Comparison of HIV self-test distribution modalities in western Kenya: a mathematical modeling study

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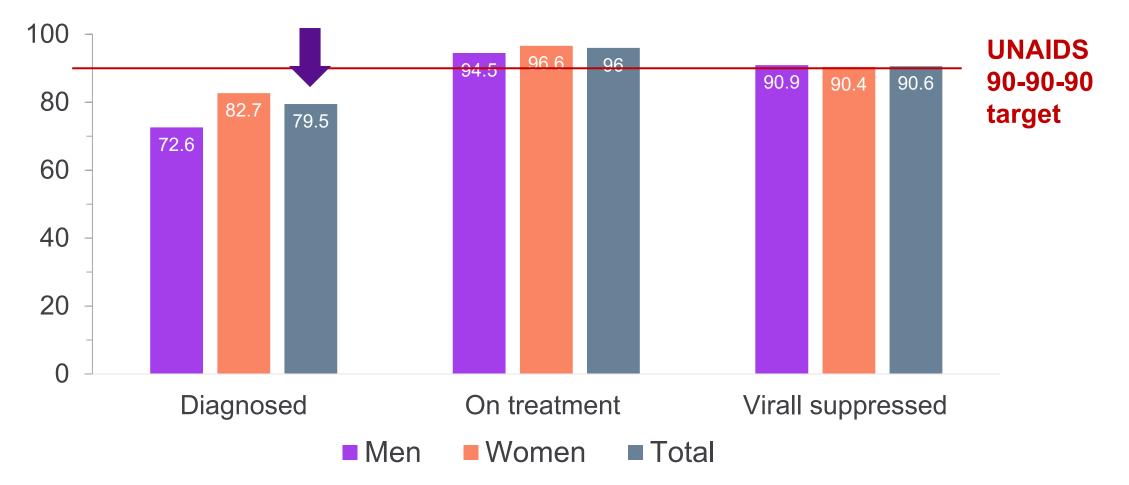
- Background
- Methods
- Results
- Discussion



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~20% PLHIV still not aware of their HIV status in Kenya



Department of Population Health NASCOP. Kenya Population-based HIV Impact Assessment (KENPHIA) 2018: Final Report. Nairobi: NASCOP; August 2022.



HIV self-testing to close the testing gap

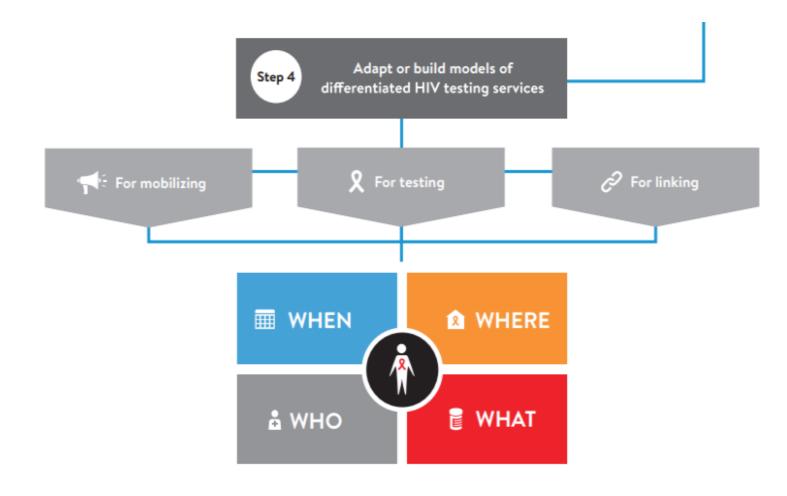
- Since 2016, WHO has recommended HIV self-testing (HIVST) as an strategy to reach UNAIDS targets to end HIV by 2030.¹
- HIVST costs US\$1 to the public sector in low- and middle-income countries.
- HIVST distributed worldwide
 - 102 countries have HIVST policies
 - 38 countries actively implementing HIVST
- However, the uptake and distribution of HIVST have been slow at the population level. •
 - 4% ever self-tested for HIV in Kenya² and 1.2% in Zimbabwe and Malawi³

1 WHO/HIV/2016.21 (2016)

Department of Population Health 2 Mwangi et al., BMC Public Health; 22:643 (2022) 3 Johnson et al., BMC Public Health; 20:779 (2020)



How to distribute HIV self-testing kits?



- Where
 - Communities
 - Facilities
 - Workplace/educational establishment
- Who
 - Partners through secondary distribution
 - Peers through social network
 - Other high-risk groups
 - General community



Department of Population Health The International AIDS Society, DSD for HIV: a decision framework for HIV testing services (2022)

HIVST distribution modalities



Antenatal Care (ANC)

Secondary distribution through pregnant women at antenatal care visits to male partners



New Index

Secondary distribution through new index patients to partners



Facility

Distribution at outpatient facilities

Department of Population Health What is the effect of HIVST distribution modalities on population-level HIV epidemic in western Kenya?



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Model setting: western Kenya

- Epidemiological MODelling (EMOD)-HIV, an agent-based HIV epidemiological model fit to HIV epidemic and population data in Nyanza, Western Kenya
- Highest HIV prevalence in Kenya in 2018 (PHIA)
 - Male: 8.3%

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Female: 16.6%



- Population size (age 15+ years): 3.6 million (2019 census)
- % tested for HIV and received results in the past 12 months, aged 15-64 years (2018 KENPHIA)
 - Men: 55.8%
 - Women: 66.2%
- Three ways for HIV testing:
 - Symptomatic testing
 - Women at antenatal care (ANC) visits (12 weeks pregnant)
 - Voluntary testing at and after sexual debut



Effect of HIVST on HIV testing uptake: meta-analysis

	Study	HIVST-N	I HIVST-D	SOC-N	soc-	D	Risk Ratio	RR	95%-CI	Weight
ANC	Secondary distrib Choko 2019a* Choko 2019b(ii)* Gichangi 2018 Masters 2016 Overall effect Heterogeneity: / ² = 949	1801 2096 322 258	1941 3027 472 297	71 515 106 148	rs 408 1396 471 303			1.87 3.03 1.78	[3.77; 7.39] [1.60; 2.19] [2.54; 3.62] [1.57; 2.01] [1.81; 3.82]	7.3% 8.6% 8.4% 8.7% 33.0%
New Index	Secondary distrib Choko 2019b(i)* Dovel 2019 Overall effect Heterogeneity: / ² = 829	225 282	474 349	to partne 81 39	rs 234 135			2 80	[0.79; 2.34] [2.14: 3.66] [1.01; 4.09]	
Facility	HIVST at facilities Dovel 2018* Kelvin 2018 Kelvin 2019a Overall effect Heterogeneity: $I^2 = 929$ Overall effect	1063 131 31 % [81%; 97%	-	-	1951 155 762			1.20 3.15 - 2.38	[2.38; 6.49] [1.07; 1.34] [1.56: 6.38] [0.97; 5.83] [1.65; 2.53]	8.7% <u>4.5%</u> 19.3%
	Heterogeneity: I ² = 949	% [92%; 96%	j, τ = 0.1316	, <i>ρ</i> < 0.01		0.5 Favours SOC	1 2 5 Favours HIVST			

The uptake of HIV testing in those receiving HIVST was two times higher than in the standard of care.

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Jamil et al., eClinicalMedicine; 38 (2021)

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Effect of HIVST on linkage to care: meta-analysis

	Study	HIVST-N	HIVST-D	SOC-N	SOC-D		, Risk R	Ratio		RR	95%-CI	Weight
ANC	Secondary distribution	ution: wom	nen to mal	e partne	rs							
	Choko 2019a(i)*	10	11	1	1					1.17	[0.51; 2.67] 4.1%
	Choko 2019a(ii)*	27	29	1	1					1.22	[0.55; 2.74] 4.3%
	Choko 2019a(iii)*	2	3	1	1	_				0.83	[0.28; 2.51] 2.4%
	Masters 2016	2	8	3	4	← •				0.33	[0.09: 1.26	1 1.7%
	Overall effect									0.94	0.58; 1.53	12.6%
	Heterogeneity: $I^2 = 2\%$	[0%; 85%], τ	² = 0.0048, µ	0 = 0.38								
New Index	Secondary distrib	ution: part	ners									
	Choko 2019b(i)*	13	13	5	5 5		-6	•		1.05	[0.81; 1.37] 22.4%
	Choko 2019b(ii)*	53	53	5	5			•		1.08	[0.85; 1.38	24.1%
	Overall effect						-	►		1.07	[0.89; 1.28	46.5%
	Heterogeneity: $I^2 = 0\%$,	$\tau^2 = 0, p = 0$.88									
Facility	HIVST at facilities											
	Dovel 2018*	19	27	5	6					0.84	[<u>0 55; 1 30</u>	12 1%
	Overall effect									0.84	[0.55; 1.30	12.1%
	Heterogeneity: not appl	icable					-		•			
	Overall effect Heterogeneity: I ² = 29%	67%1	$r^2 = 0.0183$	n = 0.19		r		•	[0.95	[0.79; 1.13] 100.0%
	rieterogeneity. 7 = 297	0 [0 /0, 0 / /0],	- 0.0103,	p = 0.13		0.2	0.5 1	2	5			
						0.2	0.0 1	2	5			
						Fav	ours SOC	Favo	ours HIVS	г		

The linkage to care in those receiving HIVST was similar to that in the standard of care.

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Jamil et al., eClinicalMedicine; 38 (2021)

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Model scenarios and assumptions

HIVST distribution

- Baseline
 - No HIVST distributed
- Three HIVST distribution strategies
 - <u>ANC</u>: Secondary distribution through pregnant women at antenatal care visits to male partners
 - Maximum two current partners with the longest relationships
 - <u>New Index</u>: Secondary distribution through new index patients to partners
 - Maximum two current partners with the longest relationships
 - <u>Facility</u>: Distribution at outpatient facilities

Assumptions

- HIVST uptake based on the meta-analysis from the RCTs in sub-Saharan Africa
- Linkage to care is ~5% worse in HIVST compared to counterfactual
- HIVST distribution between 2022 and 2052 over 30 years



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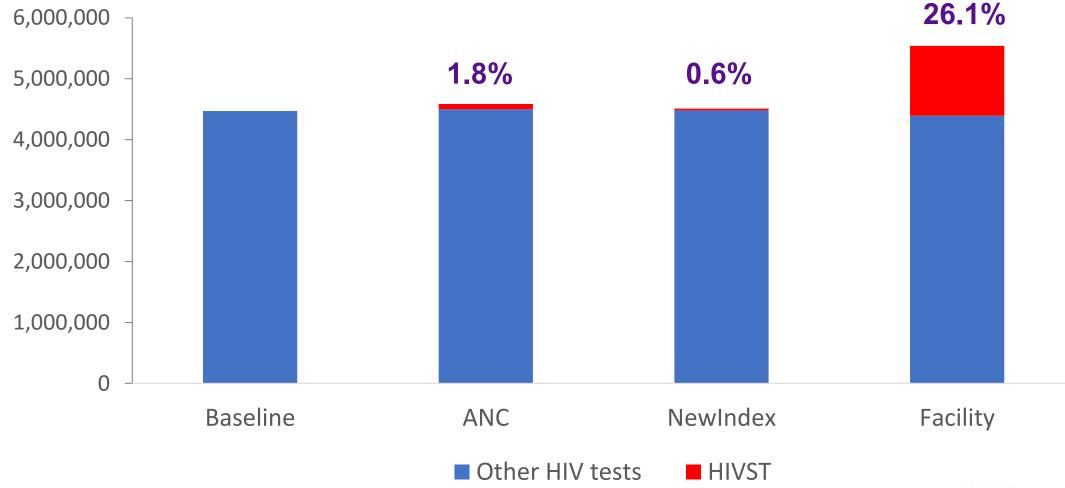


Number of HIVST distributed by scenario

- ANC
 - Pregnant women who attend ANC visits: 2.8% (n=170,300)
 - Current male partners of ANC women: 1.5% (n=92,200)
 - ~84,500 HIVST per year
- New Index
 - New index patients: 0.3% (n=19,300)
 - Current partners of new index patients: 0.6% (n=37,800)
 - ~24,000 HIVST per year
- Facility
 - ~1,147,000 HIVST per year

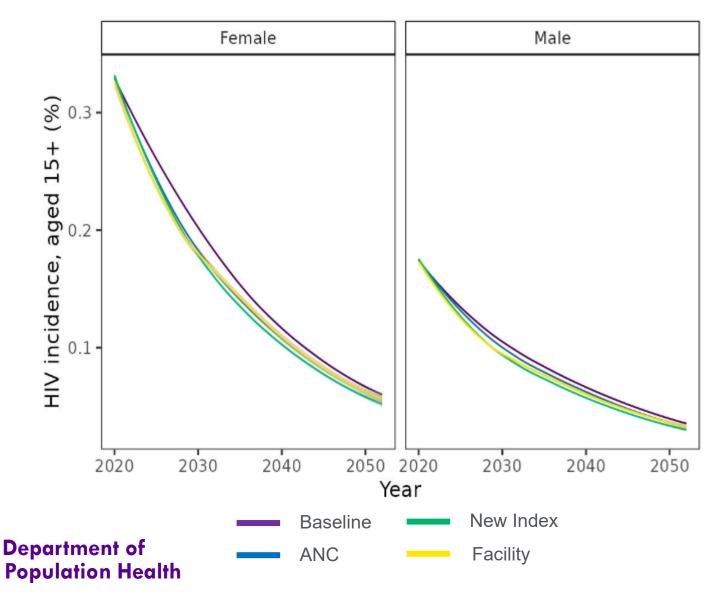


Number of HIV tests per year





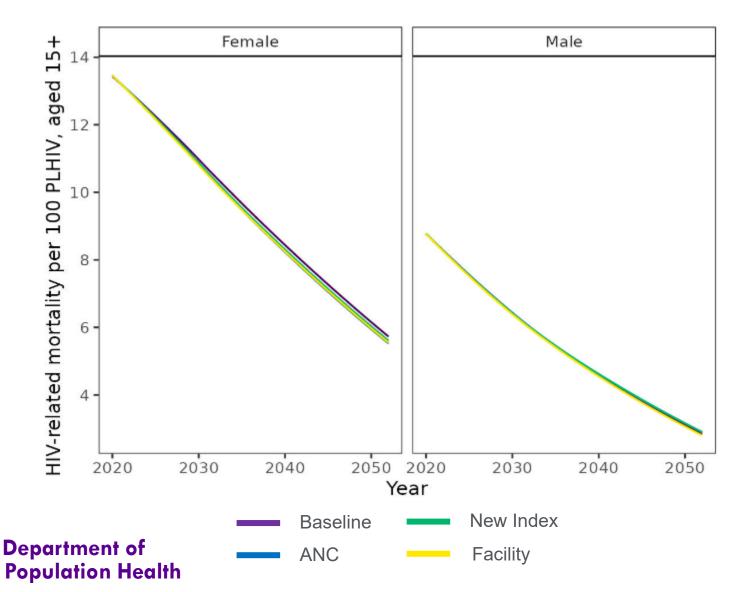
New index modality averts the largest number of HIV infections



Scenario	HIV infections averted in 2022-2052					
Baseline	Ref					
ANC	14,443	4.6%				
New Index	31,164	10.3%				
Facility	27,751	9.8%				



New index modality averts the largest number of HIV-related deaths



Scenario	HIV-related avert in 2022-	ed			
Baseline	Ref				
ANC	10,954	1.4%			
New Index	34,912	4.6%			
Facility	13,125	1.7%			



How many HIVST are needed to avert one additional HIV infection or HIV-related death?

	ANC	New Index	Facility
Number of HIVST per additional HIV infection averted	173	22	1225
Number of HIVST per additional HIV death averted	228	20	2590



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Discussion

- Secondary distribution of HIVST to partners through new index patients is most efficient and effective
 - Requires ~22 HIVST uptake to avert one additional new HIV infection
 - Reduces cumulative new HIV infections by 10% and HIV-related mortality by 5% over 30 years
- Empirically tested strategies for HIVST distribution could improve HIV diagnosis and health outcomes.
 - HIVST distribution at outpatient facilities reaches broader population but more targeted strategies might be needed.
- Further research is needed on HIVST distribution innovation.
 - Unprecedented manufacturing volumes are available in the wake of high COVID-19 rapid test demand.

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- E.g., HIVST could follow direct-to-consumer channels analogous to condom distribution.

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