AMBIT

Alternative Models of ART Delivery:
Optimizing the Benefits

Costs of Differentiated Service Delivery Models for HIV Treatment in Africa

HIV Costing Convening, Washington DC, January 6, 2020

BOSTON UNIVERSITY

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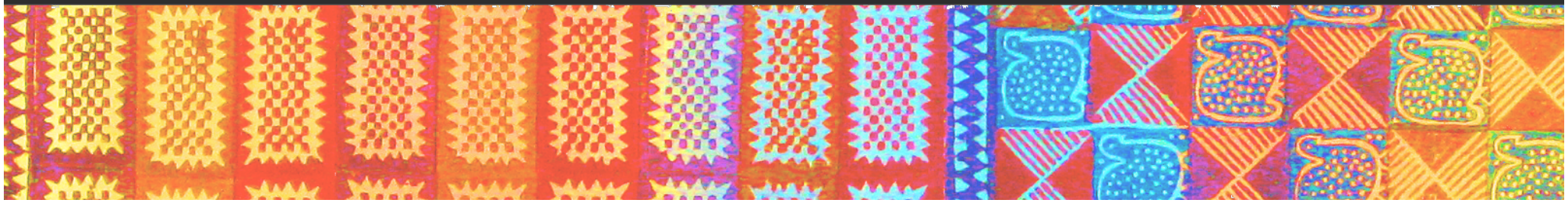

Outline

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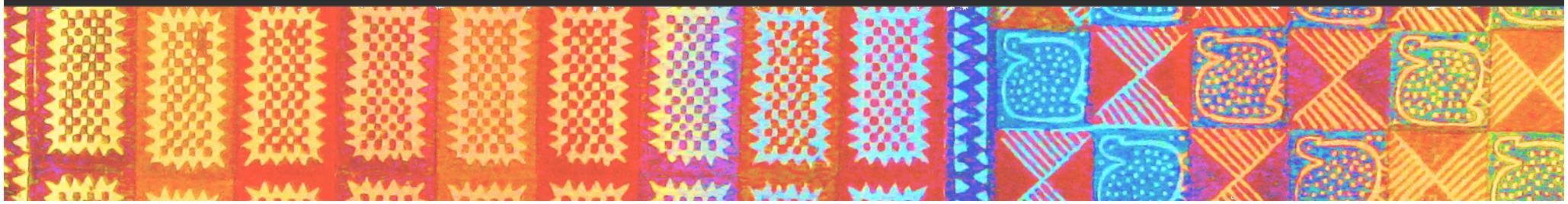
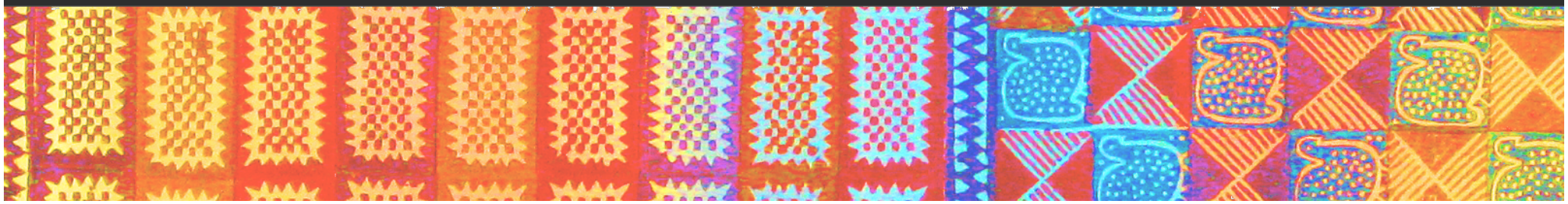
II. Methods
III. Results: Zambia and Uganda
IV. Quick look at patient costs
V. Conclusions and forthcoming work



Background: Costs of Differentiated Service Delivery Models for ART



Setting the stage

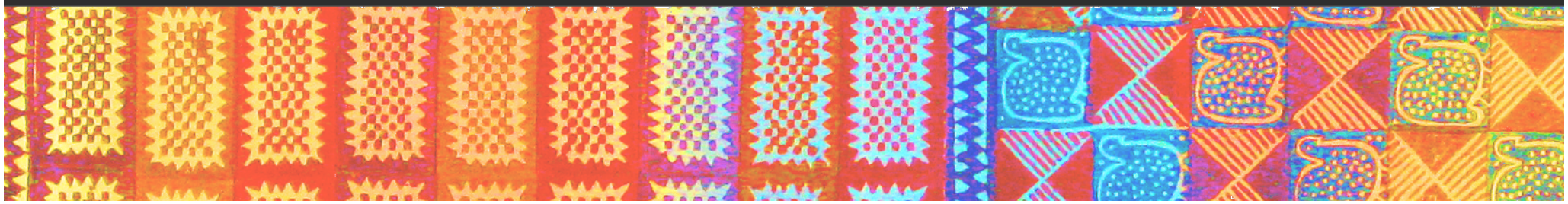
AMBIT conducted a systematic review of the published and unpublished literature on the outcomes and costs of DSD models for ART since 2016

Country	Model	Costs included				DSD (USD) cost/ patient	SOC (USD) cost/ patient	% cost ↓ due to DSD
		ARVs and labs	Clinic visits	DSD interactions	Program costs			
Empirical costing								
Kenya	Streamlined care model from the SEARCH study	✓		✓	✓	$286		
Uganda						$309		
Resource utilization quantification								
Nigeria	Multi-month scripting		Metric = patient visits/day					32%
DRC	Multiple models†		Metric = patients/provider			202	409	51%
Guidelines-based costing								
Malawi	Multimonth scripting	✓	✓	✓	✓	$121	$135	10%
	Fast track refills					$121		11%
	Community ART groups (CAGs)					$122		10%
Malawi	Teen clubs			✓	✓	$30		
South Africa	Youth care clubs			✓	✓	$48		
Tanzania	Community + facility model			✓	✓	$45	$108	58%
	Community model					$20		81%

Status of current evidence

- We found only one cost estimate based on primary, patient-level data (but no conventional care comparison); all others were modeled on the assumption of guideline-mandated resource utilization
- A few studies reported a reduction in patient burden per clinic or provider; no indication of whether this affected quantity or quality of care or overall cost
- No evidence about changes in utilization of resources “saved” by DSD models
- ***As of today, claims of cost savings to providers and greater efficiency of service delivery are speculative***

Methods

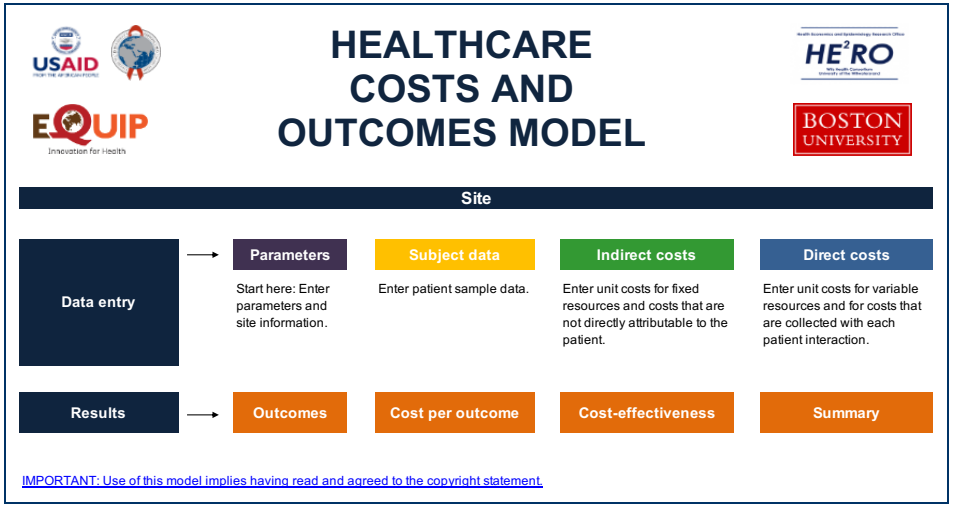


Approach and principles

- Used standard cost/outcome analysis for retrospective cohorts with primary (patient-level data); HE^{2}RO's HCOM model or variant thereof
- Goals of DSD model cost evaluation:
  - Comparative—cost/patient or cost/outcome in a DSD model is much more useful if it can be compared to another model serving the same population (which could be conventional care)
  - Empirical—based on observed outcomes and costs of an actual cohort of patients, not on modeled output or guidelines
  - Comprehensive—estimate average cost/patient for entire catchment population, not only for stable patients enrolled in DSD models

Healthcare Cost and Outcomes Model (HCOM)

- Excel-based tool for using patient-level data to estimate the costs of an intervention
- Inputs = aggregate clinic/model indicators, unit costs, and patient outcomes and resource utilization/patient from medical records
- Outputs = average cost/patient, average cost/outcome, comparisons of average costs for any sub-group of patients, allocations of costs by resource category, etc.



- Developed with USAID/South Africa and PEPFAR support
- Available at http://www.heroza.org/researchtools/the-healthcare-cost-and-outcomes-model-hcom/ with user guide, example, data collection instruments

Healthcare Cost and Outcomes Model (2)

Input parameters

Subject data headers						
Number	**Standard**	**Events**	**Labs**	**Drugs**	**Service**	**Other**
Blanks	0	0	0	0	0	0
1	studyid	Event1	Lab1	Drug1	Service1	Other1
2	start_date	Event2	Lab2	Drug2	Service2	Other2
3	end_date	Event3	Lab3	Drug3	Service3	Other3
4	baseline_cd4_date	Event4	Lab4	Drug4	Service4	Other4
5	baseline_cd4_value	Event5	Lab5	Drug5	Service5	Other5
6	Standard6	Event6	Lab6	Drug6	Service6	Other6
7	Standard7	Event7	Lab7	Drug7	Service7	Other7
8	Standard8	Event8	Lab8	Drug8	Service8	Other8
9	Standard9	Event9	Lab9	Drug9	Service9	Other9
10	mo_in_care	Event10	Lab10	Drug10	Service10	Other10
11	outcome_code	Event11	Lab11	Drug11		
12	finaloutcome	Event12	Lab12	Drug12		
13	Standard13	Event13	Lab13	Drug13		
14	Standard14	Event14	Lab14	Drug14		

Patient-level resource utilization

Subjects	**Standard**												**Events**	**Labs**	**Service**	**Other**
	studyid	start_date	end_date	baseline_cd4_date	baseline_cd4_value	Standard6	Standard7	Standard8	Standard9	mo_in_care	outcome_code	finaloutcome				
Total							0	0								
1																
2																
3																
4																
5																
6																
7																

Outcomes

- Enroll one or more cohorts of patients
  - Essential: Cohort enrolled in DSD model of interest (sites offering DSD model(s))
  - Important: Cohort eligible for DSD model but not enrolled (non-DSD sites)
  - Desirable: Remaining patients not eligible for or not enrolled in DSD model
- Set observation starting point for each patient
  - Date of entry into DSD model for those enrolled, or a calendar or other date
  - Date of eligibility for DSD model or matched time on ART for those not enrolled
  - Matched time on ART for those not eligible (+ other characteristics if available)
- Assess outcomes after specified follow up period (12-month minimum)
  - Retained in care
  - Not retained for any reason (died, lost, unrecorded transfer)
  - (Ideally would use viral suppression as primary outcome, but data incomplete)

Costs (1)

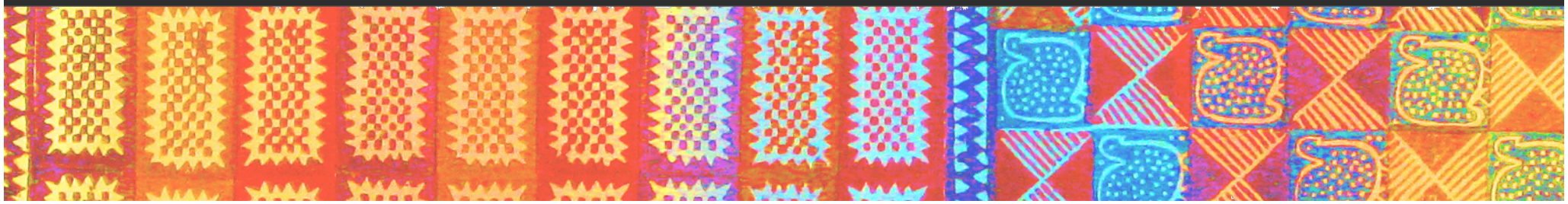
- Create data set of resource utilization for each patient during observation period (e.g. 12 months)
  - Quantity of medications dispensed
  - Number of laboratory tests performed, by type of test
  - Number and type of health system interactions, e.g.:
    - Full clinical visits
    - Medication pickup visits
    - DSD model interactions inside or outside the clinic (e.g. adherence club attendance, home visits, medication pickups from pickup points, etc.)
  - Quantity of any other supplies used or services provided per patient
- Obtain aggregate data from site(s), including
  - Number of ART and all patients served/month (or year)
  - Staff complement (all levels) and physical infrastructure
  - Detailed procedures for providing ART, by model (e.g. type and number of staff involved in packing and dispensing medications for pickup points)
  - Management/training/TA inputs, if possible

Costs (2)

- Collect unit costs for each resource utilized (standard micro-costing)
  - Medications, lab tests, and other supplies
  - Salaries of all staff (clinical, administrative, lay)
  - Monthly costs of infrastructure, utilities, etc.
  - Prices paid for anything else used to achieve patient outcomes
- Sources of cost data
  - Site and implementing partner invoices and expenditure records
  - Official price and salary lists
  - Comparable items for neighborhood (e.g. rents, utilities)
  - Local retail prices
  - Other local studies
  - When all else fails, published or modeled estimates
- Estimated average cost/patient served and production cost per patient retained (=total costs for cohort/number of patients retained)

Results:

Zambia



Methods: Details for Zambia (EQUIP/USAID/PEPFAR)

- DSD models for ART in use between 2014 and 2017
- Compared each model to conventional care at a matched site without DSD options
- Primary outcome = retention at 12 months (facility visit 9-15 months) after enrollment in DSD model or equivalent time on ART
  - Very few patients had viral load test results in their records
- Data from:
  - SmartCare, with verification from sub-sample of patient files
  - Own unit cost estimates
  - Partner lists of patients enrolled in DSD models and partner interviews
- Where non-clinic interactions were missing from SmartCare, modeled two scenarios:
  - 1) full number of recommended DSD interactions (high cost scenario)
  - 2) DSD interactions proportionate to clinic visits (low cost scenario)
- All fixed costs (infrastructure, etc.) wrapped into costs of visits

Models evaluated for Zambia

Model	Description
Individual models	
Conventional care	Current, undifferentiated model of care at facility. All data available.
Mobile ART services	Mobile ART team of medical professionals from district hospital conduct biweekly visits to select rural health centers (RHCs)—*admits stable and non-stable patients.* All data available.
Home ART delivery	CHWs conduct home visits to deliver ART, conduct health screening, monitor adherence, and refer as required. DSD interaction data incomplete (scenarios).
Group models	
Urban adherence groups (UAGs)	20-30 patients receive group adherence counseling by a lay healthcare worker and pre-packed ART at facility. DSD interaction data incomplete (scenarios).
Community adherence groups (CAGs)	±6 people, based on residential proximity or patient preference, meet monthly at a designated place in the community. Members rotate facility appointments and collect medication for other CAG members. DSD interaction data incomplete (scenarios).

Not evaluated (too recent): 6-month dispensing; fast-track refills; chronic centralized medication dispensing and delivery (CCMDD). All are individual models.

Models evaluated for Zambia (continued)

Model	Guideline-recommended interactions/year		
	Clinic visits	DSD interactions	Total interactions
Conventional care	4	0	4
Mobile ART services	0	6 (RHC visits)	6
Home ART delivery	1-2	4 (home visits)	5-6
Urban adherence groups (UAGs)	2	4-6 (group at facility)	6-8
Community adherence groups (CAGs)	2	12 (CAG meetings)	14
6-month dispensing	2	0	2
Fast-track refills	2	2	4
CCMDD	2	4	6

Note: In principle, 6-month dispensing can be combined with any other model for stable patients

Zambia sample characteristics

Model	Conventional	Mobile delivery	Home delivery	UAGs	CAGs
N	1174	216	169	193	754
% female	71%	67%	74%	72%	70%
Median age at DSD enrollment (years)	40	36	42	41	41
Time on ART at baseline (years)	4	0	4	6	6
% urban	69%	0%	31%	100%	91%

Outcomes in Zambia

Model	Retention at 12 months
Conventional care	81%
Mobile ART services	69%*
Home ART delivery	79%
Urban adherence groups (UAGs)	95%
Community adherence groups (CAGs)	83%

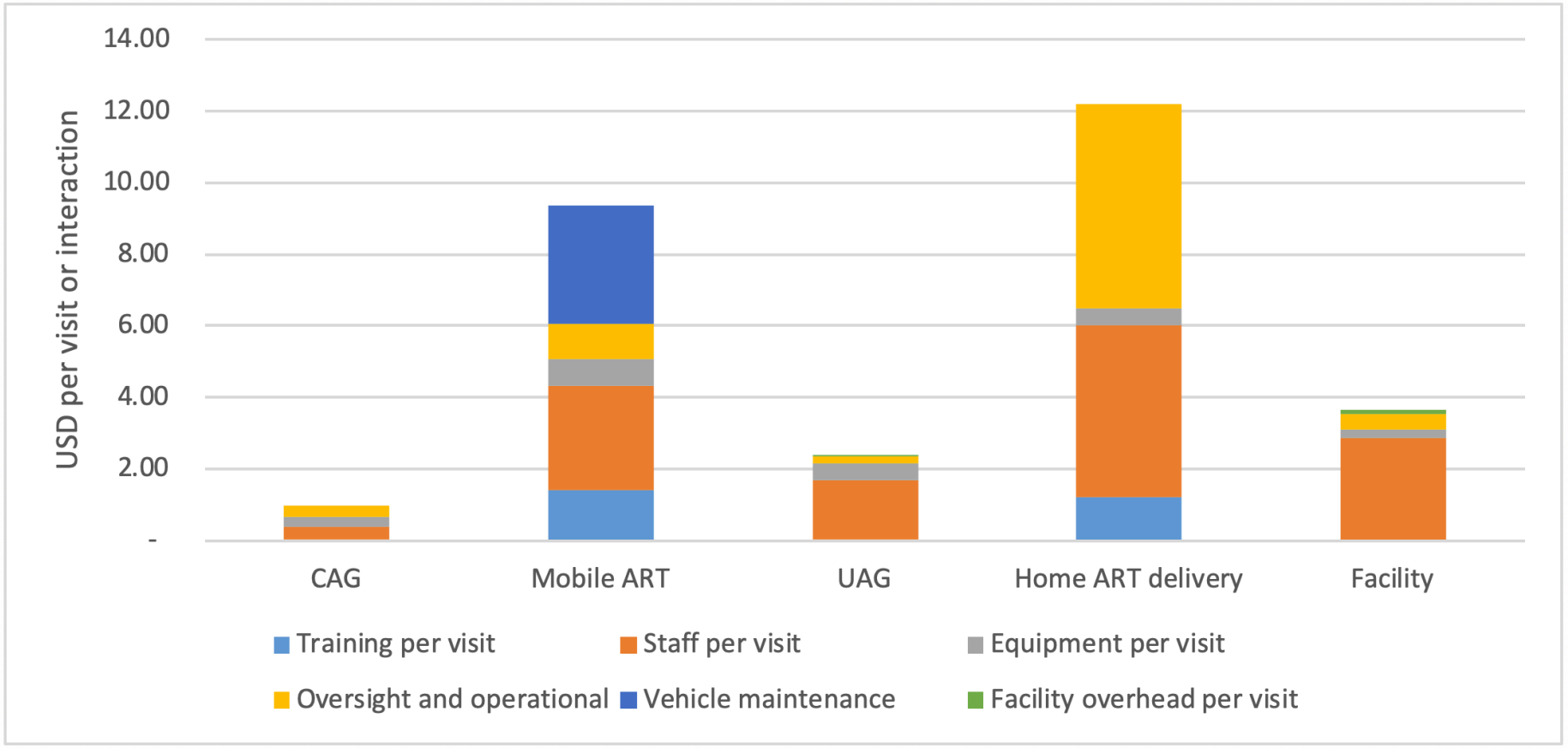
**This model enrolled patients at ART initiation, rather than ART-experienced, stable patients*

Resource utilization/patient/year, Zambia

Model	Viral load tests	Facility visits		DSD interactions		
		Observed	Guideline	Scenario 1	Scenario 2	Guideline
Conventional	0.16	4.5	4	0	0	0
Mobile ART	missing	0	0	4.8	4.8	6
Home ART delivery	0.21	3	1-2	4.2	3.3	4
UAG	0.92	3.2	2	4.8	4.5	4-6
CAG	0.24	4.5	2	12	10	12

Note: Includes all patients in cohort, including those who were not retained for 12 months

Cost/interaction, Zambia



Cost/patient (high estimate), Zambia

Component	Conventional (n=1,174)	Mobile ART (n=216)	Home ART delivery (n=169)	UAG (n=193)	CAG (n=754)
ARV medications	$87.96	$73.30	$126.63	$114.66	$101.21
Non-ARV medications	$0.13	$3.45	$0.18	$0.18	$0.10
Laboratory tests	$4.61	missing	$4.56	$23.24**	$6.92
Facility visits	$9.31	n.a.	$3.70	$11.16	$9.63
DSD interactions	n.a.	$45.71	$51.44	$11.26	$11.93
Total cost per patient	$100	$122*	$186	$160	$130

**$126.61/patient/year if we assume laboratory costs equal to conventional care; $145.24/patient/year if we assume lab costs equal to UAG model*

***Full coverage of viral load testing in UAG model; few viral load tests conducted in other models.*

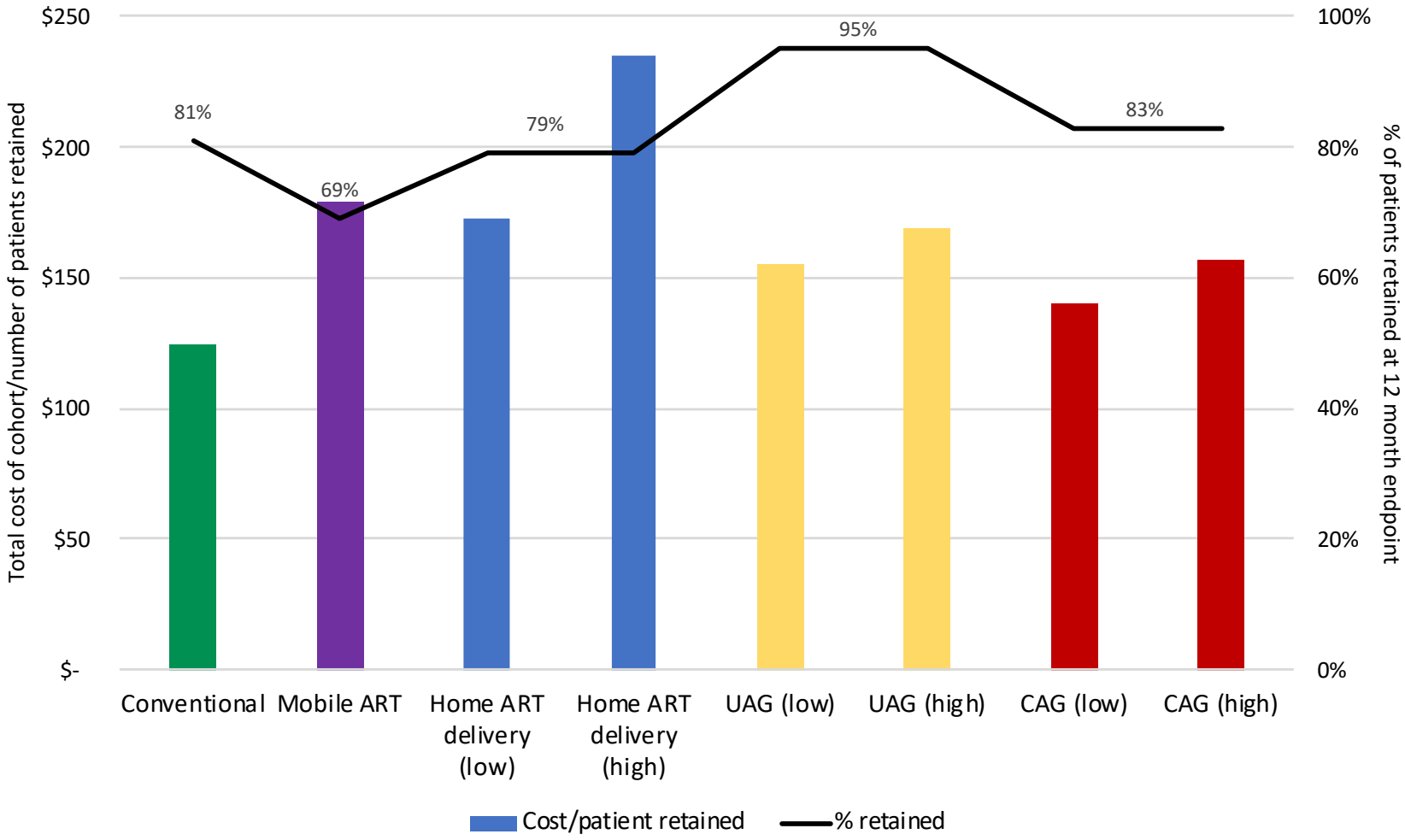
Cost/patient (low estimate), Zambia

Component	Conventional (n=1,174)	Mobile ART (n=216)	Home ART delivery (n=169)	UAG (n=193)	CAG (n=754)
ARV medications	$86.04	$73.30	$87.96	$101.87	$89.01
Non-ARV medications	$0.13	$3.45	$0.18	$0.18	$0.10
Laboratory tests	$4.61	missing	$4.56	$23.24**	$6.92
Facility visits	$9.31	n.a.	$3.70	$11.16	$9.63
DSD interactions	n.a.	$45.71	$40.78	$10.68	$9.92
Total cost per patient	$100	$122*	$137	$147	$116
Difference from high cost scenario	*$0*	*$0*	*-$49*	*-$13*	*-$14*

**$127.07/patient/year if we assume laboratory costs equal to conventional care; $145.24/patient/year if we assume lab costs equal to UAG model*

***Full coverage of viral load testing in UAG model; few viral load tests conducted in other models.*

Production cost/patient retained, Zambia

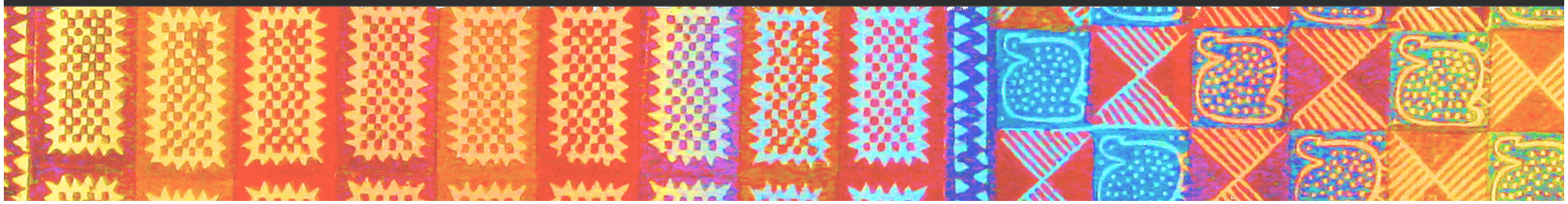


Limitations of Zambia analysis

- Only evaluated models in use in the past—we will have to wait for data to accrue to analyze newer models
- Missing data on DSD interactions; major limitation but even low cost estimates exceeding conventional care
- Few viral load results available; could not use suppression as the primary outcome
- Models evaluated serve different patient populations (urban v rural; stable v all); cannot really be compared for cost-effectiveness
- Small sample sizes, large standard deviations for all estimates

Results:

Uganda



Methods: Details for Uganda (EQUIP/USAID)

- DSD models for ART in use between 2017 and 2019
- Uganda no longer has “conventional care;” previous model is now one of the DSD models included in the study
- Primary outcome = viral suppression at 12 months after enrollment in study; also report 24-month suppression
  - Report costs for months 0-12; results for months 13-24 not shown
- Data from:
  - Chart review on site (mainly)
  - DSD model registers
  - Electronic medical records (incomplete)
  - Own unit cost estimates
  - Data from providers/implementers: interviews, expenditure records, etc.
- Fixed and infrastructure costs, above-site costs, and cost/visit were estimated from interviews and top-down, not patient cohorts

Models evaluated for Uganda

Model	Description
Individual models	
Facility-based individual management	Conventional care for all *early and non-stable patients*. Specified clinic days for different conditions/populations (children, TB, etc.).
Fast-track drug refill	Medication pick up at the facility or pick-up point for stable patients, without clinical consultation.
Group models	
Community drug distribution points	Provider-organized groups of 10-50 stable patients receive all care and medications provided at community outreach points.
Facility-based group	Group care for specified types of patients (e.g. pregnant women, adolescents, key populations). *Admits stable and non-stable patients.* Study included only facility-based groups for pregnant and breastfeeding women (PLW).
Community client-led ART delivery (CAG)	3-12 stable patients form groups in their communities and rotate medication pickup visits.

Models evaluated for Uganda (continued)

Model	Guideline-recommended interactions per year		
	Clinic visits	DSD interactions	Total interactions
Facility-based individual management	4-12	0	4-12
Fast-track drug refill	2	2	4
Community drug distribution points	0	4	4
Facility-based group	2	2-4	4-6
CAG	2	2	4

Note: Multi-month dispensing can be combined with any other model for stable patients

Uganda sample characteristics

Model	Facility individual	Fast track	Community distribution	Facility group	CAGs
N	128	133	132	129	131
% female	64%	56%	72%	100%	70%
Median age at DSD enrollment (years)	41	44	44	29	44
Time on ART at baseline (years)	3.8	7.7	7.1	2.5	5.0
Time in DSD model at baseline (years)	3.7	2.4	3.6	1.2	1.4

Outcomes in Uganda

Model	Suppression at 12 months*	Suppression at 24 months*
Facility-based individual management	86%	88%
Fast-track drug refill	89%	90%
Community drug distribution points	93%	92%
Facility-based group	89%	n.a.**
Client-led ART delivery (CAG)	95%	90%

**Viral suppression recorded in patient files; remaining patients include known unsuppressed and missing results*

***Study limited to facility-based group for pregnant and breastfeeding women; most transferred to other models before 24 month endpoint*

Resource utilization/patient/year, Uganda

Model	Viral load tests*	Facility visits*		DSD interactions*	
		Observed	Guideline	Observed	Guideline
Facility-based individual management (conventional)	1.05	7.8	4-12	0	0
Fast-track drug refill	1.02	6.1	2	Unspecified**	2
Community drug distribution points	1.18	7.0	0	10.0	4
Facility-based group	1.09	8.1	2	6.1	2-4
Community client-led ART delivery (CAG)	1.15	6.6	2	3.6	2

**Months 0-12. Includes all patients in cohort, including those who were not retained for 12 months.*
***Not distinguished from facility visits in data set.*

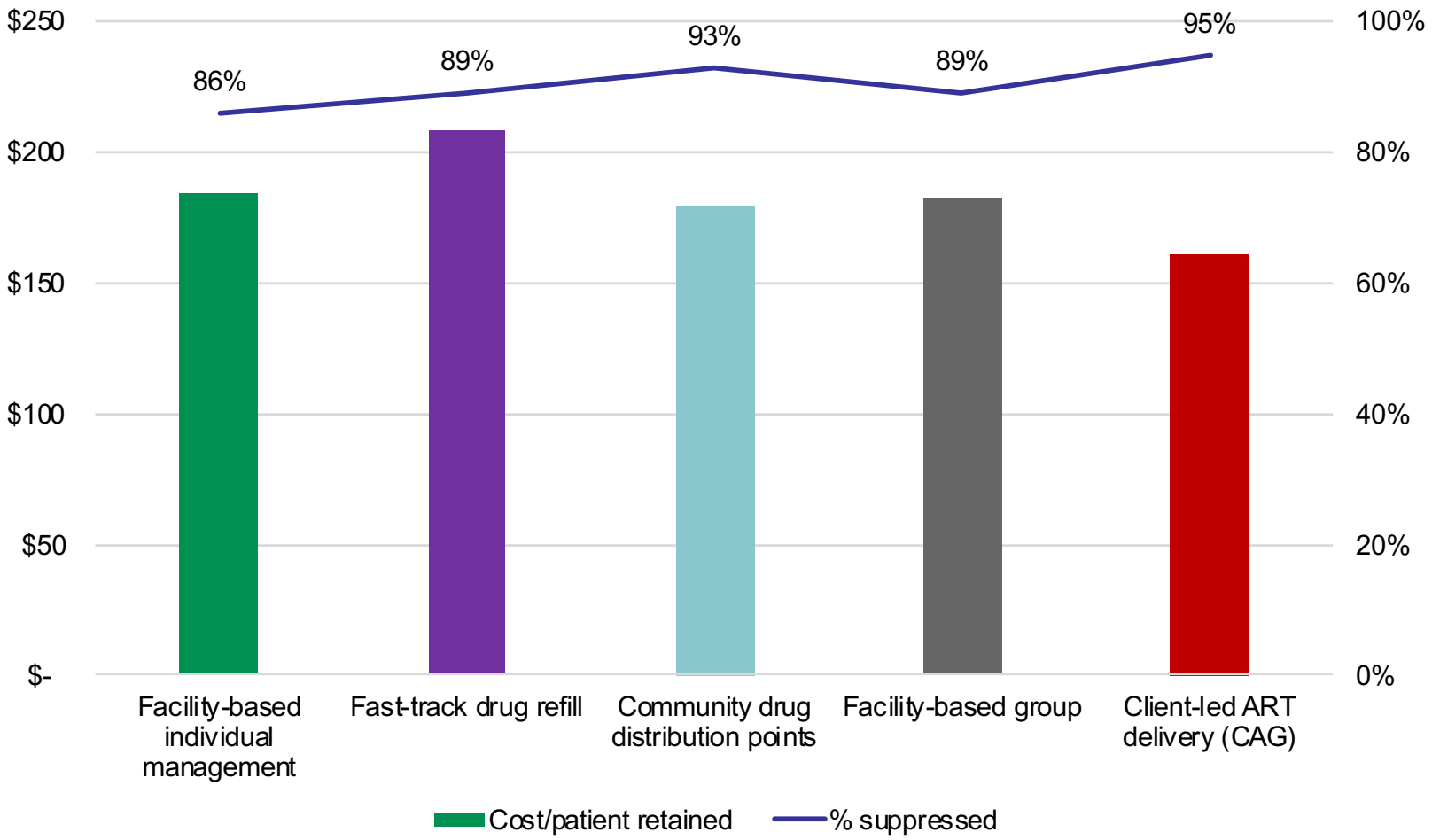
Cost/patient/year, Uganda

Component	Facility individual	Fast-track	Community drug distribution points	Facility-based group	Client ART delivery (CAG)
ARVs	$108.31	$136.83	$116.89	$104.75	$104.48
Non-ARV medications	$20.17	$23.44	$22.17	$22.07	$16.71
Laboratory tests	$14.10	$13.84	$14.96	$14.75	$14.99
Facility visits (HR only)*	$6.27	$6.22	$2.02	$11.26	$4.09
DSD interactions (HR only)	0.00	unspecified	$0.31	$0.16	$0.29
Fixed costs at site	$4.50	$2.10	$7.86	$4.51	$7.40
Above-site costs**	$4.58	$2.77	$2.65	$5.28	$5.44
Total cost per patient	$157.93	$185.20	$166.85	$162.77	$153.39
Viral suppression rate	*86%*	*89%*	*93%*	*89%*	*95%*

**Clinic visits included human resources for ARV refills, clinical assessments, TB assessments, fast-track refills, drawing blood, and unscheduled visits*

***Above-site costs, estimated from provider/partner data, include supervision, training, and management*

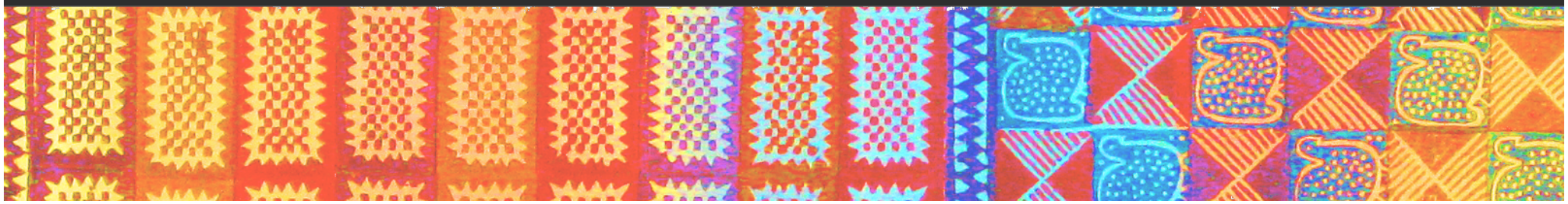
Production cost/patient retained/year, Uganda



Limitations of Uganda analysis

- Missing data on patient deaths (files removed from sites); may slightly overestimate suppression rate
  - Only one death recorded between year 1 and year 2 of study
- Small sample sizes for each model
- Varying numbers of years on ART and years participating in models at study enrolment
- Incomplete records of co-morbidity care, including OIs
- Estimates for visit costs included only staff time for patient contact, not administrative time
  - Total cost/patient does capture all costs, including all relevant staff time and above-site costs

Quick look at patient costs

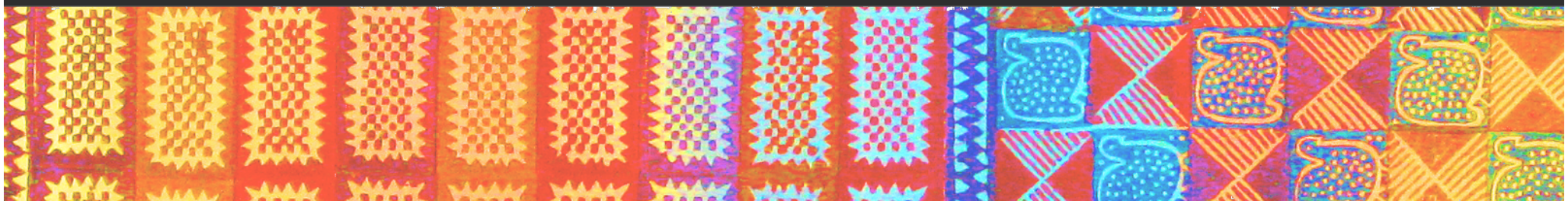


Existing evidence on patient costs

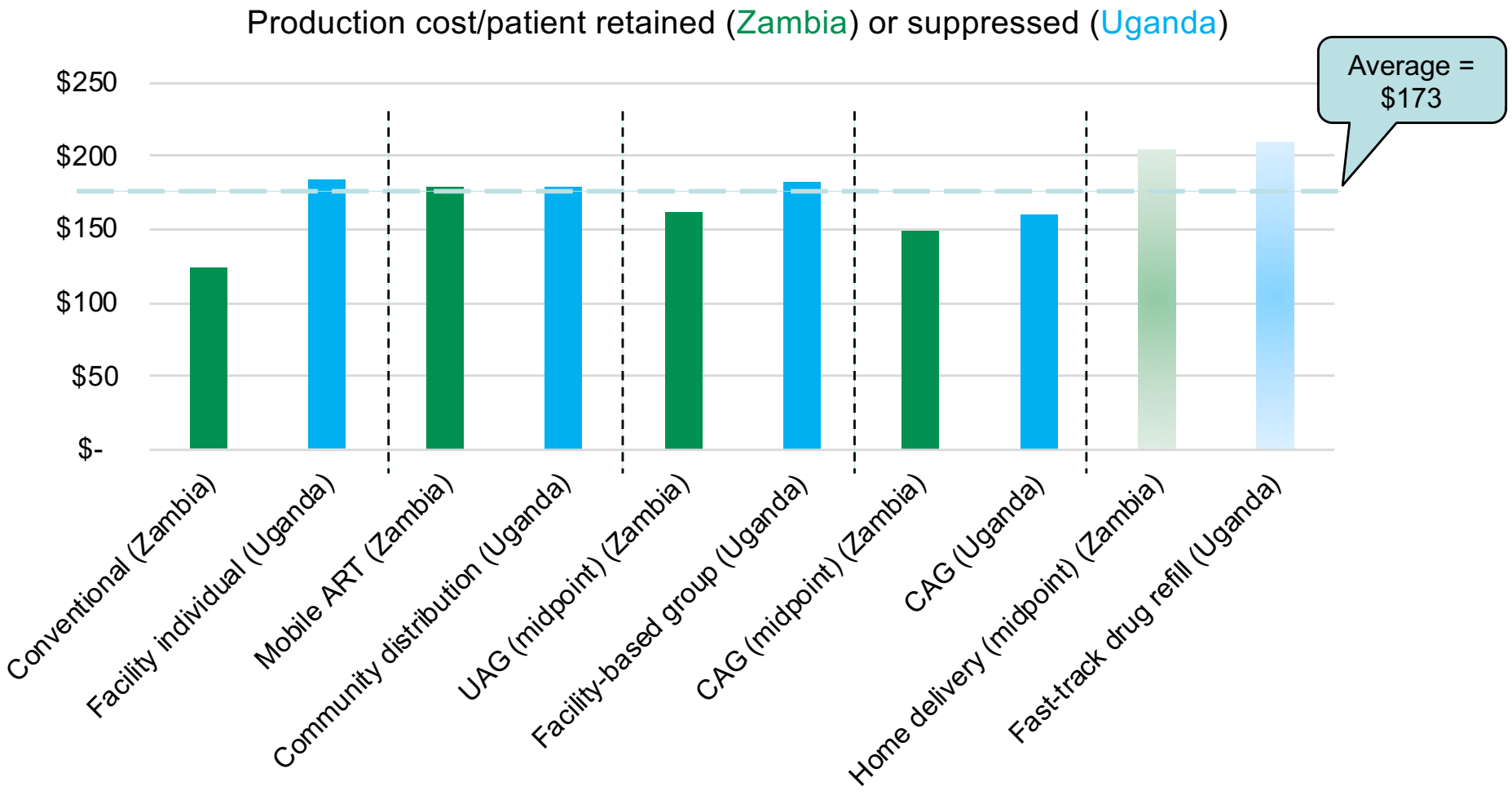
DSD models are intended to make ART more “patient-centric”; one aspect of this is to reduce the costs to patients of seeking care. AMBIT literature review included this.

Country	Model name	DSD model		SOC	
		Travel cost (USD)	Time or distance	Travel cost (USD)	Time or distance
Malawi	Fast track refills	$2.30/year	20.9 hours/year	$7.00/year	74.7 hours/year
	Multi-month scripting	$2.30/year	24.9 hours/year	$7.00/year	74.7 hours/year
South Africa	Centralized chronic medicines dispensing and distribution	$1.07/visit	12.9% patients >1 hrs/travel time to pickup point		
South Africa	Community based ART pick-up points	83% reduction in travel cost/year			
Tanzania	ARV community delivery	$0.40/year		$3.30/year	
Uganda	Community pharmacies		9.0 waiting hours/year		
South Africa	Youth care club		13.8 visit hours/year		48.0 visit hours/year
South Africa	Adherence club	$0.80/visit	20% of patients > 1 hour/ travel time from AC		
Malawi	Community ART group	$1.20/year	36.8 hrs/year	$7.00/year	74.7 hours/year

Conclusions



Dodgy comparison of cost/patient



Summary

- Outcomes of DSD models are generally good and consistent with conventional care for stable patients
- Most models in both countries cost providers roughly the same as conventional care per patient treated or more
  - Patients tend to use more care (more interactions with system) than expected
- Patient costs tend to be substantially lower in DSD models
- If we are willing to generalize from what we know, DSD models:
  - Will reduce provider budgetary costs little or not at all
  - Will not change clinical outcomes for stable patients
  - Will reduce patient costs meaningfully
  - May or may not increase healthcare system capacity
- Six-month dispensing may make most other current DSD models obsolete and will probably affect both costs and outcomes

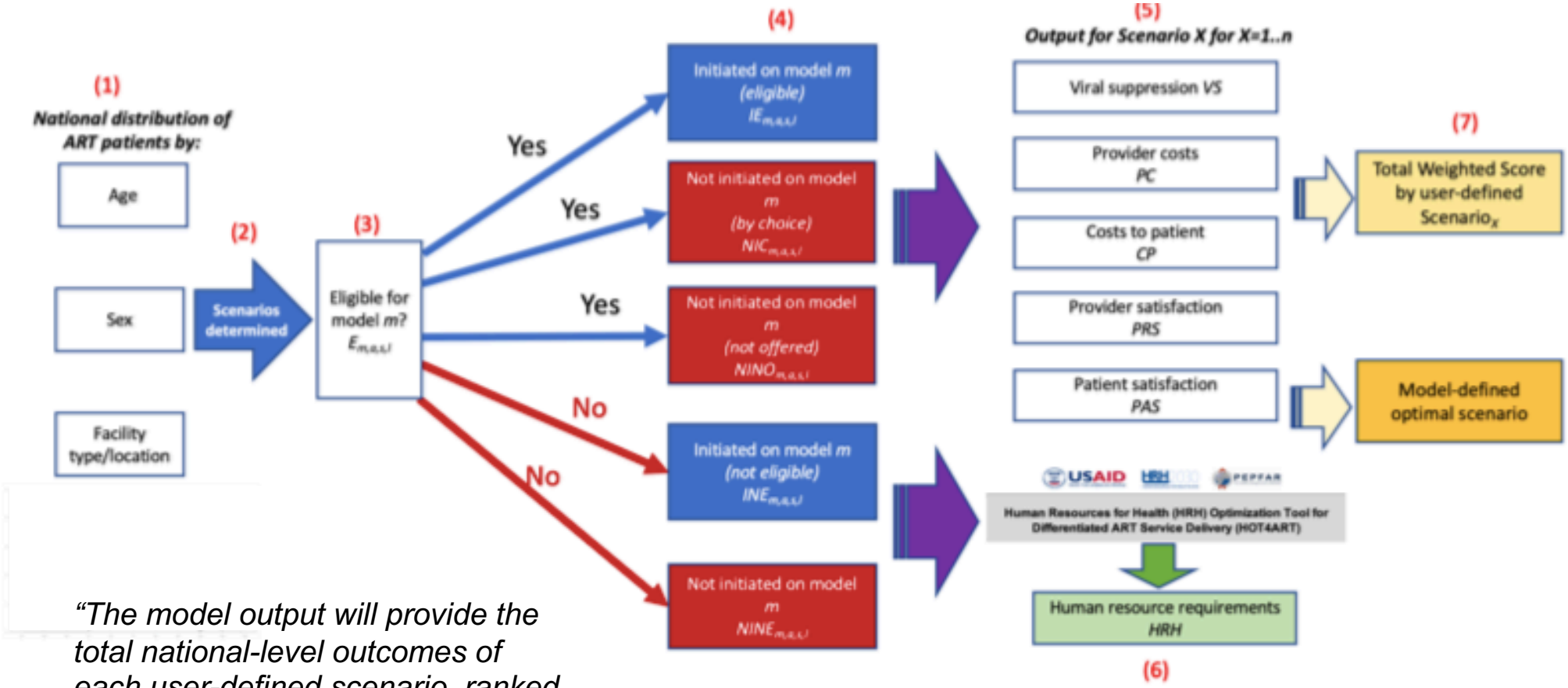
Final thoughts on methods

- Standard cost-effectiveness comparisons are not valid in studies like this
  - The unit of effectiveness (a retained or suppressed patient) is not uniform
  - The models are often not substitutes for one another
- Monetary costs do not capture what we really care about
  - No data on how shifts in visits, etc. affected overall capacity or quality of healthcare
  - No reason to expect improvements without better management
- No studies (including ours, so far) have estimated cost/patient for an entire ART population; no surprise that low-cost, stable patients continue to be low-cost and stable
- In future, focus should be more on understanding resource use and reallocation/re-motivation of resources to increase efficiency (including access, capacity, and quality), and less on specific unit costs

Forthcoming outputs (from us)

- Studies nearing completion (results by March):
  - Analysis of provider and patient costs in Lesotho (EQUIP)
  - Cost analysis of the INTERVAL trial (six-month dispensing in Zambia and Malawi) (EQUIP)
  - Cost analysis of decentralized medication delivery in the National Adherence Guidelines in South Africa (EVIDENCE)
- AMBIT's plans:
  - ADAPT: Mathematical cost optimization model for scaling up DSD models, parameterized to AMBIT focus countries
  - Annual (+/-) update of literature reviews
  - Detailed cost estimates for full ART patient cohorts at sentinel sites in Malawi, South Africa, and Zambia
  - What else can AMBIT contribute?

ADAPT: Mathematical cost optimization model for scaling up DSD models



"The model output will provide the total national-level outcomes of each user-defined scenario, ranked by the weighted optimization score, alongside the quantity of human resources required."

Acknowledgements

- EQUIP and USAID/PEPFAR
- AMBIT and the Bill and Melinda Gates Foundation
- In Zambia: Ministry of Health, Right to Care Zambia, and participating implementing partners
- In Uganda: Ministry of Health, HealthNet Consults, and participating implementing partners
- Find us at sites.bu.edu/hiv and sites.bu.edu/ambit

References and further information

- All literature mentioned is cited in the reports and presentations posted at: https://sites.bu.edu/ambit/project-documents/
- For additional information about the BU/HE^{2}RO studies presented or mentioned here:
  - Zambia: Brooke Nichols, brooken@bu.edu
  - Uganda: Teresa Guthrie, guthriehealthfinancingconsult@gmail.com, or Lawrence Long, lclong@bu.edu
  - South Africa: Bruce Larson, blarson@bu.edu
  - Lesotho: Brooke Nichols, brooken@bu.edu
  - ADAPT model: Brooke Nichols, broken@bu.edu
  - Overall: Sydney Rosen, sbrosen@bu.edu