Factors Associated with Perinatal HIV Transmission among Infants Born 1997-2001 in New York City

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Perinatal HIV Infection in the United States

• The perinatal HIV epidemic began in 1977
• In the early 1990’s, between 1,000-2,000 HIV-infected infants were born each year
• In 2000, the estimated number of HIV-infected infants dropped to 280-370
• Each year, there are between 6,000-7,000 births to HIV-infected women
• Approximately 10% of births to HIV-infected women in the United States are reported from New York City

Background

• Reductions in perinatal HIV transmission were shown:
  – In 2002: prenatal regimens containing zidovudine in combination with other antiretrovirals (*JAIDS* 2002;29:484-94)

• Recent recommendations for HIV-infected pregnant women were issued:
  – in 2003: by *US Public Health Service* to use antiretroviral agents and interventions including Cesarean-section delivery for women with HIV-1 RNA levels above 1,000 copies/ml (*www.AIDSinfo.nih.gov*)
Objectives

• To describe trends in perinatal HIV prevention measures in New York City
• To describe missed opportunities for perinatal HIV prevention
• To describe failures of perinatal HIV prevention
• To describe factors associated with perinatal HIV transmission
Methods

• HIV-exposed singleton infants born 1997-2001 in care at 22 NYC sites (10 sites participate in the national CDC-funded Pediatric Spectrum of HIV Disease Project)

• Retrospective abstraction of infant medical records with IRB approval

• Inclusion criteria for analytic cohort includes documentation of:
  – prenatal care
  – mode of delivery
  – prenatal, intrapartum, and neonatal antiretroviral use
    (data on maternal adherence is NOT collected)

• Infant HIV infection status is defined by the CDC (MMWR 1999;48;RR-13:1-36) with a modification for presumed uninfected (2 negative PCRs 1-3 months of age)
HIV-Exposed Births, New York City, 1988-2001

HIV-exposed births in NYC*

HIV-exposed birth reported to NYC DOHMH from 22 NYC sites

*New York State Data available through the Comprehensive Newborn Screening Program
HIV-exposed Singleton Births, 22 NYC Sites, 1997-2001*
N=2,612

**PRENATAL CARE**
- Unknown
  - N=406 (15%)
- No
  - N=148 (6%)
- Yes
  - N=2,058 (79%)

**MODE OF DELIVERY**
- Unknown
  - N=74 (3%)
- Vaginal
  - N=1,655 (63%)
- C-section
  - N=883 (34%)

**HIV INFECTION STATUS**
- Status by any prenatal ARV use
  - N=2,612
- Status among births with complete maternal and neonatal data (ZDV regimens)
  - N=1,684 (65%)
- Other 1-2 arm ARV Regimens
  - N=286 (11%)
- Maternal and/or neonatal ARV data incomplete
  - N=267 (10%)
- Miscellaneous other regimens
  - N=375 (14%)

- Of 2,809 births, 79 (3%) multiple births and 118 (4%) unknown birth type excluded; 2% of the 2,612 infants were breastfed
ARV=antiretroviral; ZDV=zidovudine
Results-1: Characteristics of HIV-Exposed Singleton Deliveries (N=2,612), 22 NYC Sites, 1997-2001

Maternal Race/Ethnicity:
- 65% Black
- 29% Hispanic
- 3% White
- <1% Asian, Native American
- 2% Unknown

Source of Pediatric Medical Reimbursement:
- 82% Public
- 5% Private
- 3% None
- 10% Unknown
Results 1 continued

Maternal Illicit Drug Use

- 15% Use of crack/cocaine and other street drugs
- 6% Use of injection drugs
- 79% No chart documentation of illicit drug use
## Results-2: Prenatal Care among HIV-Exposed Deliveries (N=2,612), 22 NYC sites, 1997-2001

<table>
<thead>
<tr>
<th>Year of Birth</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of deliveries</td>
<td>545</td>
<td>565</td>
<td>572</td>
<td>500</td>
<td>430</td>
<td>2,612</td>
</tr>
<tr>
<td>No. with prenatal care</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes*</td>
<td>373</td>
<td>412</td>
<td>491</td>
<td>410</td>
<td>372</td>
<td>2,058</td>
</tr>
<tr>
<td>No</td>
<td>45</td>
<td>40</td>
<td>26</td>
<td>20</td>
<td>17</td>
<td>148</td>
</tr>
<tr>
<td>Unknown</td>
<td>127</td>
<td>113</td>
<td>55</td>
<td>70</td>
<td>41</td>
<td>406</td>
</tr>
<tr>
<td>Deliveries with prenatal care data: % with prenatal care+</td>
<td>89%</td>
<td>91%</td>
<td>95%</td>
<td>95%</td>
<td>96%</td>
<td>93%</td>
</tr>
</tbody>
</table>

*Overall, 89% of women with prenatal care were diagnosed with HIV before delivery
+ Includes only Yes and No categories
Results-3: Prenatal Antiretroviral Therapies among HIV-Infected Women in Prenatal Care (N=2,058), 22 NYC Sites, 1997-2001

Year of Birth

- 1997
  - ZDV and a PI regimen*: 10%
  - ZDV and NRTI/NNRTI: 40%
  - ZDV alone: 10%
  - Other ARVs: 50%
  - Unknown: 10%
  - None: 1%

- 1998
  - ZDV and a PI regimen*: 20%
  - ZDV and NRTI/NNRTI: 20%
  - ZDV alone: 20%
  - Other ARVs: 20%
  - Unknown: 10%
  - None: 10%

- 1999
  - ZDV and a PI regimen*: 30%
  - ZDV and NRTI/NNRTI: 30%
  - ZDV alone: 20%
  - Other ARVs: 10%
  - Unknown: 10%
  - None: 10%

- 2000
  - ZDV and a PI regimen*: 20%
  - ZDV and NRTI/NNRTI: 20%
  - ZDV alone: 20%
  - Other ARVs: 20%
  - Unknown: 10%
  - None: 10%

- 2001
  - ZDV and a PI regimen*: 10%
  - ZDV and NRTI/NNRTI: 30%
  - ZDV alone: 20%
  - Other ARVs: 20%
  - Unknown: 10%
  - None: 10%

N=373 N=412 N=491 N=410 N=372

ZDV=zidovudine; PI=protease inhibitor; ARV=antiretroviral
NRTI=nucleoside reverse transcriptase inhibitor
NNRTI=non-nucleoside reverse transcriptase inhibitor

*84%: 3-drug regimens
### Results-4: Mode of Delivery in HIV-Exposed Deliveries, 22 NYC Sites (N=2,612), 1997-2001

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of deliveries</strong></td>
<td>545</td>
<td>565</td>
<td>572</td>
<td>500</td>
<td>430</td>
</tr>
<tr>
<td><strong>Vaginal</strong></td>
<td>77%</td>
<td>75%</td>
<td>59%</td>
<td>50%</td>
<td>51%</td>
</tr>
<tr>
<td><strong>C-section</strong>*</td>
<td>20%</td>
<td>21%</td>
<td>39%</td>
<td>47%</td>
<td>47%</td>
</tr>
<tr>
<td><strong>Unknown</strong></td>
<td>3%</td>
<td>4%</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
</tr>
</tbody>
</table>

*All C-section deliveries regardless of indication; beginning in 1999, indications collected*
Results 5: Indications for C-Section Deliveries in HIV-Exposed Births (N=661), 22 NYC Sites, 1999-2001

- 60% HIV prevention
- 7% Unknown
- 21% Obstetrical/neonatal complications
- 8% Elective/Repeat
- 4% HIV prevention and obstetrical/neonatal complications
Results-6: Infant HIV Infection Status (N=2,612), by Prenatal Antiretroviral Use, 22 NYC Sites, 1997-2001

Mother Prescribed Any Prenatal Antiretroviral Therapy*

- **Yes**
  - n=1,832 (71%)
  - 80%
  - 16%
  - 4%

- **No**
  - n=532 (20%)
  - 61%
  - 22%
  - 17%

- **Unknown**
  - n=248 (9%)
  - 65%
  - 18%
  - 17%

*Any prenatal antiretroviral (ARV): zidovudine (ZDV) alone or in combination with other antiretrovirals (ARVs) (80 ARV regimens did not include ZDV) regardless of intrapartum and neonatal ARVs
## Results-7: Infant HIV Infection Status (N=1,684), by Antiretroviral Use, 22 NYC Sites, 1997-2001

<table>
<thead>
<tr>
<th>Timing of ARV Use</th>
<th>N</th>
<th>% INF</th>
<th>% UNF</th>
<th>% IND</th>
<th>OR (95% CI)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prenatal ZDV with other ARVs plus intrapartum and neonatal ZDV</td>
<td>675</td>
<td>2</td>
<td>84</td>
<td>14</td>
<td>0.07 (0.04-0.15)</td>
</tr>
<tr>
<td>Prenatal, intrapartum and neonatal ZDV</td>
<td>644</td>
<td>5</td>
<td>77</td>
<td>18</td>
<td>0.21 (0.12-0.35)</td>
</tr>
<tr>
<td>Intrapartum and neonatal ZDV only</td>
<td>63</td>
<td>11</td>
<td>67</td>
<td>22</td>
<td>0.54 (0.21-1.37)</td>
</tr>
<tr>
<td>Neonatal ZDV only*</td>
<td>84</td>
<td>8</td>
<td>69</td>
<td>23</td>
<td>0.36 (0.14-0.91)</td>
</tr>
<tr>
<td>None (no ARVs)*</td>
<td>218</td>
<td>20</td>
<td>60</td>
<td>20</td>
<td>Referent</td>
</tr>
</tbody>
</table>

INF=infected, UNF=uninfected, IND=indeterminate; OR=Odds Ratio, CI=Confidence Interval
ZDV=zidovudine; PI=protease inhibitor; ARV=antiretroviral

*Based on the comparison of infected and uninfected infants

+Initiation of neonatal ZDV within 24 hours of birth

*Infants first evaluated for HIV exposure within 2 months of age
Evaluation of Perinatal HIV Prevention Methods

1999 Institute of Medicine Report
### Results-8: Infant HIV Infection Status (N=1,951) by Methods for Perinatal HIV Prevention, 22 NYC Sites, 1997-2001*

<table>
<thead>
<tr>
<th></th>
<th>Infected N=134</th>
<th>Uninfected N=1,476</th>
<th>Indeterminate N=341</th>
<th>Total N=1,951</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)⁺</td>
<td>N (%)⁺</td>
<td>N (%)⁺</td>
<td>N (%)⁺</td>
</tr>
<tr>
<td><strong>Missed Opportunities for Perinatal HIV Prevention</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No prenatal care (Step 1)</td>
<td>25 (18.7)</td>
<td>85 (5.8)</td>
<td>38 (11.0)</td>
<td>148 (7.6)</td>
</tr>
<tr>
<td>Prenatal care but no prenatal HIV diagnosis (Step 2)</td>
<td>31 (23.1)</td>
<td>88 (6.0)</td>
<td>31 (9.1)</td>
<td>150 (7.7)</td>
</tr>
<tr>
<td>Prenatal care, prenatal HIV diagnosis but no ARVs (Step 3)</td>
<td>6 (4.5)</td>
<td>15 (1.0)</td>
<td>6 (1.8)</td>
<td>27 (1.4)</td>
</tr>
<tr>
<td><strong>Any Missed Opportunity #</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>62 (46.3)</td>
<td>188 (12.8)</td>
<td>75 (21.9)</td>
<td>325 (16.7)</td>
</tr>
<tr>
<td><strong>Incomplete ARV Regimens for Perinatal HIV Prevention</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prenatal care, prenatal HIV diagnosis, 1-2 arm ARVs</td>
<td>22 (16.4)</td>
<td>191 (12.9)</td>
<td>58 (17)</td>
<td>271 (13.9)</td>
</tr>
<tr>
<td>Prenatal HIV Prevention Provided</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prenatal care, prenatal HIV diagnosis, 3-arm ARVs</td>
<td>50 (37.3)@</td>
<td>1,097 (74.3)@</td>
<td>208 (60.1)</td>
<td>1,355 (69.4)</td>
</tr>
</tbody>
</table>

ARV=antiretroviral

*661 (25%) of 2,612 infants born in the same period have incomplete data

+Column percents shown

#Any Missed Opportunity among Infected vs. Uninfected: Unadjusted odds ratio 5.90 (4.00-8.71)

@Failures of perinatal HIV prevention, N=50; @Successes of prevention, N=1,097
Results-9: Factors Associated with Failures of Perinatal HIV Transmission in a Logistic Regression (N=1,039), 22 NYC sites, 1997-2001

Adjusted for race/ethnicity, type of medical insurance, type of delivery, gestational age, and year of birth

Maternal illicit drug use vs. none:

\[ \text{OR: } 2.5 \ (95\% \ CI \ 1.3-5.0) \ p=0.007 \]

3-arm ZDV vs. 3-arm with prenatal ZDV with other ARVs:

\[ \text{OR: } 2.6 \ (95\% \ CI \ 1.3-5.0) \ p=0.006 \]
### Results-10: Factors Associated with Perinatal HIV Transmission in a Logistic Regression (N=1,532)*, 22 NYC sites, 1997-2001

<table>
<thead>
<tr>
<th>Year of Infant Birth</th>
<th>OR</th>
<th>95% C.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>1.6</td>
<td>0.8-3.3</td>
</tr>
<tr>
<td>1998</td>
<td>1.3</td>
<td>0.7-2.7</td>
</tr>
<tr>
<td>1999</td>
<td>1.2</td>
<td>0.6-2.4</td>
</tr>
<tr>
<td>2000</td>
<td>1.1</td>
<td>0.5-2.3</td>
</tr>
<tr>
<td>2001</td>
<td>1.1</td>
<td>Referent</td>
</tr>
</tbody>
</table>

### Race/Ethnicity

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>OR</th>
<th>95% C.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>2.7</td>
<td>1.0-7.1</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.2</td>
<td>0.8-1.8</td>
</tr>
</tbody>
</table>

### Pediatric Medical Insurance

<table>
<thead>
<tr>
<th>Pediatric Medical Insurance</th>
<th>OR</th>
<th>95% C.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>0.8</td>
<td>0.3-2.0</td>
</tr>
<tr>
<td>None</td>
<td>0.5</td>
<td>0.1-2.3</td>
</tr>
</tbody>
</table>
Results 10 continued

### Prenatal Interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Prenatal HIV testing, no ARVs</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Prenatal HIV testing, no ARVs</td>
<td>0.8</td>
<td>0.3-2.2</td>
</tr>
<tr>
<td>Prenatal HIV testing, 1-2 arm regimens</td>
<td>0.2⁺⁺⁺</td>
<td>0.1-0.4</td>
</tr>
<tr>
<td>Prenatal HIV testing, 3-arm zidovudine</td>
<td>0.1⁺⁺⁺</td>
<td>0.08-0.3</td>
</tr>
<tr>
<td>Prenatal HIV testing, 3-arm combination zidovudine</td>
<td>0.06⁺⁺⁺</td>
<td>0.03-0.1</td>
</tr>
</tbody>
</table>

### Delivery Type

<table>
<thead>
<tr>
<th>Type</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaginal</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Caesarian</td>
<td>1.1</td>
<td>0.7-1.7</td>
</tr>
</tbody>
</table>

### Maternal Illicit Drug Use

<table>
<thead>
<tr>
<th>Use</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>No/Unknown</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2.1+++</td>
<td>1.3-3.3</td>
</tr>
</tbody>
</table>

*Only deliveries with prenatal care included; breastfeeding not included in the model because data on duration of breastfeeding not collected among the 6 infected and 20 uninfected infants who were breastfed

**Prenatal zidovudine with other antiretrovirals

⁺⁺⁺⁺p<0.001; +⁺⁺⁺⁺p=0.002
Summary

- Among the HIV-exposed infants born 1997-2001, the majority of their mothers received prenatal care, were diagnosed with HIV before delivery and were prescribed prenatal antiretroviral therapy.
- HIV transmission rates are lowest among infants born to mothers who received prenatal combination therapies.
- Despite successes, 46% of the HIV-infected infants in our hierarchy model were born to mothers with missed opportunities for perinatal HIV prevention.
• Failure to diagnose HIV prenatally is the most common missed opportunity for perinatal HIV prevention among women in prenatal care
• Perinatal HIV transmission was associated with lack of prenatal HIV testing, incomplete antiretroviral regimens, and maternal illicit drug use
• Epidemiological data provide critical information to help guide HIV perinatal prevention programs and to monitor the population-wide success of the programs
Participating Institutions and Pediatricians
NYC Special Study Sites

• Albert Einstein Hospital (Arye Rubinstein)
• Beth Israel Hospital (Joanna Dobroszycki)
• Bronx Lebanon Hospital (Saroj Bakshi)
• Brookdale Hospital (Mahmoud Hassanein)
• Columbia-Presbyterian (Marc Foca)
• University Hospital of Brooklyn (Edward Handelsman)
• Harlem Hospital (Elaine Abrams)
• Incarnation Children’s Center (Cathy Painter)
• Jacobi Hospital (Andrew Wiznia)
• Kings County Medical Center (Ninad Desai)
• Lincoln Hospital (Hermann Mendez)
• Long Island College (John Belko)
• Long Island Jewish Medical Center (Vincent Bonagura)
• Metropolitan Hospital (Marukh Bamji)
• Montefiore Hospital (Nathan Litman)
• Mount Sinai Medical Center (Roberto Posada)
• New York Hospital (Joseph Stavola)
• North Central Bronx (Jacob Abadi)
• Queens General Hospital (Paul Zam)
• St Lukes-Roosevelt Hospital (Stephen Arpadi)
• St. Vincents Hospital (Mona Rigaud)
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