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Optimal HIV testing strategies to achieve high levels of HIV diagnosis in South Africa

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Background

- UNAIDS estimates that globally 70% of HIV-positive individuals know they are HIV-positive.
- UNAIDS target is to get 90% of HIV-positive population diagnosed by 2020.
- Current HIV testing strategies may be insufficient to reach this target – so community-based HIV testing strategies and other new approaches need to be considered.
- Recent work by Avenir Health considered the need for new testing strategies to reach the 90% target in four countries (Mozambique, Nigeria, Senegal, Bolivia).
- In addition, the HIV Modelling Consortium commissioned work to assess which testing strategies would be most important in reaching the 90% target in other settings.

HIV testing in South Africa

- South Africa has made good progress towards the UNAIDS target of 90% diagnosed by 2020, but challenges remain:
  - The % diagnosed is substantially lower in men than in women, and the gender gap has widened over time.
  - The % diagnosed remains low among youth.
  - There is concern that HIV testing may not be reaching key populations (FSW, MSM).
- In addition, there is concern that our current testing strategies might not be as efficient and cost-effective as they could be.
- Almost all HIV testing in SA to date has been facility-based.

Key research questions

- How do different HIV testing strategies compare in terms of the % of tested individuals who are newly diagnosed (efficiency), and in terms of cost-effectiveness?
- Which HIV testing strategies are most critical to reduce the fraction of the HIV-positive population that is undiagnosed?

Approach

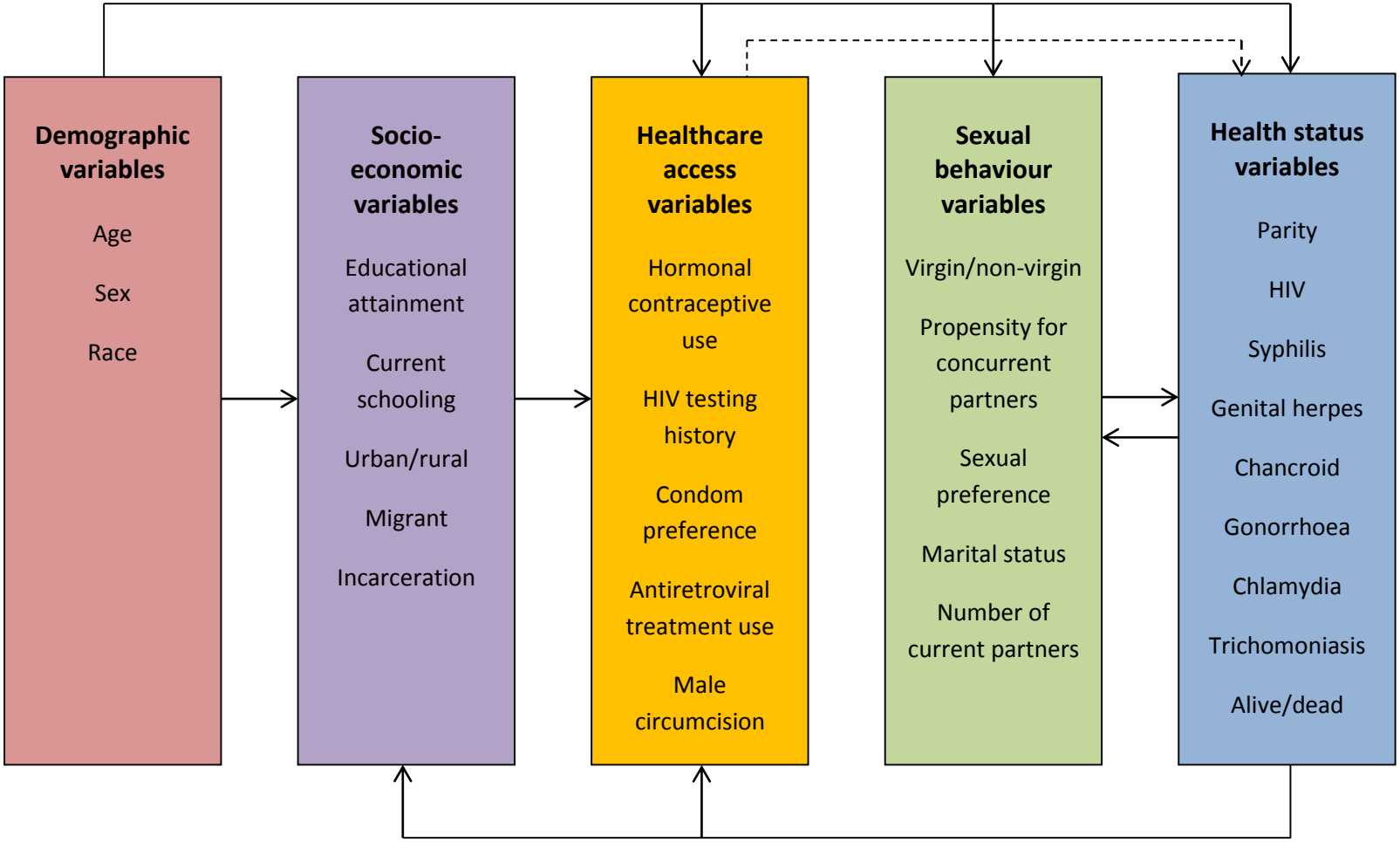
Overview

- We extended a previously-developed agent-based model of HIV and other STIs in SA (MicroCOSM) to represent the potential effects of different HIV testing modalities.
- HIV testing modalities included in the baseline scenario:
  - 'General' testing (e.g. self-initiated testing)
  - Testing of patients with HIV opportunistic infections
  - Testing of pregnant women
  - Testing of STI patients
  - Testing of men who seek MMC
  - Testing of men entering prison
  - Testing of sex workers receiving PrEP
  - Testing of partners of diagnosed individuals

New HIV testing strategies

- Home-based HIV testing (urban/rural, with or without offer of self-testing (ST))
- Mobile testing (urban/rural, with/without community mobilization)
- Assisted partner notification
- Invitation letters or ST kits to partners of women attending antenatal clinics (ANC)
- Testing targeted to sex workers
- Testing targeted to MSM
- Testing in family planning clinics
- School-based testing
- Workplace testing

Individual-level variables



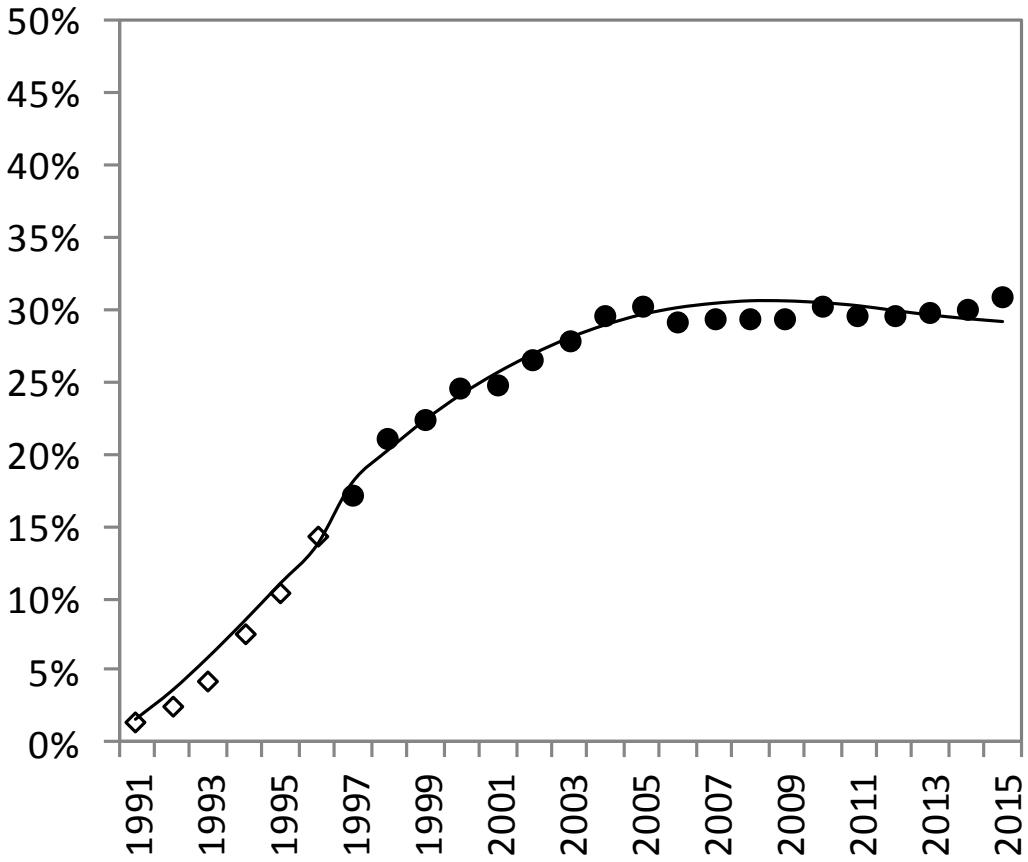
Assumed effects of diagnosis

- Adults who are diagnosed positive are assumed more likely to use condoms consistently (depending on whether they disclose their HIV status to their partner).
- Disclosure of HIV status can lead to partner testing.
- Individuals diagnosed positive can link to ART immediately or after a delay. Rate of linkage depends on
  - Testing modality (highest in facility-based settings, especially ANC and OI clinics)
  - Gender, period, ART eligibility criteria
- Individuals who were previously diagnosed also have an increased probability of linkage if they retest.

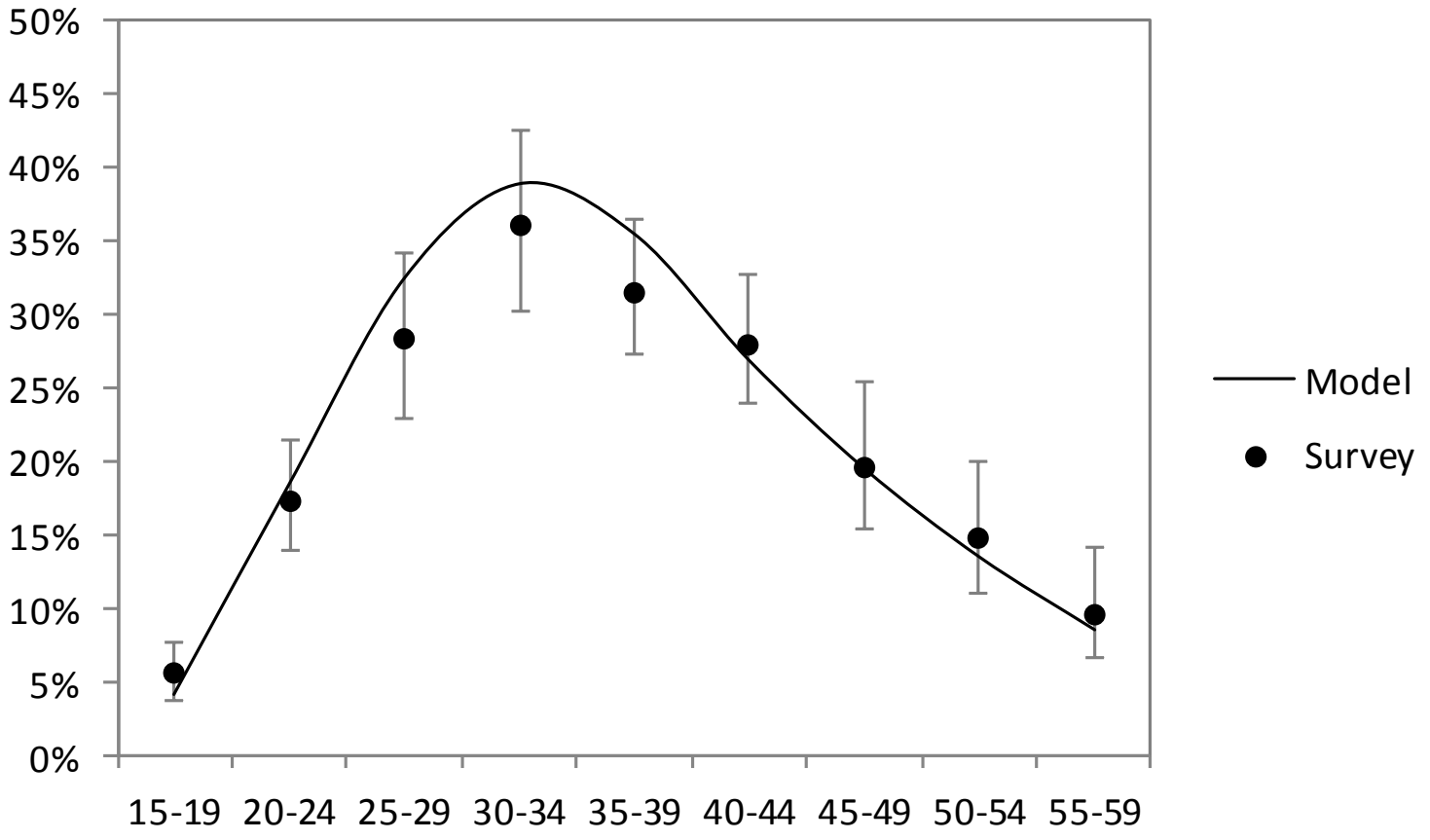
Calibration

- Model has previously been fitted to age-specific HIV prevalence data from national antenatal and household surveys.
- Rates of past HIV testing have been set based on
  - Total numbers of HIV tests performed in SA since 2002
  - Routine data on % of pregnant women screened for HIV
  - Routine data on % of TB patients screened for HIV
  - Data from Department of Correctional Services (number of prisoners tested)
  - Household survey data on % of individuals ever tested (by age, sex and HIV status)

HIV prevalence in pregnant women



HIV prevalence in women, 2012

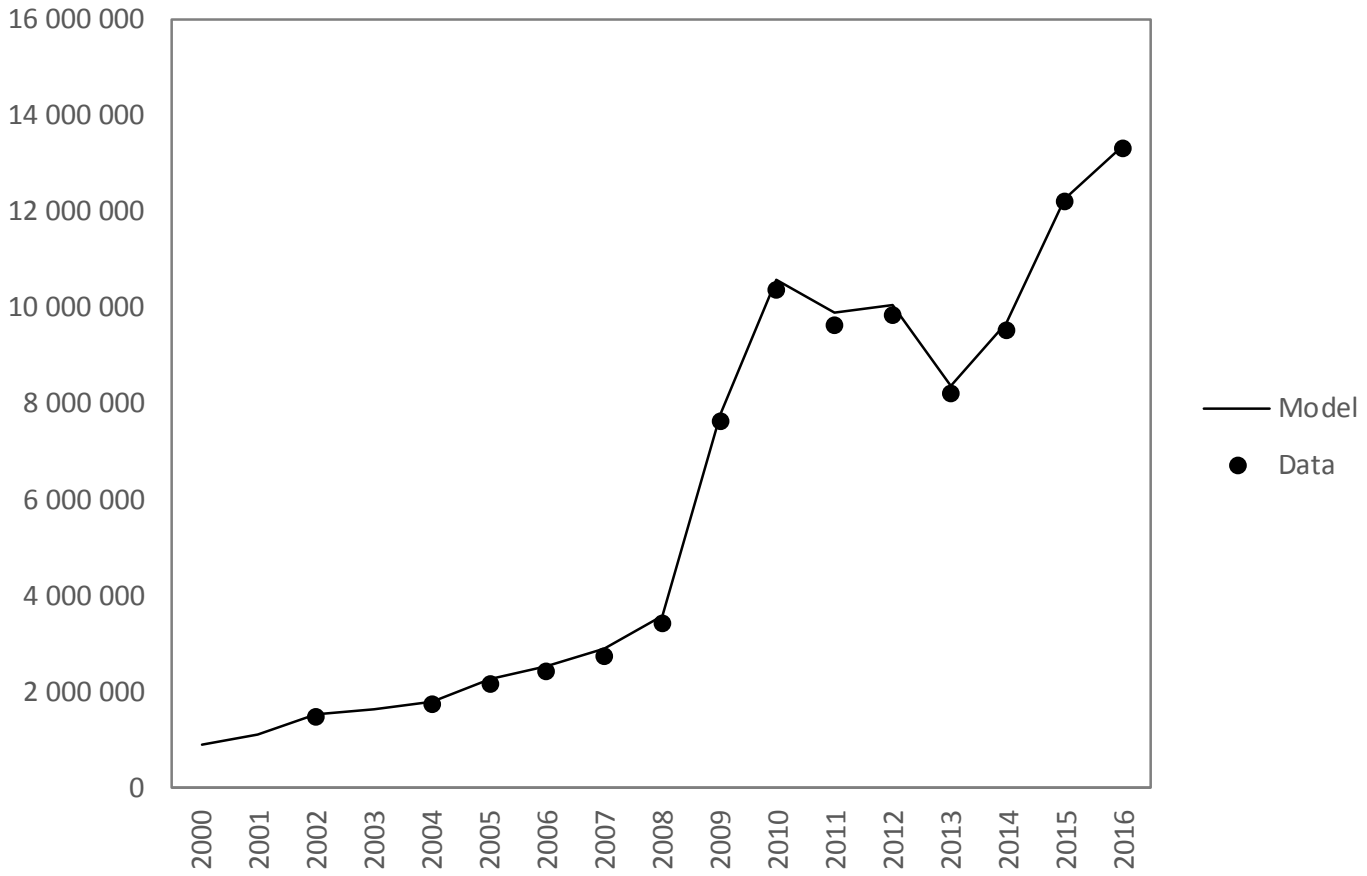


Cost-effectiveness analysis

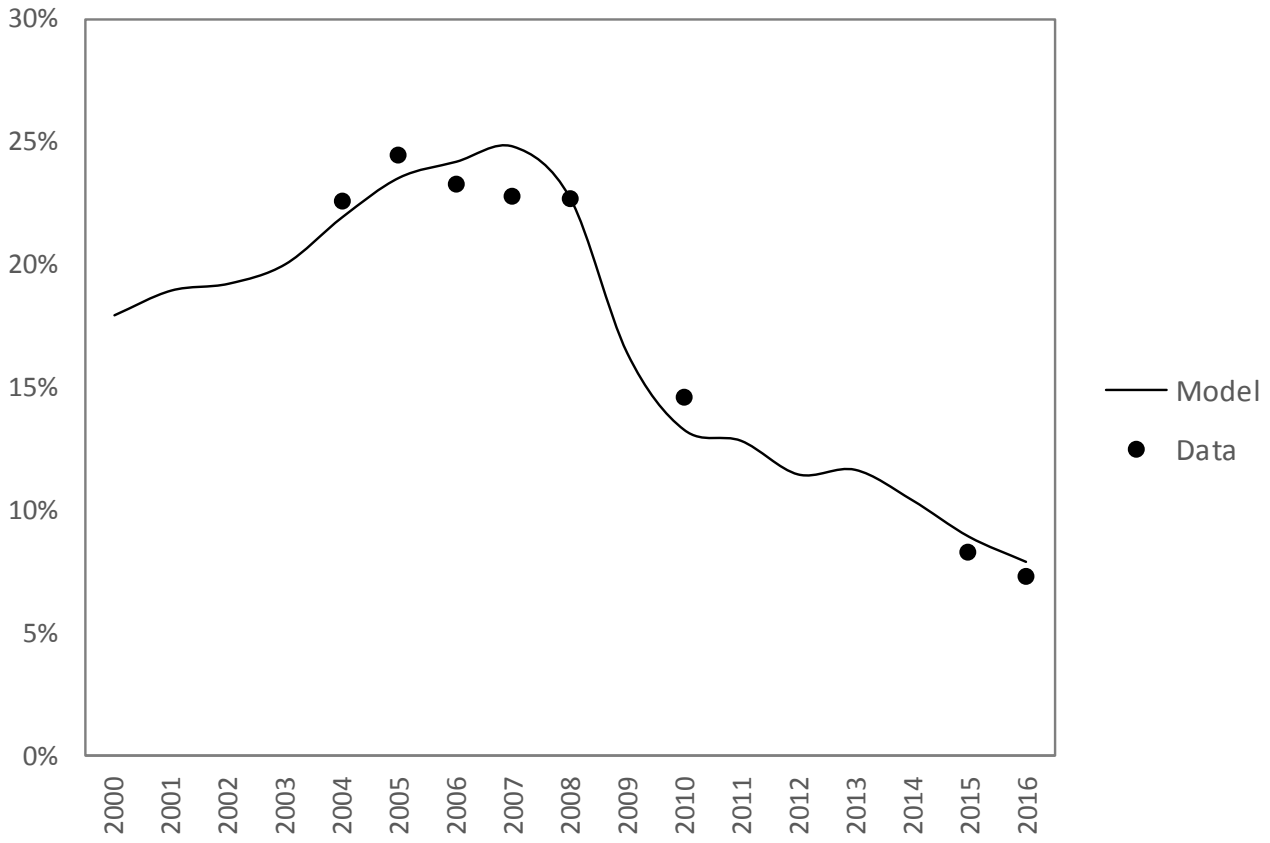
- Costed several modalities (or adapted from literature)
  - Facility-based testing
  - Mobile testing
  - Household-based testing
  - Testing as part of MMC and PrEP
- All costs are incremental to existing services and include staff, transport (differs by urban/ rural), test kits and other consumables as well as demand creation costs.
  - Demand creation includes costs of other services that are thought to reduce stigma in the case of workplace and school-based testing.
- ICERs calculated as cost per HIV infection averted and cost per life year saved.

Preliminary findings

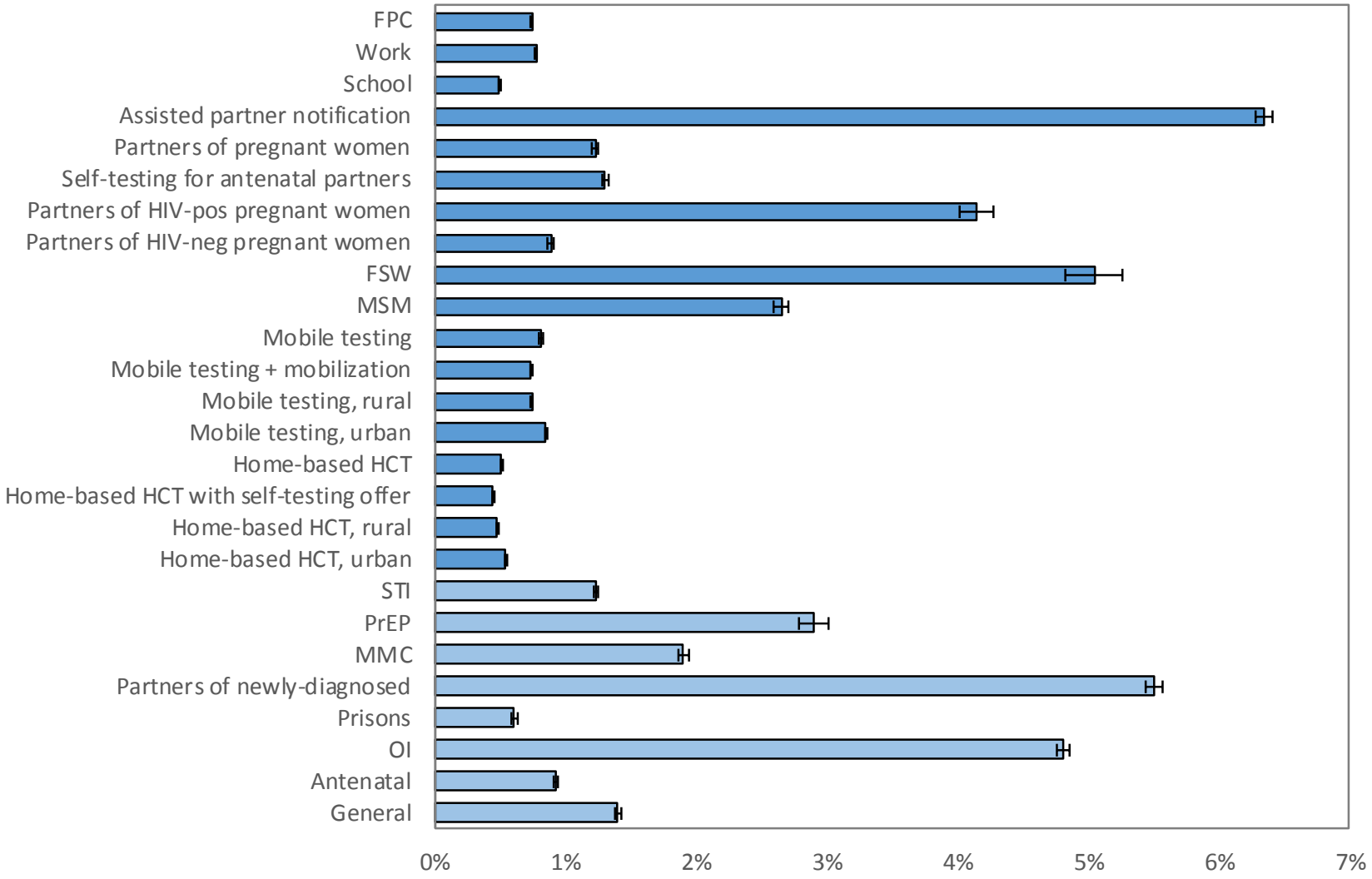
Total HIV tests performed in adults



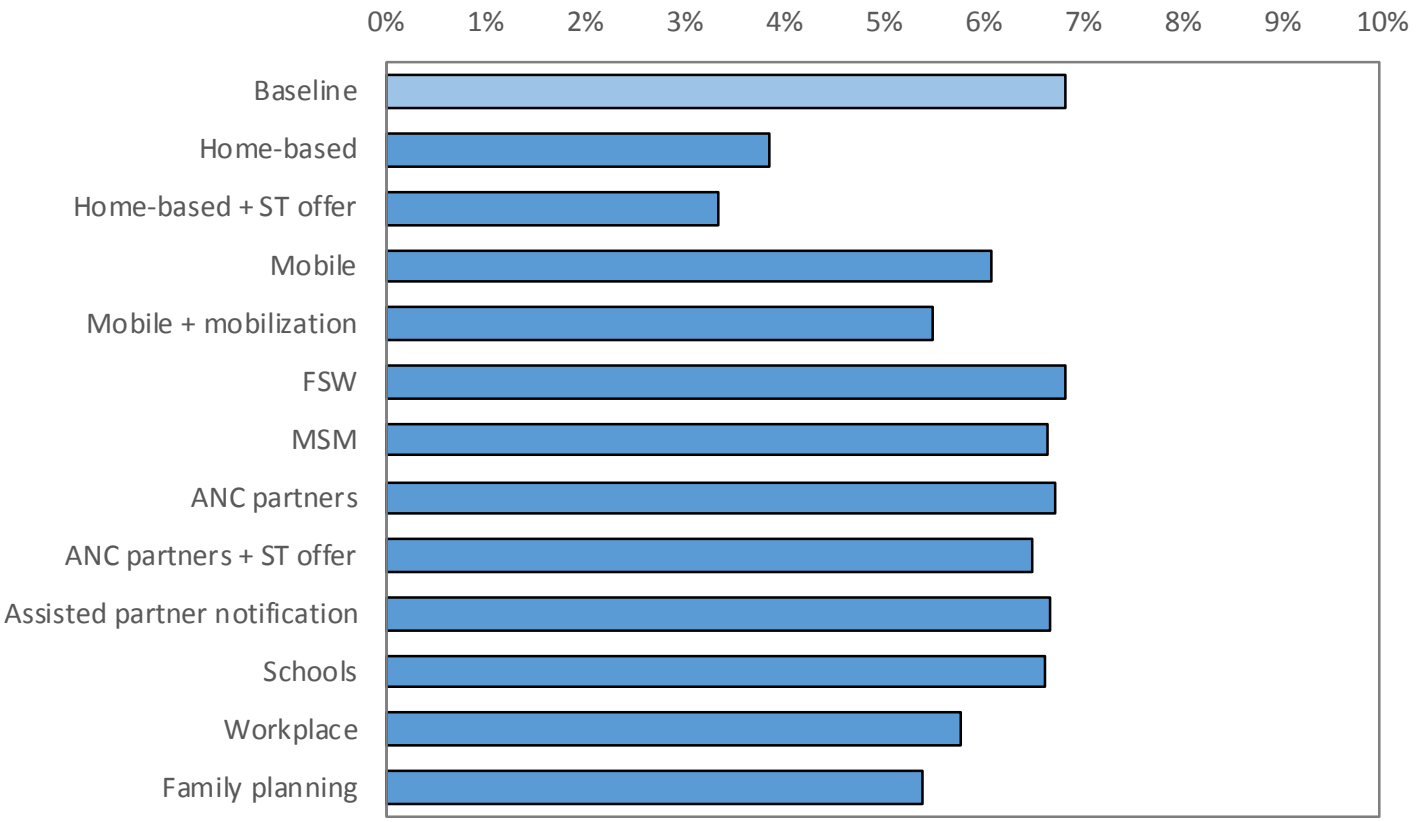
HIV prevalence in adults tested for HIV



New HIV diagnoses per tested adult, 2019-39, by testing modality



% of HIV-positive adults undiagnosed in 2025, by testing scenario



ST = self-testing

Incremental cost-effectiveness ratios (testing costs only)

	ICER per infection averted ($)	ICER per life year saved ($)
Home-based HCT, urban	**3,527 (3,143-4,017)**	669 (628-716)
Home-based HCT, rural	**4,407 (3,455-6,083)**	1,072 (906-1,312)
Home-based HCT (combined)	**3,994 (3,663-4,389)**	734 (701-770)
Mobile testing, urban	2,625 (1,681-5,993)	689 (482-1210)
Mobile testing, rural	2,860 (1,412-*)	**1,673 (622-*)**
Mobile testing (combined)	2,472 (1,838-3,774)	613 (497-799)
MSM	**264 (159-784)**	**188 (81-*)**
FSW	*	*
Family planning	1,482 (1,344-1,651)	372 (347-702)
Assisted partner notification	**389 (148-*)**	*
Schools	**3,605 (2,140-11,447)**	**5,257 (1,339-*)**
Workplace	2,184 (1,718-2,996)	**334 (300-375)**
Home-based testing + ST offer	**6,978 (6,496-7,538)**	**1,277 (1,230-1,327)**
ANC partners	1,377 (389-*)	*
ANC partners + ST offer	1,370 (829-3,953)	545 (312-2,144)
Mobile testing + mobilization	**11,098 (9,160-14,074)**	**2,269 (2,011-2,601)**

* Result not shown because stochastic variation causes a negative saving.

Total costs of HIV programme

- Incremental costs dropped substantially when considering the impact on the cost of the entire HIV programme. In particular, the following strategies became cost-saving:
  - Testing of MSM
  - Testing of sex workers
  - Assisted partner notification
  - Secondary distribution of self-testing kits to partners of pregnant women
- But the change in overall programme costs was generally small (<0.1% for most scenarios).

Conclusions

- Of current testing strategies, testing in partners of newly diagnosed, OI patients and FSWs on PrEP achieves highest rates of new diagnosis.
- Community-based testing strategies would substantially reduce the undiagnosed fraction but are generally the least cost-effective strategies.
- Assisted partner notification and HIV testing targeted to MSM would be highly cost-effective.
- Testing in FSWs and distribution of self-testing kits to partners of pregnant women would probably also be very efficient, but stochastic model variation makes it difficult to quantify ICERs with precision.
- Offering self-testing kits could substantially increase the uptake of testing in settings where it is currently low.

Next steps

- Preliminary results have been shared with South African Department of Health.
- We are currently revising the results following the recalibration of the HIV model.
- We are also assessing the uncertainty associated with key variables (e.g. relative rates of testing in previously-diagnosed adults, testing uptake in key populations).
- We have also been asked to consider additional self-testing scenarios.

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Additional resources

For more information on the MicroCOSM model see the model description on BioRxiv:
https://www.biorxiv.org/content/early/2018/04/30/310763