AIDS in Developing Countries
MODES OF TRANSMISSION

- Blood
- Semen/genital secretions
- Vertical
RISK ACTIVITIES THAT PROMOTE TRANSMISSION OF HIV

- Receiving blood contaminated with HIV
- Being born to an HIV-infected mother
- Engaging in anal intercourse with an HIV-infected partner
- Engaging in vaginal intercourse with an HIV-infected partner
- Engaging in oral-genital intercourse with an HIV-infected partner
- Sharing needles with an HIV-infected individual
- Being exposed to HIV-infected material; e.g., health or laboratory worker
RISK GROUPS

- Homosexual/bisexual
- Intravenous drug users
- Promiscuous heterosexuals
- Blood product and organ recipients
- Children of infected individuals
- Health/laboratory workers
- Partners of HIV-infected individuals
TABLE 1: ROUTES OF EXPOSURE AND HIV

<table>
<thead>
<tr>
<th>INFECTION ROUTE</th>
<th>RISK OF INFECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEXUAL TRANSMISSION</td>
<td></td>
</tr>
<tr>
<td>Female-to-male transmission</td>
<td>1:700 to 1:3,000</td>
</tr>
<tr>
<td>Male-to-female transmission</td>
<td>1:200 to 1:2,000</td>
</tr>
<tr>
<td>Male-to-male transmission</td>
<td>1:10 to 1:1,600</td>
</tr>
<tr>
<td>Fellatio</td>
<td>0 to 6%</td>
</tr>
<tr>
<td>PARENTERAL TRANSMISSION</td>
<td></td>
</tr>
<tr>
<td>Transfusion of infected blood</td>
<td>95:100</td>
</tr>
<tr>
<td>Needle sharing</td>
<td>1:150</td>
</tr>
<tr>
<td>Needle stick</td>
<td>1:200</td>
</tr>
<tr>
<td>Needle stick /AZT PEP</td>
<td>1:10,000</td>
</tr>
<tr>
<td>TRANSMISSION FROM MOTHER TO INFANT</td>
<td></td>
</tr>
<tr>
<td>Without AZT treatment</td>
<td>1:4</td>
</tr>
<tr>
<td>With AZT treatment</td>
<td>Less than 1:100</td>
</tr>
</tbody>
</table>

Adapted from Royce, Sena, Cates and Cohen, *NEJM* 336, 1072 (1997)

Figure 1: Sexual transmission of HIV. The relative risk of transmission over the course of the disease, as a function of viral load in semen. Orange indicates HIV RNA copies per ml semen, yellow indicates the reduced viral burden expected from host defenses evoked by a vaccine or early use of antiviral therapy. The dashed line offers a theoretical viral burden threshold below which HIV transmission will not occur. Numbers provided at the different stages of disease represent the probability of HIV transmission/episode of heterosexual intercourse. Adapted from ref. 9.

Spread of HIV in Africa, 1990-2009

Spread of HIV in Central and South America, 1990-2009

Spread of HIV in eastern Europe and central Asia, 1990-2009

Spread of HIV in Asia, 1990-2009

HIV prevalence among MSM, IDU and FSW: 2007 - 2009

Source: Sentinel surveillance surveys and IBBS

http://www.aidsdatahub.org
HIV prevalence among FSW: 2007 - 2009

Source: Sentinel surveillance surveys and IBBS

http://www.aidsdatahub.org
Asia
(East, Southeast, and South)

• Number HIV+: 4.9 million (4.5-5.5 million)
• Incidence stable: Most countries
• Incidence rising: Philippines
  • Bangladesh
  • Pakistan
Burma

Total Population
Estimated Number of Adults and Children Living with HIV/AIDS
Adult HIV Prevalence
HIV in Most-at-Risk Populations
FSWs (National) (2008)
18.1%
IDUs (National) (2008)
36.3%
MSM (National) (2008)
28.8%

Cambodia (2009)

• Prevalence: 0.6%
• Risk groups:
  • MSM
  • Non-brothel sex workers
  • Mother-to-child (1/3 of total)
<table>
<thead>
<tr>
<th></th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Population</td>
<td>1.3 billion</td>
</tr>
<tr>
<td>Estimated Number of Adults and Children Living with HIV/AIDS</td>
<td>740,000</td>
</tr>
<tr>
<td>Adult HIV Prevalence</td>
<td>0.1%</td>
</tr>
<tr>
<td>HIV in Most-at-Risk Populations</td>
<td></td>
</tr>
<tr>
<td>FSWs (Yunnan Province) (2006)</td>
<td>20%</td>
</tr>
<tr>
<td>FSWs (National) (2009)</td>
<td>0.6%</td>
</tr>
<tr>
<td>IDUs (One Prefecture of Yunnan province) (2006)</td>
<td>50%</td>
</tr>
<tr>
<td>IDUs (National) (2009)</td>
<td>9.3%</td>
</tr>
<tr>
<td>MSM (National) (2009)</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

Spread of HIV over time in China, 1985–1998
India

Prevalence of HIV: 0.3% (2.31 million) – 39% of total are females

Risk groups: Injection drug users (northeast, Tamil Nadu)
Sex workers (south and west)
Truck drivers
Migrant workers
MSM
Monogamous wives

http://www.avert.org/aids-asia.htm
Indonesia (2009)

• Number HIV+: 314,000 (<0.2%)

• Risk groups: Injection drug users
  Sex workers (male & female)
  MSM (prevalence 5%)
<table>
<thead>
<tr>
<th>Lao PDR</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Population</strong></td>
<td><strong>6.99 million</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Estimated Number of Adults and Children Living with HIV/AIDS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adult HIV Prevalence</strong></td>
<td><strong>0.2%</strong></td>
<td></td>
</tr>
<tr>
<td><strong>HIV in Most-at-Risk Populations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FSWs (2008)</strong></td>
<td><strong>0.43%</strong></td>
<td></td>
</tr>
<tr>
<td><strong>MSM (Vientiane) (2007)</strong></td>
<td><strong>5.6%</strong></td>
<td></td>
</tr>
</tbody>
</table>

Malaysia

- HIV/AIDS prevalence: 0.6%
- Percent who are women: 20% (2006)
- Risk groups:
  Injection drug users (majority)
  Sex workers (male & female)
The Philippines

- Number HIV+: 8,700 (<0.47% 2007-2009)
- Risk groups:
  - Sex workers
  - MSM
  - Injection drug users
<table>
<thead>
<tr>
<th>Thailand</th>
<th>66.4 million</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Population</strong></td>
<td>66.4 million</td>
</tr>
<tr>
<td>Estimated Number of Adults and Children Living with HIV/AIDS</td>
<td>530,000</td>
</tr>
<tr>
<td>Adult HIV Prevalence</td>
<td>1.3%</td>
</tr>
<tr>
<td>HIV in Most-at-Risk Populations</td>
<td></td>
</tr>
<tr>
<td>FSWs (Bangkok) (2009)</td>
<td>2.8%</td>
</tr>
<tr>
<td>IDUs (Bangkok) (2009)</td>
<td>38.7%</td>
</tr>
<tr>
<td>MSM (Bangkok) (2009)</td>
<td>13.5%</td>
</tr>
</tbody>
</table>

Timor-Leste

- HIV/AIDS prevalence: 0.2%
- Risk groups:
  - Sex workers (3% HIV prevalence)
  - Men who have sex with men (1% HIV prevalence)
<table>
<thead>
<tr>
<th>Vietnam</th>
<th>85.2 million (mid-2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Number of Adults and Children Living with HIV/AIDS</td>
<td>260,000 (2005)</td>
</tr>
<tr>
<td>Adult HIV Prevalence</td>
<td>0.5% (2005)</td>
</tr>
<tr>
<td>HIV in Most-at-Risk Populations</td>
<td>16% (2005)</td>
</tr>
<tr>
<td>Commercial Sex Workers</td>
<td>63% (2005)</td>
</tr>
<tr>
<td>IDUs in Hanoi</td>
<td>63% (2005)</td>
</tr>
<tr>
<td>MSM in Ho Chi Minh City</td>
<td>8% (2003)</td>
</tr>
</tbody>
</table>

Table 1.1  Overview of HIV Prevalence in South Asia, 2007
(Percent)

<table>
<thead>
<tr>
<th>Country</th>
<th>Adult HIV prevalence</th>
<th>SW HIV prevalence</th>
<th>MSM HIV prevalence</th>
<th>IDU HIV prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>0.36</td>
<td>2.6–60</td>
<td>2–20</td>
<td>0–50</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.49</td>
<td>1.4–16</td>
<td>n.a.</td>
<td>22–68</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0</td>
<td>0–0.5</td>
<td>0–2</td>
<td>0.5–23</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>0</td>
<td>0–1.7</td>
<td>0–0.8</td>
<td>0–4.9</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>0</td>
<td>n.a.</td>
<td>n.a.</td>
<td>0–3</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>0</td>
<td>0–1</td>
<td>0–1</td>
<td>n.a.</td>
</tr>
<tr>
<td>Bhutan</td>
<td>0</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>


SW=sex worker; MSM=men who have sex with men; IDU=intravenous drug users

Initial State of HIV/AIDS Epidemic

- Incidence HIV
- Prevalent HIV
- AIDS Cases
Early State of HIV/AIDS Epidemic

- Incidence HIV
- Prevalent HIV
- Incidence AIDS
- Prevalent AIDS

HIV Infection

AIDS Cases
Steady State of HIV/AIDS Epidemic

- Incident HIV
- Prevalent HIV
- Incident AIDS
- Prevalent AIDS
- AIDS Cases
- Incident AIDS Deaths
- AIDS Deaths
Steady State of HIV/AIDS Epidemic

HIV Infection

Incidence = Prevalence ÷ Duration

HIV incidence = HIV prevalence ÷ 9-10 Years
Early Phase of HIV/AIDS Epidemic

1 AIDS Case

8-10,000 HIV infected persons
Steady State Phase of HIV/AIDS Epidemic

1 AIDS Case

3-6 HIV infected persons

HIV/AIDS Iceberg
Table 1. Incidence, prevalence and mortality of HIV/AIDS (example)

<table>
<thead>
<tr>
<th>Year</th>
<th>HIV Infected Persons</th>
<th>AIDS Cases</th>
<th>AIDS Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incident</td>
<td>Prevalent</td>
<td>Incident</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>48</td>
<td>70</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>195</td>
<td>265</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>359</td>
<td>624</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>702</td>
<td>1,326</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>1,512</td>
<td>2,838</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>4,068</td>
<td>6,906</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>8,131</td>
<td>15,036</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>12,317</td>
<td>27,347</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>16,520</td>
<td>43,852</td>
<td>15</td>
</tr>
<tr>
<td>13</td>
<td>21,569</td>
<td>65,453</td>
<td>48</td>
</tr>
<tr>
<td>14</td>
<td>26,157</td>
<td>91,415</td>
<td>195</td>
</tr>
<tr>
<td>15</td>
<td>29,857</td>
<td>120,913</td>
<td>359</td>
</tr>
</tbody>
</table>
HIV Testing Strategies

**Blood:**
1. Resistance to invasive procedures
2. Problems of processing and transport
3. Tests
   - ELISA
   - Electrophoretic techniques - the Western blot
   - Rapid testing
   - Viral load – PCR; p24 antigen
HIV Testing Strategies

Urine testing:
1. Non-infectious material
2. Non-invasive
3. Difficulty of collecting
4. Preservation of urine
5. Ease of transport
6. Problem of assuring source of specimen
7. Reasonable sensitivity and specificity
HIV Testing Strategies

Saliva testing:

1. Non-infectious material
2. Non-invasive
3. Easily collected
4. Ease of transport
5. Good sensitivity and specificity
6. Rapid tests
HIV Testing Strategies

Pooling:

1. For screening/surveillance, not counseling
2. Cost-effectiveness decreases with increasing prevalence
COST SAVING
POOLING 10 SERA

- Prevalence = 1%
  \[
  \left( \frac{100}{10} + 10 \right) \times $1 = $20
  \]

- Prevalence = 10%
  \[
  \left( \frac{100}{10} + 100 \right) \times $1 = $110
  \]

- No Pooling
  \[100 \times $1 = $100\]
Viral Testing

• Culture
  – Expensive
  – Technically demanding

• Virus particles
  ◆ Polymerase chain reaction (amplifies virus)
  ◆ Expensive
  ◆ Requires sophisticated technology

• p24 antigen
  ◆ Less accurate
Lymphocyte counts

• CD3, CD4, CD8, etc.
  – Flow cytometry
  – FACS analysis
  – Requires sophisticated technology
  – Expensive
Alternate Testing

• Total lymphocyte counts
  – Inexpensive
  – Simple technology
  – CD4:CD8 equilibrium results in changing relationship of subsets
  – CD4/TLC curves not parallel
  – Low sensitivity
• p24 acid-dissociated Ag
  – Low sensitivity
  – Low cost
  – Low technology
• Serologic tests for T-cells (e.g., Dynabeads)
Testing Strategies

• Voluntary counseling and testing (opt-in)
• Routine testing (opt-out)
• Mobile testing
• Home testing
  – Mail-in/phone for results
  – Rapid test – self read in 1—20 minutes
• Confirmatory testing
FACTORS AFFECTING SPREAD OF HIV-1

BIOLISTIC

- Co-prevalence of other STDs
- Circumcision status
- Stage of HIV infection
- Viral load
- Treatment availability access and cost
FACTORs AFFECTING SPREAD OF HIV-1

BEHAVIORAL

- Roles of males and females
- Cultural acceptance of multiple partners
- Types of intercourse (vaginal, anal)
- Customs involving penetration of skin
- Concurrency of multiple sex partners (sexual mixing)
- Condom use
- Drug use (injection and non-injection)
FACTORS AFFECTING SPREAD OF HIV-1

POLITICAL/ECONOMIC

- Political commitment
- Attitudes toward risk groups
- Legal status of risk groups
- Attitudes toward specific sex education
- Acceptability and ease of access to testing
- Status of women
- Level of stigma
- Poverty
- Availability and access to testing and treatment
FACTORS AFFECTING SPREAD OF HIV-1

DEMOGRAPHIC

• High proportion of 15-25-year-olds
• High male:female ratio
• Rapid urbanization
• Use of trucks for transport of goods
• Large migrant population – rural to urban
• Proportion of circumcized males
Impact of the HIV/AIDS Epidemic in Developing Countries

Alteration of the Producer:Dependent Ratio

- Decreased productivity due to illness
- Removal of producers by death
- Increased number of dependents:
  - Sick babies
  - Increased number of orphans
Impact of the HIV/AIDS Epidemic in Developing Countries

Increased Health Care Costs

- Diversion of funds from other urgent health problems
- Issues and costs of care and hospitalization
- Need for trained health providers
Impact of the HIV/AIDS Epidemic On the Individual

- Uncertain future
- Contemplating painful death
- Stigmatization and social isolation
- Loss of employment
- Limited access to health care
- Loss of self-esteem
Impact of the HIV/AIDS Epidemic On the Family

- Potential infection of spouse and children
- Loss of economic support of family
- Ostracism and social isolation
- Children become orphans
Impact of the HIV/AIDS Epidemic On Society

- Loss of productive segment of society
- Increased number of dependents
- Breakdown of family structure
- Sense of fear and distrust
- Huge burden of long-term treatment of HIV patients
Impact of the HIV/AIDS Epidemic in Developing Countries

Political impact

• Political instability
• Increased dependency on rich nations
BARRIERS AGAINST HIV/AIDS CONTROL (1)

- Status of women
- Low condom acceptance (esp. non-commercial sex)
- Dependence on external support
- Long-term sustainability of external support
- Low awareness/acceptance of vulnerability (women/youth)
- Low acceptance of testing (misguided emphasis on “opt-in” and individual rights)
- Insufficient funds for prevention/intervention
- Stigma (risk groups, HIV-infected, those seeking testing)
BARRIERS AGAINST HIV/AIDS CONTROL (2)

- High proportion of uncircumcised men
- Cost and complexity of adult circumcision
- Low acceptance of circumcision
- Low literacy rates
- Few female-controlled prevention strategies (e.g. microbicides)
- Vaccine unlikely in the near future
- Cost of control and treatment
- Reaching unknown HIV-infected persons
- Continuum of care
International Support of HIV/AIDS Treatment (Gates, Clinton, PEPFAR, etc.)

• Buys needed drugs
• Need for infrastructure
  – Source? Existing health personnel
  – Undermining public health infrastructure or separate infrastructure
• Distribution
• Adherence and counseling
• Long-term problems
  – Lets local governments “off the hook”
  – Sustainability
  – NGOs lose interest
  – Capacity of government to absorb
Current HIV/AIDS Problems in Developing Countries (1)

Need for more widespread testing
Testing of hidden HIV+ individuals
Human rights – who are you protecting?
Continuum of care
Hidden populations (e.g., married MSM)
Persisting stigma
Current HIV/AIDS Problems in Developing Countries (2)

Treatment

- Cost of drugs
- Monitoring clinical course
- Assuring adherence
- Reaching rural areas
- Impact of huge HIV/AIDS-directed funds on:
  - Public health programs
  - Government responsibility
- Sustainability – what happens when donors lose interest?
Percentage of persons with HIV engaged in select states of the continuum of care in the United States, by race/ethnicity

Current HIV/AIDS Problems in Developing Countries (3)

• Treatment as prevention
• Maintaining effort and funding
• Implementing and funding for prophylactic treatment of vulnerable populations
• Reaching unknown HIV-infected persons
• Continuum of care
SUMMARY

- Despite progress made in many countries and the declining trend of new HIV infections, AIDS is still a leading cause of morbidity and death among adults.
- Early successes in controlling HIV epidemics may not be sustainable in the future if continued commitment to care and prevention is not secured.