Causal interactions among structural, behavioural and biological drivers of STD/HIV epidemics

What does the "mega model" look like?

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What is a "model"?*

- Representation or simplified version of a concept or system to:
  - Facilitate understanding by eliminating unnecessary components and connections.
  - Aid in decision making by simulating "what if" scenarios.
  - To explain and/or predict events based on past observations.

* http://www.businessdictionary.com/definition/model.html

Why do we need a model for STI/HIV programming?

- To understand heterogeneity epidemic trajectories
  - Why do populations that look similar often have very different HIV epidemics?
  - Which epidemics are likely to grow fastest?

- To design effective prevention strategies, especially in mixed epidemics
  - Which interventions – structural, behavioural, biomedical?
  - Which populations?
  - When?
  - How much (coverage, intensity?)

Some historical echoes....

- Limited appreciation for complex interactions and network properties
- Focused more on pathogen characteristics, rather than individual biological and "host-pathogen" interactions
- Ignored the concept of individual trajectories over time

SYMPOSIUM
Populations, pathogens, and epidemic phases: closing the gap between theory and practice in the prevention of sexually transmitted diseases

J. P. Blanchard

- Sex work organization
- Characteristics of hotspots
- Law enforcement
- Health System
- Stigma
- Individual life events
- Experience of violence
- Perception of sex and HIV risk with different sex partners
- Perception of Stigma

Network

Behaviour

Biology

Socio-cultural milieu
- Economy
- Geography
- Political factors

Transmission dynamics and epidemic trajectory

Components

Micro-Structural Factors
- Socio-cultural milieu
- Economy
- Geography
- Political factors
- Environment
- Health System
- Stigma

Macro-Structural Factors
- Sex work organization
- Characteristics of hotspots
- Law enforcement
- Health System
- Stigma

Network

Behaviour

Biology

Socio-cultural milieu
- Economy
- Geography
- Political factors

Outcomes

Transmission dynamics and epidemic trajectory
The Transition Period and the Access Gap

Pathway (Individual)

• Start with a conceptual model, not a mathematical model
• Focus on programmatic considerations, not necessarily robust in explanatory power
• Consider:
  – Key elements that directly influence individual risk and population transmission dynamics – biology, behaviour, networks
  – Opportunities for programs to influence these
  – Pathways through the elements

A simple start – “pathways” and “windows”

• “Pathways”
  – Trajectories that individuals and groups follow through time.
  – Sometimes they are unidirectional, but they are often bidirectional and/or recursive
• “Windows”
  – Important frames along the pathway that have dimensions of time, space and interactions.
  – Have variable characteristics and influences on risk.
  – Provide “windows” of opportunity for programs

A simple pathway example – from “Transitions”

Average Sexual “Life Course” for FSWs in 4 Cities of India

<table>
<thead>
<tr>
<th>City</th>
<th>Age (years)</th>
<th>No sex</th>
<th>Non-commercial sex</th>
<th>Sex work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangalore</td>
<td>0</td>
<td>16.8</td>
<td>16.1</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
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<td>30</td>
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</tr>
<tr>
<td></td>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What’s happening in the “windows” along this pathway?

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Networks</th>
<th>Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate partner change</td>
<td>High or low overlap with other</td>
<td>Very high biological susceptibility</td>
</tr>
<tr>
<td>Low condom use</td>
<td>high risk networks</td>
<td></td>
</tr>
<tr>
<td>Very high partner change</td>
<td>High or low overlap with</td>
<td>Moderate biological susceptibility</td>
</tr>
<tr>
<td>Moderate condom use</td>
<td>other high risk networks</td>
<td></td>
</tr>
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</tr>
<tr>
<td>Low condom use</td>
<td>high risk networks</td>
<td></td>
</tr>
</tbody>
</table>
**Schematic representation of temporal asymmetry in FSW behaviour and risk**

- Condom Use
- Biological susceptibility
- HIV Incidence

**Time / Age**

**Different contexts, different pathways at the individual and population levels**

- **Structural Factors**
  - Macro
  - Meso

**Social organization of sex work in Pakistan**

**Relative size (per 1000 men) of key populations in cities of Pakistan**

<table>
<thead>
<tr>
<th>City</th>
<th>FSW</th>
<th>MSW</th>
<th>HSW</th>
<th>IDU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lahore</td>
<td>9.5</td>
<td>11.0</td>
<td>12.3</td>
<td>4.0</td>
</tr>
<tr>
<td>Karachi</td>
<td>0.6</td>
<td>3.5</td>
<td>3.8</td>
<td>4.6</td>
</tr>
<tr>
<td>Peshawar</td>
<td>1.3</td>
<td>3.5</td>
<td>4.9</td>
<td>3.8</td>
</tr>
<tr>
<td>Quetta</td>
<td>1.3</td>
<td>3.5</td>
<td>4.9</td>
<td>3.8</td>
</tr>
</tbody>
</table>

**Sexual interactions between key populations in Pakistan**

- **FSW**: 9.4% IDUs paid FSW for sex in past 6 months
- **MSW**: 4.6% IDUs paid MSW for sex in past 6 months
- **IDU**: 9.8% FSWs had sex with IDUs in past 6 months
- **HSW**: 11.2% FSWs had sex with IDUs in past 6 months
- **ALL PAKISTAN**: 4.9% MSWs had sex with IDUs in past 6 months
**Networks – vary by context (example for HIV transmission among key populations in Pakistan)**

Source: Paul Sandstrom and Laura Thompson

**Programs – key elements**

- **Structural interventions**
  - Alter the micro-structural factors that influence the social organization and distribution of pathways and windows.
  - Influences the pathways and vulnerability of individuals and groups – “power within”, “power with others”, “power over resources”.

- **Behavioural interventions**
  - Addresses the behavioural risks within specific windows along the pathway, with either short-term or long-term effects

- **Biomedical interventions**
  - Reduce the susceptibility or transmission risk, either in the short term or long term

**Different contexts, different pathways at the individual and population levels**

**Some issues for further development...**

- How can we improve our description and understanding of the temporal “pathways”?  
  - What methods can we develop to systematically describe them?  
  - What are the factors that influence these pathways at the individual and population levels?

- How does risk vary in the different windows along the pathways?  
  - Biological  
  - Behavioural / network

- How can we better understand how to prioritize the focus of our interventions along the pathway?  
  - Optimize interventions for the specific pathways and windows

**Thank you**