Table S1. Summary of primary and secondary packages of interventions in each country setting, by age where applicable

Setting	List of constituent interventions
Kenya	**Primary interventions** • HIV Testing and Counselling (age 10-24) • Social asset building (age 10-24) • School-based HIV and violence prevention (age 10-24) • Financial capability training (age 10-24) • Entrepreneurship training (age 15-24) • Condom education and promotion (age 15-24) • Contraceptive method mix education and counselling (age 15-24) • PrEP education and counselling (age 18-24) **Secondary interventions** (needs based) • Families Matter Programme (age 10-14) • Educational subsidies (age 10-24) • Post violence care (age 10-24) • Cash transfers (age 15-24) • Combined socio-economic approaches (age 15-24) • Condom provision (age 15-24) • Contraceptive method mix provision (age 15-24) • PrEP provision (age 18-24)
South Africa	**Primary interventions** • School-based HIV and violence prevention (age 10-19) • Social asset building (age 10-19) • Condoms (sexually active age 10-24) • HIV Testing and Counselling (sexually active age 10-24) • Sexual and reproductive health (sexually active age 10-24)

	Secondary interventions (needs based) • Material support e.g. cash transfers and educational subsidies (age 10-19) • Post violence care (age 10-24) • Combined socio-economic approaches (age 10-24) • PrEP (age 18-24)
Zimbabwe*	Primary interventions • HIV Testing and Counselling (age 15-24) • Condom promotion and provision (age 15-24) • Social asset building (age 15-24) Secondary interventions (needs based) • Disability assessment (age 15-24) • Education support or combination socio-economic approaches (age 15-24) • Family planning services (age 15-24) • Gender based violence response (age 15-24) • Health services (other STIs) (age 15-24) • PrEP (age 15-24)

*'KP_Prev' – PEPFAR indicator for the DREAMS package of HIV prevention services for key populations [19]

Table S2. Estimated sample sizes to measure change over time in secondary outcomes among AGYW

Key outcomes of interest for AGYW	15-19 year old adolescent girls							20-24 year old young w		
	Prevalence			Estimated sample sizes				Prevalence		
	Pre-DREAMS	Post-DREAMS	Ratio ‡	80% power	90% power	Precision ±10%†	Precision ±2.5%β	Pre-DREAMS	Post-DREAMS	Ra ‡
Proportion of AGYW who know their HIV status	20%	50%	2.50	45	58	385	1537	30%	60%	2.
	30%	60%	2.00	49	63	257	1476	40%	70%	1.
	40%	70%	1.75	49	63	165	1291	50%	80%	1.
	50%	80%	1.60	45	58	97	984	60%	90%	1.
Proportion of AGYW who have ever had sex	45%	20%	0.44	62	80	1537	984	85%	40%	0.
		30%	0.67	176	230	897	1291		50%	0.
	50%	25%	0.50	66	85	1153	1153	90%	45%	0.
	55%	30%	0.55	68	88	897	1291	95%	50%	0.
Proportion of AGYW [aged 18-19] who first had sex aged <18 years	40%	20%	0.50	91	119	1537	984			
		30%	0.75	376	496	897	1291			
	50%	30%	0.60	103	134	897	1291			
	60%	40%	0.67	107	140	577	1476			
Proportion of AGYW who used a condom last time they had sex, during the past 12 months	5%	40%	8.00	27	34	577	1476	5%	40%	8.
		20%	4.00	88	114	1537	984		20%	4.
	10%	45%	4.50	30	38	470	1522	10%	45%	4.
	15%	50%	3.33	33	42	385	1537	15%	50%	3.
Proportion of AGYW who had >1 sexual partner during the past 12	2%	1%	0.50	2515	3300	38032	61	2%	1%	0.
	5%	2.5%	0.50	984	1291	14983	150	5%	2.5%	0.

months	10%	5%	0.50	474	621	7300	292	10%	5%	0.
	15%	7.5%	0.50	304	398	4738	427	15%	7.5%	0.
Proportion of AGYW [aged 18-19] pregnant before age 18	15%	7.5%	0.50	304	398	4738	427			
		10%	0.67	726	957	3458	554			
	20%	10%	0.50	219	286	3458	554			
	25%	12.5%	0.50	168	219	2690	673			
Proportion of AGYW who had a sexual partner >5 years older/younger in the past 12m	20%	10%	0.50	219	286	3458	554	50%	25%	0.
	30%	15%	0.50	134	174	2177	784	60%	30%	0.
	40%	20%	0.50	91	119	1537	984	70%	35%	0.
Proportion of AGYW who have ever experienced sexual abuse/violence	10%	5%	0.50	474	621	7300		10%	5%	0.
	15%	7.5%	0.50	304	398	4738		20%	10%	0.
	20%	10%	0.50	219	286	3458		30%	15%	0.
Proportion of AGYW [aged 18-19] who are in or have completed school	30%	50%	1.67	103	134	385				
		40%	1.33	376	496	577				
	40%	60%	1.50	107	140	257				
	50%	70%	1.400	103	134	42				

‡Post-DREAMS vs pre-DREAMS prevalence

†Sample size required to estimate the post-DREAMS prevalence to within ±10% of the point estimate ("relative" precision)

βSample size required to estimate the post-DREAMS prevalence to within ±2.5 percentage points ("absolute" precision)

Footnote: The sample sizes refer to the numbers required both pre-DREAMS and again post-DREAMS.

Table S3. Estimated sample sizes to measure change over time in key outcomes among males

Outcome of interest for males	Age	Prevalence			Estimated sample sizes			
		Pre-DREAMS	Post-DREAMS	Ratio‡	80% power	90% power	Precision ±10%†	Precision ±2.5%β
Proportion of males who know their HIV status	15-24	30%	60%	2.00	49	63	257	1476
			70%	2.33	29	36	165	1291
		40%	70%	1.75	49	63	165	1291
			80%	2.00	28	35	97	984
		50%	80%	1.60	45	58	97	984
			90%	1.80	25	31	43	554
	25-34	40%	65%	1.63	70	90	207	1399
			75%	1.88	36	46	129	1153
		50%	75%	1.50	66	85	129	1153
			85%	1.70	33	42	68	784
		60%	80%	1.33	91	119	97	984
			90%	1.50	38	49	43	554
	35-44	40%	65%	1.63	70	90	207	1399
			75%	1.88	36	46	129	1153
		50%	75%	1.50	66	85	129	1153
			85%	1.70	33	42	68	784
		60%	80%	1.33	91	119	97	984
			90%	1.50	38	49	43	554
	45-	40%	65%	1.63	70	90	207	1399

	54							
			75%	1.88	36	46	129	1153
		50%	75%	1.50	66	85	129	1153
			85%	1.70	33	42	68	784
		60%	80%	1.33	91	119	97	984
			90%	1.50	38	49	43	554
	25-54	40%	65%	1.63	70	90	207	1399
			75%	1.88	36	46	129	1153
		50%	75%	1.50	66	85	129	1153
			85%	1.70	33	42	68	784
		60%	80%	1.33	91	119	97	984
			90%	1.50	38	49	43	554
Voluntary male medical circumcision (VMMC) among HIV- males	15-24	20%	50%	2.50	45	58	385	1537
			60%	3.00	28	35	257	1476
		30%	50%	1.67	103	134	385	1537
			60%	2.00	49	63	257	1476
		40%	60%	1.50	107	140	257	1476
			70%	1.75	49	63	165	1291
		50%	70%	1.40	103	134	165	1291
			80%	1.60	45	58	97	984
	25-34	30%	50%	1.67	103	134	385	1537
			60%	2.00	49	63	257	1476
		40%	60%	1.50	107	140	257	1476

			70%	1.75	49	63	165	1291
		50%	70%	1.40	103	134	165	1291
			80%	1.60	45	58	97	984
	35-44	30%	50%	1.67	103	134	385	1537
			60%	2.00	49	63	257	1476
		40%	60%	1.50	107	140	257	1476
			70%	1.75	49	63	165	1291
		50%	70%	1.40	103	134	165	1291
			80%	1.60	45	58	97	984
	45-54	30%	50%	1.67	103	134	385	1537
			60%	2.00	49	63	257	1476
		40%	60%	1.50	107	140	257	1476
			70%	1.75	49	63	165	1291
		50%	70%	1.40	103	134	165	1291
			80%	1.60	45	58	97	984
	25-54	30%	50%	1.67	103	134	385	1537
			60%	2.00	49	63	257	1476
		40%	60%	1.50	107	140	257	1476
			70%	1.75	49	63	165	1291
		50%	70%	1.40	103	134	165	1291
			80%	1.60	45	58	97	984
Uptake of ART among	15-24	20%	50%	2.50	45	58	385	1537

Group	Age	%	%	Ratio				
HIV+ males in past 12 months			60%	3.00	28	35	257	1476
		30%	60%	2.00	49	63	257	1476
			70%	2.33	29	36	165	1291
		40%	70%	1.75	49	63	165	1291
			80%	2.00	28	35	97	984
	25-34	30%	60%	2.00	49	63	257	1476
			70%	2.33	29	36	165	1291
		40%	65%	1.63	70	90	207	1399
			75%	1.88	36	46	129	1153
		50%	70%	1.40	103	134	165	1291
			80%	1.60	45	58	97	984
	35-44	30%	60%	2.00	49	63	257	1476
			70%	2.33	29	36	165	1291
		40%	65%	1.63	70	90	207	1399
			75%	1.88	36	46	129	1153
		50%	70%	1.40	103	134	165	1291
			80%	1.60	45	58	97	984
	45-54	30%	60%	2.00	49	63	257	1476
			70%	2.33	29	36	165	1291
		40%	65%	1.63	70	90	207	1399
			75%	1.88	36	46	129	1153
		50%	70%	1.40	103	134	165	1291
			80%	1.60	45	58	97	984

	25-54	30%	60%	2.00	49	63	257	1476
			70%	2.33	29	36	165	1291
		40%	65%	1.63	70	90	207	1399
			75%	1.88	36	46	129	1153
		50%	70%	1.40	103	134	165	1291
			80%	1.60	45	58	97	984

t-DREAMS vs pre-DREAMS prevalence.

†Sample size required to estimate the post-DREAMS prevalence to within ±10% of the point estimate ("relative" precision)

$^{\beta}$Sample size required to estimate the post-DREAMS prevalence to within ±2.5 percentage points ("absolute" precision)

Footnote: The sample sizes for VMMC among HIV- males refer to the numbers required for analysis however the prevalence of HIV needs to be taken into account for the actual number needed to sample. Similarly, the figures for uptake of ART among HIV+ males represent the numbers required for analysis before accounting for HIV prevalence. If HIV prevalence is 10% the number needed to sample size will be 10 times larger since only 10% of those sampled would be HIV+; if prevalence is 20% the actual number needed to sample will be 5 times larger.

Table S4. Estimated sample sizes to assess the causal effect of key 'mediators of change' on secondary outcomes (via cohorts of AGYW)

Mediator present at baseline		Prevalence of outcome at 24 months by baseline mediator category		Prevalence ratio	Sample size†	
no	yes	Mediator=no	Mediator=yes	[yes vs no]	80% power	90% power
90%	10%	10%	7.5%	0.75	15001	19523
			5%	0.50	3536	4444
			2.5%	0.25	1447	1736
		30%	20%	0.67	2244	2899
			15%	0.50	973	1229
			10%	0.33	528	647
		50%	30%	0.60	721	928
			20%	0.40	317	397
			10%	0.20	171	204
		70%	40%	0.57	321	416
			30%	0.43	184	234
			20%	0.29	119	146
		90%	60%	0.67	219	294
			50%	0.56	137	182
			40%	0.44	94	123
70%	30%	10%	7.5%	0.75	6321	8301
			5%	0.50	1469	1886
			2.5%	0.25	598	744
		30%	20%	0.67	949	1238

			15%	0.50	411	526
			10%	0.33	223	279
		50%	30%	0.60	311	401
			20%	0.40	138	174
			10%	0.20	76	92
		70%	40%	0.57	144	186
			30%	0.43	86	107
			20%	0.29	54	67
		90%	60%	0.67	107	138
			50%	0.56	69	88
			40%	0.44	49	62
50%	50%	10%	7.5%	0.75	5211	6906
			5%	0.50	1186	1553
			2.5%	0.25	473	608
		30%	20%	0.67	783	1031
			15%	0.50	336	436
			10%	0.33	181	231
		50%	30%	0.60	258	336
			20%	0.40	113	146
			10%	0.20	63	78
		70%	40%	0.57	123	158
			30%	0.43	73	91
			20%	0.29	48	58
		90%	60%	0.67	96	123
			50%	0.56	63	78

			40%	0.44	43	53
30%	70%	10%	7.5%	0.75	6076	8131
			5%	0.50	1343	1797
			2.5%	0.25	513	684
		30%	20%	0.67	913	1213
			15%	0.50	384	509
			10%	0.33	201	268
		50%	30%	0.60	306	397
			20%	0.40	131	172
			10%	0.20	72	88
		70%	40%	0.57	147	188
			30%	0.43	84	109
			20%	0.29	56	68
		90%	60%	0.67	122	147
			50%	0.56	76	93
			40%	0.44	56	63
10%	90%	10%	7.5%	0.75	13863	18726
			5%	0.50	2951	4038
			2.5%	0.25	1051	1463
		30%	20%	0.67	2076	2788
			15%	0.50	851	1151
			10%	0.33	426	576
		50%	30%	0.60	688	913
			20%	0.40	288	376
			10%	0.20	138	188

		70%	40%	0.57	338	426
			30%	0.43	188	238
			20%	0.29	113	151
		90%	60%	0.67	276	338
			50%	0.56	176	213
			40%	0.44	126	138

†Figures inflated by dividing by 0.8 in order to allow for 20% loss to follow-up