Online Supplemental Appendix

Accompanying the manuscript:

Cost-effectiveness of point-of-care testing with task-shifting for HIV care in South Africa: a modelling study

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Table S1. Model parameters. Select model parameters used to fit the EMOD-HIV transmission model to survey data on prevalence and ART coverage from South Africa. Median and interquartile ranges (IQRs) reported for all dynamic parameters used in the calibration process from 250 best-fitting parameter sets.[†]

Parameter	Description	Dynamic	Static value / fitted mean (IQR)	Source
AIDS_Duration_In_Months	The length of time, in months, prior to an AIDS-related death over which the AIDS_Stage_Infectivity_Multiplier is applied	no	9	(1)
AIDS_Stage_Infectivity_Multiplier	Multiplier acting on Base_Infectivity to determine the per-act transmission probability of an individual during AIDS stage	no	4.5	(1)
ART_CD4_at_Initiation_Saturating_Reduction_in_Mortality	The duration from ART enrollment to on-ART HIV-caused death increases with CD4 at ART initiation up to a threshold determined by this parameter value.	no	350	
ART_dropout	Exponentially distributed mean number of days from ART initiation until ART dropout, corresponds to 5% annual dropout.	no	7300	
ART_Link_Max	The right asymptote for the sigmoid trend of probability of ART linkage (given eligibility) over time.	yes	0.992 (0.987 - 1)	
ART_Link_Mid	The time of the inflection point in the sigmoid trend of probability of ART linkage (given eligibility) over time.	yes	2005.9 (2005.7 - 2006.2)	
ART_link_Min	The left asymptote for the sigmoid trend of probability of ART linkage (given eligibility) over time.	no	0	
ART_link_Rate	The slope of the inflection point in the sigmoid trend of probability of ART linkage over time. A Rate of 1 sets the slope to a 25% change in probability per year.	no	1	
Base_Infectivity	The probability of transmission when none of the transmission multipliers apply to a coital act (or when all multipliers are set to 1).	yes	0.00144 (0.00138 - 0.00155)	(2)
CD4_At_Death_LogLogistic_Heterogeneity	The inverse shape parameter of a Weibull distribution that represents the at-death CD4 cell count.	no	0.7	
CD4_At_Death_LogLogistic_Scale	The scale parameter of a Weibull distribution hat represents the at-death CD4 cell count.	no	2.96	
CD4_Post_Infection_Weibull_Heterogeneity	The inverse shape parameter of a Weibull distribution that represents the post-acute-infection CD4 cell count.	no	0.2756	

CD4_Post_Infection_Weibull_Scale	The scale parameter of a Weibull distribution that represents the post-acute-infection CD4 cell count.	no	560.43	
Circumcision_Reduced_Acquire	The reduction of susceptibility to HIV by voluntary male medical circumcision (VMMC)	no	0.6	(3-5)
Coital_Act_Rate	Number of coital acts per day for all relationships except commercial ones	no	0.33	
Coital_Act_Rate_Commercial	Number of coital acts per day for commercial relationships	no	0.002739726	
Coital_Dilution_Factor_2_Partners	The multiplicative reduction in the coital act rate for all relationship types when an individual has exactly two current partners. Represents coital dilution.	no	0.75	
Coital_Dilution_Factor_3_Partners	The multiplicative reduction in the coital act rate for all relationship types when an individual has exactly three current partners. Represents coital dilution.	no	0.6	
Coital_Dilution_Factor_4_Plus_Partners	The multiplicative reduction in the coital act rate for all relationship types when an individual has exactly three current partners. Represents coital dilution.	no	0.45	
	The maximum asymptote for commercial relationships	no	0.85	
Commercial_Condom_Mid	The year of the inflection point for commercial relationships	no	1999.5	
Commercial_Condom_Min	The minimum asymptote of the probability of condom use per coital act for informal relationships for commercial relationships	no	0.5	
Commercial_Condom_Rate	The rate proportional to the slope at the inflection point for commercial relationships	no	1	
Commercial_Form_Rate	Exponentially distributed mean number new relationships formed per day for commercial relationships	no	0.15	
Condom_Transmission_Blocking_Probability	The per-act multiplier of the transmission probability when a condom is used	no	0.8	
Days_Between_Symptomatic_And_Death_Weibull_Heterogeneity	The time between the onset of AIDS symptoms and death is sampled from a Weibull distribution; this	no	0.5	

	parameter governs the heterogeneity (inverse shape) of the Weibull.		
Days_Between_Symptomatic_And_Death_Weibull_Scale	The time between the onset of AIDS symptoms and death is sampled from a Weibull distribution; this parameter governs the scale of the Weibull.	no	618.34
Delay_Period_Mean	Delay from HIV infection until ART initiation for future ART scale-up scenarios, post 2016 (in days).	no	180
HIV_Adult_Survival_Scale_Parameter_Intercept	Determines the intercept of the scale parameter for the Weibull distribution used to determine HIV survival time. Survival time with untreated HIV infection depends on the age of the individual at the time of infection, and is drawn from a Weibull distribution with shape parameter (see HIV_Adult_Survival_Shape_Parameter) and scale parameter. The scale parameter is allowed to vary linearly with age as follows λ = HIV_Adult_Survival_Scale_Parameter_Intercept + HIV_Adult_Survival_Scale_ Parameter_Slope * Age (in years).	no	21.182
HIV_Adult_Survival_Scale_Parameter_Slope	This parameter determines the slope of the scale parameter for the Weibull distribution used to determine HIV survival time.	no	-0.2717
HIV_Adult_Survival_Shape_Parameter	This parameter determines the shape of the Weibull distribution used to determine age-dependent survival time for individuals infected with HIV.	no	2
HIV_Age_Max_for_Adult_Age_Dependent_Survival	Survival time with untreated HIV infection depends on the age of the individual at the time of infection, and is drawn from a Weibull distribution with shape parameter and scale parameters (See HIV_Adult_Survival_Scale_Parameter_Intercept, HIV_Adult_Survival_Scale_ Parameter_Slope, and HIV_Adult_Survival_Shape_Parameter). Although the scale parameter for survival time declines with age, it cannot become negative. To avoid negative survival times at older ages, this parameter, HIV_Age_Max_for_Adult_Age_Dependent_Survival, determines the age beyond which HIV survival is no longer affected by further aging.	no	50
HIV_Age_Max_for_Child_Survival_Function	The maximum age at which an individual's survival will be fit to the child survival function. If the value of	no	15

	this parameter falls between zero and the age of sexual debut, model results are not sensitive to this parameter as there is no mechanism for children to become infected between infancy and sexual debut.		
HIV_Child_Survival_Rapid_Progressor_Fraction	The proportion of HIV-infected children who are rapid HIV progressors.	no	0.57
HIV_Child_Survival_Rapid_Progressor_Rate	The exponential decay rate, in years, describing the distribution of HIV survival for children who are rapid progressors.	no	1.52
HIV_Child_Survival_Slow_Progressor_Scale	The Weibull scale parameter describing the distribution of HIV survival for children who are slower progressors.	no	16
HIV_Child_Survival_Slow_Progressor_Shape	The Weibull shape parameter describing the distribution of HIV survival for children who are slower progressors.	no	2.7
Informal_Condom_Max	The maximum asymptote for informal relationships	yes	0.355 (0.328 - 0.38)
Informal_Condom_Mid	The year of the inflection point for informal relationships	yes	1999.1 (1997.9 - 2000.2)
Informal_Condom_Min	The minimum asymptote of the probability of condom use per coital act for informal relationships	no	0
Informal_Condom_Rate	The rate proportional to the slope at the inflection point for informal relationships	yes	1.947 (1.788 - 2.099)
Informal_Form_Rate	Exponentially distributed mean number new relationships formed per day for informal relationships	yes	0.00096 (0.00083 - 0.00105)
Male_To_Female_Relative_Infectivity_Multiplier_Old	An array of scale factors governing the susceptibility of females relative to males, by age ≥ 25	yes	2.311 (2.187 - 2.43)
Male_To_Female_Relative_Infectivity_Multiplier_Young	An array of scale factors governing the susceptibility of females relative to males, by age < 25	yes	3.755 (2.803 - 4.463)
Marital_Condom_Max	The maximum asymptote for marital relationships	yes	0.213 (0.187 - 0.24)

Marital_Condom_Mid	The year of the inflection point for marital relationships	yes	1995.0 (1994.3 - 1995.7)
Marital_Condom_Min	The minimum asymptote of the probability of condom use per coital act for informal relationships for marital relationships	no	0
Marital_Condom_Rate	The rate proportional to the slope at the inflection point for marital relationships	yes	3.528 (3.465 - 3.675)
Marital_Form_Rate	Exponentially distributed mean number new relationships formed per day for marital relationships	yes	0.0001 (0.000095 - 0.000111)
Maternal_Infection_Transmission_Probability	The probability of transmission of infection from mother to infant at birth.		0.3
Maternal_Transmission_ART_Multiplier	The maternal transmission multiplier for on-ART mothers.	no	0.03334
preART_Link_Max	The right asymptote for the sigmoid trend of probability of preART linkage (given eligibility) over time.	yes	0.870 (0.828 - 0.937)
preART_Link_Mid	The time of the inflection point in the sigmoid trend of probability of preART linkage (given eligibility) over time.	yes	1999.1 (1998 - 2000.1)
preART_link_Min	The left asymptote for the sigmoid trend of probability of preART linkage (given eligibility) over time.	yes	0.621 (0.6 - 0.653)
preART_link_Rate	The slope of the inflection point in the sigmoid trend of probability of preART linkage over time. A Rate of 1 sets the slope to a 25% change in probability per year.	no	1
Proportion_Low_Risk	Proportion of the initial population that is low risk	yes	0.497 (0.446 - 0.546)
Sexual_Debut_Age_Female_Weibull_Heterogeneity	The inverse shape of the Weibull distribution for female debut age.	yes	0.052 (0.04 - 0.065)
Sexual_Debut_Age_Female_Weibull_Scale	The scale term of the Weibull distribution for female debut age.	yes	16.401 (16.219 - 16.56)
Sexual_Debut_Age_Male_Weibull_Heterogeneity	The inverse shape of the Weibull distribution for male debut age.	yes	0.037 (0.026 - 0.048)
Sexual_Debut_Age_Male_Weibull_Scale	The scale term of the Weibull distribution for male debut age.	yes	16.623 (16.32 - 16.938)
Sexual_Debut_Age_Min	The minimum age at which individuals become eligible to form sexual relationships.	no	13
Transitory_Condom_Max	The maximum asymptote for transitory relationships	yes	0.584 (0.555 - 0.624)

Transitory_Condom_Mid	The year of the inflection point for transitory relationships	yes	2007.2 (2006.4 - 2007.8)
Transitory_Condom_Min	The minimum asymptote of the probability of condom use per coital act for informal relationships for transitory relationships	no	0
Transitory_Condom_Rate	The rate proportional to the slope at the inflection point for transitory relationships	yes	1.975 (1.839 - 2.038)
Transitory_Form_Rate	Exponentially distributed mean number new relationships formed per day for transitory relationships	yes	0.001291 (0.001219 - 0.001386)
Transitory_Weibull_Heterogeneity	Inverse of the Weibull shape (1/kappa) parameter of relationship duration in years for transitory relationships	no	0.833333333
Transitory_Weibull_Scale	Weibull scale parameter of relationship duration in years for transitory relationships.	no	0.956774771

†A full description of all parameters and references available is at: http://idmod.org/docs/hiv/parameter-configuration.html and elsewhere. (6)

Cost estimates

In the standard of care scenario, we assumed 3% of patients on ART were on second line treatment and 20% of those on ART were participating in Differentiated Service Delivery (DSD) based on the literature for South Africa.(7, 8) Therefore, ART costs were assumed to be weighted average accounting for individuals on second line treatment as well as those participating in DSD. In the intervention scenario, we assumed that 4% of patients on ART were on second line treatment in the and 45% of patients on ART were participating in DSD for ART pick-up at local pharmacies, based on the results from the STREAM clinical trial. Cost estimates of point-of-care monitoring tests were obtained through a detailed microcosting of the STREAM trial from the payer perspective.(9) We conducted time-and-motion observations of sample collection and processing to estimate staff time costs. Expense reports were utilized to estimate consumables, POC instrument and maintenance costs. Capital costs were annualized assuming 5-years of useful life with 3% discounting.(10) Public laboratory tests were obtained from the South African National Health Laboratory Service (NHLS) price lists and costs of nurse time and consumables were added based on the STREAM microcosting. We assumed enrolled nurses conducted POC testing in the intervention scenario as implemented in the STREAM trial. Enrolled nurses in South Africa complete two years of training (compared to four years for professional nurses) and are trained to perform all aspects of HIV clinical care including point of care testing, clinical assessments, and adherence counseling.(11, 12)

Table S2. Cost per test for point of care and centralized laboratory costs[¥]

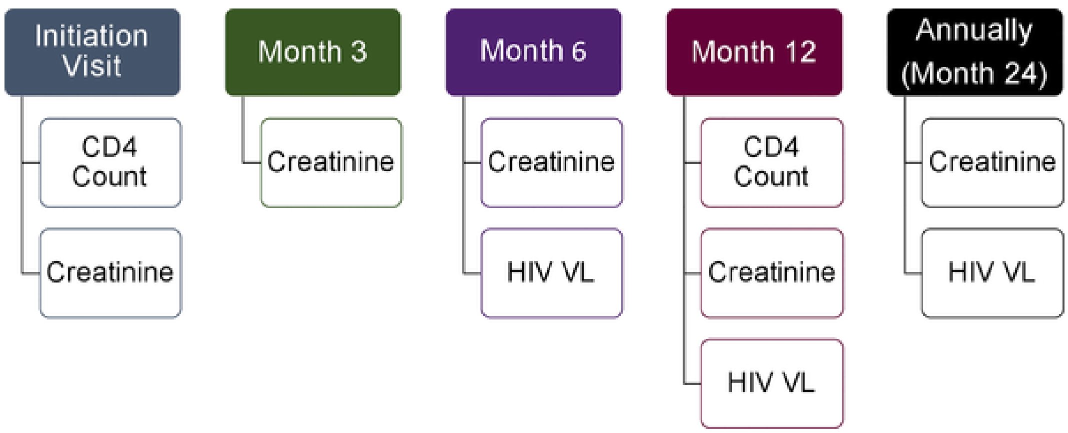
	Point of Care	Centralized Laboratory
CD4 Count		
Clinic Medical Consumables	0.41	0.41
Lab Consumables	0.11	4.84
Cartridge/Test	6.62	
Lab Staff Costs	0.2	
Instrument/Supply Costs	3.33	
Clinic Staff Costs	0.44	0.78
Total Per Test	**11.11**	**6.03**
HIV Viral Load		
Clinic Medical Consumables	0.41	0.48
Lab Consumables	0.11	24.72
Cartridge/Test	18.82	
Lab Staff Costs	0.33	
Instrument/Supply Costs	5.28	
Clinic Staff Costs	0.44	0.78
Total Per Test	**25.39**	**25.98**
Creatinine		
Clinic Medical Consumables	0.22	0.42
Lab Consumables	0	2.21
Cartridge/Test	8.14	
Lab Staff Costs	0	
Instrument/Supply Costs	0.23	
Clinic Staff Costs	0.22	0.78
Total Per Test	**8.81**	**3.41**

¥POC test costs assuming a clinic volume of 50 monthly ART initiations

Table S3. Utility weights for estimating disability-adjusted life-years averted

Health State	DALY Weight	Reference
HIV-negative	0	Salomon *et al.*[41]
HIV-positive CD4>350	0.078	
HIV-positive CD4 200-350	0.274	
HIV-positive CD4<200	0.582	
HIV-positive on ART	0.078	
Dead	1	

Figure S1: Flowchart of WHO monitoring guidelines for patients on ART



Impact of viral suppression on excess mortality among HIV-infected adults on ART

In the model, mortality risk among people living with HIV (PLHIV) on antiretroviral therapy (ART) is dependent on viral load (VL), dichotomized into categories of less than or greater than 1,000 viral copies/mL. To model VL-dependent mortality among PLHIV on ART, we assume that the overall distribution of mortality risk is a weighted average of the VL stratum-specific distributions of mortality risk as follows:

$$\frac{k_t}{\lambda_t}\left(\frac{x}{\lambda_t}\right)^{\lambda_t-1} e^{-\left(\frac{x}{\lambda_t}\right)^{k_t}} = p_s * \left(\frac{k_s}{\lambda_s}\left(\frac{x}{\lambda_s}\right)^{k_s-1} e^{-\left(\frac{x}{\lambda_s}\right)^{k_s}}\right) + p_{ns} * HR_{ns} * \left(\frac{k_s}{\lambda_s}\left(\frac{x}{\lambda_s}\right)^{k_s-1} e^{-\left(\frac{x}{\lambda_s}\right)^{k_s}}\right)$$

where k_t and λ_t are the shape and scale parameters, respectively, of the overall Weibull-distributed mortality risk; k_s and λ_s are the shape and scale parameters, respectively, of Weibull-distributed mortality risk among individuals on ART with <1,000 viral copies/mL; p_s and p_{ns} are the proportion of individuals with less than and greater than 1,000 viral copies/mL, respectively; HR_{ns} is the hazard ratio of death among individuals on ART with viral load great than 1,000 viral copies/mL relative to those with less than 1,000 viral copies/mL; and x indicates time since ART initiation.

As described in our previous modeling work, values for k_t and λ_t are estimated based on observed survival from IeDEA cohorts of individuals initiating ART in 2004-2007 in Côte d'Ivoire, Malawi, and South Africa.(13) The weights applied to the VL strata, p_s and p_{ns}, are based on 2012 estimates of percentage of persons virally suppressed on ART in South Africa, 0.754 and 0.246, respectively.(14) Consistent with other models of HIV transmission dynamics,(15) we assume that this proportion increases over time and stabilizes at 83% by 2018, although we vary this assumption in sensitivity analyses. Based on clinical trial data, we assume that individuals on ART with VL greater than 1,000 viral copies/mL experience a 1.96-fold increase in the risk of death at any given time point.(16)

Substituting these values into the corresponding variables, our equation becomes:

$$\frac{0.34}{123.83}\left(\frac{x}{123.83}\right)^{123.83-1} e^{-\left(\frac{x}{123.83}\right)^{0.34}} = 0.754 * \left(\frac{k_s}{\lambda_s}\left(\frac{x}{\lambda_s}\right)^{k_s-1} e^{-\left(\frac{x}{\lambda_s}\right)^{k_s}}\right) + 0.246 * 1.96 * \left(\frac{k_s}{\lambda_s}\left(\frac{x}{\lambda_s}\right)^{k_s-1} e^{-\left(\frac{x}{\lambda_s}\right)^{k_s}}\right)$$

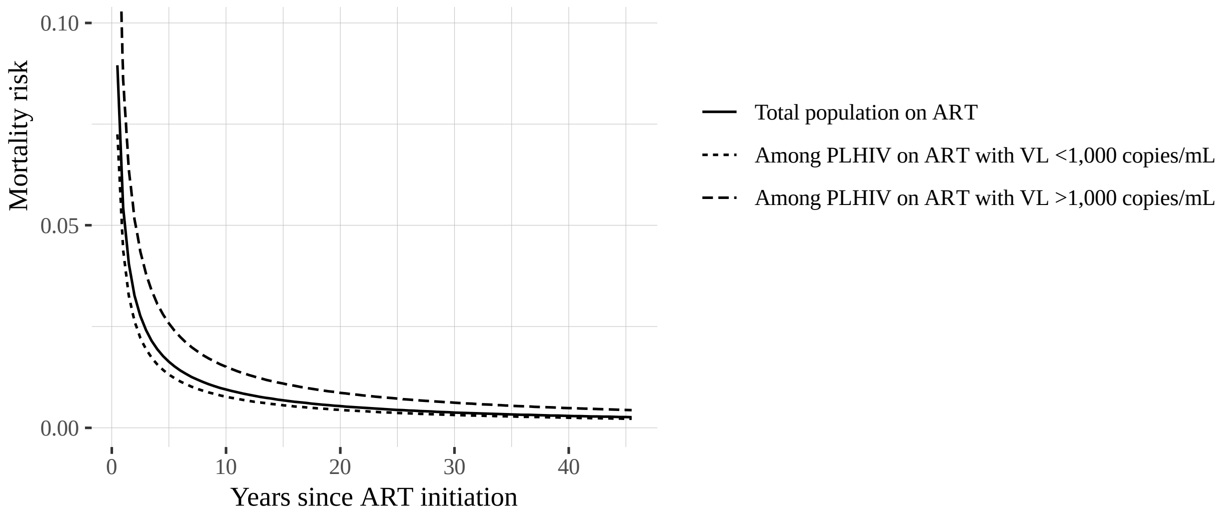
Which is then rearranged as:

$$\frac{\frac{0.34}{123.83}\left(\frac{x}{123.83}\right)^{123.83-1} e^{-\left(\frac{x}{123.83}\right)^{0.34}}}{1.23616} = \frac{k_s}{\lambda_s}\left(\frac{x}{\lambda_s}\right)^{k_s-1} e^{-\left(\frac{x}{\lambda_s}\right)^{k_s}}$$

We assume ranges of possible values for λ_s of [100, 400] and for k_s of [0.01, 0.50], and identify the combination of λ_s and k_s parameter values that minimizes the inequality in equation above, as evaluated by the difference in their squared errors. The resulting parameter values that characterize Weibull-distributed mortality risk among PLHIV on ART with viral load less than 1,000 viral copies/mL are λ_s=302 and k_s

=0.32. This Weibull distribution is multiplied by 1.96 at all time points to infer the mortality risk among PLHIV on ART with viral load greater than 1,000 viral copies/mL (Figure S2).

Figure S2. Weibull distribution of mortality risk among the total population of individuals on ART and stratified by viral load less than/greater than 1,000 viral copies/mL



Transmission risk by viral load among individuals on antiretroviral therapy

We assume that individuals on ART have a reduced risk of transmission, which depends on their VL (stratified as less than or greater than 1,000 viral copies/mL). Based on clinical data, we estimate that individuals on ART with VL <1,000 viral copies/mL experience a reduction in transmission risk of 96%.(17) There is a lack of empiric data on HIV transmission risk among persons on ART who are not virally suppressed (VL >1,000 viral copies/mL). Studies have estimated the relative risk of transmission per $\log_{10}$ increase in viral load is 2.89 among individuals not on ART and 1.88 among individuals on ART (after controlling for relevant covariates).(17, 18) Therefore we assumed the relative reduction in HIV transmission for persons on ART with VL >1,000 viral copies/mL is 1-(1.88/2.89) = 35%. However, to due the uncertainty of this parameter, we varied our assumption in sensitivity analyses from 0-70%.

Table S4: HIV prevalence data by age and sex from population-based surveys for model calibration[¥]

Sex	Age group	Year				
		2002	2005	2008	2012	2017
Men	15-19	0.040	0.032	0.025	0.007	0.047
	20-24	0.080	0.060	0.051	0.051	0.048
	25-29	0.220	0.121	0.157	0.173	0.124
	30-34	0.240	0.233	0.258	0.256	0.184
	35-39	0.180	0.233	0.185	0.288	0.238
	40-44	0.120	0.175	0.192	0.158	0.224
	45-49	0.120	0.103	0.084	0.134	0.248
	50-54	0.050	0.142	0.104	0.155	0.202
	55-59	0.070	0.064	0.062	0.055	0.148
	15-49	0.128	0.117	0.116	0.145	0.148
Women	15-19	0.070	0.094	0.067	0.056	0.058
	20-24	0.170	0.239	0.211	0.174	0.156
	25-29	0.320	0.333	0.327	0.284	0.275
	30-34	0.240	0.260	0.291	0.360	0.347
	35-39	0.140	0.193	0.248	0.316	0.394
	40-44	0.190	0.124	0.163	0.280	0.359
	45-49	0.110	0.087	0.141	0.197	0.303
	50-54	0.080	0.075	0.102	0.148	0.222
	55-59	0.070	0.030	0.077	0.097	0.176
	15-49	0.177	0.202	0.213	0.232	0.263

[¥]Sources: South African National HIV Prevalence, Incidence and Behaviour Surveys (2002, 2005, 2008, 2012 and 2017) from the Human Sciences Research Council (HSRC)(19-22)

Table S5: Number of people on ART by sex (ages 15-49 years) [¥]

Year	Male	Female
2001	2713	3543
2002	5768	7586
2003	9321	12313
2004	17717	24423
2005	34874	59240
2006	66629	123308
2007	118977	228753
2008	186564	367389
2009	277931	548206
2010	402000	781477
2011	558131	1095411
2012	713294	1415016
2013	876749	1732515
2014	1013499	2003014
2015	1130063	2239669
2016	1238815	2518238
2017	1403702	2998170

[¥]Source: South Africa Department of Health Surveys(23)

Table S6: HIV incidence by age and sex[§]

Year	Sex	Age group	HIV incidence	95% LB	95% UB
2012	Male	15 - 24	0.0055	0.0045	0.0065
2012	Female	15 - 24	0.0254	0.0204	0.0304
2012	Male	15 - 49	0.0121	0.0097	0.0145
2012	Female	15 - 49	0.0228	0.0184	0.0274
2017	Male	15 - 24	0.0049	0.0027	0.0071
2017	Female	15 - 24	0.0151	0.0131	0.0171
2017	Male	15 - 49	0.0069	0.006	0.0076
2017	Female	15 - 49	0.0093	0.0071	0.0111

[§]Source: Human Sciences Research Council (HSRC) 2012 and 2018 Surveys(19, 20)

Table S7: Population of South Africa by age and sex¥

Sex	Age group	Year				
		2002	2005	2008	2012	2017
Men	0 - 4	2634839	2651819	2692300	2784372	2886299
	5 - 9	2559246	2570683	2592577	2644720	2767111
	10 - 14	2582620	2565499	2557928	2578751	2636981
	15 - 19	2546968	2596517	2584945	2572032	2587023
	20 - 24	2348165	2488613	2572307	2606447	2594656
	25 - 29	2069939	2215800	2362377	2530034	2612453
	30 - 34	1759391	1899279	2018461	2227862	2488823
	35 - 39	1488894	1568198	1664587	1845019	2131687
	40 - 44	1270053	1324166	1367150	1493652	1731088
	45 - 49	1077752	1122009	1159644	1234887	1398602
	50 - 54	831061	925655	973184	1038560	1147992
	55 - 59	636945	677128	760379	856728	947123
Women	0 - 4	2587465	2602664	2640997	2729586	2825703
	5 - 9	2523770	2535299	2555462	2604517	2719700
	10 - 14	2557891	2533039	2526253	2545219	2603685
	15 - 19	2527828	2568409	2552976	2535920	2555420
	20 - 24	2323512	2451570	2523985	2560705	2550570
	25 - 29	2064262	2167428	2282514	2447992	2550351
	30 - 34	1807453	1906808	1967958	2123170	2394266
	35 - 39	1577255	1648612	1717873	1821711	2039776
	40 - 44	1370835	1434647	1491937	1594914	1745050
	45 - 49	1184477	1243314	1302936	1396666	1541175
	50 - 54	924873	1054059	1124243	1214556	1348848
	55 - 59	727478	783876	898804	1035986	1160340

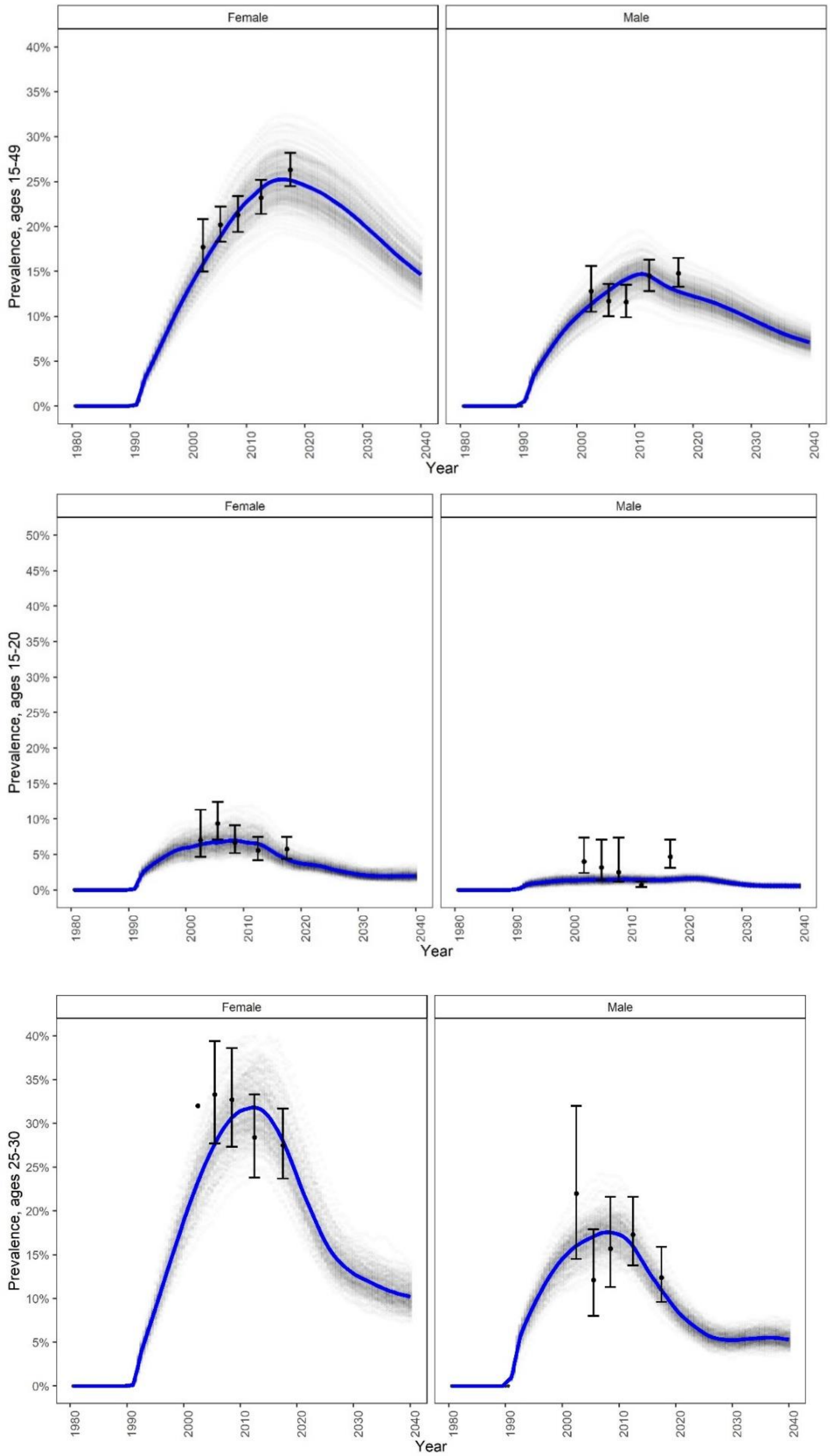
¥Source: United Nations Population Database(24)

Table S8: Number of voluntary medical male circumcisions conducted in South Africa by age group*

Year	Age Group					
	10 - 14	15 - 19	20 - 24	25 - 34	35 - 49	≥50
2010	55,431	30,552	15,856	18,047	7,864	1,160
2011	137,648	75,866	39,374	44,816	19,527	2,881
2012	175,060	96,487	50,075	56,996	24,834	3,664
2013	156,496	86,255	44,765	50,952	22,201	3,276
2014	199,750	110,095	57,138	65,035	28,337	4,181
2015	199,535	109,976	57,076	64,965	28,306	4,176
2016	165,672	91,312	47,390	53,940	23,502	3,468
2017	203,960	112,415	58,342	66,406	28,934	4,269
2018	279,500	154,050	79,950	91,000	39,650	5,850
2019	258,000	142,200	73,800	84,000	36,600	5,400
2020	236,500	130,350	67,650	77,000	33,550	4,950
2021	215,000	118,500	61,500	70,000	30,500	4,500
2022 onwards	43,000	23,700	12,300	14,000	6,100	900

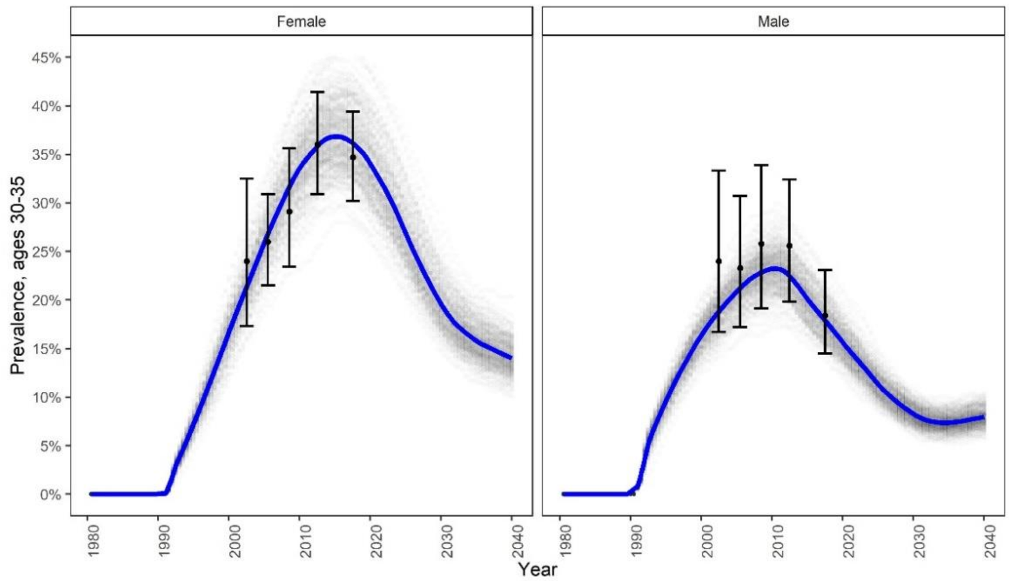
*Source: South Africa Department of Health (unpublished data) and South Africa National Strategic Plan for HIV, TB, and STIs 2017-2022(25)

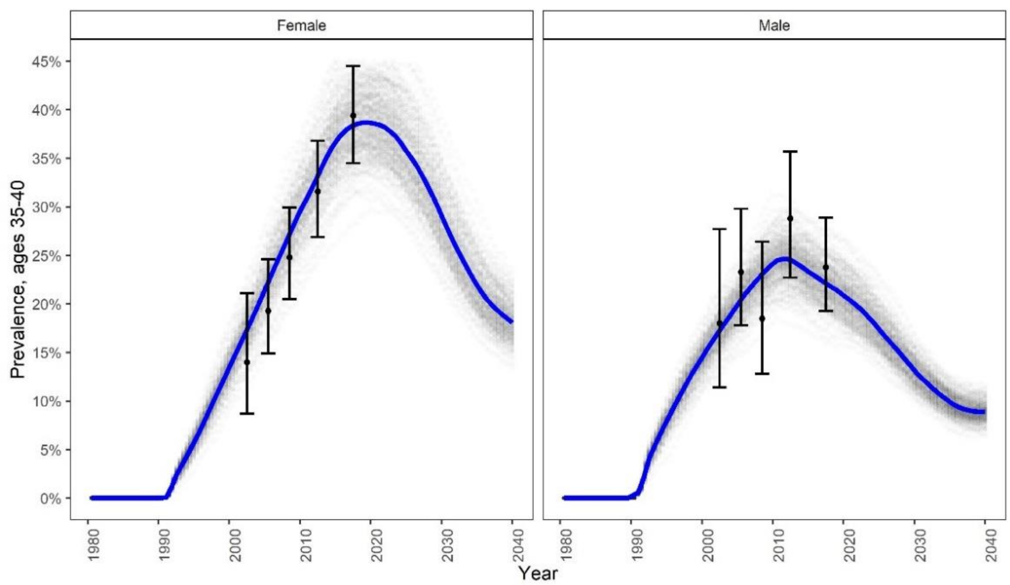
Figure S3: Calibration: Model fit to age-specific and overall prevalence from population-based surveys by sex.*



* Points and error bars represent empiric data. 250 good-fitting parameter sets are shown in gray and loess average is shown in blue. Sources for HIV prevalence: South African National HIV Prevalence, Incidence and Behaviour Surveys (2002, 2005, 2008, 2012 and 2017) from the Human Sciences Research Council (HSRC)(19-22)

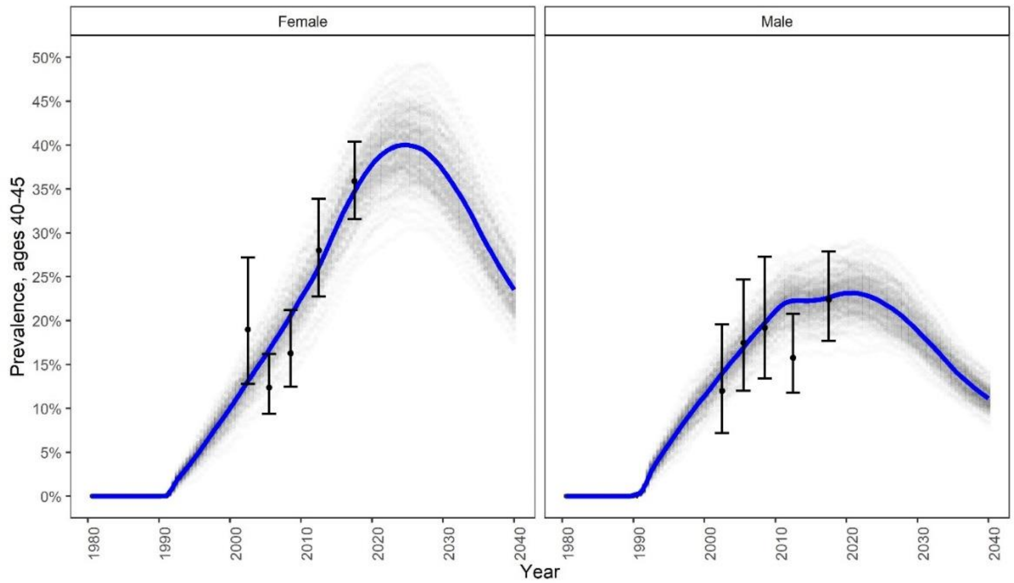
Figure S3 cont'd: Calibration: Model fit to age-specific and overall prevalence from population-based surveys by sex.*

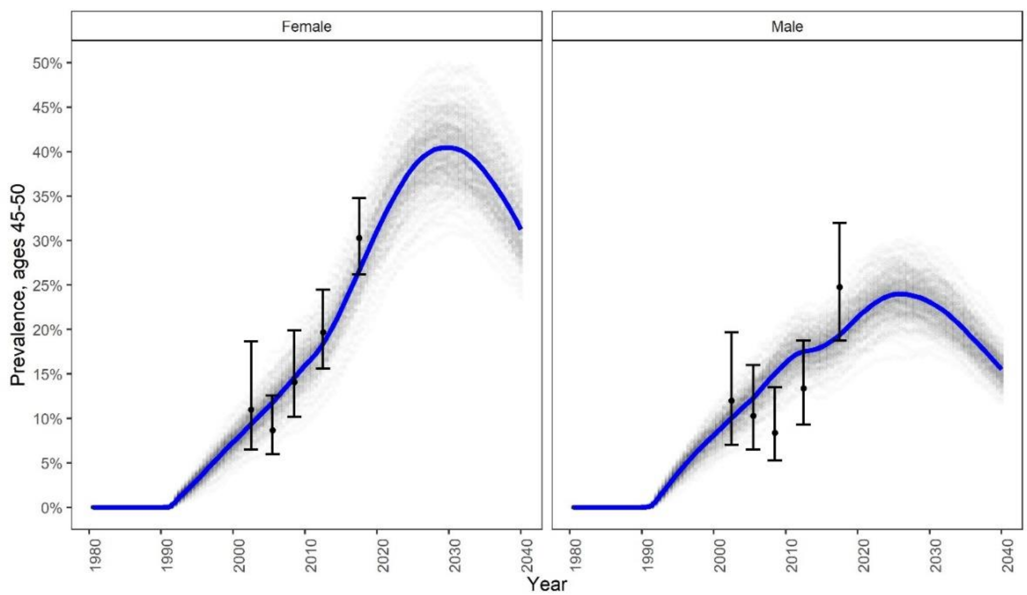




* Points and error bars represent empiric data. 250 good-fitting parameter sets are shown in gray and loess average is shown in blue. Sources for HIV prevalence: South African National HIV Prevalence, Incidence and Behaviour Surveys (2002, 2005, 2008, 2012 and 2017) from the Human Sciences Research Council (HSRC) (19-22)

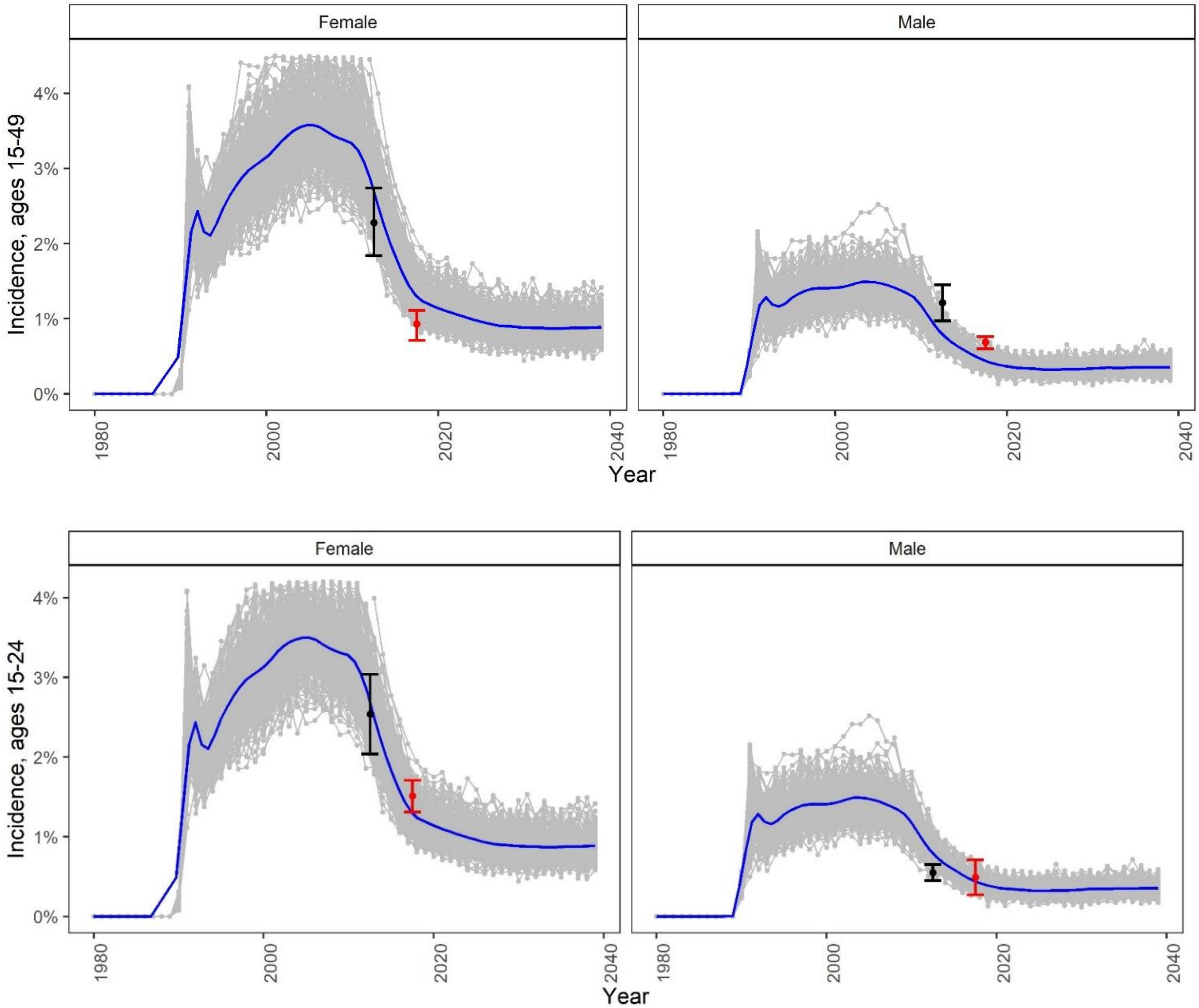
Figure S3 cont'd: Calibration: Model fit to age-specific and overall prevalence from population-based surveys by sex.*





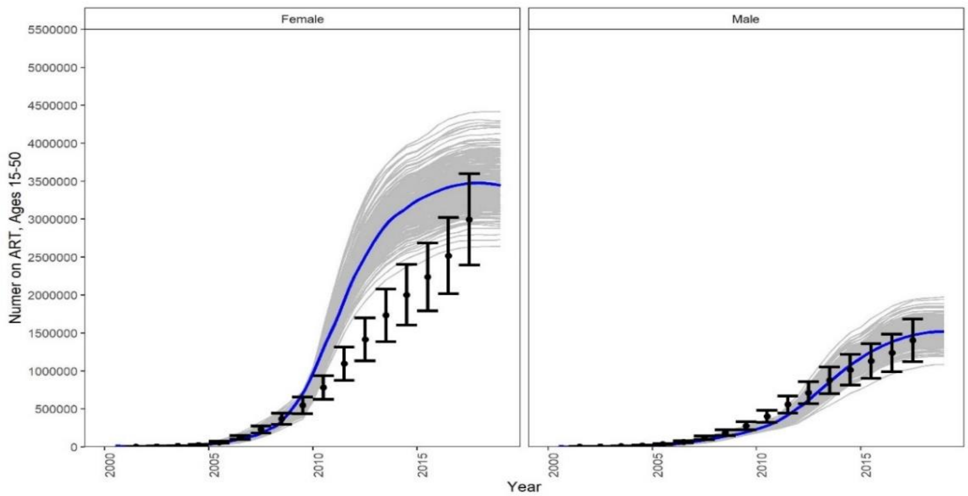
* Points and error bars represent empiric data. 250 good-fitting parameter sets are shown in gray and loess average is shown in blue. Sources for HIV prevalence: South African National HIV Prevalence, Incidence and Behaviour Surveys (2002, 2005, 2008, 2012 and 2017) from the Human Sciences Research Council (HSRC) (19-22)

Figure S4: Model fit to HIV incidence and number of person on ART by sex.*



* Points and error bars represent empiric data. 250 good-fitting parameter sets are shown in gray and loess average is shown in blue. Source for HIV incidence: Human Sciences Research Council (HSRC) 2012 and 2018 Surveys(19, 20)

Figure S5: Model fit to number of person on ART by sex.*



* Points and error bars represent empiric data. 250 good-fitting parameter sets are shown in gray and loess average is shown in blue. Source for number of people on ART: South Africa Department of Health Surveys.(23)

Table S9: Sensitivity analysis[§]

	Baseline	No increase in referral to ART DSD	20% higher referral to ART DSD	2X higher switching to 2nd line ART in intervention	No increase in switching to 2nd line ART in intervention	20% higher ART costs	20% lower ART costs
Cost-effectiveness ($ per DALY averted)							
Clinic volume: 50	-239 (-602, -96)	719 (90, 2,526)	-894 (-2768, -268)	-15 (-95, 179)	-449 (-1262, -149)	-191 (-470, -81)	-274 (-719, -102)
% under $500 threshold	100%	72%	100%	97%	100%	100%	100%
Clinic volume: 40	-72 (-176, 26)	879 (125, 3,034)	-751 (-2277, -237)	145 (-38, 694)	-289 (-765, -108)	-30 (-123, 148)	-113 (-257, -39)
% under $500 threshold	100%	68%	100%	94%	100%	97%	100%
Clinic volume: 30	197 (-27, 863)	1,149 (184, 3,886)	-511 (-1458, -177)	415 (23, 1,559)	-21 (-102, 160)	238 (-25, 1,011)	156 (-30, 719)
% under $500 threshold	93%	56%	100%	84%	97%	91%	93%
Clinic volume: 20	734 (93, 2,569)	1,686 (296, 5,585)	-32 (-110. 122)	951 (140, 3,255)	517 (48, 1879)	775 (96, 2,721)	692 (90, 2,413)
% under $500 threshold	72%	36%	97%	64%	80%	71%	73%
Clinic volume: 10	2,348 (436, 7,681)	3,300 (635, 10,733)	1,404 (276, 5,069)	2,564 (481, 8,375)	2130 (389, 6984)	2,389 (439, 7,828)	2,306 (432, 7,530)
% under $500 threshold	9%	11%	34%	8%	21%	16%	18%

[§]Values in parenthesis represent 90% model variability across 250 simulations. Values in green represent scenarios where the mean ICER is considered cost-effective at both thresholds of $500 and $1,175 per DALY averted. Values in yellow represent scenarios where the mean ICER is considered cost-effective using only the threshold of $1,175 per DALY averted and values in red exceed both thresholds.

Table S10: Sensitivity analysis cont'd§

	Baseline	0% discount rate	6% discount rate	60% POC testing coverage	80% POC testing coverage	Probabilistic sensitivity analysis
Cost-effectiveness ($ per DALY averted)						
Clinic volume: 50	-239 (-602, -96)	-192 (-457, -93)	-250 (-659, -96)	-165 (-591, -46)	-239 (-502, -67)	-339 (-1919, 1376)
% under $500 threshold	100%	100%	100%	99%	99%	88%
Clinic volume: 40	-72 (-176, 26)	-80 (-169, -9)	-60 (-169, 32)	71 (-321, 24)	-110 (-229, 1)	-64 (-1334, 1616)
% under $500 threshold	100%	100%	100%	99%	100%	80%
Clinic volume: 30	197 (-27, 863)	102 (-35, 470)	246 (-19, 1002)	461 (-159, 415)	107 (-125, 397)	152 (-1150, 2259)
% under $500 threshold	93%	90%	91%	88%	97%	72%
Clinic volume: 20	734 (93, 2,569)	663 (74, 1766)	858 (122, 3102)	1,005 (163, 3,660)	537 (42, 1,423)	942 (-494, 3300)
% under $500 threshold	72%	78%	64%	60%	81%	58%
Clinic volume: 10	2,348 (436, 7,681)	2,050 (377, 5240)	2695 (502, 9408)	3,096 (502, 5020)	1,832 (372, 4,509)	1,879 (211, 8066)
% under $500 threshold	9%	10%	5%	6%	30%	23%

§Values in parenthesis represent 90% model variability across 250 simulations. Values in green represent scenarios where the mean ICER is considered cost-effective at both thresholds of $500 and $1,175 per DALY averted. Values in yellow represent scenarios where the mean ICER is considered cost-effective using only the threshold of $1,175 per DALY averted and values in red exceed both thresholds. In the probabilistic sensitivity analysis, point-of-care testing costs were varied across the 250 parameter sets using a log normal distribution with a mean of the log of average costs.

Table S11: 5-year budget impact analysis (2018 USD)[¥]

Cost category	Standard of care	Clinic volume 50	Clinic volume 40	Clinic volume 30	Clinic volume 20	Clinic volume 10
ART monitoring	6,664,494	7,471,136	7,692,736	8,062,032	8,802,224	11,025,557
ART drugs and provision	31,075,279	30,107,263	30,107,263	30,107,263	30,107,263	30,107,263
HIV testing	1,093,583	1,093,451	1,093,451	1,093,451	1,093,451	1,093,451
Health-care use for HIV+ not in care	1,548,242	1,547,030	1,547,030	1,547,030	1,547,030	1,547,030
End of life care	209,894	204,547	204,547	204,547	204,547	204,547
Total	**40,591,492**	**40,423,428**	**40,645,027**	**41,014,323**	**41,754,515**	**43,977,849**
Cost difference compared to SOC	**-**	**(168,064)**	**53,535**	**422,831**	**1,163,023**	**3,386,356**

[¥]SOC: Standard of care

Figure S6: 20-year budget impact analysis: Incremental costs by year of POC intervention and standard of care

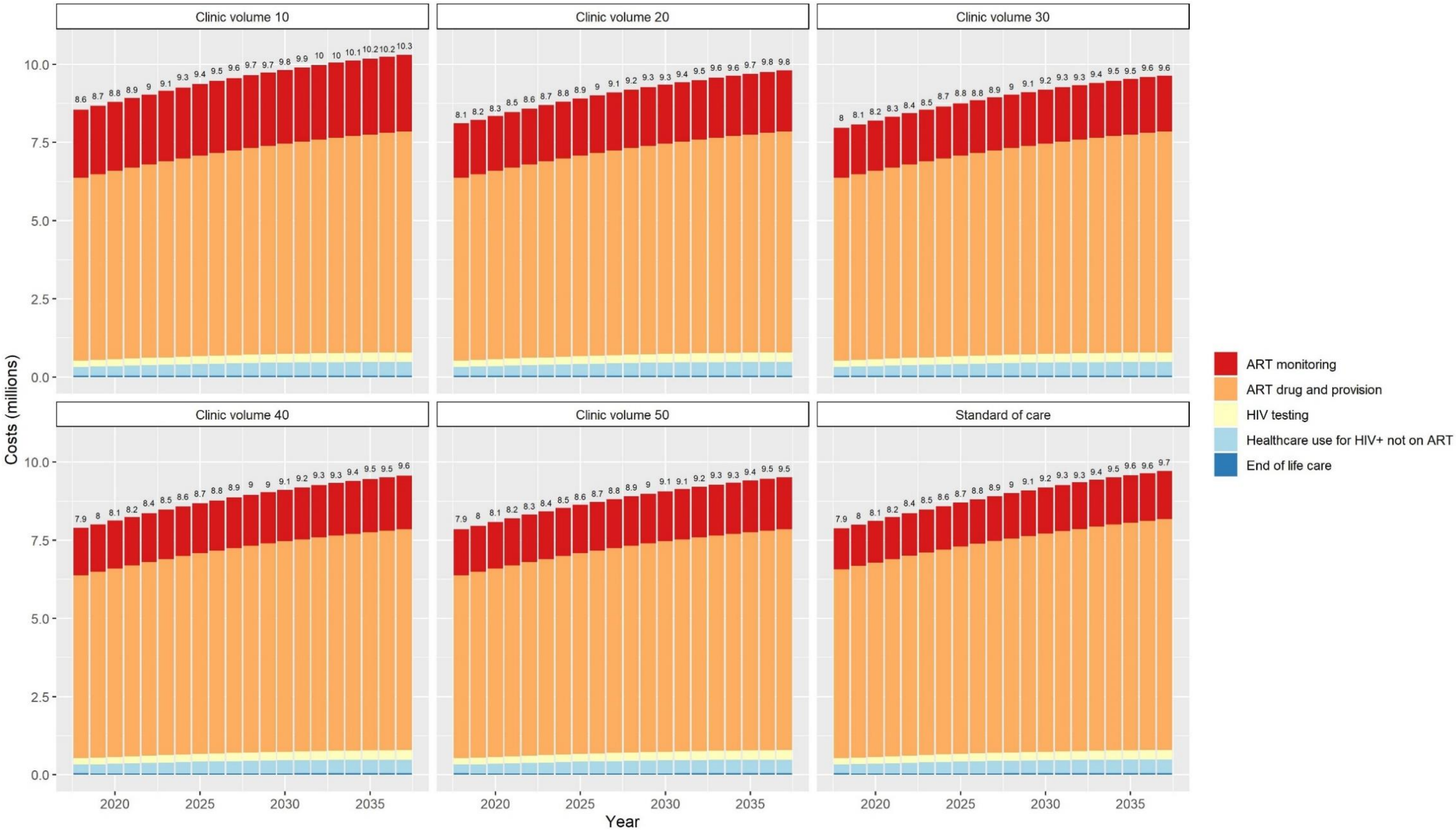
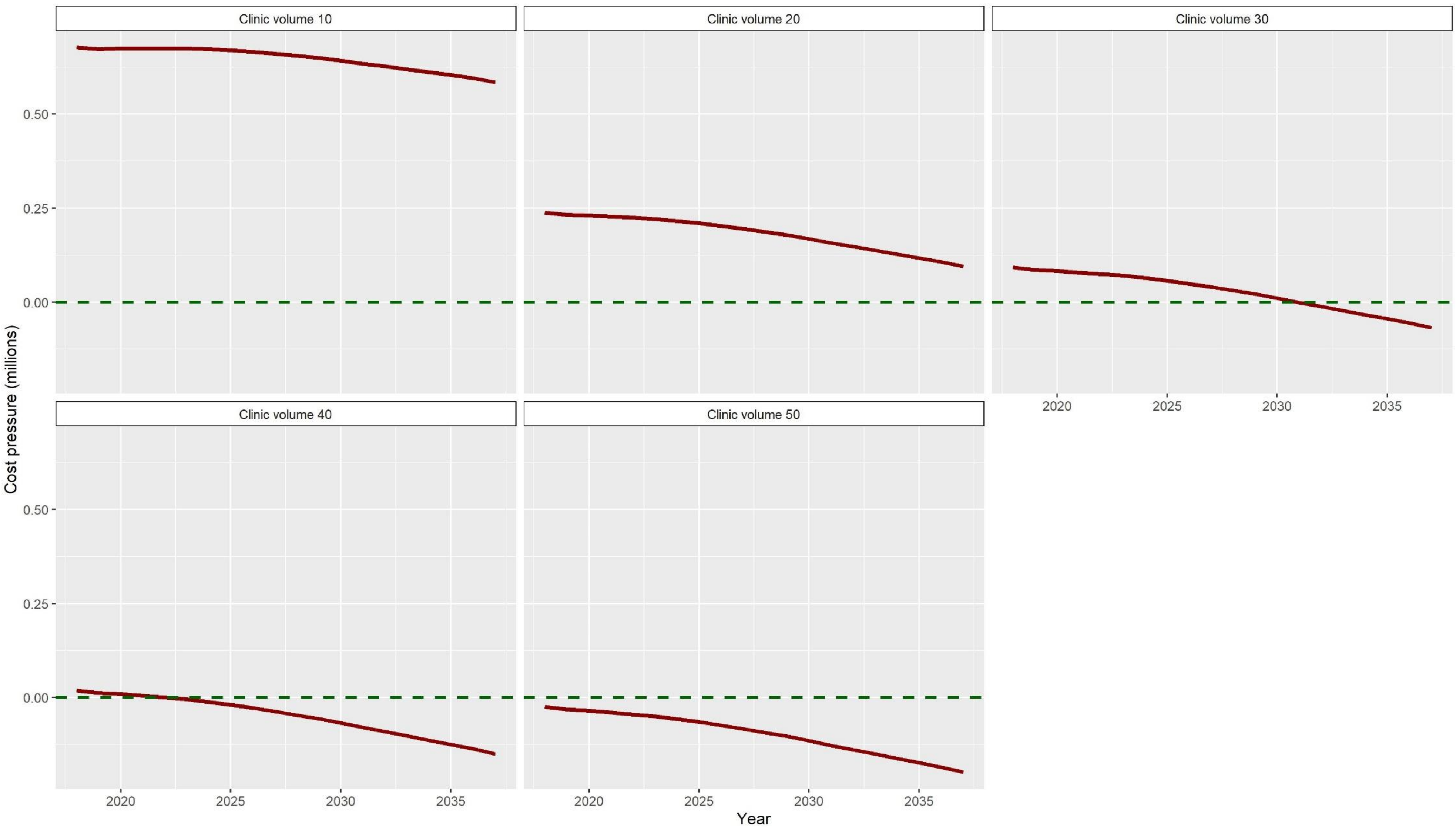


Figure S7: 20-year cost pressure analysis of intervention incremental costs compared to standard-of-care



¥Dashed green line indicates cost of intervention is the same as standard of care

Assessment of clinic volume of facilities in South Africa

In order to estimate the proportion of persons living with HIV (PLHIV) in South Africa who can be cost-effectively reached by the POC testing intervention, we assessed clinic volume of healthcare facilities by quantile (Table S12) using data from the World Bank and District Health Information Software (DHIS). Overall, approximately 2 million of the 2.95 million PLHIV on ART (68%) receive care at the top 25% largest volume facilities. Assuming that the number of new ART initiations per month is 16-25% of the total volume of ART patients at the facilities, we would estimate that the monthly ART initiations for the largest volume facilities is between 31-37 PLHIV. Our modeling analysis suggests that POC testing would be cost-effective in clinics with 20-30 ART initiations per month; therefore we estimate that approximately 70% of PLHIV in South Africa can be cost-effectively served by the intervention; however this proportion will likely decline over time as South Africa achieves epidemic control and the number of patients on ART decline across facilities.

Table S12: Clinic volume by quantile in South Africa[¥]

Clinic size	Number of facilities DHIS	total number of PLHIV on ART (DHIS)	Percentage of total PLHIV served by facility size quantile	Mean number of PLHIV on ART in each facility	Mean number of ART initiations per month (assuming 25% of patients are new initiations)	Mean number of ART initiations per month (assuming 16% of patients are new initiations)
1st quartile	919	2,020,925	68%	2,199	37	31
2nd quartile	918	579,486	20%	631	11	9
3rd quartile	918	262,049	9%	285	5	4
4th quartile	919	88,699	3%	97	2	1
Total	**3674**	**2,951,159**	**100%**	**803**	**13**	**11**

[¥] Data source: World Bank(26). DHIS: District Health Information Software.

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