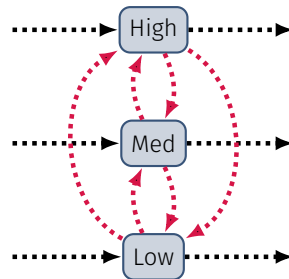# Influence of simulated risk group turnover in STI epidemics with assortative mixing

Jesse Knight, Sharmistha Mishra

Institute of Medical Science
University of Toronto

Canadian Student Health Research Forum

2020 August 25

Disclosures

None

Acknowledgements

Background

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[1]Rowley et al. 2019.
[2]UNAIDS 2020.
[3]Mishra et al. 2014.

Background

STI — *Sexually Transmitted Infections*

► 1+ million new STI infections per day[1]

► 1.7 million new HIV infections per year[2]

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Background

STI — *Sexually Transmitted Infections*

► 1+ million new STI infections per day[1]
► 1.7 million new HIV infections per year[2]

tPAF — *Transmission Population Attributable Fraction*[3]

► based on epidemic simulation models
► prioritize risk groups with interventions

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Key Modelling Concepts

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Turnover:
movement between risk groups

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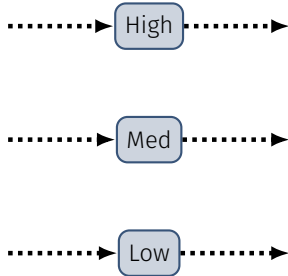movement between risk groups

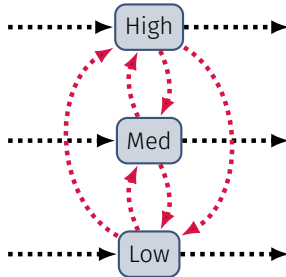High

Med

Low

Key Modelling Concepts

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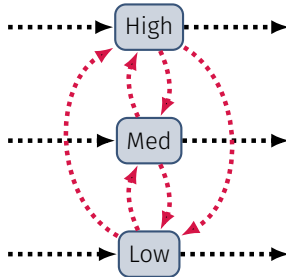# Key Modelling Concepts

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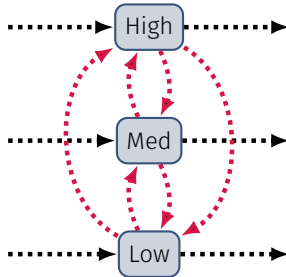
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like-with-like (vs random) partnerships

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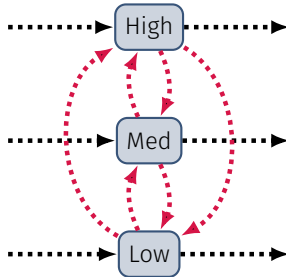

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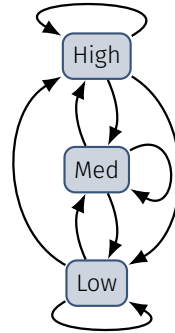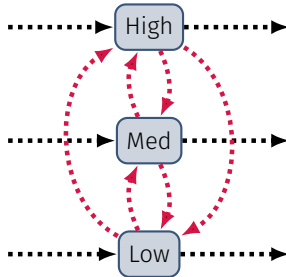
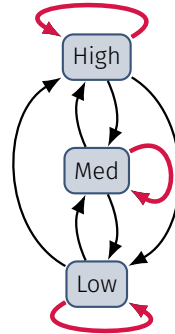# Key Modelling Concepts

Turnover:
movement between risk groups

Assortative Mixing:
like-with-like (vs random) partnerships

Research Questions

Influence of turnover on:

1. equilibrium STI prevalence

2. tPAF of High Risk group

…under **random** vs **assortative** mixing

Methods

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▶ Susceptible, Infectious, Recovered (SIR)

$$ S \longrightarrow I \longrightarrow R $$

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▶ Calibrate risk group partners per year to reproduce the same STI prevalence

▶ 4 model variants:

Random		No Turnover
vs	$\times$	vs
Assortative		Turnover

Methods

▶ Susceptible, Infectious, Recovered (SIR)

S ⟶ I ⟶ R

▶ Stable turnover in 3 risk groups

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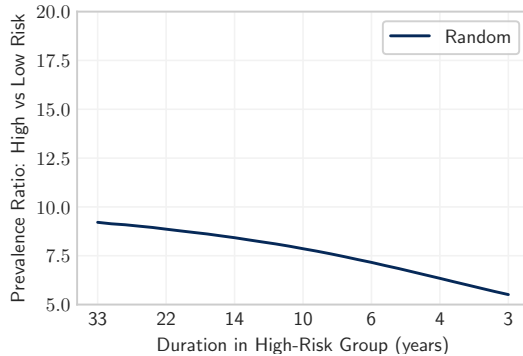▶ Calibrate risk group partners per year to reproduce the same STI prevalence
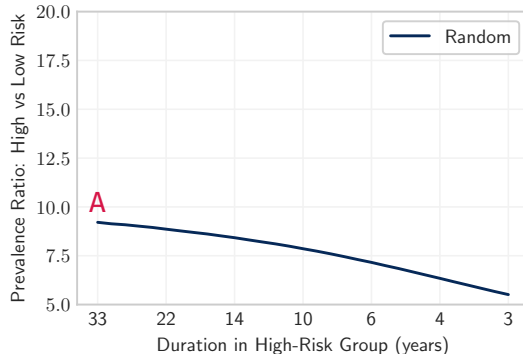
▶ 4 model variants:

Random		No Turnover
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▶ tPAF for each variant

Random mix — turnover "homogenizes" STI prevalence

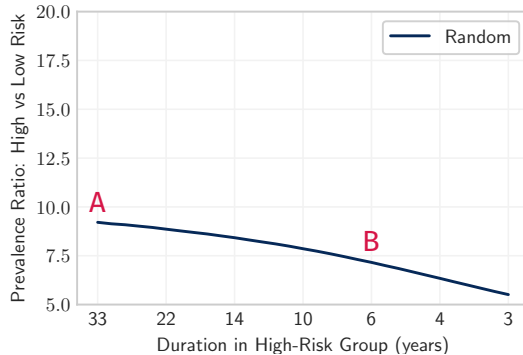# Random mix — turnover "homogenizes" STI prevalence
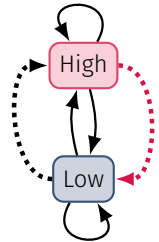

No Turnover (A)

Random mix — turnover "homogenizes" STI prevalence

Random mix — infer larger risk ratio with turnover → higher tPAF+

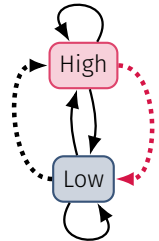|	No Turnover	Turnover
STI prevalence *		
Partners per year *		
10-year tPAF (Cal)		

* Ratios = (High : Low) Risk; Pre → Post-Calibration

No Turnover (A)   Turnover (B)

Random mix — infer larger risk ratio with turnover $\rightarrow$ higher tPAF+

	No Turnover	Turnover
STI prevalence *	9.2 $\rightarrow$ 6.7	6.7 $\rightarrow$ 6.7
Partners per year *		
10-year tPAF (Cal)		

* Ratios = (High : Low) Risk; Pre $\rightarrow$ Post-Calibration

No Turnover (A)   Turnover (B)

Random mix — infer larger risk ratio with turnover → higher tPAF+

	No Turnover	Turnover
STI prevalence *	9.2 → 6.7	6.7 → 6.7
Partners per year *	25.0 → 15.2	25.0 → 23.9
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No Turnover (A)   Turnover (B)

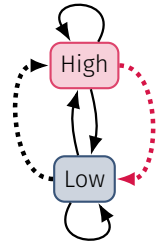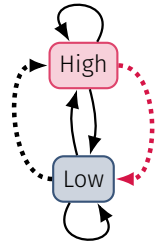# Random mix — infer larger risk ratio with turnover → higher tPAF+

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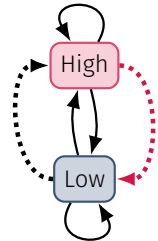# Random mix — infer larger risk ratio with turnover → higher tPAF+

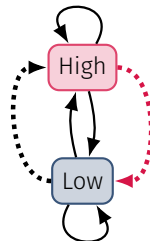|	No Turnover	Turnover
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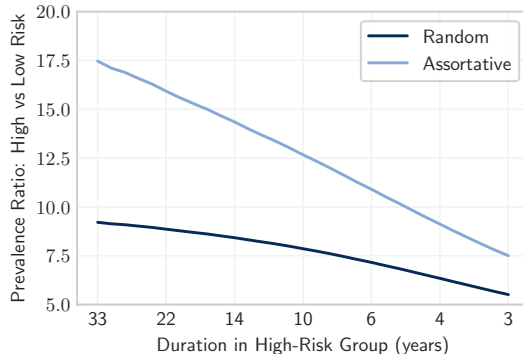
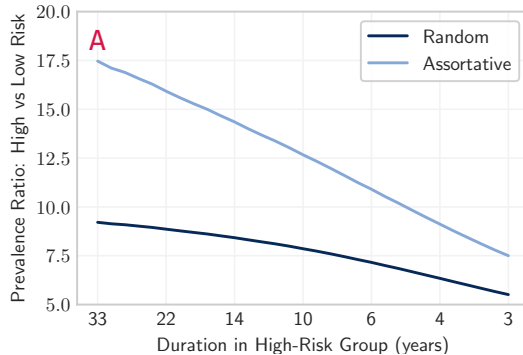▶ Ignore turnover → underestimate tPAF (5.6%)

No Turnover (A)   Turnover (B)

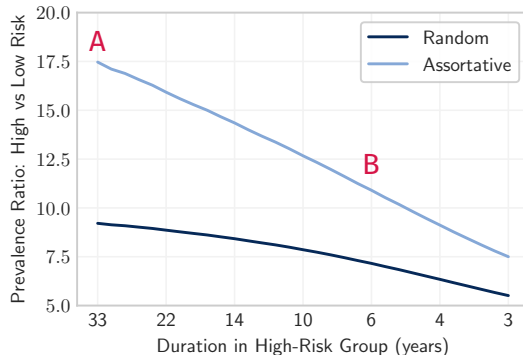Assort mix — turnover allows infections to "escape" sexual networks

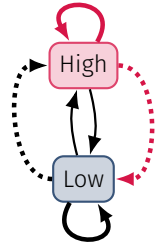# Assort mix — turnover allows infections to "escape" sexual networks

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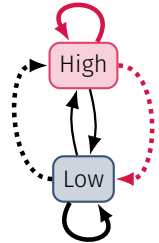|	No Turnover	Turnover
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	No Turnover	Turnover
STI prevalence *	17.5 → 6.7	9.8 → 6.7
Partners per year *		
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	No Turnover	Turnover
STI prevalence *	17.5 → 6.7	9.8 → 6.7
Partners per year *	25.0 → 6.0	25.0 → 10.1
10-year tPAF (Cal)		

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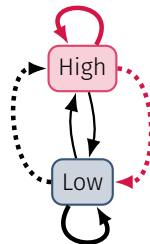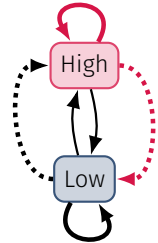# Assort mix — higher risk ratio & escaped infections → higher tPAF++

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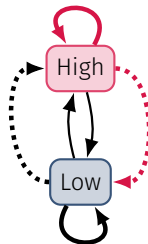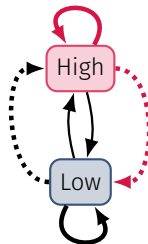# Assort mix — higher risk ratio & escaped infections $\rightarrow$ higher tPAF++

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Also relevant to non-STI epidemics …

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1. Influence of **turnover** on STI epidemics is larger under **assortative** mixing

2. If turnover is **ignored**: we underestimate impact of reaching **high risk** groups

Also relevant to non-STI epidemics ...like COVID-19

References

Mishra, Sharmistha et al. (Feb. 2014). "Distinguishing sources of HIV transmission from the distribution of newly acquired HIV infections: Why is it important for HIV prevention planning?" In: *Sex Transm Infect* 90.1, pp. 19–25. URL: doi.org/10.1136/sextrans-2013-051250.

Rowley, Jane et al. (2019). "Chlamydia, gonorrhoea, trichomoniasis and syphilis: global prevalence and incidence estimates, 2016". In: *Bull World Health Organ* 97, pp. 548–562. URL: doi.org/10.2471/BLT.18.228486.

UNAIDS (2020). *AIDSinfo*. URL: http://aidsinfo.unaids.org/.