Factors of Risk Heterogeneity in Deterministic Compartmental Models of HIV Transmission & Possible Influence on ART Prevention Impact

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Factor	Sub-Factor	Model Parameter(s)	Definition		Possible marginal influence on ART prevention impact and why
Biological					
HIV Infection	Acute Infection	Trans Prob Per Act	Increased transmission probability immediately following infection	−	Acute infection transmissions are unlikely to be prevented by ART
HIV Infection	Late Stage	Trans Prob Per Act	Increased transmission probability during late stage (symptomatic) phase	+	Late-stage transmissions are more lilely to be prevented by ART
HIV Infection	Drug Resistance	Trans Prob Per Act	Factor (possibly transmitted) that delays viral suppression among a population subset	−	Transmissions during longer delay to achieving viral suppression will not be prevented by ART
Sex Acts	Gender Differences	Trans Prob Per Act	Biological differences in transmission probability are considered (higher susceptibility among women)	?	Unclear
Sex Acts	Circumcision	Trans Prob Per Act	Decreased transmission probability (lower susceptiblity among men)	?	Unclear
Sex Acts	Anal Sex	Trans Prob Per Act; N Acts	Anal sex is considered, with higher receptive transmission probability	−	If higher risk groups practice anal sex more; then higher risk heterogeneity increases R0 and the challenge of epidemic control
Sex Acts	STI Co-Infection	Trans Prob Per Act	Increased transmission probability due to coinfection	−	If disproportionately affecting higher risk groups, then higher risk heterogeneity increases R0 and the challenge of epidemic control
HIV Infection	HIV Mortality	Mortality Rate	Increased HIV/AIDS associated mortality at during late-stage disease	−	Reduced mortality via ART could increase the overall HIV prevalence
Social					
HIV Infection	HIV Morbidity	Partner Rate; N Acts	Reduced sexual activity associated with symptomatic HIV/AIDS during late stage disease	+	Reduced morbidity via ART could increase HIV prevalence among sexually active population
Population Strata	Age	Partner Rate; Condom Use	Any stratification defined by age	?	Unclear
Population Strata	Activity	Partner Rate; Condom Use	Any stratification defined by rate of partnership formation	−	Higher risk heterogeneity increases R0 and the challenge of epidemic control
Population Strata	Key Populations	Partner Rate; Condom Use	Any epidemiologically defined higher risk groups, including: FSW, Clients, MSM, PWID, AGYW	−	Higher risk heterogeneity increases R0 and the challenge of epidemic control
Turnover	Population	Birth Rate; Mortality Rate	Individuals enter into and exit from the overall population, reflecting the lifecourse of sexual activity	−	Replacement of virally suppressed individuals ceasing sexual activity with susceptible individuals entering sexual activity could make ART coverage more difficult to achieve
Turnover	Activity; Key Pops	Internal Turnover	Individuals move between activity groups and/or key populations	±	Lower risk heterogeneity as cumulative exposure to risk experienced by any one individual is reduced; but viral suppression may be achieved only after periods of highest risk
Mixing	Age	Mixing Matrix	Any assortative or semi-assortative mixing by age group, including older men with younger women	?	Unclear
Mixing	Activity	Mixing Matrix	Any assortative mixing by activity group and/or key populations	−	Higher risk heterogeneity increases R0 and the challenge of epidemic control
Partnership Types	Duration; Condom Use	N Acts	Some partnership types (casual, sex work) have decreased volume of sex and/or higher condom use versus other partnership types (steady)	+	If only higher risk groups form such partnerships, then risk heterogeneity is reduced versus assuming all partnerships are equal
Partnership Types	Concurrent Types	Partner Rate	Partnership types are not defined by the risk groups involved, so e.g. higher risk groups can form steady partnerships too	−	Higher risk heterogeneity versus assuming higher risk groups cannot form steady partnerships
Intervention					
Behaviour Change	HIV Counselling	Partner Rate; Condom Use	Reduced sexual activity / increased condom use associated with HIV diagnosis	+	Increased HIV testing as part of ART scale-up can contribute to prevention benefits even before viral suppression is achieved
Behaviour Change	Risk Compensation	Partner Rate; Condom Use	Increased sexual activity / reduced condom use associated with ART (before or after viral suppression)	−	Higher risk bevhaviour, especially before achieving viral suppression, could increas transmission risk
Historical	Any Prevention	Multiple	Any increase in prevention interventions reflecting observed trends	−	Declining incidence due to other interventions reduces the potential for ART prevention benefit
Historical	ART	Testing; Initiation; Viral Suppression Rates	Any increase in ART coverage reflecting observed trends	−	Declining incidence due to other interventions reduces the potential for additional ART prevention benefit
Combination	Any Prevention	Multiple	Any increase in prevention interventions reflecting projected trends	−	Declining incidence due to other interventions reduces the potential for additional ART prevention benefit
Gaps	ART	Testing; Initiation; Viral Suppression Rates	Differential ART cascade coverage across activity groups and/or key populations, where higher risk groups have lower coverage	−	Lower viral suppression among higher risk groups specifically could allow higher volumes of onward transmission to persist