THESIS APPENDIX

This appendix contains 3 supplementary files attributed to the content presented in this thesis. They are as follows:

- Supplementary File 1 – The accompanying file for **Results P1**, accepted as an Appendix in *Applied Health Economics and Health Policy*
- Supplementary File 2 – The search strategy for the literature review of mathematical models of HIV testing strategies conducted for **Results P2**
- Supplementary File 3 – The accompanying file for **Results P3**, published as an Appendix in *BMC Health Services Research*,

– SUPPLEMENTARY FILE 1 –

Modelling Methods of Economic Evaluations of HIV Testing Strategies in sub-Saharan Africa: A Systematic Review

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I. TECHNICAL SPECIFICATIONS

Appendix I – Individual Database Search Strategies

Databases Searched: Sept 16, 2020
All restricted to 2000 – current

MEDLINE SEARCH STRATEGY

Concept 1: **HIV**

Search Terms: 1 -	(HIV or hiv-1 or hiv-2 or hiv1 or hiv2 or human immunodeficiency virus or human immunedeficiency virus or human immuno-deficiency virus or human immune-deficiency virus).ti,ab,kf.
Search Terms: 2 –	(acquired immunodeficiency syndrome or acquired immunedeficiency syndrome or acquired immuno-deficiency syndrome or acquired immune-deficiency syndrome).ti,ab,kf.
Search Terms: 3 –	exp HIV/ or exp HIV infections/
Combine	1 or 2 or 3
Results	409112

Concept 2: **Testing**

Search Terms: 4 -	(Service* or Test* or Counsel* or Prevent*).ti,ab,kf
Search Terms: 5 –	(HTC or HTS or VCT or mVCT or PICT or HBCT or HIVST or partner notification or index-linked or index linked).ti,ab,kf.
Search Terms: 6 –	((Facility or Community or Home or Self or Index) adj3 test*).ti,ab,kf.
Search Terms: 7–	exp AIDS Serodiagnosis/
Combine	4 or 5 or 6 or 7
Results	5015777

Concept 3: **Modelling**

Search Terms: 8 –	((Dynamic or Static or Deterministic or Stochastic) adj3 model*).ti,ab,kf.
Search Terms: 9 –	((Decision tree or Markov or Microsimulation or transmission or monte carlo or system dynamics or agent based or discrete event) adj3 model*).ti,ab,kf.
Search Terms: 10 –	models, statistical/ or exp models, economic/
Combine	8 or 9 or 10
Results	157004

Concept 4: **Economic Evaluation**

Search Terms : 11 –	exp Cost-Benefit Analysis/
Search Terms : 12 –	((economic evaluation or cost effective* or cost-effective* or cost utility or cost-utility or cost benefit* or cost-benefit* or cost minimi* or cost-minimi* or cost consequence* or cost-consequence*) adj2 analysis).ti,ab,kf.

Search Terms : 13 –	(CEA or CUA or CBA or CMA or CCA or DALY or QALY).ti,ab,kf.
Combine	11 or 12 or 13
Results	126842

Combining Concepts 1 and 2 and (3 or 4): 2668 results

EMBASE SEARCH STRATEGY:

Concept 1: **HIV**

Search Terms: 1 -	(HIV or hiv-1 or hiv-2 or hiv1 or hiv2 or human immunodeficiency virus or human immunedeficiency virus or human immuno-deficiency virus or human immune-deficiency virus).ti,ab,kw.
Search Terms: 2 –	(acquired immunodeficiency syndrome or acquired immunedeficiency syndrome or acquired immuno-deficiency syndrome or acquired immune-deficiency syndrome).ti,ab,kw.
Search Terms: 3 –	exp HIV/ or exp HIV infections/
Combine	1 or 2 or 3
Results	552423

Concept 2: **Testing**

Search Terms: 4 -	(Service* or Test* or Counsel* or Prevent*).ti,ab,kw.
Search Terms: 5 –	(HTC or HTS or VCT or mVCT or PICT or HBCT or HIVST or partner notification or index-linked or index linked).ti,ab,kw.
Search Terms: 6 –	((Facility or Community or Home or Self or Index) adj3 test*).ti,ab,kw.
Search Terms: 7–	exp AIDS Serodiagnosis/
Combine	4 or 5 or 6 or 7
Results	7047823

Concept 3: **Modelling**

Search Terms: 8 –	((Dynamic or Static or Deterministic or Stochastic) adj3 model*).ti,ab,kw.
Search Terms: 9 –	((Decision tree or Markov or Microsimulation or transmission or monte carlo or system dynamics or agent based or discrete event) adj3 model*).ti,ab,kw.
Search Terms: 10 –	models, statistical/ or exp models, economic/
Combine	8 or 9 or 10
Results	209523

Concept 4: **Economic Evaluation**

Search Terms : 11–	exp Cost-Benefit Analysis/

Search Terms : 12 –	((economic evaluation or cost effective* or cost-effective* or cost utility or cost-utility or cost benefit* or cost-benefit* or cost minimi* or cost-minimi* or cost consequence* or cost-consequence*) adj2 analysis).ti,ab,kw.
Search Terms : 13 –	(CEA or CUA or CBA or CMA or CCA or DALY or QALY).ti,ab,kw.
Combine	11 or 12 or 13
Results	184249

Combining Concepts 1 and 2 and (3 or 4): 3954 results

ECONLIT SEARCH STRATEGY:

Concept 1: **HIV**

Search Terms: 1 –	(HIV or hiv-1 or hiv-2 or hiv1 or hiv2 or human immunodeficiency virus or human immunedeficiency virus or human immuno-deficiency virus or human immune-deficiency virus).mp.
Search Terms: 2 –	(acquired immunodeficiency syndrome or acquired immunedeficiency syndrome or acquired immuno-deficiency syndrome or acquired immune-deficiency syndrome).mp.
Search Terms: 3 – *Invalid for Database*	~~exp HIV/ or exp HIV infections/~~
Combine	1 or 2
Results	1932

Concept 2: **Testing**

Search Terms: 4 -	(Service* or Test* or Counsel* or Prevent*).mp.
Search Terms: 5 –	(HTC or HTS or VCT or mVCT or PICT or HBCT or HIVST or partner notification or index-linked or index linked).mp.
Search Terms: 6 –	((Facility or Community or Home or Self or Index) adj3 test*).mp.
Search Terms: 7– *Invalid for Database*	~~exp AIDS Serodiagnosis/~~
Combine	4 or 5 or 6
Results	280464

Concept 3: **Modelling**

Search Terms: 8 –	((Dynamic or Static or Deterministic or Stochastic) adj3 model*).mp.
Search Terms: 9 –	((Decision tree or Markov or Microsimulation or transmission or monte carlo or system dynamics or agent based or discrete event) adj3 model*).mp.
Search Terms: 10 – *Invalid for Database*	~~models, statistical/ or exp models, economic/~~
Combine	8 or 9
Results	51574

Concept 4: **Economic Evaluation**

Search Terms : 11 – *Invalid for Database*	~~exp Cost-Benefit Analysis/~~
Search Terms : 12 –	((economic evaluation or cost effective* or cost-effective* or cost utility or cost-utility or cost benefit* or cost-benefit* or cost minimi* or cost-minimi* or cost consequence* or cost-consequence*) adj2 analysis).mp.
Search Terms : 13 –	(CEA or CUA or CBA or CMA or CCA or DALY or QALY).mp.
Combine	12 or 13
Results	8791

Combining Concepts 1 and 2 and (3 or 4): 46 results
*****Combining Concepts 1 and (3 or 4): 92 results**

GLOBAL HEALTH SEARCH STRATEGY:

Concept 1: **HIV**

Search Terms: 1 -	(HIV or hiv-1 or hiv-2 or hiv1 or hiv2 or human immunodeficiency virus or human immunedeficiency virus or human immuno-deficiency virus or human immune-deficiency virus).mp.
Search Terms: 2 –	(acquired immunodeficiency syndrome or acquired immunedeficiency syndrome or acquired immuno-deficiency syndrome or acquired immune-deficiency syndrome).mp.
Search Terms: 3 –	exp HIV/ or exp HIV infections/
Combine	1 or 2 or 3
Results	194747

Concept 2: **Testing**

Search Terms: 4 -	(Service* or Test* or Counsel* or Prevent*).mp.
Search Terms: 5 –	(HTC or HTS or VCT or mVCT or PICT or HBCT or HIVST or partner notification or index-linked or index linked).mp.
Search Terms: 6 –	((Facility or Community or Home or Self or Index) adj3 test*).mp.
Search Terms: 7–	exp human immunodeficiency viruses/
Combine	4 or 5 or 6 or 7
Results	1371593

Concept 3: **Modelling**

Search Terms: 8 –	((Dynamic or Static or Deterministic or Stochastic) adj3 model*).mp.
Search Terms: 9 –	((Decision tree or Markov or Microsimulation or transmission or monte carlo or system dynamics or agent based or discrete event) adj3 model*).mp.

Search Terms: 10 –	exp mathematical models/
Combine	8 or 9 or 10
Results	28807

Concept 4: **Economic Evaluation**

Search Terms : 11 – *(Additional MeSH Heading)*	Exp economic evaluation/
Search Terms : 12 –	exp 'cost benefit analysis'/
Search Terms : 13 –	((economic evaluation or cost effective* or cost-effective* or cost utility or cost-utility or cost benefit* or cost-benefit* or cost minimi* or cost-minimi* or cost consequence* or cost-consequence*) adj2 analysis).mp.
Search Terms : 14 –	(CEA or CUA or CBA or CMA or CCA or DALY or QALY).mp.
Combine	11 or 12 or 13 or 14
Results	18030

Combining Concepts 1 and 2 and (3 or 4): 2833 results

SCOPUS SEARCH STRATEGY:

Concept 1: **HIV**

Search Terms: 1 -	TITLE-ABS-KEY (HIV or hiv-1 or hiv-2 or hiv1 or hiv2 or "human immunodeficiency virus" or "human immunedeficiency virus" or "human immuno-deficiency virus" or "human immune-deficiency virus")
Search Terms: 2 –	TITLE-ABS-KEY ("acquired immunodeficiency syndrome" or "acquired immunedeficiency syndrome" or "acquired immuno-deficiency syndrome" or "acquired immune-deficiency syndrome")
Search Terms: 3 – *Invalid for Database*	exp HIV/ or exp HIV infections/
Combine	1 or 2
Results	120597

Concept 2: **Testing**

Search Terms: 4 -	TITLE-ABS-KEY (Service* or Test* or Counsel* or Prevent*)
Search Terms: 5 –	TITLE-ABS-KEY (HTC or HTS or VCT or mVCT or PICT or HBCT or HIVST or "partner notification" or "index-linked" or "index linked")
Search Terms: 6 –	TITLE-ABS-KEY ((Facility or Community or Home or Self or Index) w/3 test*)
Search Terms: 7– *Invalid for Database*	exp human immunodeficiency viruses/
Combine	4 or 5 or 6
Results	13923743

Concept 3: **Modelling**

Search Terms: 8 –	TITLE-ABS-KEY ((Dynamic or Static or Deterministic or Stochastic) w/3 model*)
Search Terms: 9 –	TITLE-ABS-KEY ((“Decision tree” or Markov or Microsimulation or transmission or “monte carlo” or “system dynamics” or “agent based” or “discrete event”) w/3 model*)
Search Terms: 10 – *Invalid for Database*	exp mathematical models/
Combine	8 or 9
Results	526437

Concept 4: **Economic Evaluation**

Search Terms : 11 – *Invalid for Database*	exp ‘cost benefit analysis’/
Search Terms : 12 –	TITLE-ABS-KEY ((“economic evaluation” or “cost effective*” or “cost-effective*” or “cost utility” or “cost-utility” or “cost benefit*” or “cost-benefit*” or “cost minimi*” or “cost-minimi*” or “cost consequence*” or “cost-consequence*”) w/2 analysis)
Search Terms : 13 –	TITLE-ABS-KEY (CEA or CUA or CBA or CMA or CCA or DALY or QALY)
Combine	12 or 13
Results	385799

Combining Concepts 1 and 2 and (3 or 4): 1441 results

FINAL TALLY: 10988 REFERENCES

(After duplicate removal: 7175)

Appendix II – Modelling Abstraction Data Tool: Assessing Reporting of Individual Model Quality

	Attributes	Description
MODEL STRUCTURE		
	C1. Are inputs and outputs relevant to the decision-making perspective of the economic evaluation? (I.e. broad outputs for decision-making concerning allocation of resources across a range of health interventions at the societal level.)	Is a perspective stated? Are the model inputs and outputs presented appropriate for selected perspective?
	C2. Structure of model consistent with both health condition being modeled and with available evidence regarding causal linkages between variables? (I.e. linkages supported by available evidence and consistent with widely accepted theories.)	Is a figure of the model structure provided? Is a discussion around structure and parameters presented and easy to follow/understand?
	C3. Are limitations of evidence supporting chosen model structure acknowledged?	Is there adequate mention, description or explanation of structure + accompanying data?
	C4. Is choice of time horizon and cycle length reported and justified? (I.e. Cycle length of model should be short enough that multiple changes in pathology, symptoms, treatment decisions or costs within a single cycle are unlikely. Longer cycle lengths will help evaluate the purported benefits of an HIV intervention)	Is time horizon and cycle length explicitly stated? Is rationale for their choice presented?
	C5. Is the structure of the model as simple as possible, while capturing underlying essentials of the disease process and interventions?	Is the model structure simple and easy to follow?
	C6. Is the structure appropriate for the question	Is the model comprehensive and include relevant parameters for the question?
DATA HANDLING		
Data identification	**C7.** Has a review of the literature on key model inputs been conducted?	Table of parameters and their input value and sources provided?
	C8. (Including Uncertainty) Do upper and lower bound ranges accompany base-case estimates of all input parameters for which sensitivity analyzes are performed?	Are parameter input ranges for sensitivity analysis explicitly presented?
Data modelling	**C9.** Do data modelling methods follow generally accepted methods of biostatics and epidemiology? (I.e. Was data handled properly: are the mathematical steps taken to transform empirical observations into a form that is useful for decision modelling appropriate?)	Is there an explanation given for how data was transformed? For how were outcome measures tabulated? Are there any accompanying equations to help understand the calculations?
	C10. Are data modelling assumptions disclosed?	Is there mention or discussion around assumptions? I.e. assuming one rate is a proxy for another etc.
Data Inclusion	**C11.** Is the process consistent? Are measurement units, time intervals, and population characteristics mutually consistent throughout the model?	Evaluated as a summary of reporting across C4, C5, C7 and C9.
MODEL VALIDATION		
Internal validation	**C12.** Explicitly state that a method to check the model has been employed: Has evidence of internal testing and debugging been provided? (Is the model behaving according to a real world scenario?)	Was the process of model calibration to data described? Was the data calibration source mentioned?
External validation	**C13.** Explicitly state that a formal process to conduct an external validation test was employed: Is the model based on the best evidence available at the time it was built?	Is there mention of generalizability? Have outputs been examined against trial data? Has face validity of the model been established through frequent use/citing in the literature?

Note: An updated version (2012) of this report exists, however the general tenets of best practices conveyed were more of generalized advice/ an overview and too vague to quantify, while the remaining recommendations were highly specific and differentiated by each type of modelling approach (i.e. state transition, DES, dynamic) [1].

II. ADDITIONAL RESULTS

Table S1. Characteristics of Economic Evaluations of HIV Testing Strategies Included in Systematic Review

Reference	Setting	Pop. Of Interest	Intervention Assessed	Software	Type of EE	(Author Classified) Modelling Approach	Perspective	Time Horizon/ Cycle Lengths	Discount Rate	Outcome Measures
CEA										
Kim et al., 2013 [2]	Uganda	Women presenting for prenatal care	Various HIV screening strategies during pregnancy	TreeAge Pro 2009	CEA	Decision Tree	Health Care System	Not reported; N/A	3%	ICER per Life Year Saved
Mulogo et al., 2013 [3]	Uganda	Adult Population: 18-59 yrs	Home-based voluntary counselling and testing	TreeAge Pro 2009	CEA	Decision Model (Unspecified)	Provider	Not reported; (assuming) N/A	3%	ICER per additional positive case identified
Rutstein et al., 2014 [4]	Malawi	Sex partners of HIV positive index cases	Provider-based partner notification strategies	Excel 2010	CEA	Decision Tree	Health System	1 year; N/A	Not specified	ICER per transmission averted
Bassett et al., 2014 [5]	South Africa	Not specified (Assuming, entire population: anyone who would access facility based testing)	Mobile HIV screening	C++	CEA	Monte Carlo Microsimulation	Societal	5 years; assuming monthly	3%	ICER per Year of Life Saved
Francke et al., 2016 [6]	South Africa	Infants: 6 weeks	Various HIV screening strategies for infants accessing early infant diagnosis (EID)	C++	CEA	Monte Carlo Microsimulation	Health Care System	Not reported	3%	ICER per Year of Life Saved
Gilbert et al., 2016 [7]	South Africa	General Population: 15 – 64yrs	Community based TB/HIV screening	Not specified	CEA	Deterministic Compartmental Dynamic Transmission Model	Health Provider	10 years; multiple cycle lengths	3%	ICER per life year saved
Nguyen et al., 2018 [8]	Kenya	Adult population: 15-59 years	Community-based voluntary HIV testing	Not specified	CEA	Time-Discrete Dynamic Microsimulation/ Agent-Based Model	Not reported	15 years; monthly	3%	ICER per Year of Life Saved
Johnson et al., 2019 [9]	South Africa	Adult population: age range unspecified	Various different HIV testing modalities previously introduced in setting: home-based testing; mobile testing; assisted partner notification; testing in schools and workplaces; female sex workers (FSW), men who have sex with men (MSM), family planning clinic attendees; partners of pregnant women	Not specified	CEA	Agent-Based Model	Provider	20 years; not reported	Undiscounted	Cost per Life Year Saved
McCann et al., 2020 [10]	Zimbabwe	Infants: 6 weeks	Various HIV screening strategies for infants accessing early infant diagnosis (EID)	C++	CEA	Monte Carlo Microsimulation	Not reported	Not reported; assuming monthly	3%	ICER per Year of Live Saved

Wall et al., 2020 [11]	South Africa; Zimbabwe; Kenya; Tanzania; Ivory Coast; Sierra Leone	Heterosexual adults in stable couples	Couples voluntary HIV counselling and testing	Excel	CEA	Deterministic Compartmental Dynamic Transmission Model	Donor	5 years; 1 year	3%	Cost per HIV infection averted
CUA										
Hove-Musekwa et al., 2014 [12]	Zimbabwe	General Population: 15-59 yrs	Home-based voluntary counselling and testing	MATLAB	CUA	Dynamic System/ Epidemic Transmission Model	Not reported	19 years; unspecified	5%	ICER for strategy implementation; Cost per QALY gained
Cambiano et al., 2015 [13]	Zimbabwe	General Population: 15-65 yrs	HIV self-testing	SAS 9.3	CUA	Individual Based-Stochastic Model	Health Provider	20 years; 3 months	3%	Cost-effectiveness threshold per DALY averted
Smith et al., 2015 [14]	South Africa	Adult population: 18+ yrs	Community-based HIV testing and counselling	MATLAB 2011b	CUA	Individual-Based Stochastic Model	Provider	10 years; 1 month	3%	ICER per HIV infection averted; ICER per DALY averted
Olney et al., 2016 [15]	Kenya	General population: 0 – 80+	HIV interventions along the care cascade including home-based counselling and testing as well as voluntary counselling and testing	Spectrum Software: Avenir Health (C++)	CUA	Individual-based microsimulation	Health Care Provider	20 years; time-to-event	6%	Cost per DALY averted
Sharma et al., 2016 [16]	Kenya	Pregnant women and their male partners (couples counselling)	Home-based HIV testing and education	MATLAB v 2015a	CUA	Deterministic Compartmental Dynamic Transmission Model	Payer	10 years; 3 months	3%	ICER for adding intervention to standard of care; Cost per DALY averted
Ying et al., 2016 [17]	South Africa	Generalized Population: 0-59 years	Home-based HIV testing and counseling	MATLAB	CUA	Deterministic Compartmental Dynamic Transmission Model	Programmatic	10 years; 3 months	3%	ICER per HIV infection averted; ICER per HIV associated death averted; ICER per QALY gained
Maheswaran et al., 2018 [18]	Malawi	Adult population: 16+ years	HIV self-testing	TreeAge Pro 2017	CUA	Individual-Level (Monte Carlo) Microsimulation	Health Provider	20 years; 1 month	3%	ICER per QALY gained
Olney et al., 2018 [19]	Kenya	Not stated: assumed to be the same as Olney et al,. 2016	Optimal timing of homebased HIV counselling and testing campaigns	Not stated: assumed to Spectrum Software – Avenir Health (see Olney et al., 2016)	CUA	Individual-Based Microsimulation	Health Care Provider	20 years; not explicitly stated – assuming time-to-event (see Olney, 2016)	6%	Cost per DALY averted
Sharma et al., 2018 [20]	Kenya	Facility based HTC (voluntary and provider-initiated) clients and their partners	Assisted partner notifications services	MATLAB v 2015a	CUA	Individual-Based Stochastic Model	Payer	13 years; 1 month	3%	ICER for adding intervention to standard of care; Cost per DALY averted
Cambiano et al., 2019 [21]	Zimbabwe; Malawi; Zambia	1.) Women having transactional sex (WTS); 2.) Young people (15-24 yrs); 3.) Adult men (25-49 yrs)	HIV self-testing	Not stated: assumed to be SAS 9.3 (see Cambiano et al., 2015)	CUA	Individual Based-Stochastic Model	Health Provider	50 years; 3 months	3%	ICER for intervention implementation options; Cost per DALY averted
Phillips et al., 2019 [22]	Malawi	Subset of the population: 15 – 64 yrs	Core testing + Additional testing	Not stated: assumed to be	CUA	Individual Based-Stochastic Model	Healthcare	50 years; 3 months	3%	Cost per Diagnosis; ICER per DALY averted

1.) Pregnant Women; 2.) Sex Workers; 3.) Men Seeking Circumcision	SAS 9.3 (see Cambiano et al., 2015)	

Table S2. HIV Progression Variables Among the Models Used in Economic Evaluations of HIV Testing Strategies						
Reference	**CD4$^+$ Count, copies/μL**	**Viral Load, copies/mL**	**WHO Staging**	**Hospitalization**	**HIV Related Mortality**	**Other**
Static Models – Aggregate [(Assumed) Decision Trees]						
Kim (2013)	*Not Included*	*Not Included*	*Not Included*	*Not Included*	*Not Included*	*Not Included*
Mulogo (2013)	*Model Structure and Parameters Unspecified*	*Model Structure and Parameters Unspecified*	*Model Structure and Parameters Unspecified*	*Model Structure and Parameters Unspecified*	*Model Structure and Parameters Unspecified*	*Model Structure and Parameters Unspecified*
Rutstein (2014)	*Not Included*	*Not Included*	*Not Included*	*Not Included*	*Not Included*	*Not Included*
Static Models – Individual [Microsimulation]						
Bassett (2014)	- >500 - 351-500 - 201-350 - 51-200 - ≤50	- ≤ 3,000 - 3,001-10,000 - 10,001-30,000 - 30,001-100,000 - > 100,000	WHO Stage 3 or 4	Hospitalization as: - Inpatient - Outpatient	Monthly risk	TB Event or OI
Francke (2016)	CD4% for children <5 yrs; absolute count thereafter	*Not Included*	WHO Stage 3 or 4	*Not Included*	Monthly risk	Monthly risk of OI
Olney (2016 & 2018)	- >500 - 350-500 - 200-350 - <200	*Not Included*	WHO Stage: 1; 2; 3; 4	*Not Included*	Yes	*None*
Maheswaran (2018)	- >500 - 351-500 - 201-350 - 51-200 - ≤50	*Not Included*	Yes	Hospitalization for 10 severe HIV-associated illnesses	Yes	*None*
McCann (2020)	CD4% for children <5; CD4 count subsequently modelled via CEPAC adult model for lifetime projection of HIV positive child	*Not Included*	New or recurring observed clinical WHO Stage 3 or 4	Hospitalization for 10 clinical events: - 2 events: <60 months of age - 8 events: ≥60 months of age	Monthly risk Within 30 days of clinical event	TB Event or OI
Dynamic Models – Aggregate [Compartmental]						
Hove-Musekva (2014)	*Not Included*	*Not Included*	*Not Included*	Hospitalization for AIDS related illnesses	Yes	*Not Included*
Gilbert (2016)	Stage of HIV Disease: - Early: CD4+ Count >350 - Late: CD4+ Count ≤ 350	*Not Included*	*Not Included*	*Not Included*	Yes	TB Co-Infection

Sharma (2016)	- HIV Negative - Acute Infection - >500 - 500-350 - 350-200 - <200	- HIV Negative - Acute Infection - <1000 - 1000-10,000 - 10,000-50,000 - > 50,000	*Not Included*	*Not Included*	HIV Related Mortality (on ART): - According to age and CD4 count o Acute o >350 o 200-350 o <200	*None*
Ying (2016)	- HIV Negative - Acute Infection - >500 - 500-350 - 350-200 - <200	- HIV Negative - Acute Infection - <1000 - 1000-10,000 - 10,000-50,000 - > 50,000	*Not Included*	Hospitalization With/Without ART	Yes	*None*
Wall (2020)	*Not Included*	*Not Included*	*Not Included*	*Not Included*	*Not Included*	*None*
Dynamic Models – Individual [Agent-Based]						
Cambiano (2015 & 2019); Phillips (2019)	Yes: categories unspecified	Yes: categories unspecified	WHO Stage 4	*Not Included*	Yes	*Not Included*
Smith (2015); Sharma (2018)	- >500 - 351-500 - 201-350 - ≤ 200	*Not Included*	*Not Included*	*Not Included*	HIV Related Mortality (on ART): - According to CD4 cell count and time since initiation o Acute o >350 o 200-350 o <200	*Not Included*
Nguyen (2018)	(Individual) Median CD4 cell count	*Not Included*	WHO Stage 3 or 4	Monthly Probability of *Hospitalization* (and *dying* during hospitalization) by CD4 count: - >500/μL - 351-500/μL - 201-350/μL - 101-200/μL - 51-100/μL - ≤50/μL	Mortality by CD4 count: - >500/μL - 351-500/μL - 201-350/μL - 101-200/μL - 51-100/μL - ≤50/μL	*Not Included*
Johnson (2019)	Individual level variation	Individual level variation	*Not Included*	*Not Included*	Yes	*Not Included*

Table S3. ART Variables Among the Models Used in Economic Evaluations of HIV Testing Strategies

Reference	Initiation/Enrollment/Linked	Retention	Suppression/Non-Suppressed	Loss to follow up/ Drop-Out	Other
Static Models – Aggregate [(Assumed) Decision Trees]					
Kim (2013)	*Not Included*	*Not Included*	*Not Included*	*Not Included*	*Not Included*
Mulogo (2013)	*Model Structure and Parameters Unspecified*	*Model Structure and Parameters Unspecified*	*Model Structure and Parameters Unspecified*	*Model Structure and Parameters Unspecified*	*Model Structure and Parameters Unspecified*
Rutstein (2014)	*Not Included in branch pathway, but assumption for CEA*	*Not Included in branch pathway, but assumption for CEA – see text*	*Not Included in branch pathway, but assumption for CEA – see text*	*Not Included in branch pathway, but assumption for CEA – see text*	*Not Included in branch pathway, but assumption for CEA – see text*
Static Models – Individual [Microsimulation]					
Bassett (2014)	ART Initiation: - according to WHO stage 3 and 4 disease presentation, TB or CD4 <350/μL	*Not Included*	Virologic Suppression Monthly CD4 count increase: - at initial 8 weeks - after 8 weeks	Monthly Risk of Loss to Follow Up: - Pre-ART - On ART	Monthly Probability of Return to Care: - With acute WHO stage 3-4 disease or TB - Without acute WHO stage 3-4 disease or TB
Francke (2016)	Linkage to care and ART initiation post diagnosis	*Not Included*	Viral Suppression at: - at 24 weeks - at 48 weeks	Monthly Loss to Follow-Up	ART Failure ART Efficacy
Olney (2016 & 2018)	ART Initiation	*Not Included*	Viral Suppression	Lost from ART Care	Non-Adherence
Maheswaran (2018)	ART Initiation: - according to modelled CD4 counts (and progression to WHO clinical stage 3 and 4 under 2010 WHO eligibility guidelines)	Retention In-ART: - 13-24 months - >24 months	*Not Included*	*Not Included*	*None*
McCann (2020)	ART Initiation	*Not Included*	Virologic Suppression Monthly Risk of Treatment Failure after suppression at 24 or 48 weeks	Monthly Risk of Loss to Follow Up	Monthly Probability of Return to Care
Dynamic Models – Aggregate [Compartmental]					
Hove-Musekva (2014)	*Not Included*	*Not Included*	*Not Included*	*Not Included*	*None*
Gilbert (2016)	ART Initiation	*Not Included*	*Not Included*	Loss to Follow Up	Default
Sharma (2016)	*Not Included*	*Not Included*	*Not Included*	Drop – Out Rate: 6%	*None*

Ying (2016)	Enrollment In	*Not Included*	*Not Included*	Drop – Out Rate: 6%	*None*
Wall (2020)	*Not Included*	On ART/Self-Reported ART Use	*Not Included*	*Not Included*	*None*
Dynamic Models – Individual [Agent-Based]					
Cambiano (2015 & 2019); **Phillips (2019)**	ART Initiation	*Not Included*	*Not Included*	Loss to Follow Up	ART Adherence: - 0% - <50% - 50% - <80% - ≥80 Interruption of ART : - due to poor adherence - due to interruption of drug supply Re-Initiation of ART after Interruption Resistance (due to interruption): - Development of Mutation Development of Specific Drug Toxicities
Smith (2015); Sharma (2018)	ART Initiation: - At rate ε o CD4 >500/μL o 351-500/μL o 201-350/μL o ≤ 200/μL	*Not Included*	*Not Included*	ART Drop Out: - At rate ψ o First Year (0.0083) o Later Years (0.0042)	*None*
Nguyen (2018)	Linked	Retained	Suppressed on ART Non suppressed	*Not Included*	*None*
Johnson (2019)	ART initiation varied according to testing modality	*Not Included*	*Not Included*	*Not Included*	*None*

III. PRISMA CHECKLIST

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Pg. 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Pg. 2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Pg. 3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Pg. 3
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Pg. 4
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Pg. 4; Supplemental
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplemental
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Pg. 5
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Pg. 4, 5
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Pg. 5
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Pg. 5
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Pg. 6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	N/A
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	N/A
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	N/A
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Pg. 5, 6
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Pg. 5, 6
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A

	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N/A
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Pg. 7
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Pg. 7
Study characteristic	17	Cite each included study and present its characteristics.	Pg. 7-9; Supplemental
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	N/A
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	N/A
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Pg. 9-18; Supplemental
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Pg. 19-21
	23b	Discuss any limitations of the evidence included in the review.	Pg. 21
	23c	Discuss any limitations of the review processes used.	Pg. 21
	23d	Discuss implications of the results for practice, policy, and future research.	Pg. 22
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Pg. 2
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Pg. 4
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Pg. 24

Competing interests	26	Declare any competing interests of review authors.	Pg. 24
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Supplemental

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit:
http://www.prisma-statement.org/

IV. SUPP FILE 1 REFERENCES

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– SUPPLEMENTARY FILE 2 –

Chapter 4 – Results Paper 2: A Narrative Review of Child and Adolescent Integration Within Well – Described, Frequently Used and Cited Dynamic Mathematical Models of HIV in the SSA Context

I. Technical Specifications

- Appendix I – Search Strategy

I. TECHNICAL SPECIFICATIONS

Appendix I – Medline Search Strategy

- Medline search strategy employed for literature review for the background section of **chapter 4 (Results P2)**
- Medline Searched: Sept 24, 2021

Concept 1: **HIV**

Search Terms: 1 -	**(HIV or hiv-1 or hiv-2 or hiv1 or hiv2 or human immunodeficiency virus or human immunedeficiency virus or human immuno-deficiency virus or human immune-deficiency virus).ti,ab,kf.**
Search Terms: 2 –	(acquired immunodeficiency syndrome or acquired immunedeficiency syndrome or acquired immuno-deficiency syndrome or acquired immune-deficiency syndrome).ti,ab,kf.
Search Terms: 3 –	exp HIV/
Combine	1 or 2 or 3
Results	366283

Concept 2: **Testing**

Search Terms: 4 -	**(Service* or Test* or Counsel* or Prevent*).ti,ab,kf.**
Search Terms: 5 –	(HTC or HTS or VCT or mVCT or PICT or HBCT or HIVST or partner notification or index-linked or index linked).ti,ab,kf.
Search Terms: 6 –	((Facility or Community or Home or Self or Index) adj3 test*).ti,ab,kf.
Search Terms: 7–	exp AIDS Serodiagnosis/
Combine	4 or 5 or 6 or 7
Results	5352026

Concept 3: **Modelling**

Search Terms: 8 –	**((Dynamic or Static or Deterministic or Stochastic or Individual or Agent) adj3 model*).ti,ab,kf.**
Search Terms: 9 –	Math* Model*.ti,ab,kf.
Combine	8 or 9
Results	100058

Concept 4: **Geographical Setting - SSA**

Search Terms : 10 –	**(Angola or Benin or Botswana or Burkina Faso or Burundi or Cameroon or Canary Islands or Cape Verde or Central African Republic or Chad or Comoros or Congo or "Democratic Republic of Congo" or Djibouti or Equatorial Guinea or Eritrea or Ethiopia or Gabon or Gambia or Ghana or Guinea or Guinea Bissau or Ivory Coast or "Cote d'Ivoire" or Jamahiriya or Jamahiryia or Kenya or Lesotho or Libia or Madagascar or Malawi or Mali or Mauritania or**

	Mauritius or Mayote or Mozambique or Mocambique or Namibia or Niger or Nigeria or Principe or Reunion or Rwanda or Sao Tome or Senegal or Seychelles or Sierra Leone or Somalia or South Africa or St Helena or Sudan or Swaziland or Tanzania or Togo or Uganda or Western Sahara or Zaire or Zambia or Zimbabwe or Central Africa or Central African or West Africa or West African or Western Africa or Western African or East Africa or East African or Eastern Africa or Eastern African or South African or Southern Africa or Southern African or sub-Saharan Africa* or subSaharan Africa* or "Africa south of the sahara").ti,ab,kf.
Search Terms : 11 –	exp "africa south of the sahara"/
Combine	10 or 11
Results	444329

Combining Concepts 1 and 2 and 3 and 4: 564 results

– SUPPLEMENTARY FILE 3 –

A Costing Analysis of B-GAP: Index-linked HIV Testing for Children and Adolescents in Zimbabwe

Arthi Vasantharoopan, Hendramoorthy Maheswaran, Victoria Simms, Chido Dziva Chikwari, Tariro Chigwenah, Rudo Chikodzore, Khulamuzi Nyathi, Gertrude Ncube, Rashida A Ferrand, Lorna Guinness

I. Technical Specifications

- Appendix I – Summary of Time Tracking Diaries for ILHIVT Activities: Compiled via Direct Observation and Self-Evaluation
- Appendix II – Table A1: Detailed Description of Cost Resource Collection: Methods
- Appendix III – Table A2: Detailed Description of Cost Resource Collection: Interviews
- Appendix IV – Ingredients to Costing B-GAP Service Delivery

II. Additional Results

- Supplementary Figure 1 – Sensitivity Analysis: Tornado Plots Illustrating Parameter Impact on Cost per Diagnosis

I. TECHNICAL SPECIFICATIONS

Appendix I – Summary of Time Tracking Diaries for ILHIVT Activities: Compiled via Direct Observation and Self-Evaluation

Time tracking diaries completed by the costing team through direct observation, as well as time tracking diaries completed by research assistants through self-evaluation had the same format: an activity code, a description of the activities and a table which divided the workday into half hour increments. The following illustrates an abbreviated version of how human resource use was delineated and recorded.

Instructions: Using the activity codes below, please record the appropriate activity for each half hour interval of your work day, over the course of one consecutive week. If activities conducted do not fall into one of the pre-listed activities below, please specify the activity in the blank codes (code 13-15), and enter into the table.

Activity Code	Description of Activity
01	***Organization/Administrative Activities*** (Ex. Preparing CRFs for use the next day, photo copying, filing, filling out petty cash ledger etc.)
02	***Screening Index Cases***, Including morning health talk and evaluating self-testing competency
03	***Testing Children/Adolescents*** of Index Cases
04	***Filling out CRFs*** (All CRFs: Enrolment, Outcome, Locator, etc.)
05	***Follow-Up***, including phone calls made for testing reminders, initiating testing & following-up of results with community partners, linking to treatment, enrolling in CHW intervention, etc.
06	***Outcome Assess*ment**, including exit interview, sample collection, sending sample out for processing
07	***Meetings*** (Ex. With study coordinator; at clinic; with community partners; with stakeholders)
08	Assisting clinic staff with ***non-B-Gap related*** tasks (Ex. Testing O/I patients)
09	***Breaks*** and ***Down-Time*** (Ex. During a slow day, waiting for patients etc.)
10	***Community Testing*** (Home Visits)
11	***Travelling*** to households for community testing
12	***Collection*** of ***Assisted Self-Test*** kits
13	

Time of Day	Monday	Tuesday	Wednesday	Thursday	Friday
08:00 – 08:30					
08:30 – 09:00					
Etc.					

A total of 56 direct observation hours and 535 self-evaluation hours were recorded via the time tracking diaries. Daily activity breakdown is classified into three categories and presented below: Clinic Hours; Community Hours; Administration

Allocation of Human Resource Use Involved in ILHIVT Activities: Percent of Time Spent			
Clinic	**Clinic Hours**	**Community Hours**	**Administration**
A – Bulawayo (Urban)	20.3%	20.6%	59.1%
B – Bulawayo (Urban)	22.1%	11.3%	66.7%
C – Mangwe (Rural)	7.3%	22.8%	70.0%

Appendix II – Table A1: Detailed Description of Cost Resource Collection: Methods

Cost Category	Primary Method of Data Collection	Details
		Recurrent Costs
Personnel	**HTS:** Interviewing the Nurse-In-Charge **Index-Linked-Testing:** Interviews with the study coordinator and research assistants, in addition to direct observation	**HTS:** - When all clinic staff was recorded, clinic staff time was measured through direct observation, with a particular focus on the HTS. - A PCC at each clinic was observed for a full work day, by two separate individuals, and was also interviewed. **Index-Linked-Testing:** - Study personnel demarcate their time solely to index-linked testing activities. As a result time-tracking diaries were completed by study personnel to detail time spent on specific activities over the course of the study, and directly observed while in clinic also. - 6 research assistants completed diaries spanning two weeks each. - Direct observation was completed by 2 separate individuals, observing each of the 6 assistants for one day each.
Consumables	**HTS:** Interviewing the primary care counsellors **Index-Linked-Testing:** Interviewing study research assistants	**HTS:** First, PCCs were asked to specify every consumable which was required for an HTS client. Then each item was catalogued by natural unit – ex. 500g bag of absorbent cotton, 1 roll per bag. Following this, each consumable was quantified per consumption length – ex. one pack of cotton lasts on average, 3.5 weeks. Use was then calculated monthly (ex. 1.14 pack/month), and monthly use was then extrapolated to cover a one-year time period. **Index-Linked-Testing:** Method, same as above.
Training	**HTS:** Interviewing the Nurse-in-Charge/District Medical Officer	Frequency of training and refresher training sessions was noted.

	Index-Linked-Testing: Abstracting study accounting files and interview with study coordinator.	
Transportation/ Duties	**Index-Linked-Testing** (only)**:** Abstracting study accounting files	Frequency and amount of duties related to index-linked testing consumables was noted.
Overheads	**HTS:** Interviewing nurse-in-charge **Index-Linked-Testing:** Abstracting study accounting files	**HTS:** Overheads were collected and then apportioned according to HTS usage, compared to the size of the other clinic departments. **Index-Linked-Testing:** Abstracting study accounting files.
Lab-Processing	**Index-Linked-Testing** (only)**:** Abstracting study accounting files	Frequency and amount of processing fees related to viral load suppression assessment was noted.
Capital Costs		
Building/ Facility Space	**HTS:** Direct observation and physically pacing/spacing the clinic.	The area of the clinic and HTS were manually measured.
Furniture and Equipment	**HTS:** Direct observation and recording **Index-Linked-Testing:** Direct observation, recording and abstracting study accounting files	Furniture and equipment directly involved in service provision were physically counted and recorded.
Intervention Start – Up	**Index-Linked-Testing** (only)**:** Abstracting study accounting files	Frequency and financial resources invested in initial RA training, as well as RA rapid diagnostic and OMT testing training, was noted.

Appendix III – Table A2: Detailed Description of Cost Resource Collection: Interviews

Interviewee	Purpose
	HTS
1 Nurse in Charge at each of the 3 clinics (supplemented by at least one other RGN at each clinic)	To obtain: - Rundown of all clinic personnel and their roles - All inputs included in clinic overheads
1 Primary Care Counsellor at each of the three clinics	To obtain: - Activity breakdown of HTS - Resource data collection involved in HTS
Assistant Director of Bulawayo City Council (BCC) and BCC finance department	To obtain: - Bulawayo clinic personnel salary schedule - Costs per training/refresher training workshops related to HTS - All overhead costs
Provincial Medical Director and MAT South finance department	To obtain Mangwe clinic personnel salary schedule
District Medical Director (Mangwe)	To obtain: - Salary for district's HIV focal person - Costs per training/refresher training workshops related to HTS
District Environmental Health Officer (Mangwe)	To obtain Mangwe clinic overhead costs
MAT South Pharmacist	To obtain HTS consumable costs
	Index-Linked Testing
Research Coordinator	To understand overall flow of study, obtain outcome data, query clarifications
6 Research Assistants; 2 at each of the three clinics	To discern daily activity breakdown and recurrent resources consumed over the course of study activities
BRTI Study Accountant	To obtain all study related costs: - RA salary schedule - Study consumable costs - Recurrent costs: Overheads and Training
BRTI Administrator	To obtain equipment costs

Appendix IV – Ingredients to Costing B-GAP Service Delivery

Intervention Unit Cost: Index-Linked Testing and Treatment		
Direct Service Cost: Cost per HIV positive child identified through index-linked testing and placed on treatment		
Description of Activity	**Measurement of Input**	**Method to Allocate Input**
Activity Cost: Cost per adult identified with child/adolescent in their household		
Start of Study Training	1. [Q(RAs)* P(Per person/per day, which includes catered meals and venue)]* Q(Training Days: 4) 2. Q(RAs) * P(Stationary costs, per person) 3. [Q(RAs)* P(Accommodations)]* Q(Nights Spent: 3) 4. [Q (RAs) *P(Travel Allowance)]* Q[Travel Allowance: to and from daily (8)/ to and from and stayed overnight (2)] 5. [Q (Time RAs spent at training in hours; RAs were already on contract/salaried at the time training started)* P(RA salary for those who <u>can</u> RDT test)]* Q(Training Days: 4) 6. [Q (Time RAs spent at training in hours; RAs were already on contract/salaried at the time training started)* P(RA salary for those who <u>cannot</u> RDT test)]* Q(Training Days: 4)	**Bottom-Up** • Expenditure Receipts for Venue Rental • Expenditure Receipts for Stationary Purchased • Expenditure Receipts for Accommodation Vouchers • Expenditure Receipts for Travel Allowances • RA Contract/Payment Receipt • Training Agenda/Time Table
Self-Testing Training	1. [Q(RAs)* P(Per person/per day, which includes catered meals and venue)]* Q(Training Days: 2) 2. Q(RAs)* P(Stationary costs, per person) 3. [Q(RAs)* P(Accommodations)]* Q(Nights Spent: 1) 4. [Q (RAs)* P(Travel Allowance)]* Q[Travel Allowance: to and from daily (4)/ to and from and stayed overnight (2)] 5. [Q (Time RAs spent at training in hours; RAs were already on contract/salaried at the time training started)* P(RA salary for those who can RDT test]* Q(Training Days: 2) 6. [Q (Time RAs spent at training in hours; RAs were already on contract/salaried at the time training started)* P(RA salary for those who cannot RDT test]* Q(Training Days: 2)	**Bottom-Up** • Expenditure Receipts for Venue Rental • Expenditure Receipts for Stationary • Expenditure Receipts for Accommodations • Expenditure Receipts for Travel Allowance • RA Contract/Payment Receipt • Training Agenda/Schedule, to verify time spent in training
Tech for Study Data Collection	1. Q(Tablets:6)* P(Tablet)	**Bottom-Up**

	2. Q (Time Data Team Spent Programming CRFs into tablets)* P(Payment for services) 3. Q (Time Data Team Spent Testing CRFs in tablets)* P(Payment for services)	• Receipts for Tablets Purchased • Interview with Data team at BRTI regarding time spent on item 2 and 3 • Payment scheme at BRTI's data office
Initial interaction with Index-Case	1. [Q(Time in minutes, spent with Index Case where RA completes CRFs-BG01/BG-Log01/BG-Locator, detailing information about household and any eligible child/adolescent in their household, signs consent forms for study and sets up 1 of 3 testing options for child/adolescent of index-case)* P(RA salary for those who <u>can</u> RDT test]* Q (Adults who visit each clinic/Screened) 2. [Q(Time in minutes, spent with Index Case where RA completes CRFs-BG01/BG-Log01/BG-Locator, detailing information about household and any eligible child/adolescent in their household, signs consent forms for study and sets up 1 of 3 testing options for child/adolescent of index-case)* P(RA salary for those who <u>cannot</u> RDT test]* Q (Adults who visit each clinic/Screened)	**Bottom-Up** • RA Time Tracking Diary • RA Contract/Payment Receipt • BG01 – B-Gap Screening and Enrollment Questionnaire (or BG-Log01 – Enrollment Log), to verify the numbers screened
Capital and Recurrent Costs Associated with Clinic-Based Screening of Index Cases	Capital Costs: 1. P(Clinic Building)/(% Space used by B-Gap program) 2. P(Office Equipment)/(% of equipment used by B-Gap program) 3. P(Furniture)/(% of furniture used by B-Gap program) Recurrent Costs: 1. P(Maintenance per year)/ (% Clinic Space used by B-Gap program) 2. P(Utilities per year)/ (% Clinic Space used by B-Gap program)	**Top-Down** • Rental Costs for equivalent square footage in the area • Local Retailers for the equivalent cost of office equipment and furniture • Clinic itself, or local District Health Office or to obtain the annual maintenance and utilities fees
Activity Cost: Cost per child/adolescent tested and detected		
Option 1 for Testing: Back to Clinic	Bulawayo Site: 1. [Q(Time in minutes, where RA spends interacting with clinic staff to move the child/adolescent through the clinic, including payment of user fee)* P(RA salary for those who <u>can</u> RDT test)]* Q(Child/Adolescent brought back to clinic for testing)	**Bottom-Up** • RA Time Tracking Diary • Expenditure Receipts for User Fees

	2. [Q(Time in minutes, where RA spends interacting with clinic staff to move the child/adolescent through the clinic, including payment of user fee)* P(RA salary for those who cannot RDT test)]* Q(Child/Adolescent brought back to clinic for testing) 3. Q(Child brought back to clinic for testing)* P(User Fee: $3USD) 4. Q(Adolescent brought back to clinic for testing)* P(User Fee: $5USD) 5. [Q(Time in minutes, spent with potential study participant, where RA completes CFR-BG02, gathering necessary information AND conducting rapid diagnostic test)* P(RA salary for those who can RDT test, only)]* Q(Child/Adolescent brought back to clinic for testing) 6. Q [Test Kit 'Adjacent' Supplies (have occasionally run out): Gloves, Test Kits, Buffer]* P(Test Kit Adjacent Supplies) Mangwe Site: 1. [Q(Time in minutes, where RA spends interacting with and facilitating/referring to PSI testing outside clinic)* P(RA salary for those who can RDT test)]* Q(Child/Adolescent brought back to clinic for testing) 2. [Q(Time in minutes, where RA spends interacting with and facilitating/referring to PSI testing outside clinic)* P(RA salary for those who cannot RDT test)]* Q(Child/Adolescent brought back to clinic for testing) 3. Q(Child/Adolescent brought back to clinic for testing)* P(Test Kit; PSI Cost) 4. [Q(Time in minutes where RA follows up with PSI regarding test results)* P(RA salary for those who can RDT test)]* Q(HIV Tests administered by PSI) 5. [Q(Time in minutes where RA follows up with PSI regarding test results)* P(RA salary for those who cannot RDT test)]* Q(HIV Tests administered by PSI)	• RA Contract/Payment Receipt • BG02 – B-Gap Testing Outcome Form, field A09, (or, BG-Log01 – Enrollment Log), to verify the numbers of children and adolescents tested in clinic. • Expenditure Receipts for Gloves Purchased • Expenditure Receipts for Test Kits Purchased • Expenditure Receipts for Buffer Purchased • Expenditure Receipts for Travel Vouchers • Accounting registry at PSI: test kits • RA Time Tracking Diary
Capital and Recurrent Costs Associated with Clinic-Based Testing of Child/Adolescent		

Option 2 for Testing: Community Based	1. [Q(Time in minutes, where RA spends liaising with partner community organization – MAC or PSI – to organize and facilitate testing)* P(RA salary for those who can RDT test)]* Q(Child/Adolescent opting for community-based testing) 2. [Q(Time in minutes, where RA spends liaising with partner community organization – MAC or PSI – to organize and facilitate testing)* P(RA salary for those who cannot RDT test)]* Q(Child/Adolescent opting for community-based testing) 3. Q(Child/Adolescent opting for community-based testing)* P(Test Kit: Community organization absorbs cost) 4. [Q(Time in minutes, where RA follows up with the community organization regarding test results)* P(RA salary for those who can RDT test)]* Q(Child/Adolescent opting for community-based testing) 5. [Q(Time in minutes, where RA follows up with the community organization regarding test results)* P(RA salary for those who cannot RDT test)]* Q(Child/Adolescent opting for community-based testing)	**Bottom-Up** • RA Time Tracking Diary • RA Contract/Payment Receipt • Accounting registry at MAC and PSI: test kits • BG02 – B-Gap Testing Outcome Form, field A09, (or BG-Log01 – Enrollment Log), to verify the numbers of children and adolescents tested in clinic.
Option 3 for Testing: Self-Testing	1. Q(Child/Adolescent choosing to self-test)* P(Self-Test Kits: 500 donated so far from PSI) 2. [Q(Time in minutes, where RA liaises with family when they come back to clinic and records results of test)* P(RA salary for those who can RDT test)]* Q(Child/Adolescent opting for HIVST, coming back to clinic) 3. [Q(Time in minutes, where RA liaises with family when they come back to clinic and records results of test)* P(RA salary for those who cannot RDT test)]* Q(Child/Adolescent opting for HIVST, coming back to clinic) **Or** 1. Q(Child/Adolescent choosing to self-test)* P(Self-Test Kits: 500 donated so far from PSI) 2. [Q(Time in minutes, where RA follows up personally at the household and collects kits/records results of test)* P(RA salary for those who can RDT test)]* Q(Child/Adolescent opting for HIVST, not returning to clinic with results) 3. [Q(Time in minutes, where RA follows up personally at the household and collects kits/records results of test)* P(RA salary for those who cannot RDT	**Bottom-Up** • RA Time Tracking Diary • RA Contract/Payment Receipt • BG02 – B-Gap Testing Outcome Form, field A09, (or BG02 – B-Gap Self Testing Assessment Form, or BG-Log01 – Enrollment Log), to verify the numbers of children tested via HIVST • Expenditure Receipts for Travel Allowances

	test)]* Q(Child/Adolescent opting for HIVST, not returning to clinic with results) 4. Q(Child/Adolescent opting for HIVST, not returning to clinic with results)* P(Travel Allowance)	
Activity Cost: Cost per HIV positive child/adolescent linked to care and initiated on treatment		
Linkage to Care and Treatment	1. [Q(Time in minutes, where RA links and enrolls child/adolescent into care locally)* P(RA salary for those who <u>can</u> RDT test)]* Q(Child/Adolescent identified as HIV-positive) 2. [Q(Time in minutes, where RA links and enrolls child/adolescent into care locally)* P(RA salary for those who <u>cannot</u> RDT test)]* Q(Child/Adolescent identified as HIV-positive)	**Bottom-Up** • RA Time Tracking Diary • RA Contract/Payment Receipt • BG02 – B-Gap Testing Outcome Form, field A08, (or BG-Log01 – Enrollment Log), to verify the numbers of children/adolescents tested positive
Intervention Unit Cost: Community Health Worker Intervention		
Direct Service Cost: Cost per HIV positive child/adolescent receiving CHW Support Intervention		
Description of Activity	**Measurement of Input**	**Method to Allocate Input**
Activity Cost: Associated Training and Set-Up Costs		
CHW Initial Training	1. [Q(CHW)* P(Per person/per day, which includes catered meals and venue)]* Q(Training Days: 3) 2. Q(CHW) * P(Stationary costs, per person) 3. [Q(CHW)* P(Daily Allowance/Stipend)]* Q(Training Days: 3) Mangwe Team 1. [Q(CHW)* P(Accommodations)]* Q(Nights Spent: 2) 2. [Q (CHW) *P(Travel Allowance)]* Q[Travel Allowance: to and from and stayed overnight (2)] Bulawayo Team: 1. [Q (CHW) *P(Travel Allowance)]* Q[Travel Allowance: to and from daily (6)]	**Bottom-Up** • Expenditure Receipts for Venue Rental • Expenditure Receipts for Stationary Purchased • Expenditure Receipts for Accommodation Vouchers • Expenditure Receipts for Travel Allowances

		• CHW Contract/ Payment Receipt • Training Agenda/Time Table
CHW On-Going Monthly Support	1. [Q(CHW)* P(Per person/per day, which includes catered afternoon tea and venue)]* Q(Training Days: Monthly) 2. [Q(CHW) * P(Stationary costs, per person)]* Q(Training Days: Monthly) 3. [Q(CHW)* P(Daily Allowance/Stipend)]* Q(Training Days: Monthly) 4. [Q (CHW) *P(Travel Allowance)]* Q[Travel Allowance: to and from and stayed overnight (2)* Q(Training Days: Monthly)]	**Bottom-Up** • Expenditure Receipts for Venue Rental • Expenditure Receipts for Stationary Purchased • Expenditure Receipts for Travel Allowances • CHW Contract/ Payment Receipt • Support Meeting Agenda/Time Table
CHW 1-Day Refresher Training (Half-way through support intervention)	1. [Q(CHW)* P(Per person/per day, which includes catered meals and venue)]* Q(Training Days: 1) 2. Q(CHW) * P(Stationary costs, per person) 3. [Q(CHW)* P(Daily Allowance/Stipend)]* Q(Training Days: 1) Mangwe Team 1. [Q(CHW)* P(Accommodations)]* Q(Nights Spent: 1) 2. [Q (CHW) *P(Travel Allowance)]* Q[Travel Allowance: to and from and stayed overnight (2)] Bulawayo Team: 1. [Q (CHW) *P(Travel Allowance)]* Q[Travel Allowance: to and from daily (2)]	**Bottom-Up** • Expenditure Receipts for Venue Rental • Expenditure Receipts for Stationary Purchased • Expenditure Receipts for Accommodation Vouchers • Expenditure Receipts for Travel Allowances • CHW Contract/ Payment Receipt • Training Agenda/Time Table
Liaise with community partner organization to	1. [Q(Time in minutes, where RA spends linking/initiating hand over of records/logs to CHWs for the support intervention)* P(RA salary for those who can RDT test)]* Q(Child/Adolescent enrolled in study)	**Bottom-Up** • RA Time Tracking Diary

initiate the support intervention	2. [Q(Time in minutes, where RA spends linking/initiating hand over of records/logs to CHWs for the support intervention)* P(RA salary for those who cannot RDT test)]* Q(Child/Adolescent enrolled in study)	• RA Contract/Payment Receipt • BG-Log01 – Enrollment Log, (or database where case-report forms populate), to verify the numbers of children/adolescents enrolled in study.
Activity Cost: Cost per support session, per HIV positive child/adolescent		
Core Support Session 1 (Delivered Immediately, within 1st month of diagnosis):	1. [Q(Support Intervention Manual)* P(Manual)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention 2. [Q(Hero Book)* P(Manual)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention 3. [Q(Time in minutes, CHW spends at session)* P(CHW Stipend)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention) 4. [Q(Visit-regardless of outcome of visit)* P(Travel Allowance)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention)	**Bottom-Up** • Expenditure Receipts for supplies and services involved in manual production X 2 • Expenditure Receipts for Travel Allowances • CHW Contract/ Payment Receipt • B-Gap Field Manual & Case Record for Home-Based Visits by CHW: Section 5, Visit 1 Time Log • BG-Log01 – Enrollment Log, to verify the numbers of children/adolescents enrolled in study.
Core Support Session 2 (Delivered within 2 weeks of first session)	1. [Q(Time in minutes, CHW spends at session)* P(CHW Stipend)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention) 2. [Q(Visit-regardless of outcome of visit)* P(Travel Allowance)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention)	**Bottom-Up** • Expenditure Receipts for Travel Allowances • CHW Contract/ Payment Receipt • B-Gap Field Manual & Case Record for Home-

		Based Visits by CHW: Section 5, Visit 2 Time Log • BG-Log01 – Enrollment Log, to verify the numbers of children/adolescents enrolled in study.
Core Support Session 3 (month 3)	1. [Q(Time in minutes, CHW spends at session)* P(CHW Stipend)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention) 2. [Q(Visit-regardless of outcome of visit)* P(Travel Allowance)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention)	**Bottom-Up** • Expenditure Receipts for Travel Allowances • CHW Contract/ Payment Receipt • B-Gap Field Manual & Case Record for Home-Based Visits by CHW: Section 5, Visit 3 Time Log • BG-Log01 – Enrollment Log, to verify the numbers of children/adolescents enrolled in study.
Core Support Session 4 (month 6):	1. [Q(Time in minutes, CHW spends at session)* P(CHW Stipend)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention) 2. [Q(Visit-regardless of outcome of visit)* P(Travel Allowance)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention)	**Bottom-Up** • Expenditure Receipts for Travel Allowances • CHW Contract/ Payment Receipt • B-Gap Field Manual & Case Record for Home-Based Visits by CHW: Section 5, Visit 4 Time Log • BG-Log01 – Enrollment Log, to verify the numbers of

		children/adolescents enrolled in study.
Core Support Session 5 (month 7):	1. [Q(Time in minutes, CHW spends at session)* P(CHW Stipend)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention) 2. [Q(Visit-regardless of outcome of visit)* P(Travel Allowance)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention)	• Expenditure Receipts for Travel Allowances • CHW Contract/ Payment Receipt • B-Gap Field Manual & Case Record for Home-Based Visits by CHW: Section 5, Visit 5 Time Log • BG-Log01 – Enrollment Log, to verify the numbers of children/adolescents enrolled in study.
Optional Follow-Up Session 1	1. [Q(Time in minutes, CHW spends at session)* P(CHW Stipend)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention) 2. [Q(Visit-regardless of outcome of visit)* P(Travel Allowance)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention)	**Bottom-Up** • Expenditure Receipts for Travel Allowances • CHW Contract/ Payment Receipt • B-Gap Field Manual & Case Record for Home-Based Visits by CHW: Section 5, Visit 6 Time Log • BG-Log01 – Enrollment Log, to verify the numbers of children/adolescents enrolled in study.
Optional Follow-Up Session 2	1. [Q(Time in minutes, CHW spends at session)* P(CHW Stipend)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention) 2. [Q(Visit-regardless of outcome of visit)* P(Travel Allowance)]* Q(Child/Adolescent Enrolled in Study/Participating in Support Intervention)	**Bottom-Up** • Expenditure Receipts for Travel Allowances • CHW Contract/ Payment Receipt

		• B-Gap Field Manual & Case Record for Home-Based Visits by CHW: Section 5, Visit 7 Time Log • BG-Log01 – Enrollment Log, to verify the numbers of children/adolescents enrolled in study.
Activity Cost: Cost of Quality Assurance Process		
Are visits marked as complete, actually completed?	1. [Q(Time, in minutes, RA spends following up with, and calling households to double check that completed CHW visits were actually complete)* P(RA salary for those who <u>can</u> RDT test)]* Q(QA Interviews completed) 2. [Q(Time, in minutes, RA spends following up with, and calling households to double check that completed CHW visits were actually complete)* P(RA salary for those who <u>cannot</u> RDT test)]* Q(QA Interviews completed)	**Bottom-Up** • RA Time Tracking Diary • RA Contract/Payment Receipt
Intervention Unit Cost: Outcome Assessment		
Direct Service Cost: Cost per viral load assessment for HIV positive child/adolescent enrolled in study		
Description of Activity	**Measurement of Input**	**Method to Allocate Input**
Activity Cost: Cost per final data collection, per HIV positive child/adolescent		
Data Collection and Study Exit Interview	1. [Q(Time, in minutes, RA spends with child/adolescent in their household conducting exit interview – CRF BG03: B-Gap Outcome Questionnaire – and collecting DBS sample for viral load assessment)* P(RA salary for those who <u>can</u> RDT test)]* Q(Exit interviews conducted) 2. [Q(Time, in minutes, RA spends with child/adolescent in their household conducting exit interview – CRF BG03: B-Gap Outcome Questionnaire – and collecting DBS sample for viral load assessment)* P(RA salary for those who <u>cannot</u> RDT test)]* Q(Exit interviews conducted) 3. Q(Exit interviews conducted)* P(Travel Allowance)	**Bottom-Up** • RA Time Tracking Diary • RA Contract/Payment Receipt • Expenditure Receipts for Travel Allowances • BG03 – B-Gap Screening and Enrollment Questionnaire, to verify

		number of exit interviews conducted
Activity Cost: Cost per sample processing, per HIV positive child/adolescent		
Viral Load assessment	1. Q (Dry Blood Spot Samples) * P(Sample processed at medical laboratory/facility)	**Bottom-Up** • Contract/Expenditure Payment Receipt for Sample Processing • BG04 – B-Gap Outcome Questionnaire, to verify number of viral load samples sent for testing
Intervention Unit Cost: Intergrative and Divisible Throughout All Direct Service Costs		
Description of Activity	**Measurement of Input**	**Method to Allocate Input**
Memorandum of Understanding	1. {Q[MoU (3: with MMPZ, MAC OPHID)] *P(Contract/ongoing agreement for space rental, person time, internet etc.)}* Q(Number of Years: 2)	**Top-Down** • MoU Contract/Payment Receipt

II. ADDITIONAL RESULTS

Supplementary Figure 1 – Sensitivity Analysis: Tornado Plots Illustrating Parameter Impact on Cost per Diagnosis

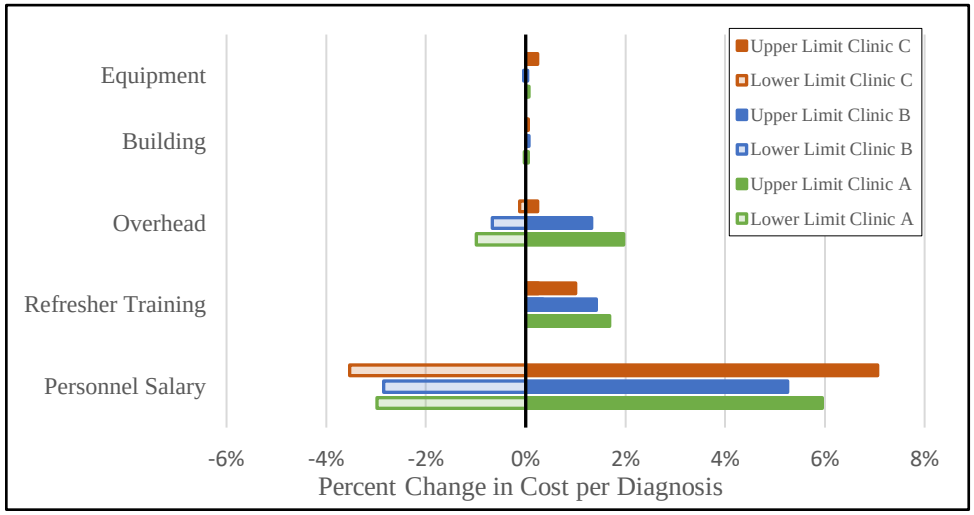

Figure S1a. Tornado plot of model parameters varied in univariate sensitivity analysis of Adolescent **SoC HTS** and impact on **Cost per Diagnosis.**
(Note: Conversion rate variable omitted)

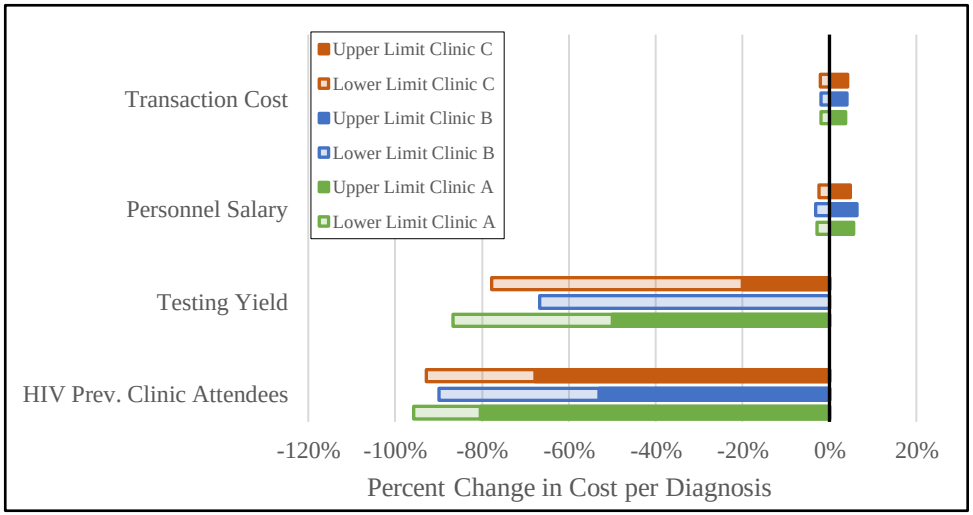

Figure S1b. Tornado plot of model parameters varied in univariate sensitivity analysis of Index-Linked Testing via **Clinic** modality and impact on **Cost per Diagnosis** (Note: Conversion rate variable omitted)

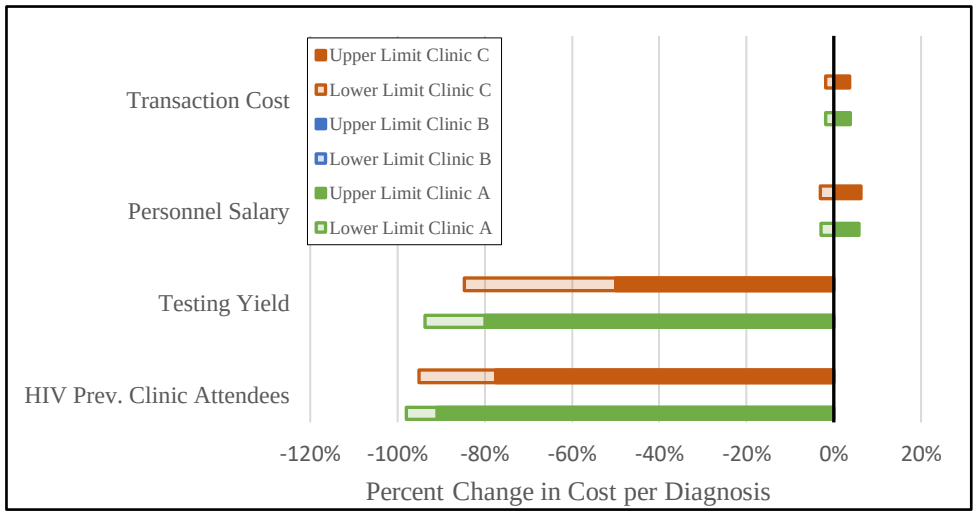

Figure S1c. Tornado plot of model parameters varied in univariate sensitivity analysis of Index-Linked Testing via **Home-Based** modality and impact on **Cost per Diagnosis** (Note: Conversion rate variable omitted)

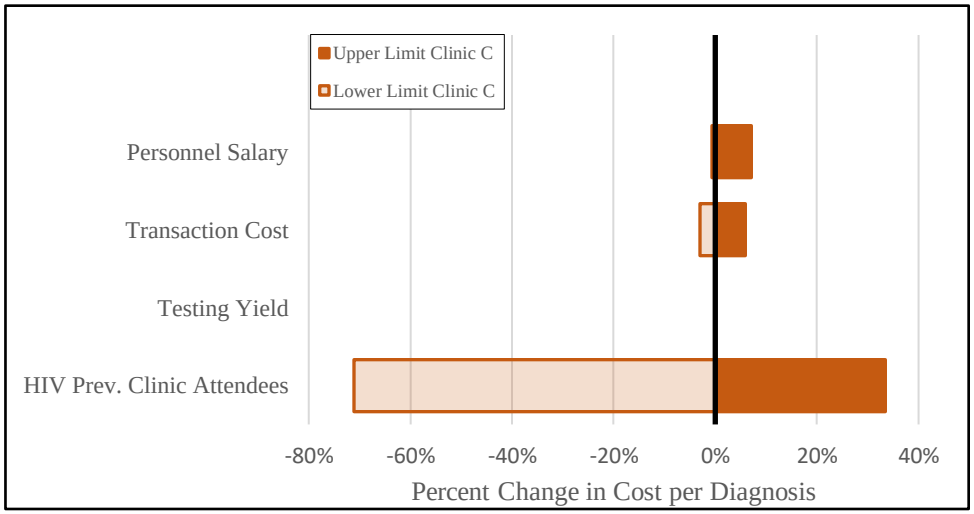

Figure S1d. Tornado plot of model parameters varied in univariate sensitivity analysis of Index-Linked Testing via **Caregiver** modality and impact on **Cost per Diagnosis** (Note: Conversion rate variable omitted)