States

By

Bridget A. Wynn

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Cheryl Lesneski, DrPH

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Rana Chakraborty MD, MSc, FRCPCH, DPhil (PhD)

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Abstract

Mother-to-child transmission of HIV is a persistent public health issue in the United States, where 151 children were estimated to be infected in 2009. The CDC has defined elimination of mother-to-child transmission of HIV as rates below 1 in 100,000 children. Currently, the United States has a rate of approximately 2.2/100,000. The rate has fallen since the epidemic began, but is above what is achievable. Each transmission is a sentinel public health event, and represents missed opportunities for intervention. This paper provides a systematic review of the literature examining barriers that currently exist towards eliminating cases and opportunities to improve service implementation. This paper will also analyze successful interventions with evidence based practice that can be implemented towards eliminating mother-to-child HIV transmission. Although major inroads to reduce transmission events have occurred in the US over the last two decades, preventable cases remain. The CDC has developed a framework to eliminate mother-to-child transmission. The framework identifies a cascade of events for preventing the transmission of mother to child HIV infection. The framework also identifies areas where local health departments and health care providers may have failed to identify HIV-infected mothers and opportunities to improve. In the last decade, research has focused on specific best-practices targeting racial disparities and other tangible mechanisms for implementing effective interventions in the United States, within local health departments and across health care providers who work with women of childbearing age that are either HIV infected or at risk for infection to eliminate mother-to-child HIV transmission. This systematic review analyzed research from three databases from 2006 to present that show successful targeting of barriers and implementation of interventions that
resulted in either: a) reduced mother-to-child HIV transmission; or b) the implementation of evidence-based practices, including the CDC framework.
**Introduction and Background**

Human Immunodeficiency Virus (HIV) affects immune cells called CD4+ T cells. Depletion of these cells is associated with the development of opportunistic infections leading to Acquired Immunodeficiency Syndrome or AIDS (CDC, 2015). Around 50,000 persons per year are estimated to contract HIV in the US. 1.2 million persons live with HIV in the US, with 14% unaware they have the disease (CDC Fact Sheet, 2012). The virus can be transmitted by body fluids (blood, semen, rectal fluids, vaginal fluids and breast milk). These fluids are transmitted during sexual intercourse, intravenous drug use, blood transfusions, and from the mother to the child during pregnancy, birth or by breastfeeding (CDC, 2015). Without interventions, the rate of mother-to-child transmission is 25-40% (WHO, 2015).

An estimated 8,700 HIV-infected women gave birth in the US in 2006 (CDC, pregnancy fact sheet). The rate of perinatally-acquired HIV infections is 2.2% in exposed infants from 2005-2008, and 2.7/100,000 births in 2004-2007. Nationally, the number of children with AIDS due to perinatal transmission peaked in 1992 with 901 cases and declined to 48 cases by 2004, (CDC, 2006). In 2010, there were an estimated 217 children younger than thirteen diagnosed with HIV in states with national reporting. Of those, 162 or (75%) were perinatally-infected (CDC, HIV Fact Sheet). Infection rates were disproportionately high among African-American women and children. In 2009, the rate of diagnosis per 100,000 live births for 46 states was 0.1 for Caucasian children, 1.7 for Hispanic/Latino, and 9.9 for Black/African-American children (CDC, 2014).
Pediatric AIDS cases were first described in the United States in 1982 (MMWR, 1982). The first policy to prevent transmission was released in 1985, when the CDC recommended avoidance of breastfeeding by HIV-infected mothers (MMWR, 1985). Recommendations continued as evidence demonstrated the effectiveness of certain interventions, including routine HIV testing for pregnant women and scheduled caesarian delivery for women with viral loads >1000 copies (MMWR, 1995; HHS, 2005). Prophylactic regimens were introduced in 1995 and the rate of transmission has fallen since that time (MMWR, 1994). In other resource rich countries such as the United Kingdom and Ireland, the rate of transmission declined from...
2.1% in 2000-2001 to 0.46% in 2010-2011. In the United States, the rate of transmission has decreased, but rates differ geographically. Southern states, New Jersey and New York show much higher rates, while in many states there are no recorded perinatal cases for years. Florida has an estimated rate of 10.5/100,000 children under the age of 13 living with HIV, while New York has an estimated rate of 22/100,000. Ninety one percent are estimated to be infected perinatally, and 9% other, which includes blood transfusion, hemophilia, or was not reported (CDC, 2007).

Three modes of perinatal transmission are possible. The first is prior to birth, from microtransfusion of maternal blood via the placenta. The second is during labor and delivery from exposure to the mother’s cervicovaginal secretions and blood. Lastly, transmission can occur after birth, primarily from breastfeeding, which can result in perinatal transmission approximately 14% of the time. For breastfeeding, the risk is higher for mothers in the acute stage of HIV, so formula feeding is especially important for women who seroconvert during pregnancy. The vast majority of transmission events occur in the last two months of pregnancy (Levinson, 2014).

The Centers for Disease Control and Prevention (CDC) defines elimination as 1 infection per 100,000 births or lower. Racial disparities present an issue for achieving elimination, particularly in the Southeastern US, which has a rate of 0.1 for Caucasian infants and 9.9 in African-Americans per 100,000 births (CDC, 2014). It is difficult to determine the exact rate of perinatal transmission in the United States as all states do not report the number of infants exposed to HIV (Whitmore, 2011). In 2006, 24 jurisdictions of 50 states and major cities
reported HIV-infected and HIV-exposed infants to surveillance systems. The CDC also funds the Enhanced Perinatal Surveillance program in 15 geographic areas (CDC, 2008). The local and state public health departments are responsible for surveillance reporting and health care providers are responsible for reporting HIV infection demographic, mode of exposure and clinical data to the health departments, as a reportable condition. Both health departments and local health care providers are responsible for the identification and appropriate treatment of HIV-infected pregnant women and their infants before, during, and after childbirth, so interventions and recommendations must be made targeting both populations that improve practices.

Figure 1: Framework for Eliminating Mother-to-Child Transmission of HIV

Nesheim (2012)
The CDC has developed a framework (figure 1) to eliminate mother-to-child transmission in the United States (Nesheim, 2012). The framework was developed from a consensus of public health experts aiming to “reduce HIV incidence, increase access to care for HIV-infected individuals and optimize their health outcomes, decrease health disparities, and increase collaboration among federal agencies engaged in HIV prevention and care activities” (Nesheim, 2012). It is developed with the idea all that parts must interact and requires constant feedback and information sharing to function. The core is real-time case finding which interacts with HIV primary care services, case review and community action, research and monitoring, and data reporting to federal agencies. These components are undertaken at the same time as the prevention cascade (Figure 2). The framework identifies areas where local health departments and local health care providers have failed to identify HIV infected mothers and link them to medical care. As an example, review of clinical cases could identify areas for research or missed opportunities for intervention. The framework also provides a cascade of events that must occur to prevent transmission. In addition to the framework, research over the past decade has focused on best-practices for implementing effective interventions in the United States to prevent the elimination of mother-to-child HIV transmission. This paper is a systematic literature review of barriers that still exist to preventing mother-to-child HIV transmission as well as opportunities presented through application of the CDC framework and implementation of effective interventions.
Methods

This paper provides a systematic review of recent (2006 to present) publications which identify possible barriers and opportunities for local public health departments and local healthcare providers to prevent mother-to-child HIV transmission. The paper seeks to answer the following question: “Using the CDC Framework, what are the barriers and successful interventions, if any, for eliminating mother-to-child HIV transmission in the United States?” Opportunities include identifying HIV-infected pregnant women and the cascade of events that prevent a transmission event; including making sure the woman receives prenatal care.

Inclusion criteria:

- Published 2006 to present
- Limited to the United States
- Published in English
• Study population includes local health departments and/or health care providers that work with HIV infected women or women themselves

• Identifies barriers and opportunities to prevent transmission

• Addresses multiple components of the CDC framework

• Presents interventions addressing barriers that are evidence-based or proven to be effective

• Study is of scientific rigor with sound study methods, statistical analysis and has meaningful recommendations. Can be descriptive, quasi-experimental, experimental, or correlational.

Exclusion Criteria:

• Focus on countries other than the United States

• Study population is not at risk for perinatal transmission or does not provide services to prevent transmission

• Not in English

• Overview without analysis of barriers and opportunities

• Did not review implementation strategies

• Published before 2006

• Excluding vaccines, as not currently a viable option for prevention.

• Antiretroviral and clinical regimens only

• Laboratory-based research

PubMed, Scopus and Popline were used as databases to search for publications. Search terms were “Perinatal HIV transmission United States”, “Perinatal HIV transmission United States”
intervention”, “Mother to child HIV Transmission HIV United States”, and “Mother to child HIV Transmission HIV United States intervention” in English, 2006 to present.

T PubMed was used to identify high quality journals with biomedical content. PubMed is the most comprehensive source of biomedical reference, with more than 23 million articles (PubMed). Popline is a database specialized for family planning and reproductive health research. Scopus is a large database for citations and abstracts of peer-reviewed literature.

Search results were screened for applicability. Results were screened to determine which publications meet inclusion/exclusion criteria. Duplicates were removed. Remaining full-text publications were reviewed for eligibility. Laboratory-based publications that studied the science behind preventing transmission at the cellular level were excluded. The United States is considered a high income country, so studies focusing on prevention of transmission in resource limited settings were not included in the review.

Results of the Systematic Review

One thousand two hundred twenty four records were identified. Of those, 162 were possibilities and assessed for eligibility. Ninety were excluded due to not meeting inclusion criteria, with 67 full-text articles reviewed. Forty-seven papers were excluded due to one or more of the following criteria: article was not available, was not focused on the United States, data was before 2006, research was too clinical in nature, or did not contain any strategies for overcoming barriers or interventions.
Table one lists references that have evidence based practice on interventions for prevention of transmission. Table two lists recommendations for overcoming barriers in prevention of transmission.
# Table 1: Application of Systematic Review Criteria to Select References with Successful Interventions

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<tr>
<th>Reference</th>
<th>Study Population</th>
<th>Study Design</th>
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<td>Educating health professionals in obstetrics and gynecology regarding rapid human immunodeficiency virus (HIV) testing in labor and delivery: a local initiative.</td>
<td>9 hospitals 194 hospital personnel 74% (n=142) nurses 12% (n=24) physicians 9% (n=16) midwives 2% (n=4) pharmacists 2% (n=3) health educators</td>
<td>Pre and post educational presentation</td>
<td>Presented educational program on HIV testing, perinatal transmission, and information to be given to the mothers by hospital staff. Compared same participants pre and post study intervention. Calculated frequency and proportion. X squared and P values determined.</td>
<td>Rapid test availability at hospital: Pre-test: 29.1% Immediate post-test:13.8%, 3-month follow-up 3.4% Does rapid HIV testing help prevent perinatal transmission? Pre-test: 42%, Immediate post-test:82.3%, 3-month follow up: 77.8% Study showed low baseline knowledge on HIV and testing among health care providers. Intervention resulted in significant increase in general knowledge of HIV but very low awareness of rapid testing availability. Showed education programs are a successful way to increase knowledge necessary for hospital staff to successfully test pregnant women with unknown status.</td>
<td>Successful Intervention: Educational program increased provider knowledge on necessity of HIV rapid testing in labor and delivery.</td>
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<td>Perinatal HIV testing and diagnosis in Illinois after implementation of the Perinatal Rapid Testing Initiative</td>
<td>1,141,799 women who gave birth in Illinois hospitals</td>
<td>Observational cohort study to observe Changes in the frequencies of HIV status documentation, rapid test utilization, and newborns discharged with unknown HIV status were assessed Exploring Universal HIV Testing.</td>
<td>In 2005, the Perinatal Rapid Testing Implementation in Illinois (PRTII) initiative was implemented, mandating all women at labor and delivery with unknown status be tested for HIV.</td>
<td>The comparison of annual data from 2005 to 2011 demonstrated a significant increase in testing. However, universal testing did not show a decrease in transmission (.10% to .09%) 63% decrease in women with undocumented HIV status (11.7% vs 4.3%, P=.001) 98% decrease in women with unknown status who did not receive rapid testing (29.6% vs 0.5%, P=.001), 99% decrease in infants with undocumented status at discharge (2.74% vs 0.01%, P=.001). 38% of hospitals prior to implementation were testing. 100% of hospitals are testing after implementation.</td>
<td>Intervention partially successful: Successfully implemented universal testing portion of framework. Did not decrease overall transmission, likely due to complex set of factors.</td>
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<td>3. Obstetric Providers’ Knowledge, Awareness, and Use of CDC’s HIV Testing Recommendations and One Test. Two Lives. (Green et al.)</td>
<td>OBGYNs who were members of American Medical Association n=500</td>
<td>Cross sectional survey given to a random sample of obstetric care providers on provider and medical practice characteristics, awareness of CDC recommendations, and HIV testing, and exposure to CDC media campaign</td>
<td>The One Test, Two Lives, social marketing campaign was developed by the CDC to increase awareness and implementation by health care workers of revised recommendations for routine universal prenatal HIV testing.</td>
<td>Survey showed OBGYN’s exposed to the campaign were significantly more likely to be knowledgeable of HIV testing recommendations and follow them. This may provide guidance in future for campaigns to change health care provider behavior.</td>
<td>Successful intervention: OBGYNs exposed to media campaign more likely to implement HIV testing and revised recommendations</td>
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<td>4. Rapid Human Immunodeficiency Virus Testing in Labor and Delivery (Jamieson et al.)</td>
<td>Women presenting at labor and delivery at 2 hospitals: 1. Active labor 24 weeks or later gestation 2. not-in labor 34 weeks or later gestation. No prenatal care (requirement removed midway) 2,369 eligible 308 tested</td>
<td>MIRIAD study implemented in two Atlanta hospitals to identify women in labor and delivery settings with previously undiagnosed HIV. Exploring Universal HIV Testing</td>
<td>Women presenting at labor and delivery were identified by residents at hospital and consented, then tested for HIV using OraQuick Rapid HIV test at critical care laboratory. Results processed. If HIV+, mother and/or child started on ARVs and put into care.</td>
<td>Of 2,369 eligible, only 308 were tested, with 3 testing positive for HIV. Low testing rates were attributed to several factors: 1. One hospital’s policy prevented rapid POC testing anywhere but in laboratory, creating complications and difficulty. 2. When women are not in prenatal care at delivery hospital, accessing records is challenging for eligibility determination to test. 3. Regular hospital staff frequently failed to identify HIV status of women at delivery. Study staff later identified status via triage log audit, missing timely intervention</td>
<td>Successful intervention: universal HIV testing was more effectively implemented in hospitals with engaged staff, policies that allow for bedside testing, and access to medication records</td>
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<td>5. Progress in Prevention of Mother-to-Child Transmission of HIV in New York State: 1998-2008/Program and Policy Interventions for Preventing Mother-to-Child Transmission of HIV in New York state (Birkhead et al.)</td>
<td>Women of childbearing age in New York City at risk or infected with HIV</td>
<td>New York City and State Health department programs and interventions to prevents perinatal HIV transmission Exploring the implementation of all portions of the framework</td>
<td>New York City and State have implemented a number of programs and services to eliminate MTCT. At community-based health and human service providers: -Primary prevention programs and services -Voluntary HIV testing and counseling -HIV primary care serving, including care management and support -Family planning services -Prenatal care: outreach for early care, prenatal counseling and testing</td>
<td>Data is not available for improvements on a specific program level, but collectively are shown to be effective. Women receiving an HIV testing during pregnancy: 1997=50%, 2002 onwards, 95-96%. Woman presenting at labor and delivery without documentation of test: 1999=14% no test, 2008=3% no test Cases requiring expedited test at delivery receiving test: 1999=82%, 2008=98% Mothers receiving prenatal care: 1997=88.5%, 2008=96.6% Mother’s awareness of status prior to delivery: 2002=67.4%, 2008=76.4% Prenatal ARV use: 1997=64.4%, 2008=93.7% Intrapartum ARV use: 1997=52.0%, 2008=93.1% Rate of perinatal transmission: 1997=11.5% (n=99), 2008=1.3% (n=6)</td>
<td>Successful Interventions: Programs implemented were primary prevention of HIV, universal HIV testing, HIV primary care, family planning and prenatal care, rapid HIV testing and post-natal care</td>
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<td>6. Promising Strategies for Preventing Perinatal HIV Transmission (Clark et al.)</td>
<td>Florida: incarcerates women in Palm Beach County Connecticut: all women presenting at labor and delivery at 1 major hospital Louisiana: Women of childbearing age</td>
<td>Reviewing 3 state’s programs for preventing perinatal transmission Florida: Implemented program to identify incarcerated HIV positive pregnant women and analyzed results Connecticut: Analyzed success of implementing medical records block unless testing performed Louisiana: Program not successful</td>
<td>Florida: Targeted Outreach for Pregnant Women Act (TOPWA) jail outreach screened women for pregnancy and HIV. Those that were positive received prenatal care and linked to services when released Connecticut: One major birthing hospital implemented a block on labor and delivery admission process without documented HIV test</td>
<td>Florida: Screened &gt;5100 women for eligibility, 1014 unsure of pregnancy status, 5.6% (n=57) pregnant. HIV testing for 2580 women, 3.1% (75) seropositive. 38% (n=193) had no prenatal care. Screening identified both HIV+ and -Pregnant women, and 100% linked to prenatal care successfully. This population may be difficult to reach, so important intervention. Connecticut: Women tested: Before block: 81.1% (n=647/798), after block= 97.2% (488/502) Block appears to be a successful way to increase rates of rapid testing at delivery for unknown status.</td>
<td>Successful Intervention: Implemented universal testing identified infection among women of childbearing potential, and linked women to prenatal care.</td>
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<td>7. Rapid Human Immunodeficiency virus-1 Testing on Labor and Delivery in 17 US Hospitals: the MIRIAD Experience (Jamieson et al.)</td>
<td>Women presenting for labor and delivery at 17 US Hospitals. 7898 women enrolled</td>
<td>Multicenter study evaluating the feasibility, acceptability and accuracy of rapid HIV testing in labor. When women presented to labor, their eligibility was determined, they were consented and tested. Medical records were reviewed for data extraction, Statistical analysis using SAS 9.1</td>
<td>Women presenting at labor and delivery were identified by residents at hospital and consented, then tested for HIV using OraQuick Rapid HIV test at critical care laboratory. Results processed. If HIV+, mother and/or child started on ARVs and put into care.</td>
<td>Test results available for 7753 women. 0.7% (n=52) were determined to be infected. Of the infants with known HIV status, 12% became infected due to perinatal transmission (n=5). Women identified before delivery: 65% (n=32) Women received intrapartum AZT prophylaxis: 69.8% (n=30) Infants received AZT: 97.6% (n=41) 48% of the infected women (n=25) were later found to have a previous positive HIV test that was not in medical records, and none (n=0) received ARVs in pregnancy. 85% of women offered testing accepted, suggesting high levels of feasibility, acceptability and accuracy of routine rapid HIV testing at labor and delivery.</td>
<td>Successful Intervention: Rapid testing of women with unknown status at labor and delivery was successfully implemented.</td>
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<td>1. Breastfeeding and HIV-infected women in the United States: harm reduction counseling strategies. (Levison et al.)</td>
<td>Two HIV-infected mothers in the United States</td>
<td>Case study and literature review Lactation suppression</td>
<td>The case study identifies areas where HIV infected mothers may wish to breastfeed and recommends steps the provider can take to remove this barrier to lactation suppression. <strong>Recommendations:</strong> validate women’s wish to breastfeed, understand motivation, offer harm reduction, suggest exclusive breastfeeding, heat treat breast milk, lactation surrogate</td>
<td><strong>Barrier:</strong> To preventing breastfeeding is lack of patient-provider communication</td>
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<td>2. Prevention of perinatal HIV transmission: the Perinatal HIV Hotline perspective. (Waldura)</td>
<td>Health care personnel who called the National Perinatal HIV hotline</td>
<td>Analyzed calls made to Perinatal HIV Hotline, grouped into major themes, and described common questions on preventing perinatal HIV transmission Neonatal ARV prophylaxis Maternal ARV use Universal HIV testing</td>
<td>Analysis of findings from hotline calls showing common questions. These questions indicate knowledge gaps in perinatal HIV transmission and opportunities for educational programs. Common questions included the use of hormonal contraceptive drugs with ARVs, indeterminate test results during pregnancy, and if ARVs should be initiated with third trimester positive results.</td>
<td><strong>Barriers:</strong> Low physician knowledge of testing, and treating HIV infected women and their infants.</td>
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<td>3. Practice of feeding premasticated food to infants: a potential risk factor for HIV transmission. (Gaur et al.)</td>
<td>3 cases of likely HIV infection from premastication</td>
<td>Case study of likely HIV infection from premastication and recommendations on future prevention Post-natal care</td>
<td>Premastatication is a transmission possibility. 3 case of pediatric HIV infection are likely to have occurred during premastication of food. Risk factors include poor adherence to ARVs, low CD4 count, bleeding gums and oral illnesses in caregiver and child. Important to understand cultural practices in order to counsel women and remove as a barrier to preventing infection.</td>
<td><strong>Barrier:</strong> HIV infected women premasticated food for infants due to cultural norms</td>
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<td>4. Missed opportunities to prevent perinatal human immunodeficiency virus transmission in 15 jurisdictions in the United States during 2005-2008. (Whitmore et al.)</td>
<td>15 jurisdictions, following HIV exposed babies from 2005-2008 until status determined. (n=4220)</td>
<td>Study followed infants in Enhanced Perinatal Surveillance project until their HIV infection status was confirmed infected or uninfected. Analyzed binary dependent variables for intervention or opportunity for prevention</td>
<td>Overall missed opportunities: Yes (N=2545) 60.3% Late HIV diagnosis: (N=220) 4.5% No prenatal care: (n=375) 7.9% Incomplete ART: (N=674) 19.5% Vaginal delivery: (1960) 40.5% No recommendations not to breastfeed (N=40) 8% Study looked at barriers to preventing perinatal infection at 5 opportunities within the framework. 60% of the women did not receive all of the framework interventions. This study shows areas to improve health care from missed opportunities within the framework, as well as specific subgroups of women more likely to have missed opportunities: injection drug users, older women, unmarried women and minority</td>
<td><strong>Barriers:</strong> Women who received an HIV diagnosis during pregnancy were not tested because of perceived low risk, and lacked education to prevent transmission to their infants.</td>
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Adjusted odds ratios (aORs) and 95% confidence intervals calculated by logistic regression analyses. Implementing all portions of the framework populations. These populations should be specifically targeted for interventions.

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<td>5. Using the Rapid HIV Test to Rescreen women in the Third Trimester of Pregnancy (Criniti et al.)</td>
<td>OB GYN Clinic in Philadelphia. (n=80) 95% accepted rescreen (n=75)</td>
<td>Evaluated via survey acceptability of HIV third trimester testing in prenatal clinic setting. Reviewed patient attitudes of HIV rescreening, the acceptability of rapid HIV testing, determine HIV risk factors, and determine pregnancy seroconversion rate. Surveyed pregnant women 18-35 &gt;/= 35 weeks gestation who had 1 first trimester negative test.</td>
<td>Acceptability of testing: The women's primary reason to consent: Good for baby's health: 88% (n=65) Good for mother's health: 76% (n=57) testing encouraged by provider 40% (n=30) Acceptability of rapid test: 91% (n=73) preferred results turnaround of rapid test. 81% (n=65) rapid testing was less stressful than conventional testing Risk factors: 35% (n=28) did not know partner's HIV status 4% (n=3) engaged in risky behavior No women seroconverted in study. The study showed high acceptance of rescreening in the third trimester. Barriers to rescreening identified were reporting results too late (91% preferred same day results) perceiving themselves as low risk for HIV (n=3 refused testing), and not being encouraged by provider. Addressing these barriers were shown to increase acceptance of testing.</td>
<td>Barrier: Third trimester testing less acceptable to pregnant women when testing results take too long and testing is not encouraged by a provider.</td>
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<td>6. Obstetrician-gynecologists and perinatal infections: a review of studies of the Collaborative Ambulatory Research Network (2005-2009) (Leddy et al.)</td>
<td>Collaborative Ambulatory Research Network and American College of Obstetricians and Gynecologists members</td>
<td>Getting tested for HIV: 91.6% (n=262) are knowledgeable that behavior prevents infections. Of those knowledgeable, recommends behavior to patients: 97.1% (n=240) Physician knowledge is a barrier to testing pregnant women via CDC recommendations. This study shows high awareness that testing prevents perinatal infections, and recommending that behavior to their patients. Recommendation for testing by physician is associated with higher uptake of testing.</td>
<td>Barrier: provider lack of knowledge of the topic prevents testing and recommending pregnant women for HIV</td>
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<td>Exploring Universal HIV Testing</td>
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<td>7. Perinatal HIV testing among African American, Caucasian, Hmong and Latina women: exploring the role of health-care services, information sources and perceptions of HIV/AIDS (King and Pate)</td>
<td><strong>Study Population</strong> 5 focus groups: 4 of HIV- women, 1 with HIV+ women, stratified sampling method for diversity, perinatal development and HIV status, 18-45 perinatal, African American, Caucasian, Hmong, or Latina. <strong>Study Method</strong> Semi-structured, open-ended focus group interviews of minority women on their experiences with health information sources, feelings at medical visits, perceptions of perinatal HIV testing and understanding of HIV/AIDS. Responses were coded for emerging themes. Adequate pre and postnatal care. <strong>Outcomes</strong> Study looked at reasons minority women may avoid prenatal care and perinatal HIV testing. Prenatal Care: African American HIV negative women expressed difficult utilizing prenatal and post-partum services, long wait times, and invasive procedures. HIV positive women reported barriers to prenatal care as long wait times for treatment, concern for ARV effect on fetal health, and feeling that care was inferior. Testing: Testing was motivated due to partner’s sexual infidelities, preventive measure for health of baby. Fear and isolation are barriers to testing for both infected and uninfected women. Developing patient-provider relationships is essential for trust and communication of health care recommendations for prenatal care and testing. <strong>Results</strong> Barrier: Minority women less likely to seek prenatal care due to difficult utilizing care, long wait time and concern over invasive procedures. Prenatal HIV testing barrier is fear and isolation from results.</td>
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<td>8. Correlates of mother-to-child transmission of HIV in the United States and Puerto Rico (Whitmore et al.)</td>
<td><strong>Study Population</strong> 15 jurisdictions, following HIV exposed babies from 2005-2008 until status determined. <strong>Study Method</strong> Used the Enhanced Perinatal Surveillance system data to analyze mother-infant pairs. 7 variables from the prevention framework were analyzed for missed opportunities to prevent HIV infection in infants. Analyzed transmission rates and population-attributable risk percentage (PAR%). Implementing all portions of the framework. <strong>Outcomes</strong> This study showed that half of infant HIV infections were from missed opportunities from the prevention framework (52%). Overall transmission rate 2.2% (n=179) Mother-infant pairs with &gt;/= missed opportunity (74.3%) rate is 3.1% pairs with all interventions rate is 1.1%. Injection drug use (22%) rate was 5.8% vs. 2.1% heterosexual contact. No prenatal care (26.8%) rate was 8.5% vs. prenatal care 1.6%. Not tested early (29.1%) rate was 15.5% vs 1.6%. No ARVS (48.6%) rate was 9.3% vs. 1.2%. Women who breast fed had a 4.6 times of the odds of having an infected infant vs. not. 26% of infections were attributed to late maternal testing, 45% to not taking ARV medications during pregnancy, and 10% to breastfeeding. For women who did not have these barriers, the infection rate is 1.1%. <strong>Results</strong> Barrier: Mothers not receiving all steps of the perinatal prevention framework to prevent transmission.</td>
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<td>Study Population</td>
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<td>9. Disparity in Hospital Utilization of Rapid HIV-1 Testing for Women in Labor with Undocumented HIV Status (Gaur et al.)</td>
<td>Random sample of 430 women given birth 6 months before implementation, and 430 6 months after implementation in New Jersey hospital</td>
<td>Retrospective study comparing rapid HIV testing of women at labor and delivery 6 months before, and after implementation of hospital program</td>
<td>Program mandating testing of all unknown women presenting at labor was implemented over a 4 week period. Women were randomly sampled from discharge files for the 6 months before and after implementation for documentation of HIV test offering. 22% of women presenting before and 18.1% after implementation did not have documentation HIV status. Eligible women tested: 7.6% (n=7/93) before, 9.6% (7/73) after. Testing rates were extremely low both before and after implementation, and showed a continued need to educate health care workers on testing to successfully achieve implementation.</td>
<td>Barrier: Universal HIV testing not implemented when physicians do not see need and lack awareness for testing outcome</td>
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Discussion:

The literature reviewed in this paper is analyzed and grouped based on the CDC event cascade framework for prevention of mother-to-child transmission of HIV: Prevention of HIV infection in women and girls of childbearing potential, identification of infection among women of childbearing potential, preconception care, early identification of HIV infection in pregnant women, prenatal care for women with HIV infection, reduction of maternal viral load, cesarean delivery with viral load not suppressed, neonatal ARV prophylaxis, avoidance of breastfeeding.

Six publications included in the data showed interventions, qualitative analysis or analyzed surveillance data. Nine studies discuss barriers and opportunities to overcome them.

The literature review attempted to find all barriers and successful interventions for the implementation of the various components of CDC’s framework. Not all of the framework components had research discussing barriers and/or interventions. The lack of treatment of barriers and interventions in literature suggests a need for further research in these areas.

1. Prevention of HIV Infection in women and girls of childbearing potential

This component of the framework lacks implementation evidence within the United States. No publications focused on barriers for prevention of HIV infection in women and girls of childbearing potential from the perspective of eliminating perinatal transmission.

Only one intervention reviewed focused on preventing HIV infection in women and girls of childbearing potential from the perspective of eliminating perinatal transmission, the New York State Department of Health (Birkhead, 2010, Birkhead, 2010). Their HIV Prevention and Care programs are discussed only briefly, and are based on CDC resources. These include “DEBI” or
diffusion of Effective Behavior Interventions, which have shown demonstrated changes, but the articles did not go into detail on specific interventions used (CDC, n.d.). Prevalence of HIV infected women has declined in New York State 70% from its peak at 1989 (.66%) to a low in 2008 (.20%). This 70% drop is attributed to identifying HIV in women of childbearing potential (Birkhead, 2010). Given that prevention of HIV infection in women and girls of childbearing age is the first step in the cascade of events needed for preventing perinatal transmission of HIV, more intervention research should be done to establish stronger evidence based practice.

2. Identification of infection among women of childbearing potential

Identifying infection in women prior to pregnancy decreases the chance for MTCT by creating the opportunity for the women to seek healthcare and be put on ARVs, decreasing their viral load before transmission can occur. No publications focused on barriers for identifying infection among women of childbearing potential. New York State has programs utilizing evidence based practice to identify infection in women before pregnancy occurs (Birkhead, 2010). The Targeted Outreach for Pregnant Women Act (TOPWA) in Palm Beach County, Florida, although geared toward pregnant women, also provided HIV testing to 2580 non-pregnant women (Clark, 2006). Of the women tested under TOPWA, 75 (3.1%) were positive (Clark, 2006). Many programs devoted to general HIV testing exist in the US outside of these targeted programs, but are not in the context of testing to prevent perinatal transmission. These testing and identification programs should incorporate practices specifically for targeting women of childbearing potential to better aid in prevention efforts.
3. Assurance of adequate preconception care and family planning services for HIV-infected women

Barriers to women accessing preconception care, specifically in African American populations, include difficulty utilizing family planning and post-partum services, long wait times, fear of invasive procedures, concern for ARV effect on fetal health, and feeling that care was inferior (King, 2013). The best opportunity to overcome these barriers is improving patient-provider communication, so the patient feels comfortable and respected by the provider. Once trust is achieved, patient fears and concerns can be talked through (King, 2013).

For interventions, New York State integrates HIV case management and support services into its primary care services, allowing for women to prevent unintended pregnancies and improve the women’s overall health before pregnancy occurs (Birkhead, 2010). Currently, only 45% of women infected with HIV in the US are receiving primary care and just 32% have achieved viral suppression (CDC, 2015). With the chance of infection for women without ARVs being 25% (Conner, 1994), connecting women with services is imperative.

4. Early identification of HIV infection of pregnant women through universal prenatal screening

Barriers to HIV testing of pregnant women are fear and isolation from their communities based on the results (King, 2013). Also, when physicians see their patients as low risk and have low awareness for the test, they recommend testing at lower rates (Gaur, 2010). Education for providers on the importance of universal testing can reduce this barrier (Gaur, 2010, Levinson, 2011, Green, 2012).

The framework component with by far the most evidence based practice and interventions is universal prenatal screening for HIV of pregnant women. Rates of HIV testing of pregnant
women varied widely in the interventions, from the Atlanta site of the MIRIAD study showing only 9% of eligible women tested by year 3 of study to 99.8% in Illinois (Dennis, 2007; Jameison, 2007, Wong, 2012). In 2005, the Perinatal Rapid Testing Implementation in Illinois (PRTII) initiative was implemented, mandating all women at labor and delivery with unknown status be tested for HIV. The comparison of annual data from 2005 to 2011 demonstrated a significant increase in testing. However, universal testing did not show a decrease in transmission (.10 % to .09%) 63% decrease in women with undocumented HIV status (11.7% vs 4.3%, P=.001) 98% decrease in women with unknown status who did not receive rapid testing (29.6% vs 0.5%, P=.001), 99% decrease in infants with undocumented status at discharge (2.74% vs 0.01%, P=.001). 38% of hospitals prior to implementation were testing and 100% of hospitals are testing after implementation (Wong, 2012).

Another study comparing rapid HIV testing of women at labor and delivery was Gaur, 2010. This retrospective study compared rapid HIV testing of women at labor and delivery 6 months before, and after implementation of hospital program 6 months before, and after implementation of hospital program. The program mandated testing of all unknown women presenting at labor was implemented over a 4 week period. Women were randomly sampled from discharge files for the 6 months before and after implementation for documentation of HIV test offering. 22% of women presenting before and 18.1% after implementation did not have documentation HIV status. Eligible women tested: 7.6% (n=7/93) before, 9.6% (7/73) after (Gaur, 2010). Testing rates were extremely low both before and after implementation, and show continued need to educate health care workers on testing is needed to successfully achieve implementation.
Criniti et al Rapid HIV Testing Study examined patient acceptability of second time screening for HIV in the 3rd trimester, the acceptability of HIV rapid tests for this screening, knowledge of partner HIV status and condom usage rate, and the rate of seroconversion during pregnancy. In an Obstetrics and Gynecology clinic in Philadelphia, PA, a convenience sample of 80 women were recruited. The women completed a survey on risk factors and HIV knowledge, and then were given a rapid HIV test. All 80 completed the survey, and 75 (95%) accepted the rescreening HIV test. A high acceptability of testing was found, with reasons of “testing is good for baby’s health” (n=65, 88%) and “testing is good for mother’s health” (n=57, 76%). Also, a strong preference for same day results was recorded (n=73, 91%) and participants felt it was less stressful than waiting for results (n=65, 81%). This study demonstrates strong acceptability and perceived value among seronegative pregnant women for repeat testing (Branson, 2006).

Leddy et al. reviewed surveys of the Collaborative Ambulatory Research Network (CARN), asking Obstetrician-Gynecologists on their rate of counseling patients on preventing infectious disease. Ninety one point six percent (n=262) believed getting tested for HIV was a behavior that prevented infections, and of those, 97.1% (n=240) reported recommending this behavior to other individuals. While these numbers are high, respondents also reported 79% had patients refusing HIV testing due to perceptions of low risk, and 28.7% of responders did not plan to offer the test in the future. Moreover, given the common scenario of a patient arriving at labor and delivery with unknown HIV status, only 56.3% of Ob/Gyn providers reported they would rapid test, with 18.2% reporting they wouldn’t and the remaining 25.5% reporting the unavailability of rapid testing (Leddy, 2010).
Another study of Obstetrician-Gynecologists also reviewed HIV testing (Green, 2012). A cross-sectional survey was given to obstetric care providers to determine exposure and outcomes from the The One Test, Two Lives, social marketing campaign was developed by the CDC to increase awareness and implementation by health care workers of revised recommendations for routine universal prenatal HIV testing. The survey showed OBGYN’s exposed to the campaign were significantly more likely to be knowledgeable of HIV testing recommendations and follow them. This may provide guide in future for campaigns to change health care provider behavior.

A review of questions received at the National Perinatal HIV Hotline suggests there are gaps in provider knowledge, specifically about interpretations of HIV test results, antiviral drug regimens, and whether to initiate antiretroviral drug therapy due to a positive rapid HIV test result (Waldura, 2011).

This leads to an important prevention opportunity in the perinatal HIV prevention cascade: universal prenatal HIV testing. It is estimated that among infants who become infected, 30-40% of their mothers did not know their HIV status before delivery (HHS, 2002). The gap is with educating providers on the importance of universal testing, and instituting policies in labor and delivery units to ensure rapid tests are readily available and used. The 2006 Revised Recommendations for HIV Testing from the CDC says: “HIV screening should be included in the routine panel of prenatal screening tests for all pregnant women” and “repeat screening in the third trimester is recommended in certain jurisdictions with elevated rates of HIV infection among pregnant women” (Branson, 2006). Levison et al. surveyed hospital personnel on
knowledge and attitudes of testing and treatment of HIV for pregnant women, (Levinson, 2012). One hundred and ninety four hospital personnel were surveyed prior to an education presentation on the topic, immediately post, and 3 months afterwards. This demonstrated both low general knowledge of HIV and HIV testing, which was addressed by the presentation. The majority, (baseline = 88.5%, post survey=96.9%, and 3-month follow up= 95.6%) knew state law said HIV testing should be done at the first obstetric visit and at the third trimester. A knowledge gap was identified where only half knew (55.3%) that HIV testing should be opt-out, and only 29.1% initially knew of rapid testing availability in their hospital. This number dropped to 13.8% immediately post-test, and to 3.4% at 3-month follow up. This suggests a serious education gap that should be addressed.

Several publications reiterate the need for third trimester testing. Jamieson et al recommends expanding on the 2006 CDC testing recommendations for a second test in the 3rd trimester, as women may acquire HIV during pregnancy. This is especially important in the 22 states with high HIV incidence, as well as all women in facilities with a prevalence of 1 per 1000 HIV infections in screened women, and women who are considered high risk. The Committee on Pediatric AIDS also supports the testing as a way to effectively reduce the risk of MTCT. They recommend testing of all women with unknown status presenting in labor and delivery. Lastly, they recommend changing state laws as necessary to promote opt-out consent of newborns instead of written maternal consent. (Committee on Pediatric AIDS, 2008).

King et al. showed from qualitative focus groups that strong patient provider relationships in both HIV negative and positive women is essential for linking patients with HIV with perinatal
health. They also demonstrated that cultural competence is critical for optimizing care in minority patients by identifying HIV misconceptions. Perinatal testing was strongly supported by the patients in this study when recommended by providers (King, 2014).

5. Provision of adequate prenatal care for women who have HIV infection

Worryingly, many women of childbearing age who become infected have fallen out the system and are “hard to reach” (Nesheim, 2013). Barriers which prevent these women from receiving prenatal care include substance abuse or mental health issues, or living in poverty. Identification, linkage and retention of these women in care would prevent a number of potential failed opportunities. Having perinatal outreach coordinators, whose job it to find these women and get them into care is an important component of prevention (Birkhead, 2010). In African American populations, barriers include difficulty utilizing prenatal services, long wait times, fear of invasive procedures, concern for ARV effect on fetal health, and feeling that care was inferior (King, 2013). The best opportunity to overcome these barriers is improving patient-provider communication, so the patient feels comfortable and respected by the provider. Once trust is achieved, patient fears and concerns can be talked through (King, 2013).

New York City, which has large numbers of HIV-infected women of reproductive age, has almost eliminated mother-to-child transmission. The city has done so with a multilevel approach that targets the mothers, the family, and peers, at the institutional level and in the community across the State. In addition, widespread culturally-competent women’s healthcare and HIV case management is available for pregnant HIV positive women. When infected women are engaged and retained in prenatal services they receive other portions of the framework
including ARV prophylaxis, and counseling on breastfeeding alternatives. These methods have led to an increase of women accessing prenatal care from 88.5% in 1997 to 96.6% in 2008. Prenatal ARV use has increased from 1997 (64.4%) to 2008 (98.7%) (Birkhead, 2010).

Whitmore et al. examined correlates of mother-to-child transmission. They conducted logistic regression on 7747 mother-infant pairs of exposed babies born in the United States and Puerto Rico. They identified specific missed opportunities, including lack of prenatal care. This missed opportunity showed an increase in transmission rates, 8.5% without prenatal care vs. 1.6% with prenatal care (Whitmore, 2012).

6. Maximum reduction of maternal viral load through appropriate use of ARV drugs

No research has focused on barriers to reducing maternal viral loads through ARV drugs, even though just 32% women in the United States have achieved viral suppression (CDC, 2015). With the chance of infection for women without ARVs being 25% (Conner, 1994), viral suppression is an important component of the cascade.

With respect to interventions, New York State implemented programs to keep pregnant women on ARVs so viral load is maximally repressed. This led to prenatal ARV use increasing from 1997 (64.4%) to 2008 (98.7%) (Birkhead, 2010). No data was available on the level of viral suppression the ARV use produced by birth, since ARV use could be intermittent. This would be an important research topic to pursue, as adherence to medications can vary. Future research should focus on additional interventions increasing ARV use, particularly in pregnant women.
7. **Caesarean delivery when maternal viral load is not maximally suppressed**

Cesarean delivery is an important tool for preventing mother-to-child transmission. For mothers with high viral loads, elective cesarean delivery can lower risk of transmission to below 2% (Mofenson, 1999). No barriers or successful interventions for cesarean delivery were discussed in the literature. Although New York State showed cesarean delivery is associated with lower transmission rates than vaginal delivery: (OR:1.77) (Birkhead, 2010), no research has focused on appropriate implementation of caesarean delivery in the United States. Furthermore, while we have data on the efficacy of cesarean delivery, no research shows evidence based interventions for implementing appropriate use at delivery. Future research should explore implementation strategies for delivery room uptake.

8. **Provision of neonatal ARV prophylaxis**

No barriers to implementation of ARV prophylaxis were discussed in the literature. With respect to interventions, New York State has worked to implement ARV prophylaxis in birth facilities for newborns. The rates for prophylaxis have risen from 61.9% in 1997 to 99.7% in 2008 (Birkhead, 2010). The state health department requires a 12 hour maximum turn around for rapid HIV testing of the mother after birth if no documentation is available. This allows for introduction of ARV prophylaxis as soon as possible (Birkhead, 2010). Data is otherwise scarce for implementation of neonate prophylaxis results, and more research is needed.

9. **Neonatal replacement feeding as well as maternal support for lactation suppression.**

Breastfeeding substantially raises the risk of postnatal transmission of HIV. In resource-rich countries, the CDC and American Academy of Pediatrics recommendations are to avoid
breastfeeding infants. New York State showed breastfeeding was more likely to lead to transmission than formula (OR:4.42) (Birkhead, 2010).

One barrier, however, is that there may be strong cultural influences promoting breastfeeding, which providers should discuss with women post-partum (MMWR, 1985; AAP, 2013). Open and non-judgmental communication with explanation of the risks may be the best way to combat barriers for breastfeeding prevention (Levinson, 2014). If breastfeeding does occur, it is imperative that the mother and baby receive ARVs. Validating the patients’ needs and desires as well as understanding cultural competencies will lower the chance of surreptitious feeding and offer providers an opportunity to manage harm reduction, including heat treatment of milk (Levinson, 2014). *Other prevention opportunities:*

Transmission via premastication is rare, although there are three possible documented linked cases in the United States. However, it is a risk factor and possible source of transmission, and routine inquiry should be made by medical providers to identify infected mothers or caregivers who follow this practice (Gaur, 2009).

Racial and ethnic disparities exist within perinatal HIV transmission in the United States and have persisted since the beginning of the epidemic. From 2004 to 2007, 85% of infants diagnosed with HIV were African-Americans (69%, 12.3 per 100,000), or Hispanics/Latinos (16%, 2.1 per 100,000). These disparities are related to HIV infection in the population as a whole, but the rate of disparities in the perinatal population is starker than any other. Studies have shown that African-American mothers who gave birth to HIV–exposed infants were twice as likely than white mothers of the same demographic to not have prenatal care, and had lower rates of
virologic suppression (CDC, 2010). However, these studies are from 15 years ago, and newer research needs to be conducted.

Nesheim et al. (2012) also echoes the importance of racial disparities, particularly with the first strategy in the Perinatal HIV Prevention Cascade: preventing HIV infection in the first place among African American and Hispanic women of childbearing age. The next strategy suggested is to utilize Perinatal HIV Services Coordinators to identify HIV infected women as early as possible in pregnancy, and link them with appropriate care (Nesheim, 2012).

**Conclusions**

Tangible solutions to functional elimination of mother-to-child transmission of HIV are available in the United States. Implementing universal HIV screening for pregnant women is the best studied evidence based practice, and local health departments and health care centers should follow this practice to implement CDC recommendations.

Barriers that prevent local health departments and providers from implementing practices that reduce mother to child HIV transmission include; lack of patient provider communication for breastfeeding and HIV testing; low physician knowledge of testing and treating HIV infected women and their infants; third trimester testing being less acceptable to pregnant women when testing results take too long or not encouraged by provider; minority women not seeking out prenatal care due to difficulty utilizing care; long waiting time and concern over invasive procedures; not seeking perinatal testing due to fear and isolation; mothers not receiving all steps of the perinatal prevention framework to prevent transmission; and HIV infected women premasicating food for their infants due to cultural norms.
Best practices from the literature identify the following for prevention of mother-to-child transmission implementation: routine education for professionals in obstetrics and gynecology on HIV testing and care; avoiding missed opportunities at key points; rescreening women in 3rd trimester for HIV; focusing on women with intravenous drug use; making sure providers are culturally competent for minority at risk populations; use of outreach coordinators to identify and link HIV-infected pregnant into prenatal care; recommend opt-out rapid testing versus signed consent for women with no prenatal care; appropriate testing of all neonates born to mothers of unknown HIV or HIV positive status; implement elective C-sections when appropriate; and counsel to avoid premastication of food and breastfeeding in HIV-exposed infants and toddlers.
References:


http://aidsinfo.nih.gov/ContentFiles/PerinatalGL.pdf.


