

# HIV Risk Estimator: Development of a teaching tool for sexual health education

Ann N. Burchell & Michael Manno  
Ontario HIV Treatment Network

CATIE Forum

Toronto, September 18, 2013

[aburchell@ohtn.on.ca](mailto:aburchell@ohtn.on.ca)

# Acknowledgements

- Jean Bacon, Mark Fisher, Dimitri Saltanovich (OHTN)
- John Maxwell (AIDS Committee of Toronto)
- Frank McGee, James Murray (AIDS Bureau)
- Len Tooley (CATIE)



# Why create an HIV risk estimator?



- Risk of HIV transmission is typically reported as a probability of transmission in a single sexual encounter
  - ~1 in 100 for receptive anal sex
  - ~1 in 1,000 for receptive vaginal sex
- These risks may appear deceptively small
- *How does risk accumulate over multiple encounters?*

# Why create an HIV risk estimator?



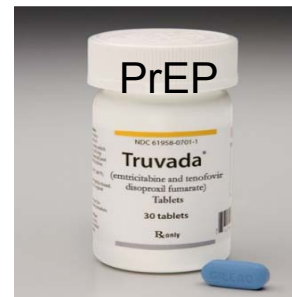
- Multiple factors affect HIV transmission risk
- Published research typically examines only a few factors at a time
- *How do these factors add up or compare to each other?*



Condoms



Male  
circumcision



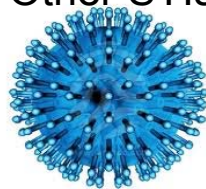
PrEP



Antiretroviral  
treatment



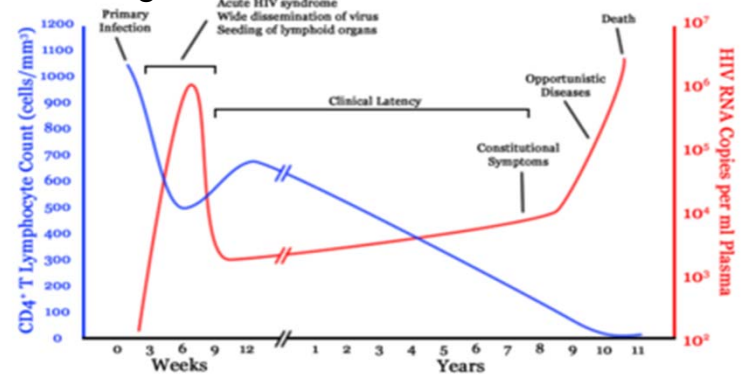
Other STIs



Pregnancy



Stage of HIV disease & viral load



# Our goal



- To develop an interactive teaching tool that would help users to...
  - Understand how HIV risk in a single sexual encounter accumulates over multiple encounters, such that a small risk can become a high risk
  - Compare chances of HIV transmission in different scenarios, allowing user to modify several risk/protective factors at once, with option to vary
    - specific sex act (male-male & male-female acts)
    - viral load & disease stage of HIV-positive partner
    - presence of other STIs, circumcision status, & pregnancy



## Risk Assessment

# Example Scenario

Male-male couple, HIV-negative man has unprotected receptive anal sex, HIV-positive partner in chronic HIV infection stage, untreated

### 1. Type of sex act (select one)

Yes/No

HIV-positive partner performs oral sex on HIV-negative partner

No

HIV-negative partner performs oral sex on HIV-positive partner

No

HIV-negative partner is insertive partner ("top") for anal sex with a condom that is used correctly throughout intercourse

No

HIV-negative partner is insertive partner ("top") for anal sex without a condom

No

HIV-negative partner is receptive partner ("bottom") for anal sex with a condom that is used correctly throughout intercourse

No

HIV-negative partner is receptive partner ("bottom") for anal sex without a condom, and HIV-positive partner does not ejaculate or a condom is applied before he ejaculates

No

HIV-negative partner is receptive partner ("bottom") for anal sex without a condom, and HIV-partner ejaculates

Yes

### 2. Characteristics of HIV-negative male partner

Circumcised / no foreskin present

No

Currently has a sexually-transmitted infection (e.g., syphilis, active herpes)

No

Has ever had Herpes simplex 2 (whether or not he currently has an active flare-up or ulcers present)

No

Taking pre-exposure prophylaxis (PrEP)

No

### 3. Characteristics of the HIV-positive male partner

Currently has a sexually-transmitted infection (e.g., syphilis, active herpes)

No

Taking HIV antiretroviral treatment (with good adherence and suppressed viral load)

No

#### Stage of HIV Infection (select one category)

Primary (within the first 5 months of HIV infection)

No

Chronic infection (more than 5 months after infection but no advanced HIV disease or AIDS)

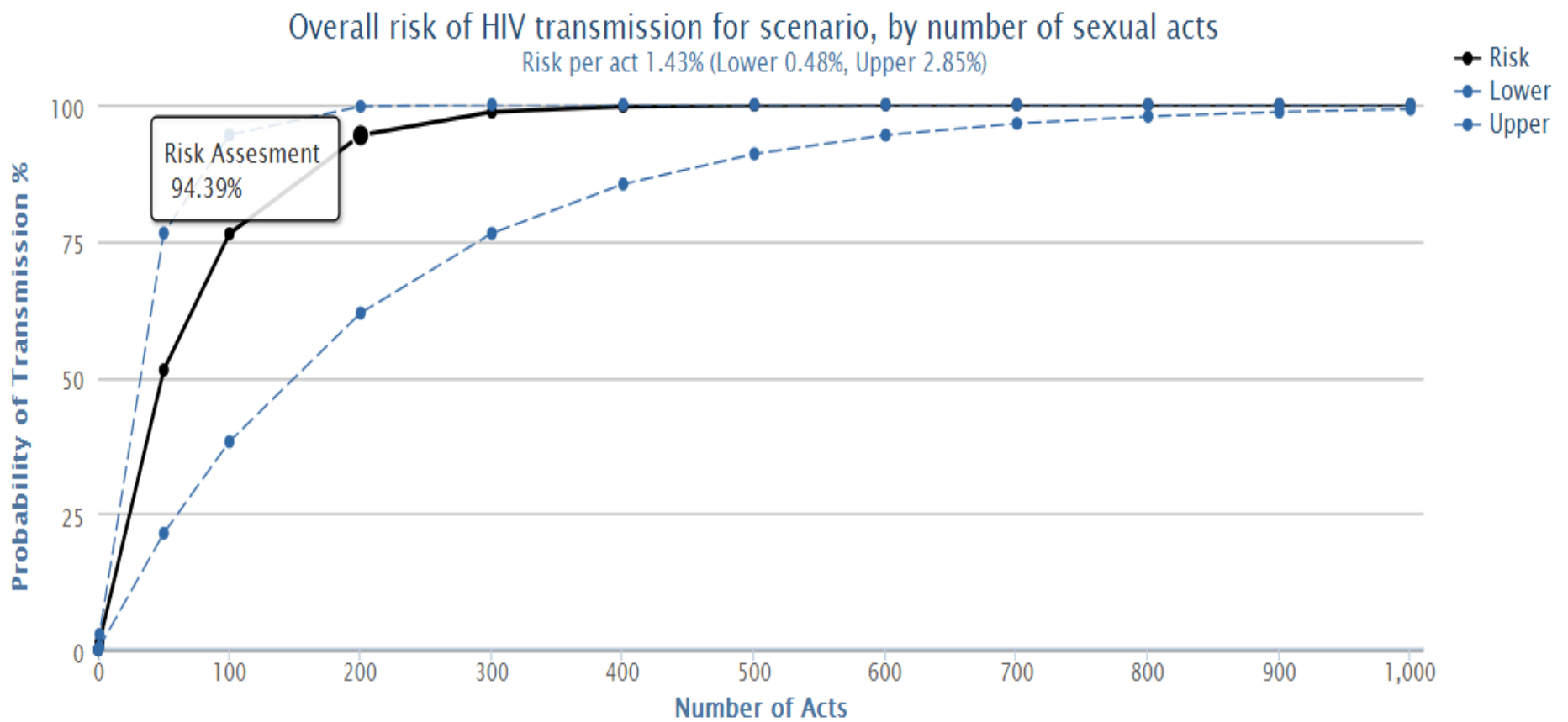
Yes

Late (advanced HIV disease or AIDS)

No



# The output



# Our approach



- Adapted published algorithm based on systematic review of HIV transmission literature as of mid 2010 [1]
- Modifications to update & expand tool to reflect
  - Most recent estimates of per-act transmission probabilities [2, 3]
  - PrEP and TasP prevention trial findings [4, 5]
  - Addressed some limitations of published algorithm [6]
  - Added receptive anal sex with withdrawal for male-male partners [7]

1. Fox *AIDS* 2011; 25:1065-82

3. Baggaley *Int J Epidemiol* 2010; 39:1048-63

5. Cohen *NEJM* 2011; 365:493-505

7. Jin *AIDS* 2010; 24:907-13

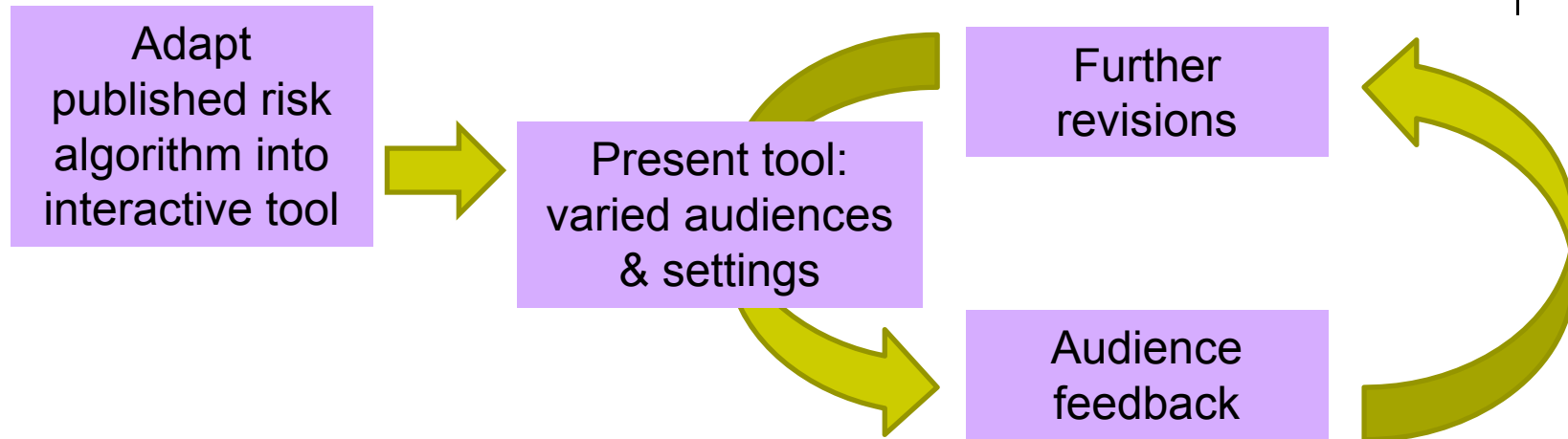
2. Boiley *Lancet Inf Dis* 2010; 9:118-29

4. Grant *NEJM* 2010; 363:2587-00

6. Gerberry & Blower, *AIDS* 2011



# Iterative process

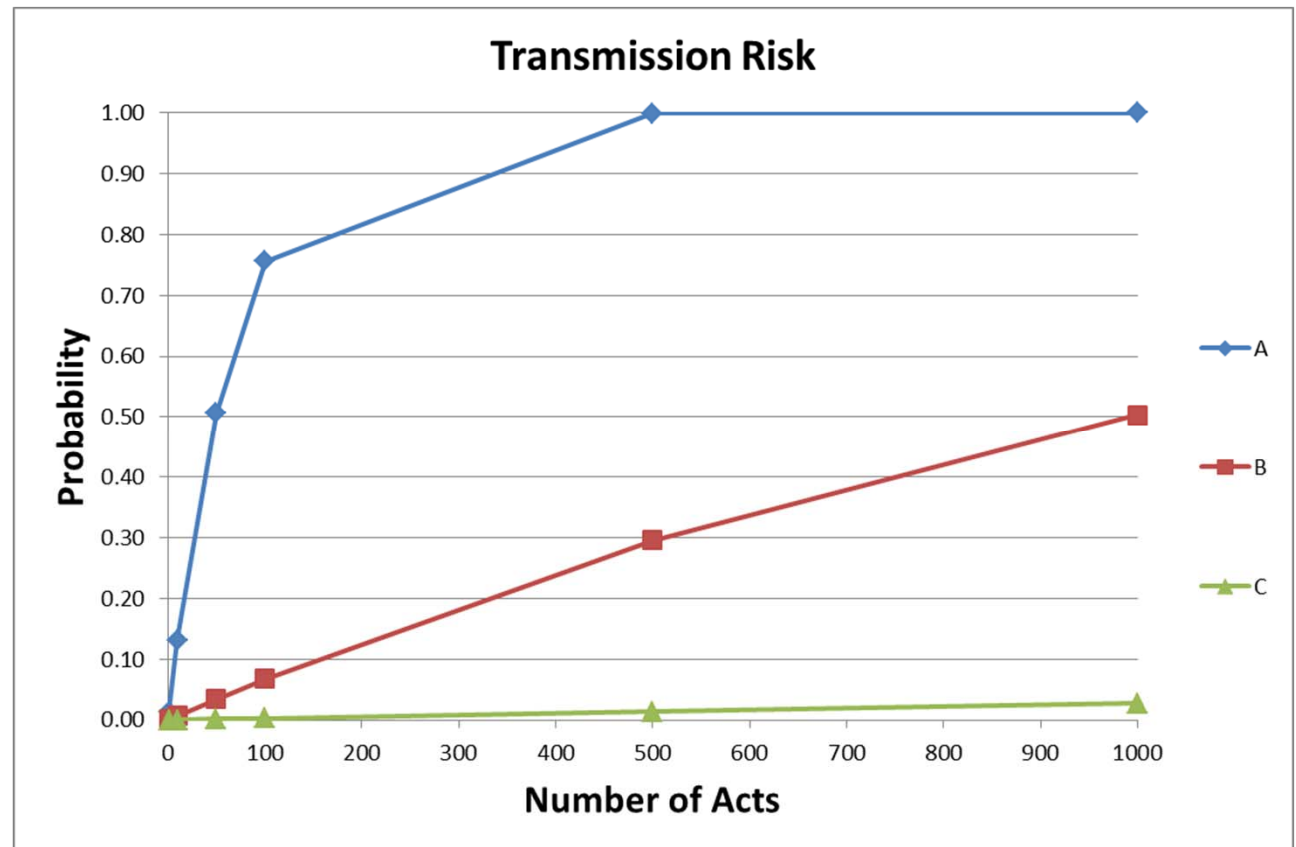


- Generally positive response: novel, would be useful for health educator training and when counselling clients
- Concerns & suggestions incorporated into subsequent versions, when possible
- Still much room for improvement!

# Useful for comparing scenarios: Example 1



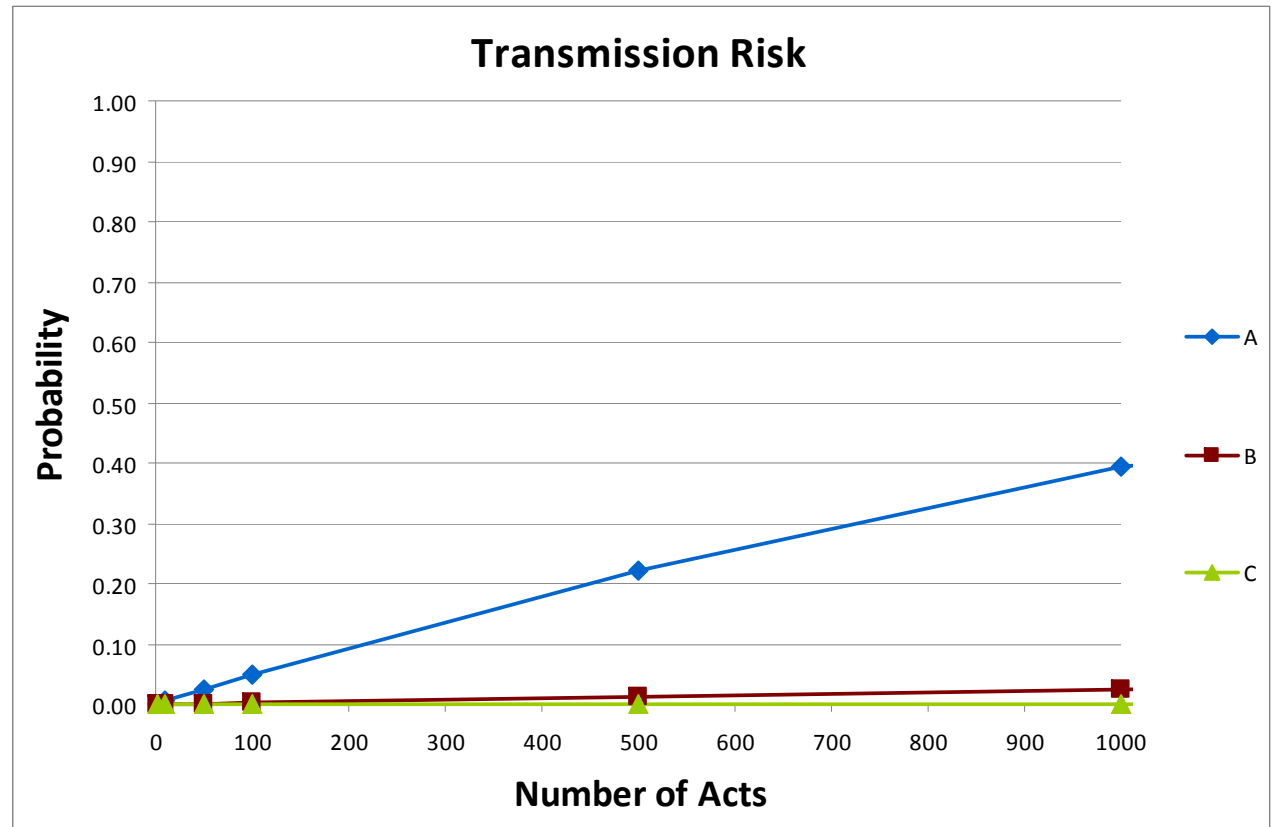
- Male-male couple, HIV-negative man has receptive anal sex
- **A:** Chronic HIV infection stage, untreated, no condom
- **B:** Add correct condom use 100% of time
- **C:** Add treatment



# Useful for comparing scenarios: Example 2



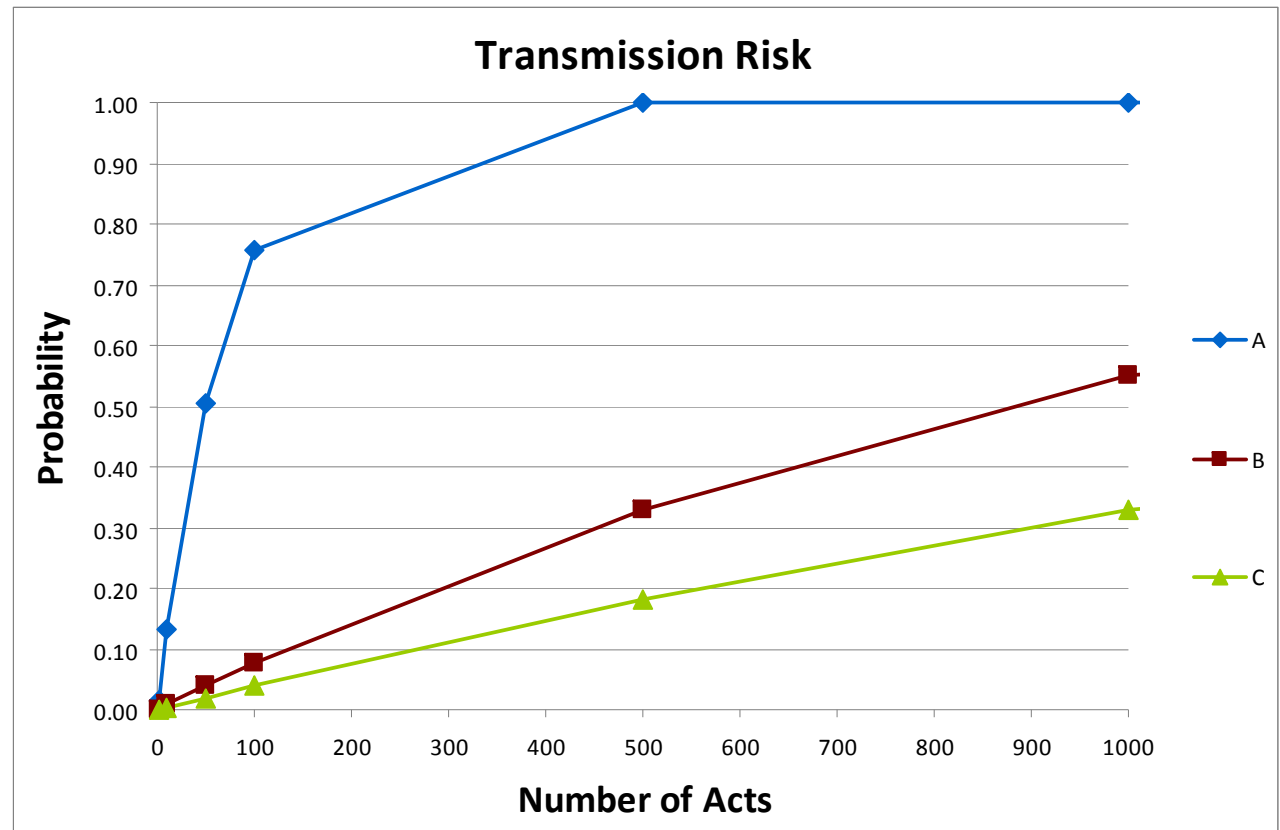
- Female positive-male negative couple, insertive vaginal sex
- A: Chronic HIV infection stage, untreated, no condom
- B: Add correct condom use 100% of time
- C: Add treatment



# Useful for comparing scenarios: Example 3



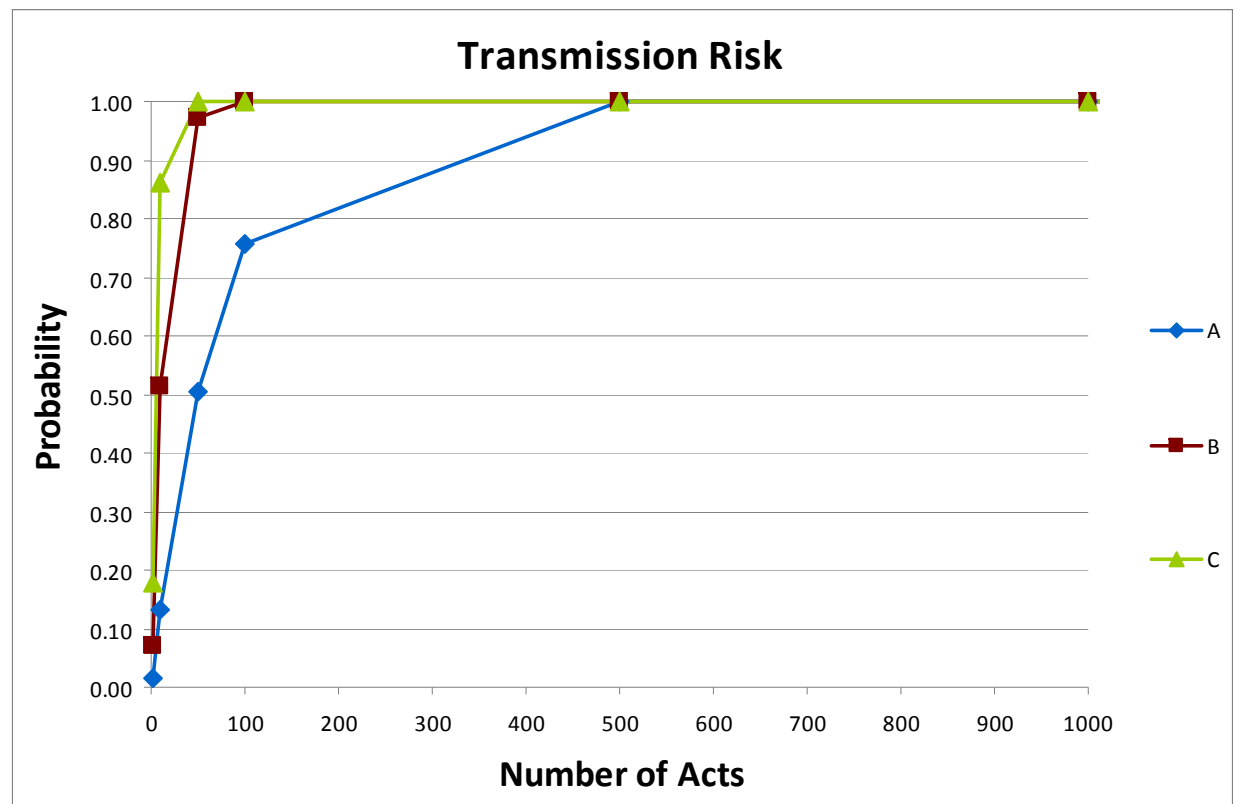
- Male positive-female negative couple, male in chronic infection, untreated, no condom
- A: Anal intercourse
- B: Vaginal intercourse
- C: Oral sex



# Useful for comparing scenarios: Example 4




- M-M couple, HIV- “bottom” for unprotected receptive anal sex
- A: Chronic HIV infection stage, untreated
- B: Acute HIV infection stage, untreated
- C: Acute, untreated, & ulcerative STI present in HIV- male



# Challenges we've faced



- How to provide just the right amount of information on the underlying science and especially its caveats – *not too much, but not too little*
- No model can represent “real life”
- Estimates for risk/protective factors can be a topic of debate
- Mixed opinions regarding direct risk communication to clients
  - some may not understand imprecision of statistical probabilities
  - some clients may already be accessing (& misinterpreting?) new evidence
- Usability
- Appropriateness of language, graphics, inclusivity
- Concern regarding risk estimates & criminalization of non-disclosure



*“Essentially, all models are  
wrong, but some are useful”*

George E.P. Box, 1987

[aburchell@ohln.on.ca](mailto:aburchell@ohln.on.ca)



# What evidence informs estimator?

## Parameter estimates



	HIV transmission probability per act
Receptive anal intercourse <sup>3</sup>	1.4% (range 0.2-2.5%)
Receptive anal intercourse with withdrawal <sup>4</sup>	0.65% (range 0.15-1.53%)
Receptive vaginal intercourse <sup>2</sup>	0.08% (range 0.06-0.11%)
Insertive anal intercourse <sup>1</sup>	0.065% (range 0.06-0.065%)
Insertive vaginal intercourse <sup>1</sup>	0.05% (range 0.01-0.14%)
Receptive oral intercourse <sup>1,5</sup>	0.04% (range 0-0.04%)
Insertive oral intercourse <sup>1</sup>	0 – not modeled
	Relative risk of HIV transmission
Condoms used correctly & consistently every time	0.05

	Relative risk of HIV transmission
<i>Characteristics of HIV-negative partner:</i>	
Male circumcision (♂ insertive) <sup>1</sup>	0.47 (0.28-0.78)
Current STI <sup>1</sup>	2.58 (1.3-5.69)
HSV-2 seropositivity <sup>1</sup>	
♀	3.1 (1.7-5.6)
♂ with ♀ partner	2.7 (1.9-3.9)
♂ with ♂ partner	1.7 (1.2-2.4)
Pregnancy (♀ with ♂ partner) <sup>1</sup>	2.16 (1.39-3.37)
PrEP (IPrEX: modified ITT) <sup>6</sup>	0.56 (0.37-0.85)
<i>Characteristics of HIV-positive partner:</i>	
Current STI <sup>1</sup>	2.04 (0.93-5.3)
Stage of HIV infection <sup>1</sup>	
Primary (<5 months)	4.98 (2.00-12.39)
Chronic	1.00
Late (advanced disease)	3.49 (1.76-6.92)
On ART – (HPTN052: linked transmissions) <sup>7</sup>	0.04 (0.01-0.27)

1. Fox *AIDS* 2011; 25:1065-82
2. Boiley *Lancet Inf Dis* 2010; 9:118-29
3. Baggaley *Int J Epidemiol* 2010; 39:1048-63
4. Jin *AIDS* 2010; 24:907-13
5. Vittinghoff *Am J Epidemiol* 1999; 150(3):306-11
6. Grant *NEJM* 2010; 363:2587-00
7. Cohen *NEJM* 2011; 365:493-505

# Assumptions of risk estimator



- Considers only 1 type of sexual act at a time
- Risk of transmission in single encounter remains constant over time
- Effect of a risk/protective factor is the same no matter what other risk/protective factors are present
- Does not account for any other risk/protective factor not specified
- No bias in parameter estimates
  - Risk estimator based on published scientific evidence
  - No study free from bias
  - Most transmission studies in discordant couples → underestimate risk
  - Generalizability of estimates uncertain