The potential impact of partially effective HIV prevention strategies: Insights from mathematical modeling analyses

Ruanne V. Barnabas, MBChB, D.Phil
Global Health and Medicine
University of Washington

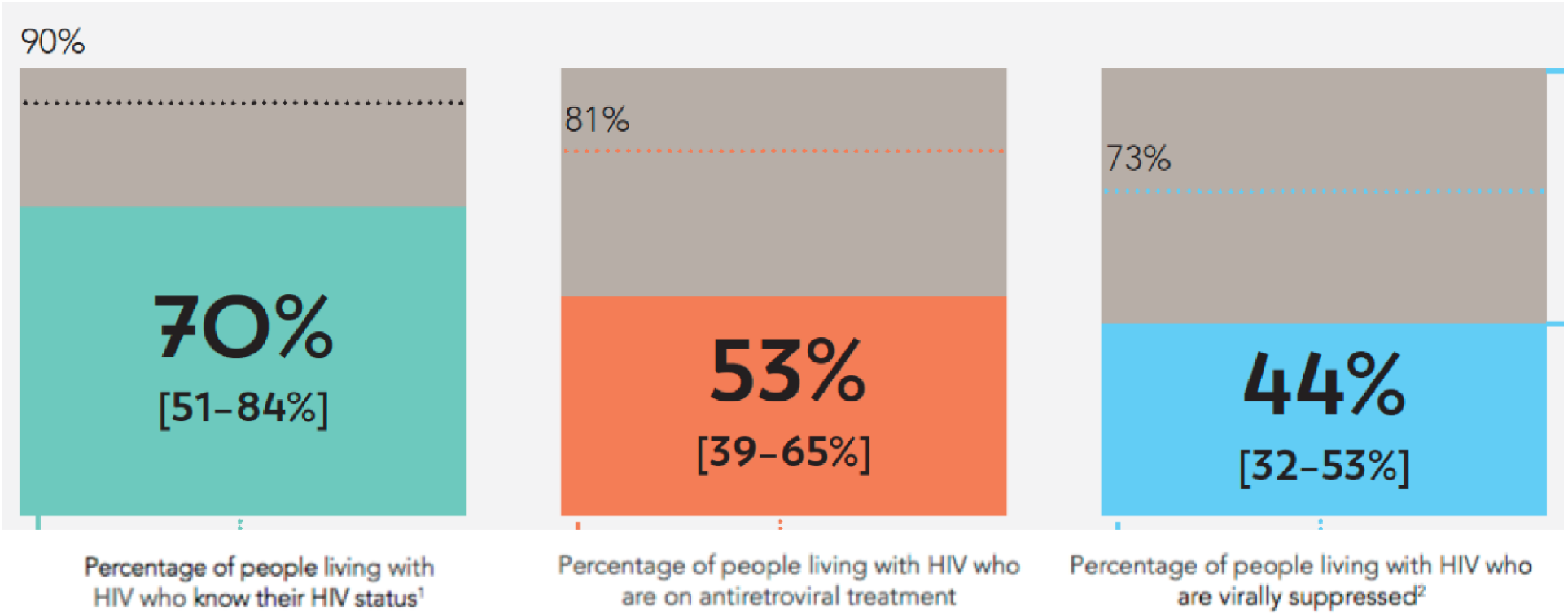
UNIVERSITY of WASHINGTON
DEPARTMENT OF GLOBAL HEALTH

UW Medicine
DIVISION OF ALLERGY AND INFECTIOUS DISEASES

Outline

- Background: Combination prevention to reduce HIV incidence
- Mathematical modeling methods
- Results: Incremental impact of prevention
- Conclusions
- Next steps

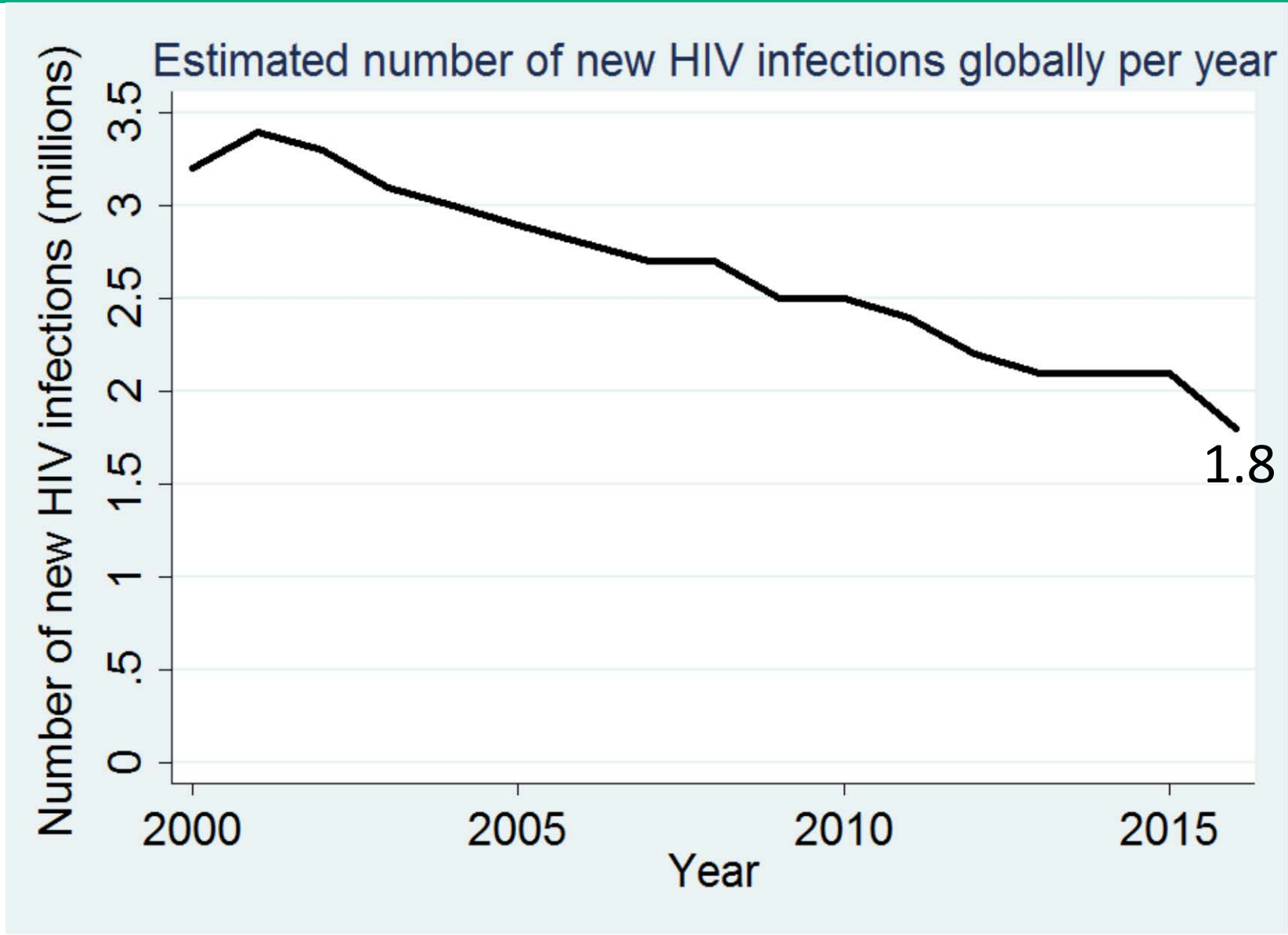
Progress towards UNAIDS 90-90-90 targets



To reach these UNAIDS targets, we need **scalable strategies** for testing, linkage, ART initiation, and monitoring

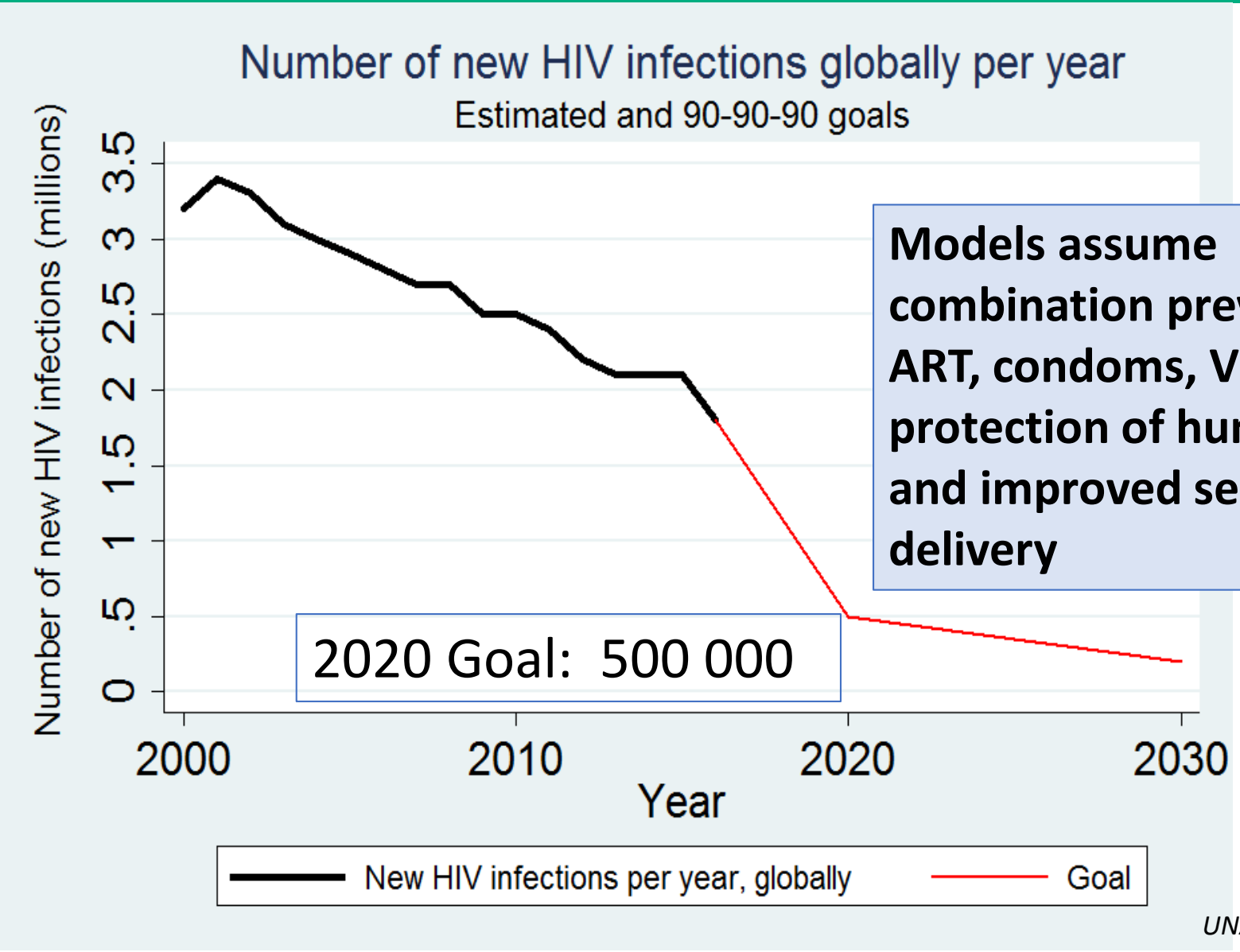
UNAIDS, 2017

Substantial declines in new HIV infections



UNAIDS, 2017

Reductions in new infections are off target

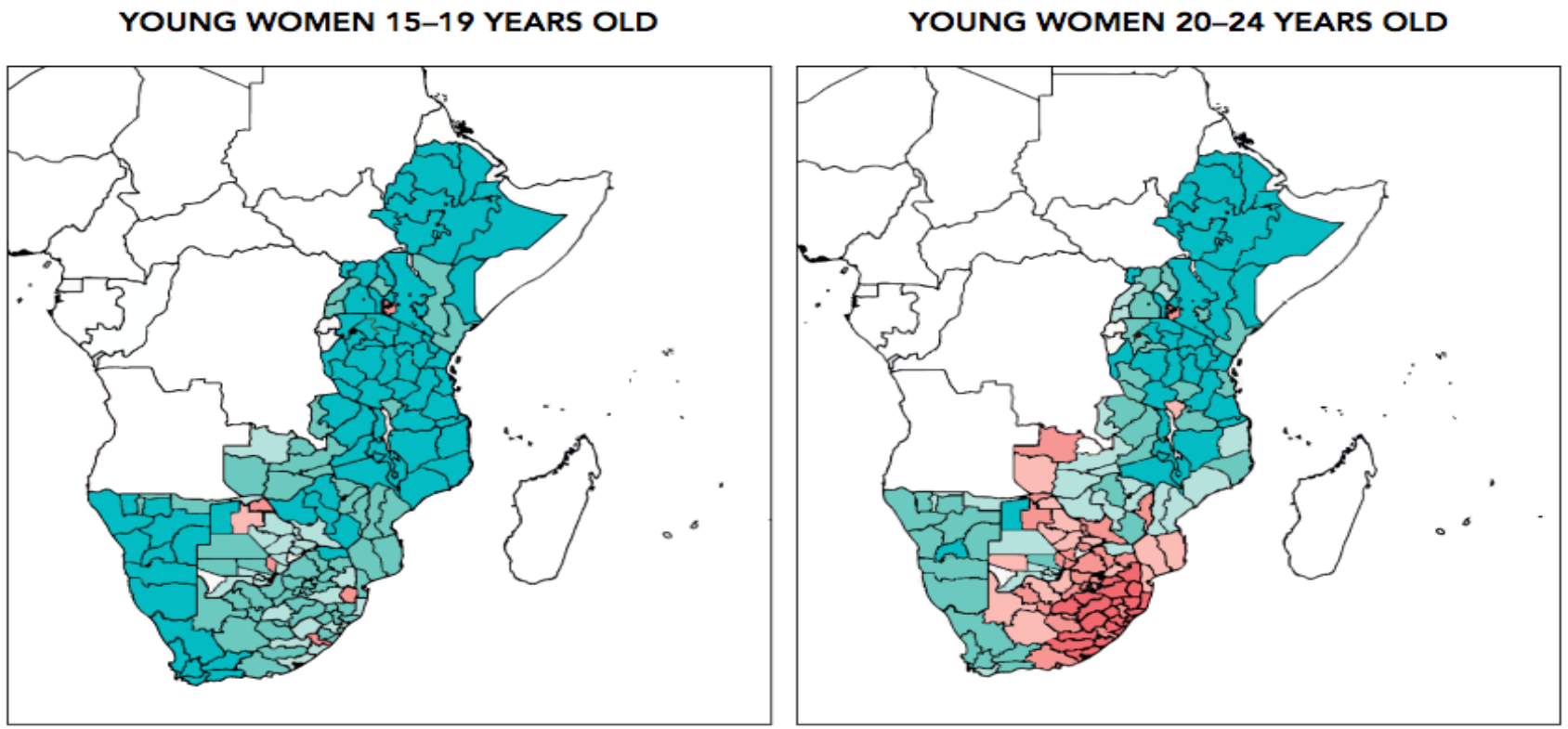


Models assume combination prevention: ART, condoms, VMMC, PrEP, protection of human rights and improved service delivery

UNAIDS, 2017

High HIV incidence among young women age 20-24 years in eastern and southern Africa

Subnational HIV incidence (%) among young women (aged 15–24 years), by age group, eastern and southern Africa, 2014–2015



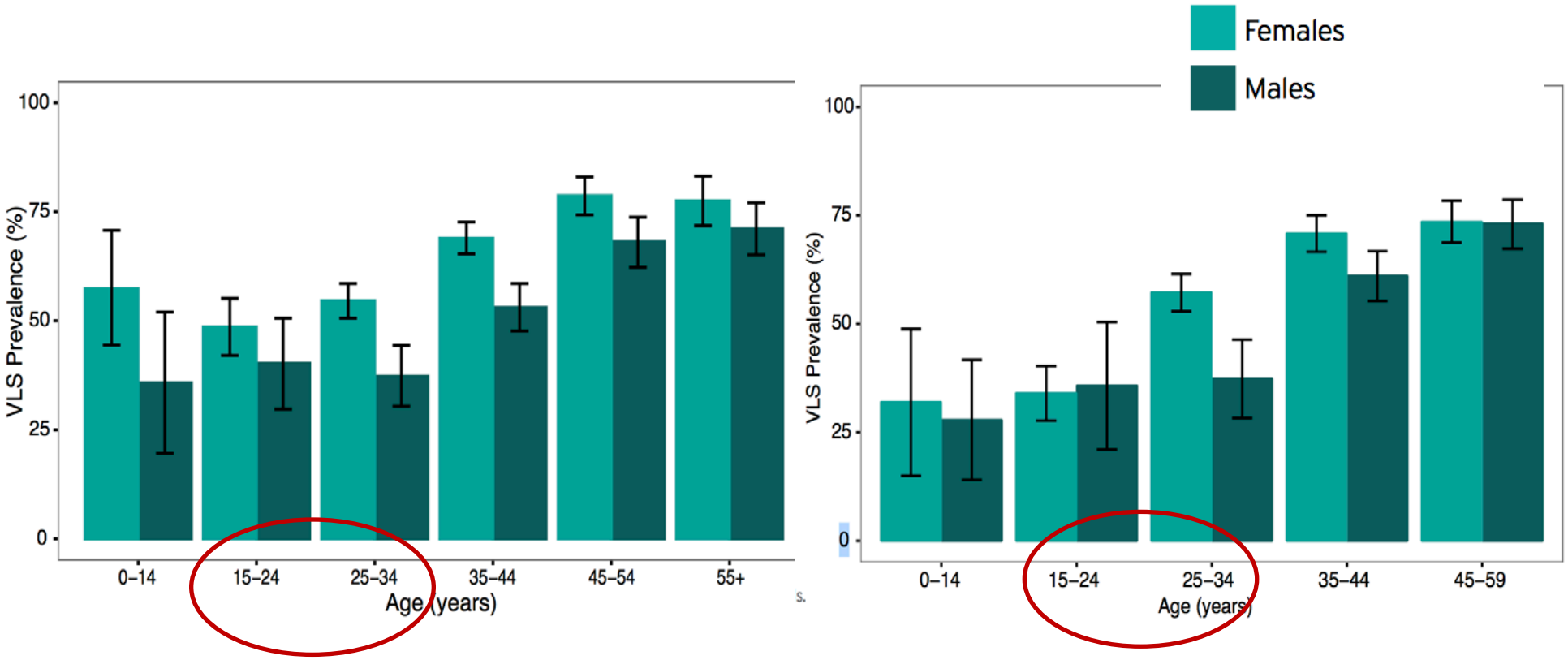
Source: UNAIDS estimates, 2014–2016 plus additional source. See annex on methods for details.

Gaps in achieving reductions in HIV incidence

- ART coverage gaps by gender and age
- Unmet need for primary prevention
  - VMMC
  - PrEP
  - New platforms for prevention
- To reduce HIV incidence: Maximize the synergy between treatment and prevention
- When 90-90-90 goals for ART are met, 50% of new infections are estimated to occur from acute HIV infection
- Acute infections are challenging to identify – as ART is scaled up, primary prevention will be critical to decrease incident HIV infections

PHIA: viral suppression lower among men and young persons

- Population-Based HIV Impact Assessment (PHIA)

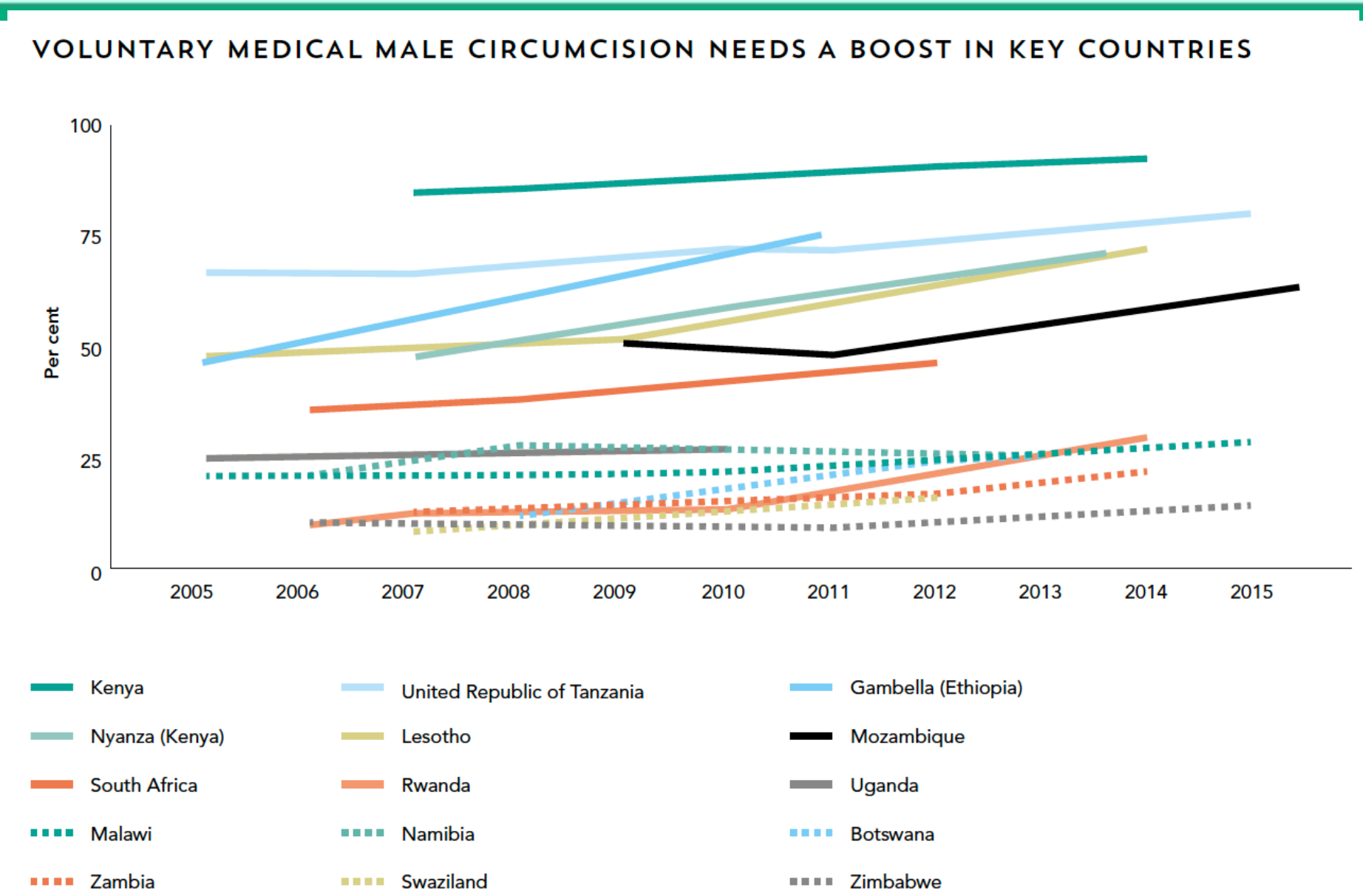


Zimbabwe

Zambia

Jessica Justman et. al., ICAP, Columbia, 2017

Low uptake of VMMC



Aim

To estimate the incremental impact of partially effective HIV prevention interventions in addition to ART scale up, specifically:

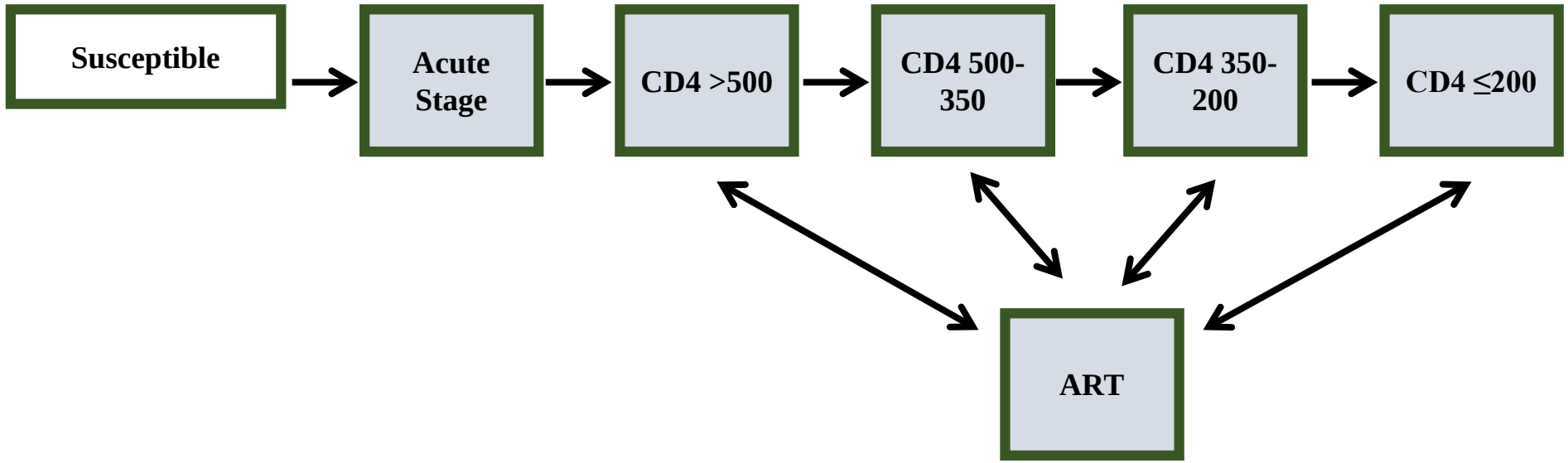
- Scale-up VMMC
- Provision of oral PrEP (25% of 15-39 year old women)
- Modest coverage for the dapivirine ring (10% and 20%)

Methods

- Adapted a mathematical model of HIV infection in KwaZulu-Natal, South Africa, a high HIV incidence setting
- Compartmental, deterministic
- Stratified for gender, age, sexual behavior, CD4, and viral load
- Continuous for time and age
- Viral load determines transmission probability
- Parameterized using local data
- Validated using independent data source
- Tracks engagement in treatment and prevention

Ying, R., et. al. CEA of home-based HTC, Lancet IHV, 2016

Mathematical modeling estimate of effectiveness



- *Force of infection – per susceptible risk of acquiring HIV (function of sexual mixing, HIV prevalence, transmission probability, viral load) – captures indirect effects

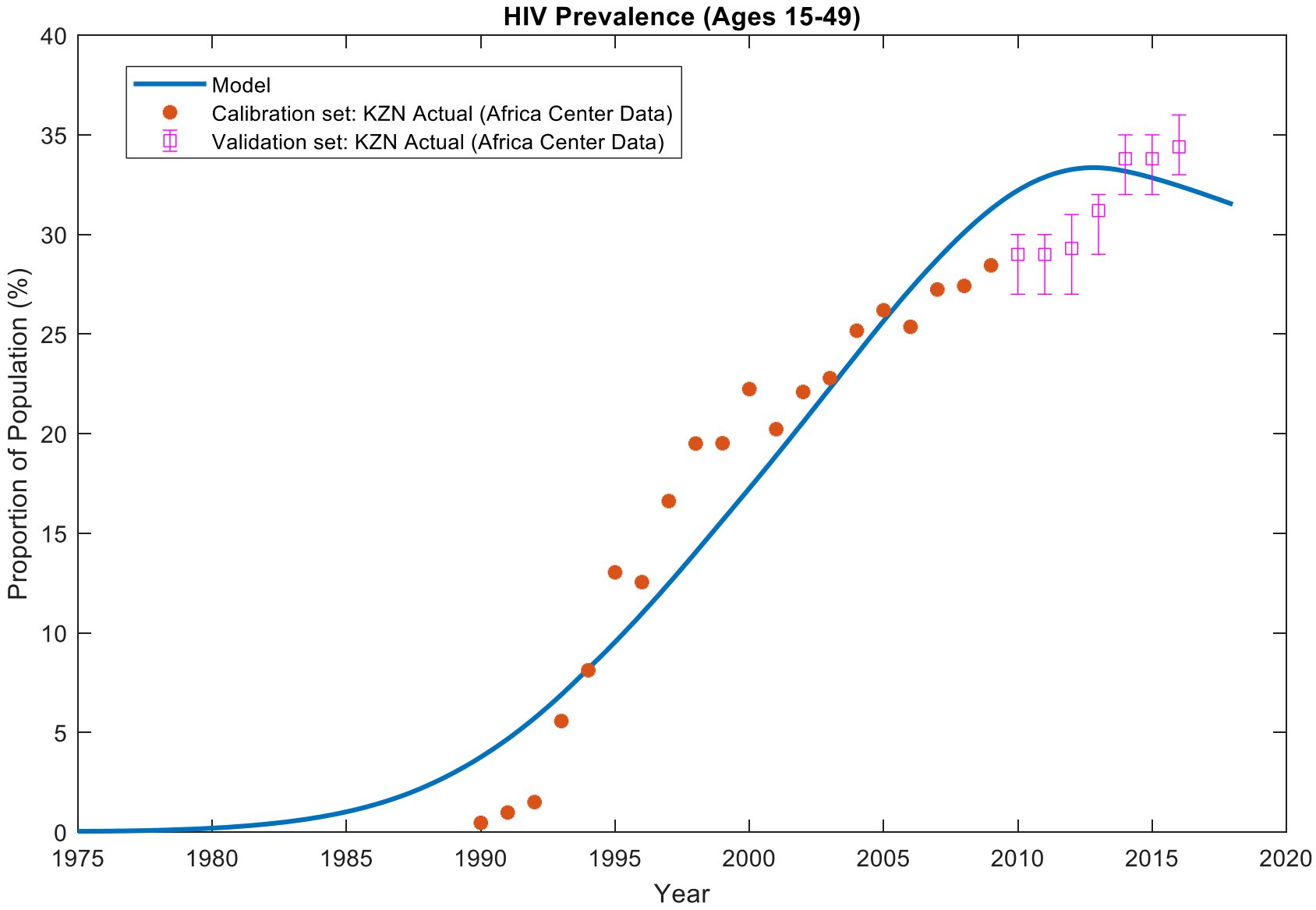
Ying, R., et. al. CEA of home-based HTC, Lancet IHV, 2016

Model assumptions

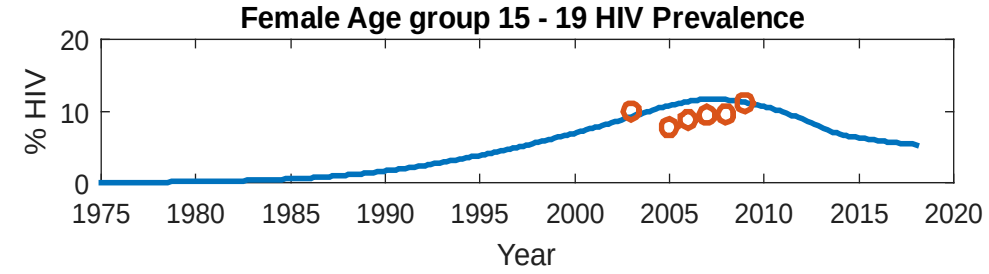
- HIV progression by CD4 and viral load count
- ART coverage – 60% of PLWH are virally suppressed
- VMMC: 10% then scaled up to 50%
- Efficacy assumptions:
  - PrEP: 70% (assuming high adherence)
  - Dapivirine ring*
    - Females aged 15-19: 27%
    - Females aged 20+: 50%
  - Circumcision: 60%

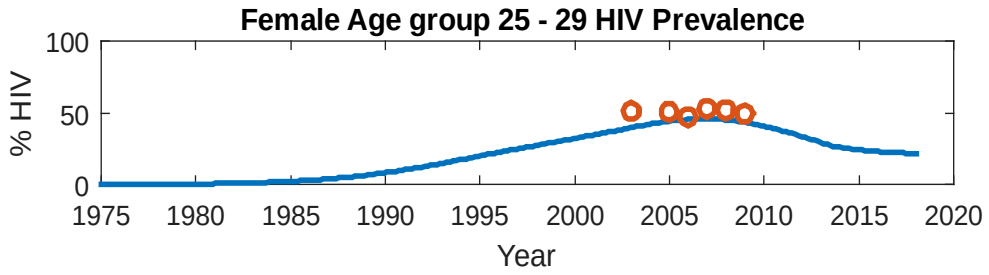
*Baeten and colleague, ASPIRE and HOPE Studies; Nel and colleagues, The Ring and DREAM Studies

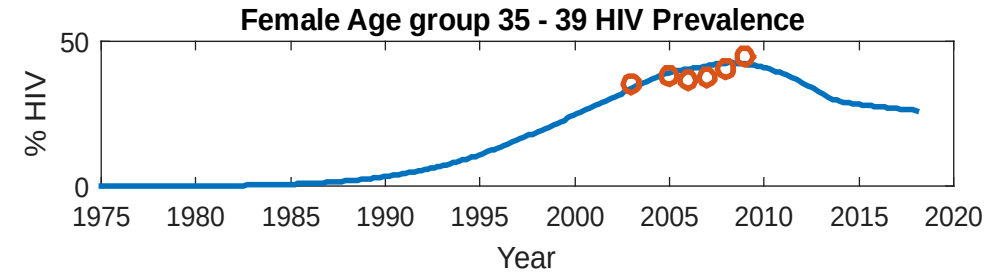
Model validation

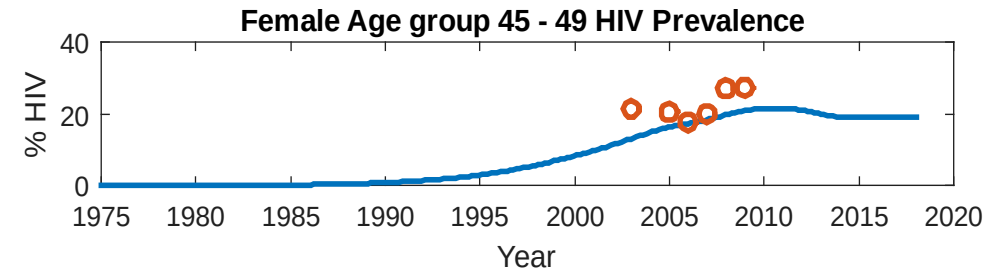


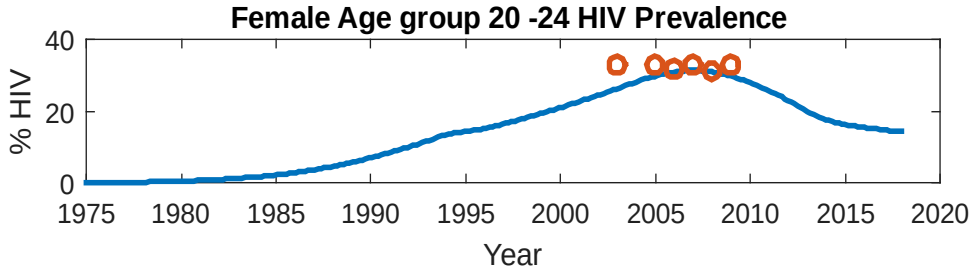
Model validation

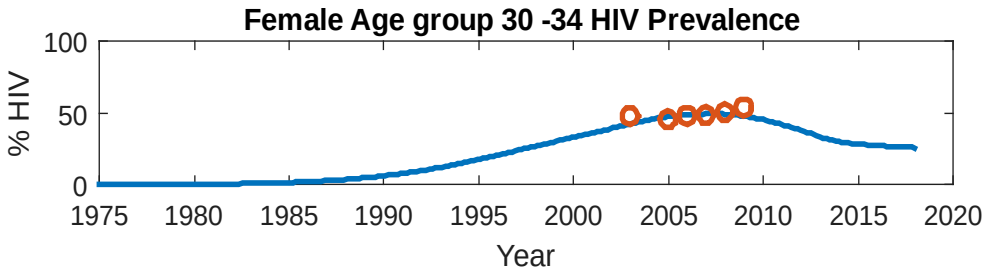


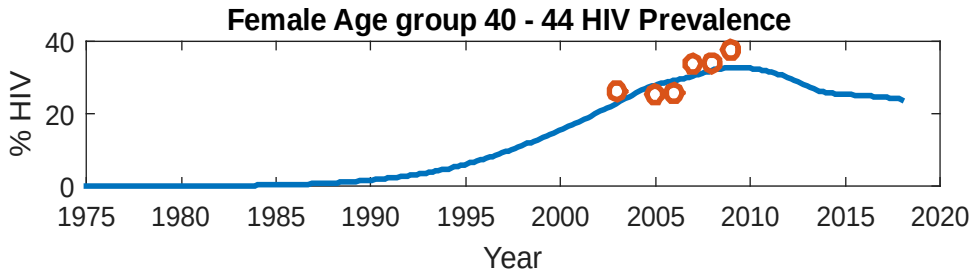


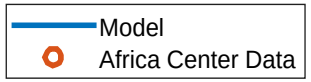






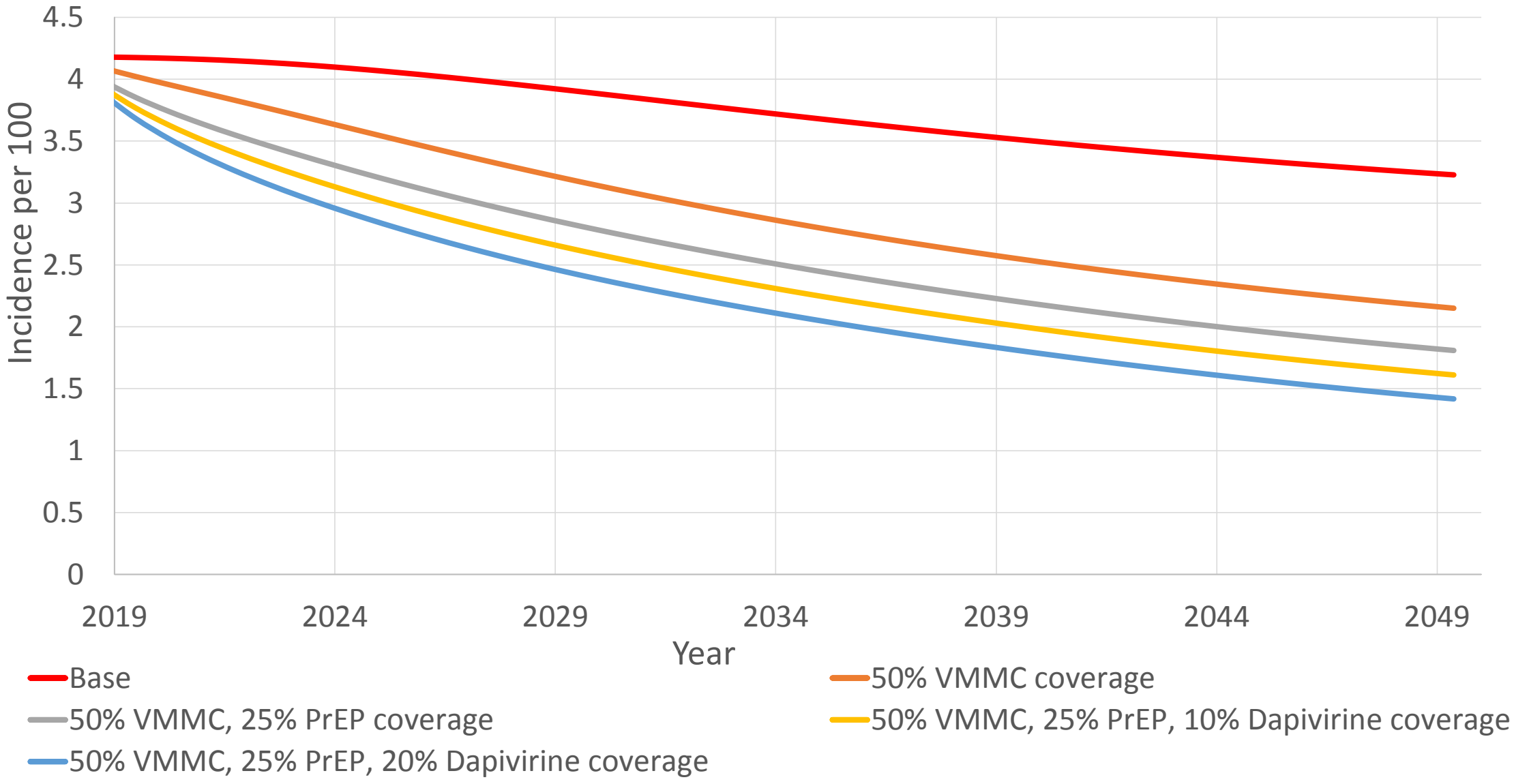






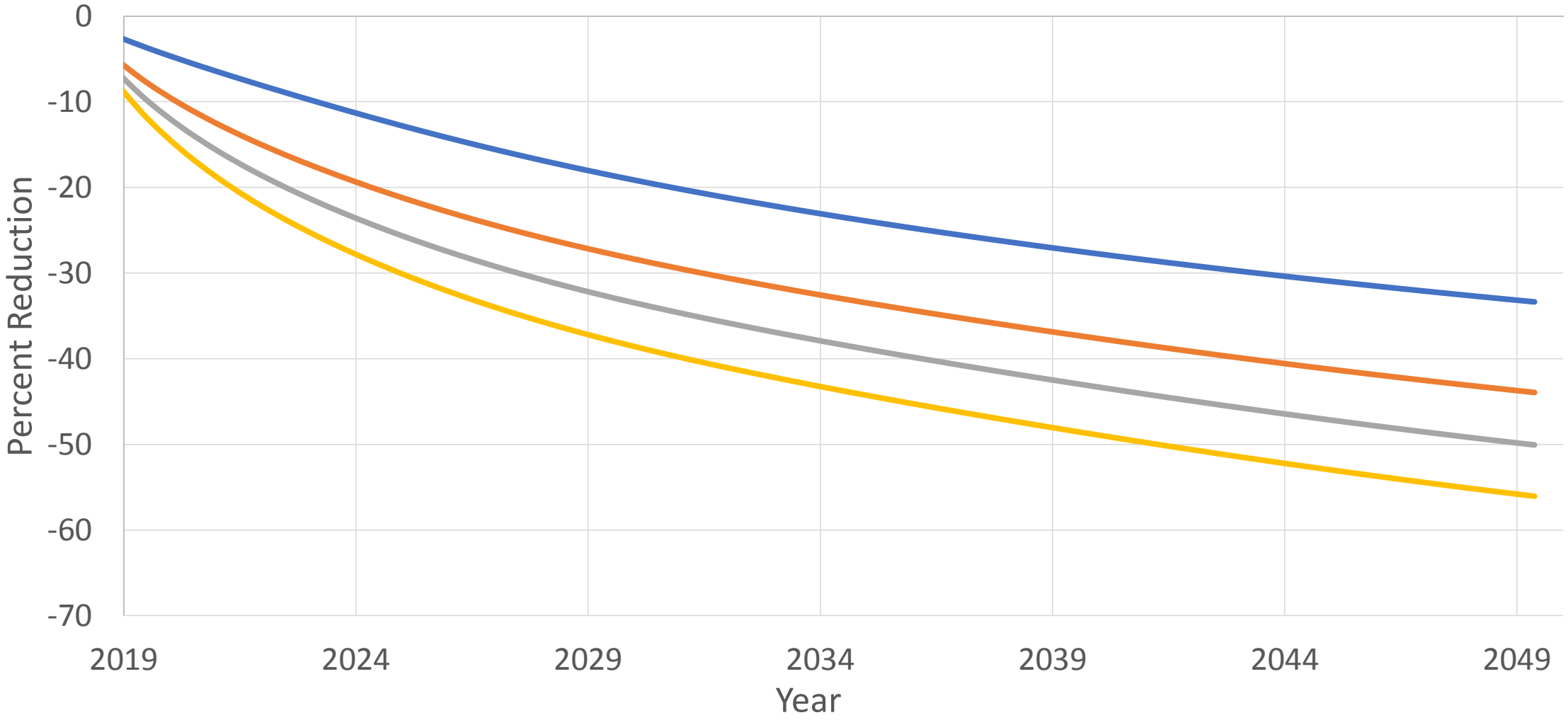
Results

HIV Incidence



Results

HIV Incidence Reduction



Conclusions

- HIV incidence continues to be high, specifically among young women and priority populations
- Synergy between treatment and prevention has the potential to reduce HIV incidence compared to treatment alone
- Modest coverage of partially effective prevention interventions, such as the dapivirine ring, could result in real decreases in HIV incidence at a population level while we await more efficacious long-acting interventions
- Next step - look at interventions stratified by age and gender

Thank you

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