Heterosexual HIV transmission in Eswatini: a descriptive modelling analysis

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NSERC CRSNG

INTRODUCTION: HIV IN ESWATINI

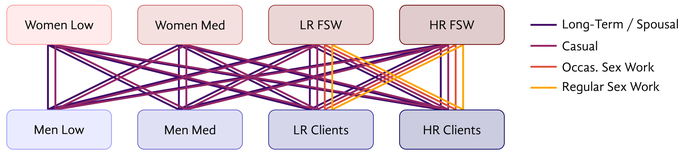
- Highest national HIV prevalence in the world: 27% (2020)
- Female sex workers (FSW, 1–6% women) even higher: 60+% (2011)
- Yet, also hit 95-95-95 by 2020: % diagnosed, on ART, virally suppressed
- What are likely past/present networks of heterosexual transmission?

OBJECTIVES

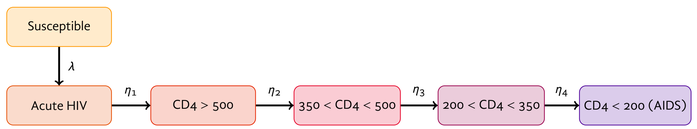
1. **Develop & calibrate** a model of heterosexual HIV transmission in Eswatini
2. Infer the proportions of **infections transmitted** to/from **risk groups** and via **partnership types** throughout past & present Eswatini HIV epidemic

TRANSMISSION MODEL: STRATIFICATIONS

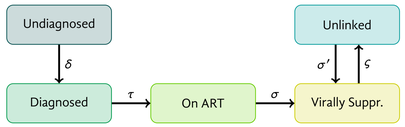
HIV risk: by # partners & engagement in sex work within past year



HIV infection: by CD4 for mortality, infectiousness, & ART eligibility

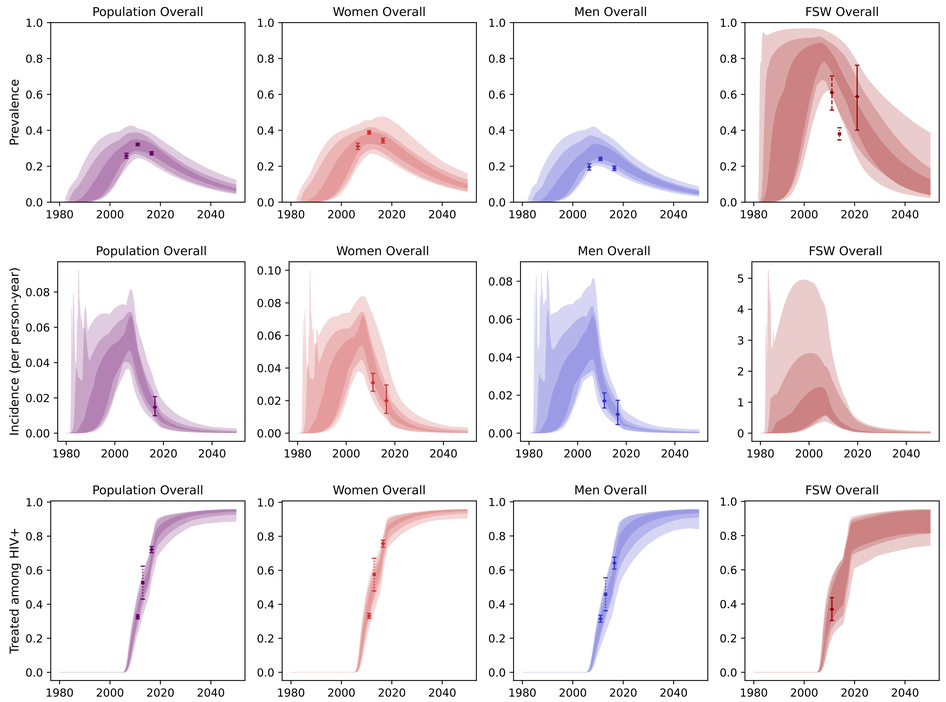


HIV care cascade: key steps + ART failure / unlinked state



Key References + Data Sources:
FSW: Baral (2014) PLOS ONE; JHU CGH R2P Eswatini Report.
Wider population: SDHS (2006/07); SHIMS (2011); SHIMS2 (2016/17)
HIV: Boily (2009) Lancet; Béhanzin (2013) STI; Mangal (2017) AIDS

MODEL CALIBRATION: RESULTS



Points + whiskers: calibration targets (95% CI); Ribbons: 100%, 10%, 1% quantile intervals among 1000 calibrated model projections

MODEL CALIBRATION: METHODS

- **Calibrated parameters:** risk group sizes & turnover, partner numbers & duration, sex frequency, condom use, HIV transmission probability & modifiers (circumcision, STI symptoms), acute HIV
- **Calibration targets:** HIV prevalence & incidence, CD4 among HIV+, % diagnosed, % on ART, % virally suppressed, population size — all with uncertainty & stratified by risk group where possible
- **Calibration method:** 1) Sample 100,000 parameter sets from parameter priors; 2) Solve model & compute log-likelihood for model vs targets; 3) Select top 1000 (1%) parameter sets

GitHub: github.com/mishra-lab/hiv-fsw-art

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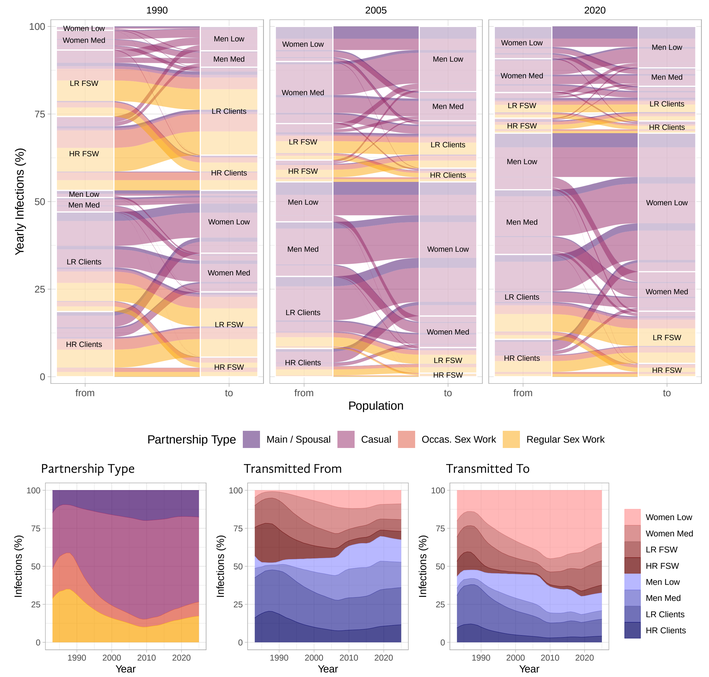
WHO INFECTED WHOM AND HOW



Unmet prevention needs in the context of …

- Casual partnerships → majority of transmission throughout
- Regular (repeat) sex work → much early transmission & rising again
- Clients of FSW → acquisition via sex work, large onward transmission
- Lower risk women → large acquisition, minimal onward transmission
- FSW → may soon acquire more infections than transmit due to turnover

IMPLICATIONS

- **Unmet needs of FSW & clients**: disproportionate transmission impact, even in high-prevalence epidemic → **tailored services needed**
- **Calibrated model** can now be used to **answer research questions** through hypothetical scenarios: retrospective & future projections