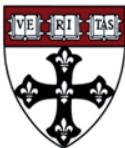


# **CAN THE HIV EPIDEMIC BE ELIMINATED IN SOUTH AFRICA USING COMBINATION PREVENTION? A MODELING ANALYSIS**

Nadia Abuelezam, ScD

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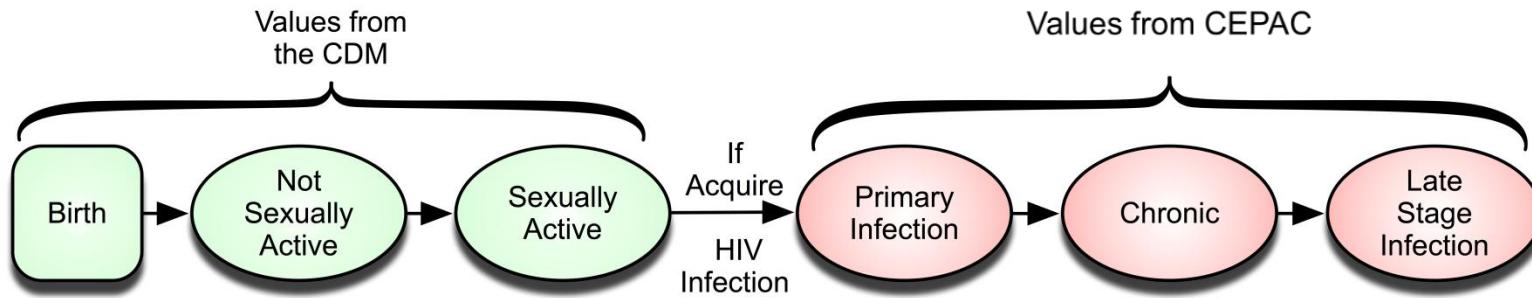
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# THE CEPAC DYNAMIC MODEL (CDM)

- Individual-based stochastic model simulates HIV transmission
- Population of male and female persons
  - High risk (HR) or low risk (LR) sexual behavior
  - Males are circumcised at birth or during an intervention at particular proportions
- Sexual Partnerships and Selection
  - Males select female partners
  - Concurrent partnerships allowed: steady, regular, casual, commercial sex worker (CSW) partnerships
  - Each partnership type has a specified length, number of sexual acts (per month), and proportion of acts protected by condoms
- Force of infection
  - HIV-RNA (HIV disease stage), condom use, circumcision

# CDM (CONT.)



- ❑ Health Status (from CEPAC)
  - ❑ Disease transition states defined by CD4 count and HIV RNA level
  - ❑ HIV+ individuals at risk for opportunistic infections and mortality
  - ❑ ART impacts HIV RNA level and subsequently ability to transmit
- ❑ Seeded with 6 initial HIV cases after 50 year stabilization period
- ❑ Calibrated to historical South African prevalence, incidence, and sexual behavior (Abuelezam NN et al. PLoS One 2014)

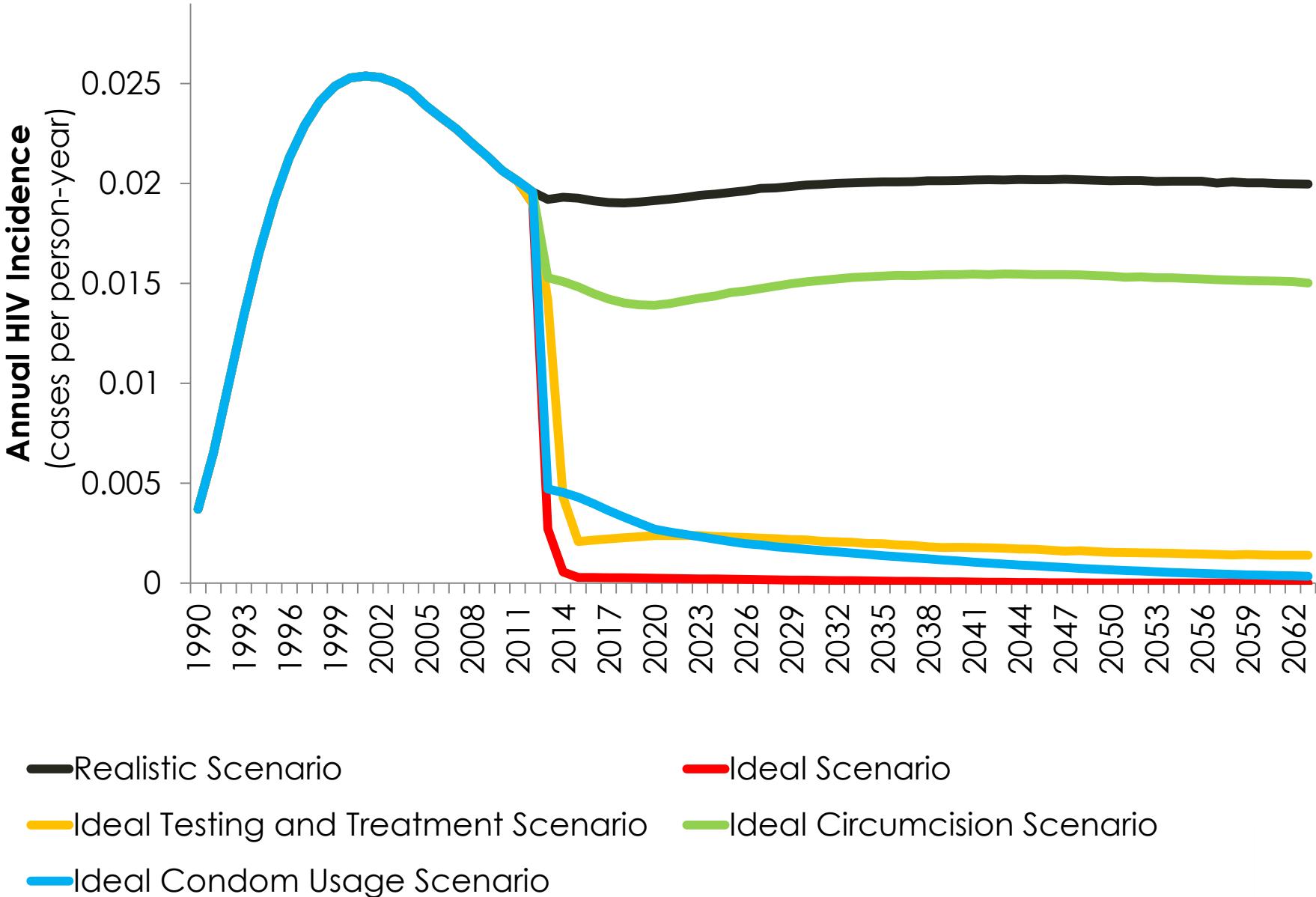
<b>Scenarios</b>	<b>Realistic</b>
<b>Rollout Type</b>	Slow
<b>Adult male circumcision in 2013 onward (%)</b>	35
<b>Condom Usage (%)</b>	
<b>Steady</b>	12 (SD 6)
<b>Regular</b>	29 (SD 15)
<b>Casual</b>	37 (SD 19)
<b>CSW</b>	50 (SD 25)
<b>HIV testing interval</b>	1 year
<b>Acceptance of HIV testing (%)</b>	50
<b>Linkage to care (%)</b>	46.8
<b>ART Suppression at 6 months (%)</b>	78
<b>Monthly late ART failure probability (%)</b>	0.1
<b>ART program loss to follow up at 12 mo. (%)</b>	9.9
<b>CD4 at ART start criteria (/mm<sup>3</sup>)</b>	<350

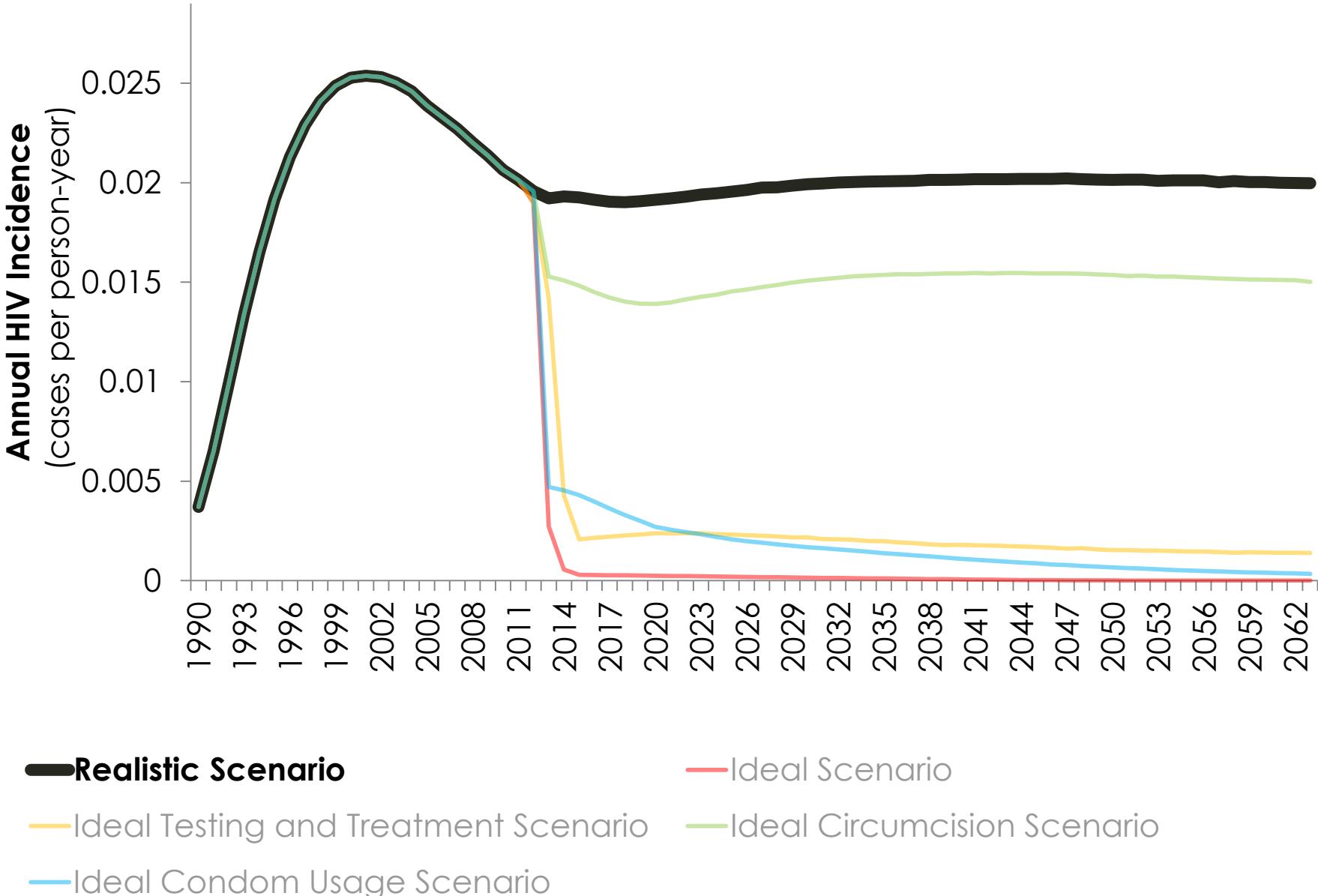
Scenarios	Realistic	Ideal
<b>Rollout Type</b>	Slow	Rapid
<b>Adult male circumcision in 2013 onward (%)</b>	35	100
<b>Condom Usage (%)</b>		
<b>Steady</b>	12 (SD 6)	100
<b>Regular</b>	29 (SD 15)	100
<b>Casual</b>	37 (SD 19)	100
<b>CSW</b>	50 (SD 25)	100
<b>HIV testing interval</b>	1 year	1 month
<b>Acceptance of HIV testing (%)</b>	50	100
<b>Linkage to care (%)</b>	46.8	100
<b>ART Suppression at 6 months (%)</b>	78	100
<b>Monthly late ART failure probability (%)</b>	0.1	0
<b>ART program loss to follow up at 12 mo. (%)</b>	9.9	0
<b>CD4 at ART start criteria (/mm<sup>3</sup>)</b>	<350	All levels

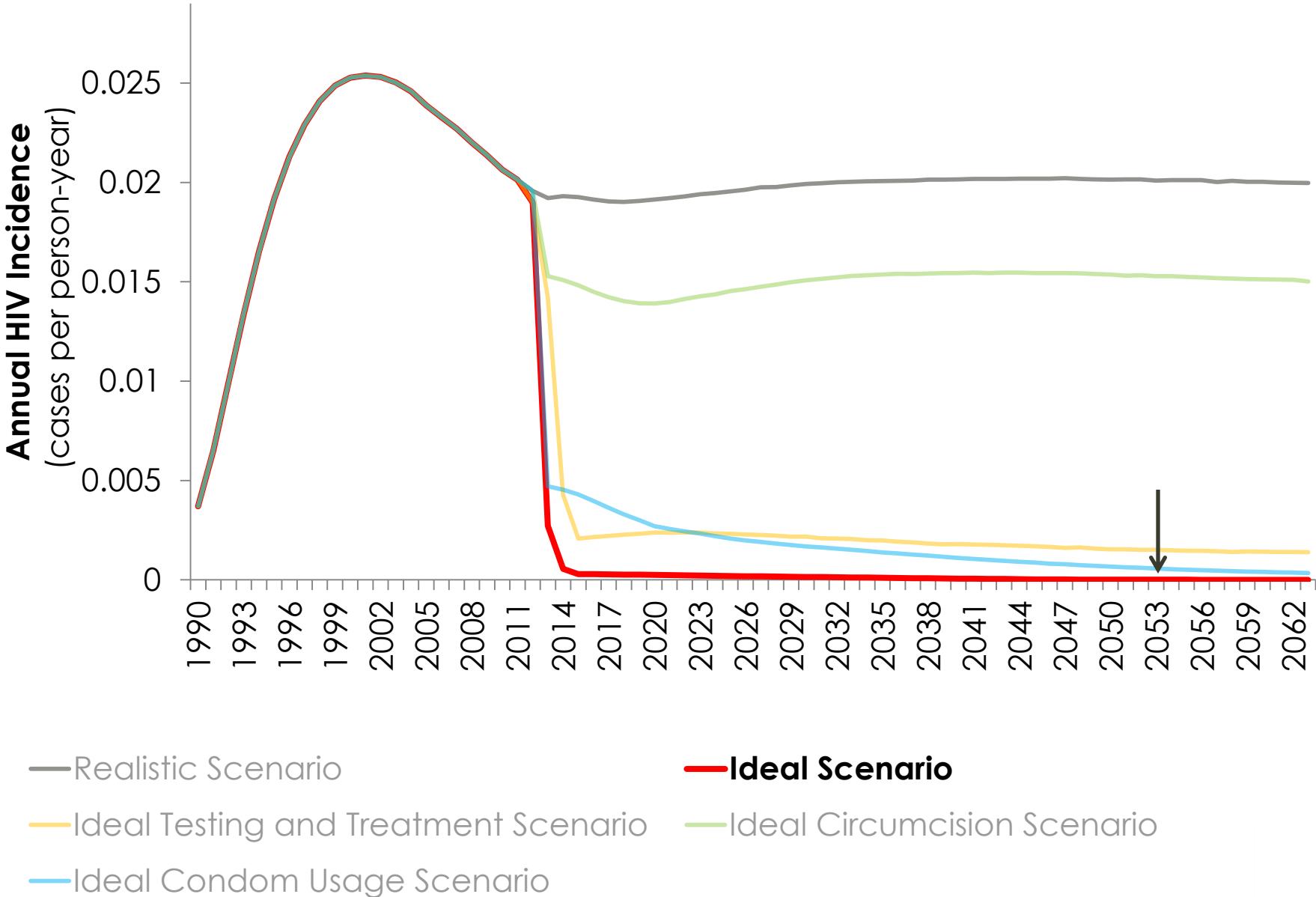
Scenarios	Realistic	Ideal	Ideal Condom Use
<b>Rollout Type</b>	Slow	Rapid	Slow
<b>Adult male circumcision in 2013 onward (%)</b>	35	100	35
<b>Condom Usage (%)</b>			
<b>Steady</b>	12 (SD 6)	100	100
<b>Regular</b>	29 (SD 15)	100	100
<b>Casual</b>	37 (SD 19)	100	100
<b>CSW</b>	50 (SD 25)	100	100
<b>HIV testing interval</b>	1 year	1 month	1 year
<b>Acceptance of HIV testing (%)</b>	50	100	50
<b>Linkage to care (%)</b>	46.8	100	46.8
<b>ART Suppression at 6 months (%)</b>	78	100	78
<b>Monthly late ART failure probability (%)</b>	0.1	0	0.1
<b>ART program loss to follow up at 12 mo. (%)</b>	9.9	0	9.9
<b>CD4 at ART start criteria (/mm<sup>3</sup>)</b>	<350	All levels	<350

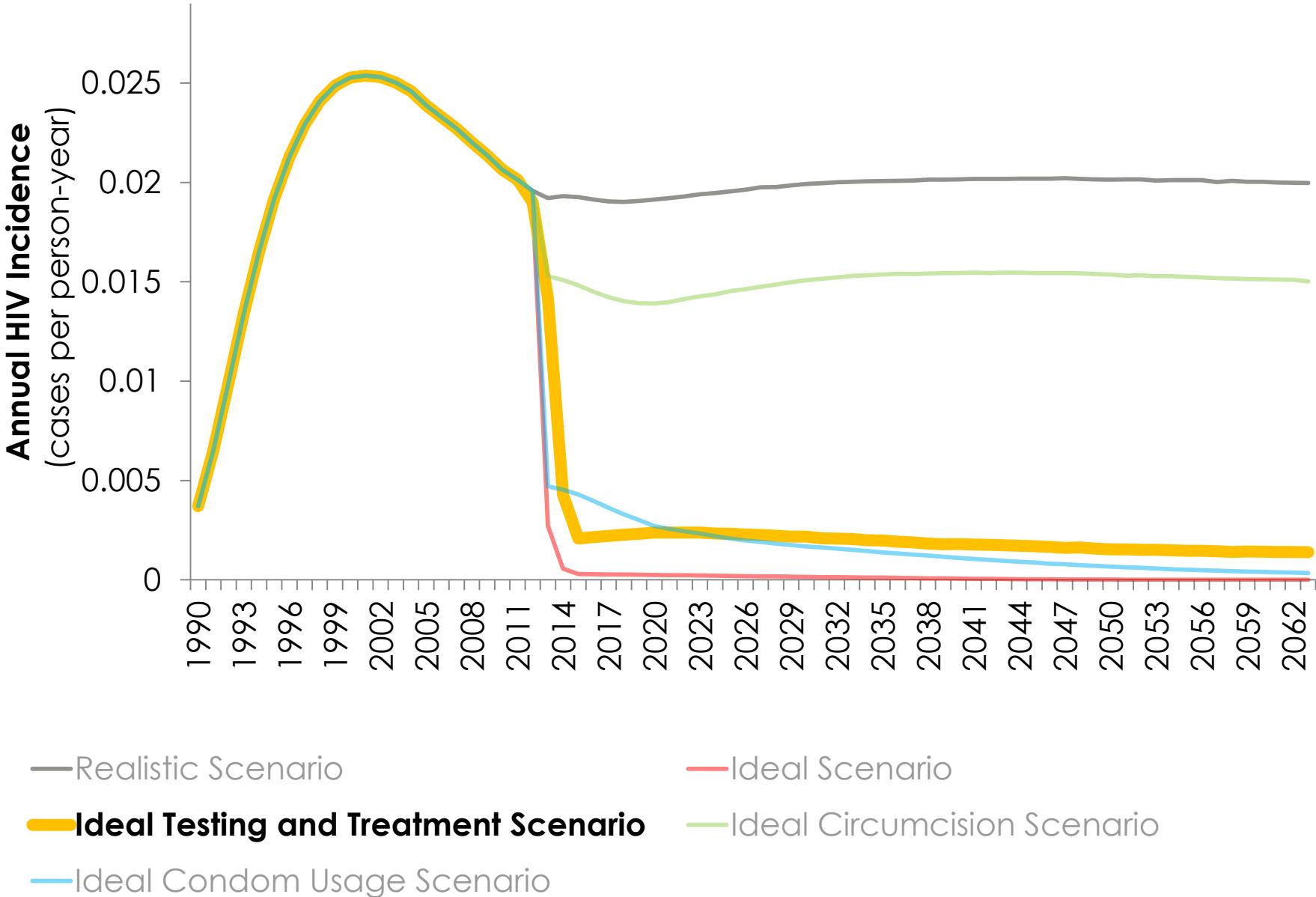
Scenarios	Realistic	Ideal	Ideal Condom Use	Ideal Circumcision
<b>Rollout Type</b>	Slow	Rapid	Slow	Slow
<b>Adult male circumcision in 2013 onward (%)</b>	35	100	35	100
<b>Condom Usage (%)</b>				
<b>Steady</b>	12 (SD 6)	100	100	12 (SD 6)
<b>Regular</b>	29 (SD 15)	100	100	29 (SD 15)
<b>Casual</b>	37 (SD 19)	100	100	37 (SD 19)
<b>CSW</b>	50 (SD 25)	100	100	50 (SD 25)
<b>HIV testing interval</b>	1 year	1 month	1 year	1 year
<b>Acceptance of HIV testing (%)</b>	50	100	50	50
<b>Linkage to care (%)</b>	46.8	100	46.8	46.8
<b>ART Suppression at 6 months (%)</b>	78	100	78	78
<b>Monthly late ART failure probability (%)</b>	0.1	0	0.1	0.1
<b>ART program loss to follow up at 12 mo. (%)</b>	9.9	0	9.9	9.9
<b>CD4 at ART start criteria (/mm<sup>3</sup>)</b>	<350	All levels	<350	<350

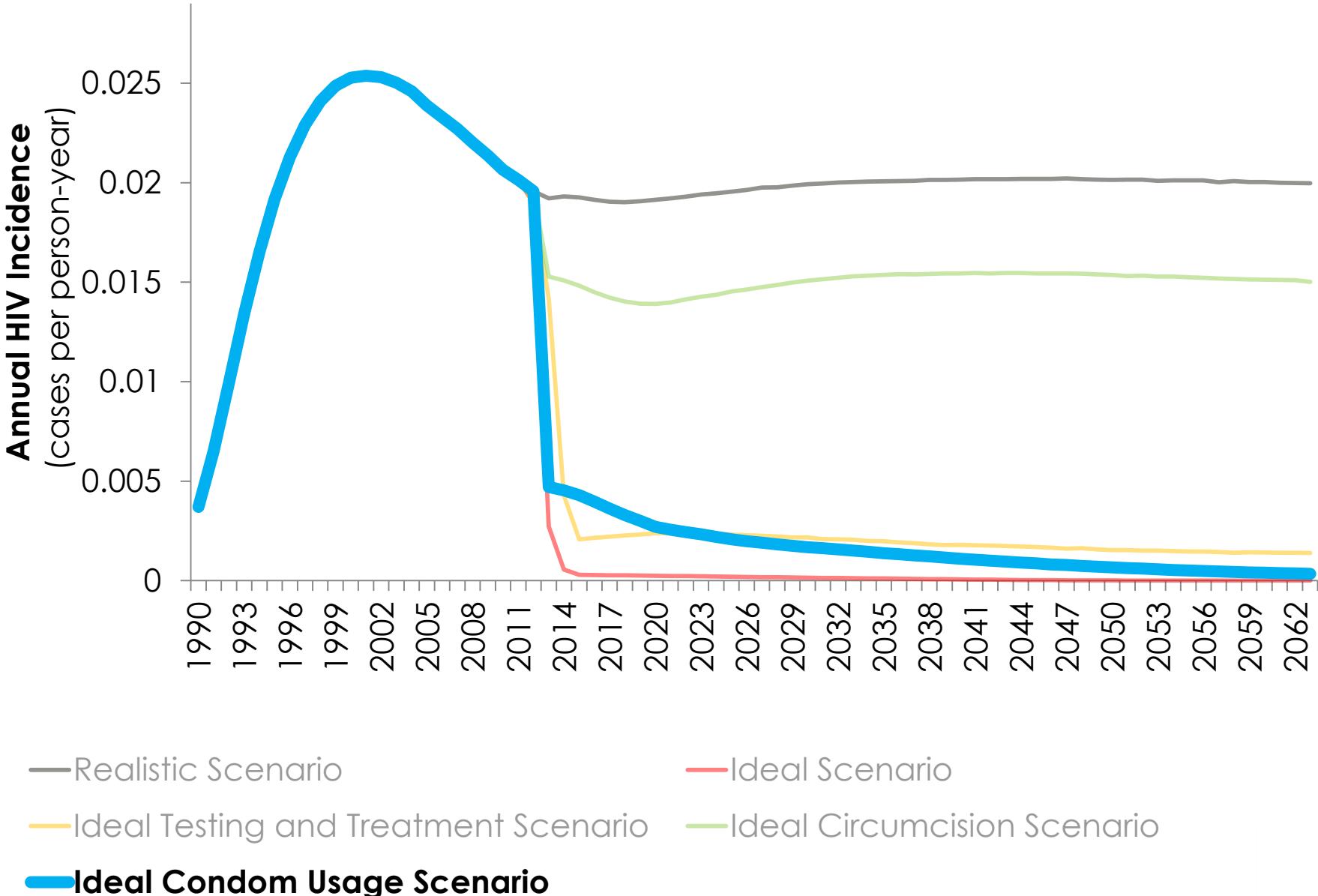
Scenarios	Realistic	Ideal	Ideal Condom Use	Ideal Circumcision	Ideal Testing and Treatment Only
<b>Rollout Type</b>	Slow	Rapid	Slow	Slow	Rapid
<b>Adult male circumcision in 2013 onward (%)</b>	35	100	35	100	35
<b>Condom Usage (%)</b>					
<b>Steady</b>	12 (SD 6)	100	100	12 (SD 6)	12 (SD 6)
<b>Regular</b>	29 (SD 15)	100	100	29 (SD 15)	29 (SD 15)
<b>Casual</b>	37 (SD 19)	100	100	37 (SD 19)	37 (SD 19)
<b>CSW</b>	50 (SD 25)	100	100	50 (SD 25)	50 (SD 25)
<b>HIV testing interval</b>	1 year	1 month	1 year	1 year	1 month
<b>Acceptance of HIV testing (%)</b>	50	100	50	50	100
<b>Linkage to care (%)</b>	46.8	100	46.8	46.8	100
<b>ART Suppression at 6 months (%)</b>	78	100	78	78	100
<b>Monthly late ART failure probability (%)</b>	0.1	0	0.1	0.1	0
<b>ART program loss to follow up at 12 mo. (%)</b>	9.9	0	9.9	9.9	0
<b>CD4 at ART start criteria (/mm<sup>3</sup>)</b>	<350	All levels	<350	<350	All levels

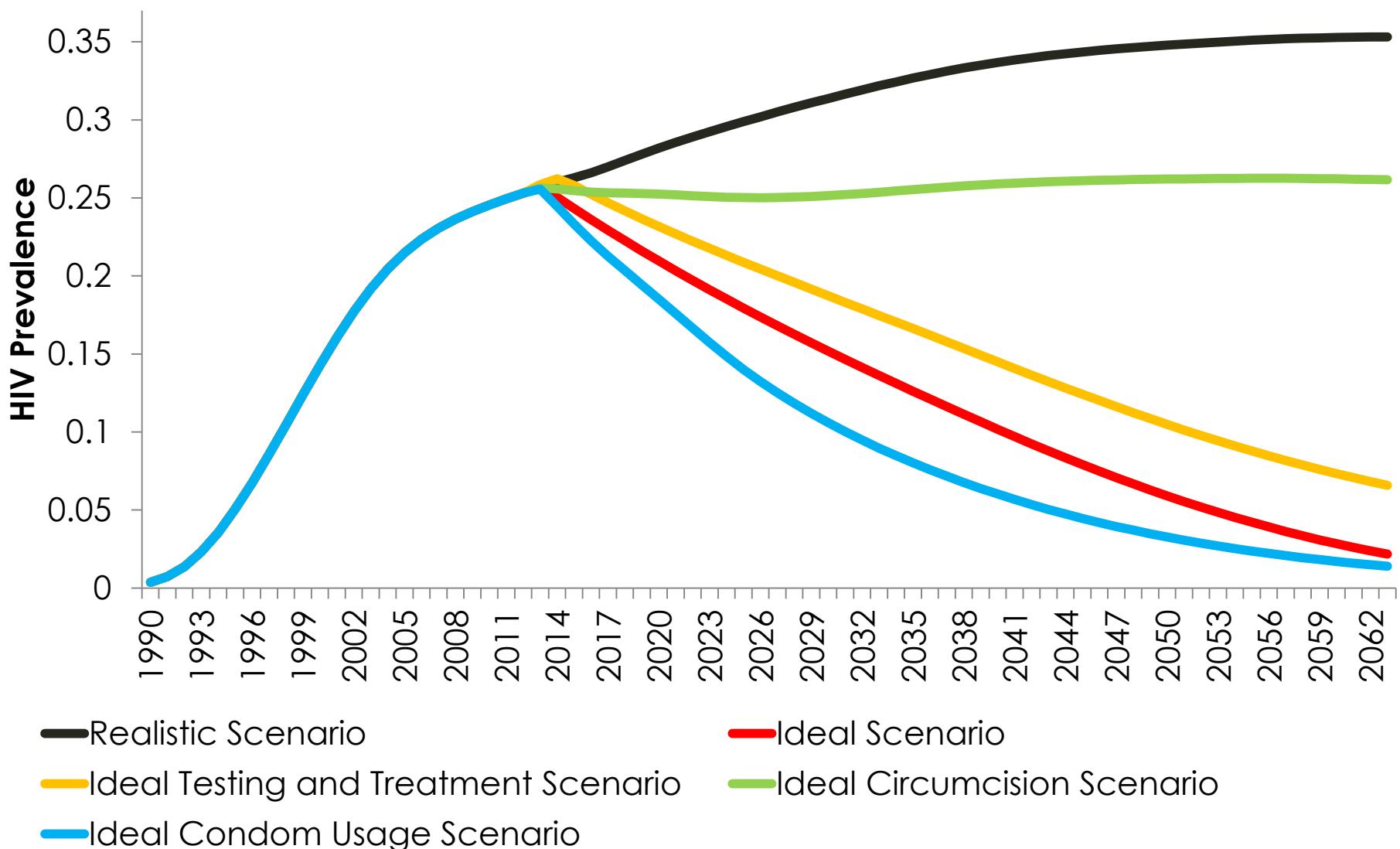


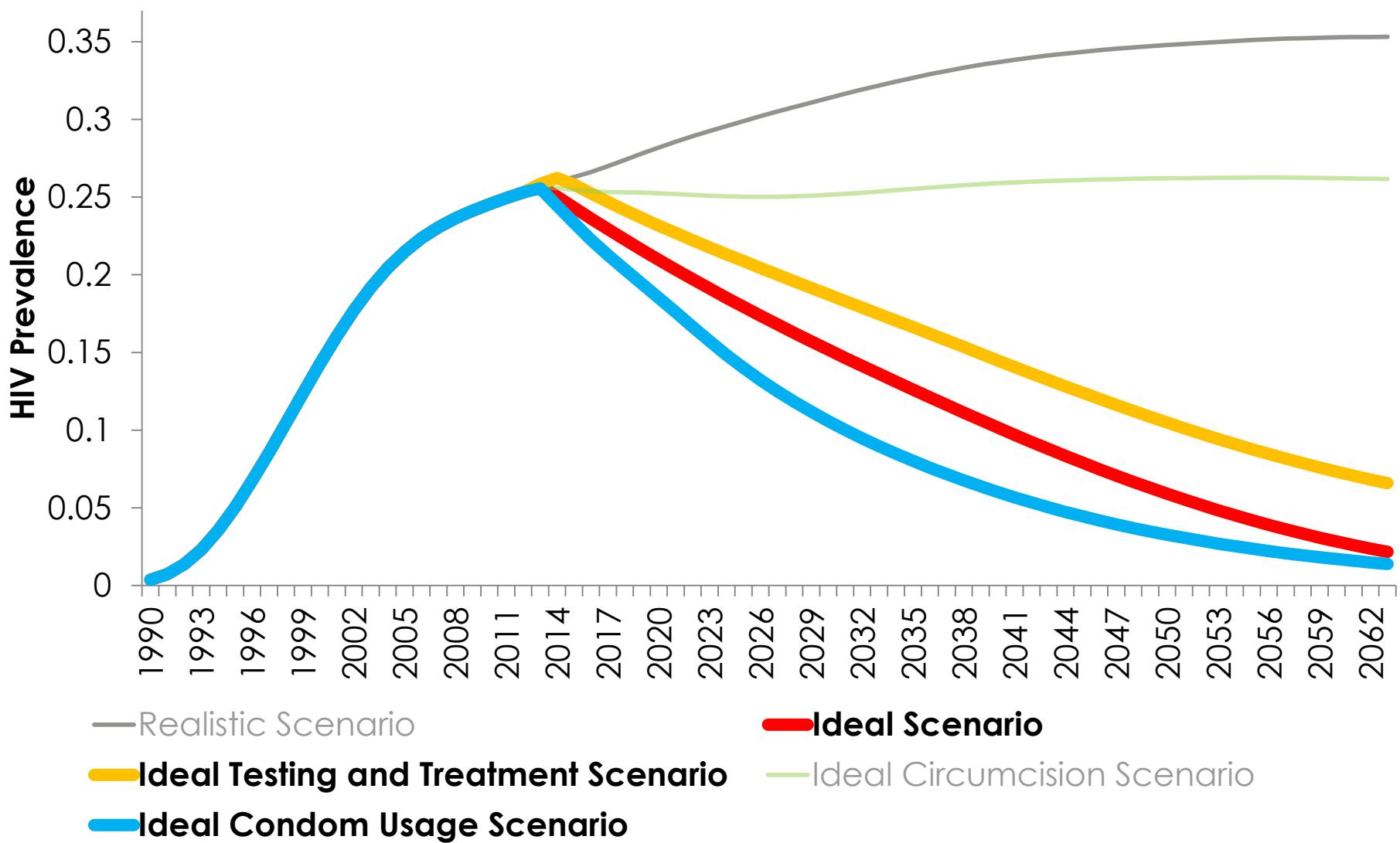


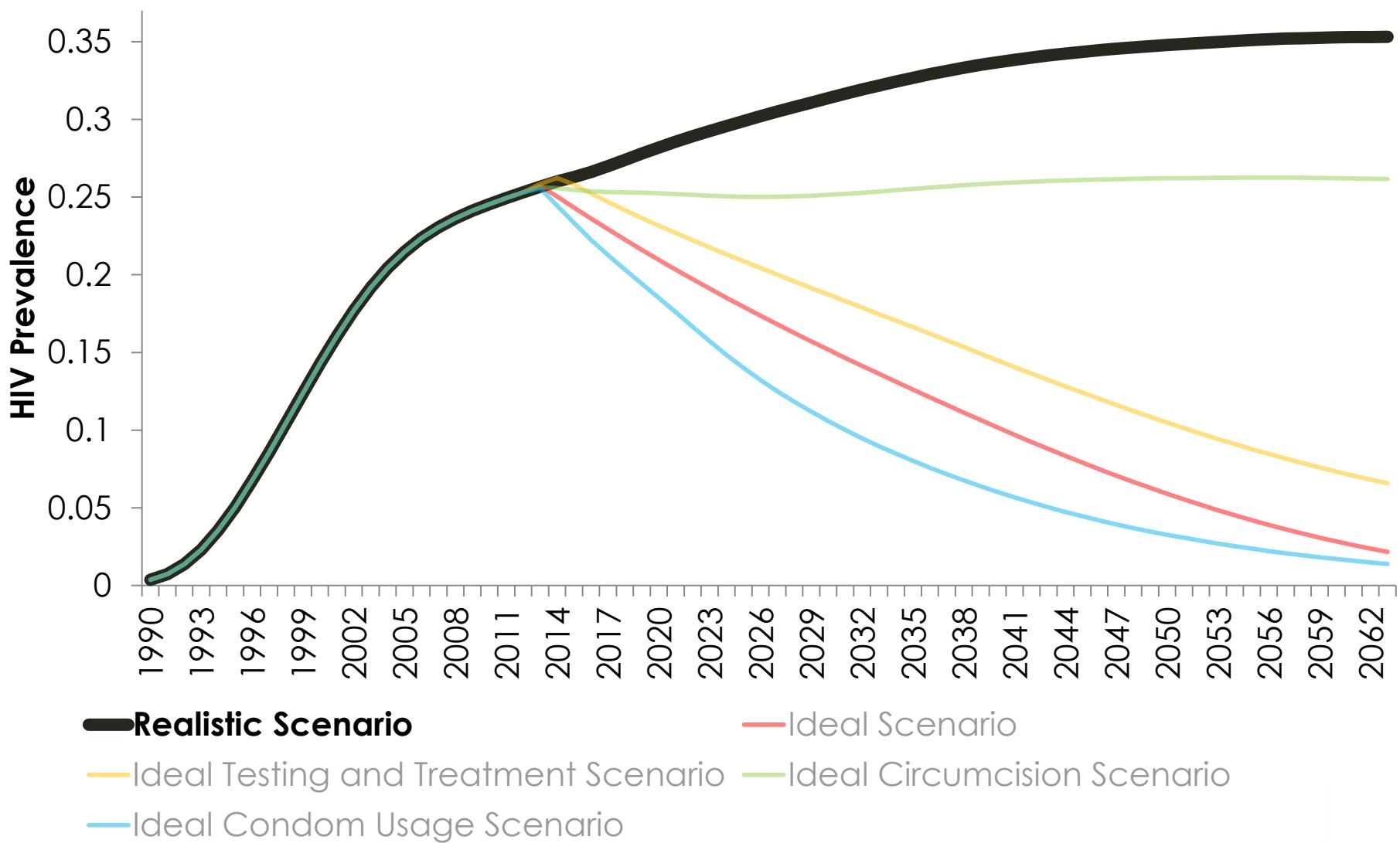












## RESULTS: INFECTIONS AVERTED

Scenario	Total Infections (2013-2063)	Infections Averted (vs. Realistic Scenario)
Realistic	278,373	--
Ideal	2,014	276,359
Ideal Condom Use	20,914	257,459
Ideal Testing and Treatment	33,858	244,515
Ideal Circumcision	219,236	59,137

## ADDITIONAL ASSUMPTIONS

- ❑ Behavioral disinhibition or other post-testing, treatment or circumcision changes are assumed to be non-existent.
- ❑ Sexual behavior and testing/treatment behavior are assumed to be independent.



## DISCUSSION

- Timeline towards elimination is not as short as previously calculated.
- Testing and treatment in the absence of primary prevention does not lead to elimination on a 50-year time scale.
- Aggressive combination prevention programs that include primary prevention interventions provide the greatest chance for reduction in incidence and eventual elimination.



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# SUPPLEMENTAL SLIDES



## RESULTS: HISTORICAL ART ROLLOUT

