

# Determinants of HIV Treatment Costs in Developing Countries

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## Motivation

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- ❑ HIV treatment consumes substantial funds, pressure to increase treatment coverage
- ❑ Programs face budget pressure, motivated to reduce costs
- ❑ Understanding determinants of HIV treatment costs important
  - *For estimating future resource needs*
  - *For suggesting approaches to improve efficiency*

## A look ahead...

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- ❑ Analysis of per-patient treatment costs assessed at the site level
- ❑ Site maturity, patient volume, and price levels are influential determinants of per-patient costs
- ❑ Other operating characteristics, intensity of service provision appear to play a smaller role
- ❑ Difficult to find any relationship between per-patient costs and health system level, rural/urban location, and type of administration

## Methods: Data Sources

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- ❑ Data from 54 HIV treatment sites in Botswana, Ethiopia, Mozambique, Nigeria, Uganda, and Vietnam
- ❑ Sites: out-patient clinics providing free HIV treatment
- ❑ Costs assessed from a comprehensive provider perspective
- ❑ Data collected retrospectively for full duration of site activities from start of treatment scale-up to the time of data collection, broken into successive 6-month periods for analysis
- ❑ Economic cost per patient-year (2010 USD) calculated for 5 patient types (4 ART subdivisions + pre-ART)

*More detail: Menzies et al AIDS 2011*

## Methods: Analysis

- Average cost per patient-year (excl. ARVs), regressed\* against possible cost determinants:

Proximal Determinants		Distal Determinants	
Site Maturity	→	Months since scale-up	
Patient Volume	→	Total no. HIV patients	
Price Levels	→	Log per-capita GDP	
Operating Characteristics	→	Clinician:patient ratio Doctor:clinician ratio Percent mgmt-admin	
Intensity of Care	→	Freq. of clinic visits Freq. of CD4 counts Index of care services	
		Health System Level	→ Primary vs. secondary vs. tertiary
		Location	→ Urban vs. non-urban
		Type of Administration	→ Govt vs. other

\* GLMM regression with log link function. Random effects used to account for clustering at country, site, and time period level. Fixed effects included for each patient type

## Results: Per-Patient Costs vs. Proximal Determinants

	Coefficient	Std. Error	
Site maturity	-0.055	0.011	***
Site maturity squared	0.0008	0.0002	***
Patient volume	-0.166	0.057	**
Patient volume squared	0.006	0.003	*
Log per-capita GDP	0.280	0.113	*
Clinic visit frequency	0.037	0.006	***
CD4 count frequency	0.186	0.019	***
Clinician:patient ratio	0.010	0.002	***
Index of care services	0.094	0.055	
Pct mgmt-admin	0.013	0.008	
Doctor:clinician ratio	-0.551	0.489	

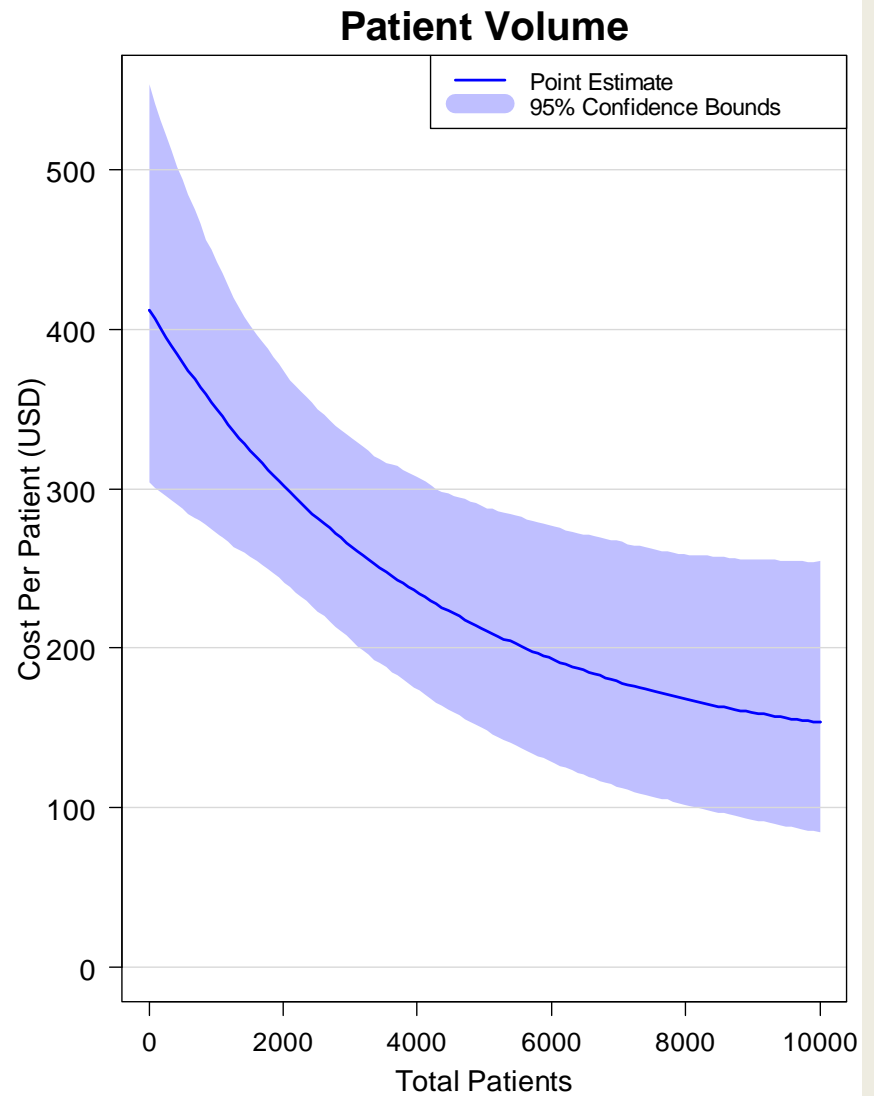
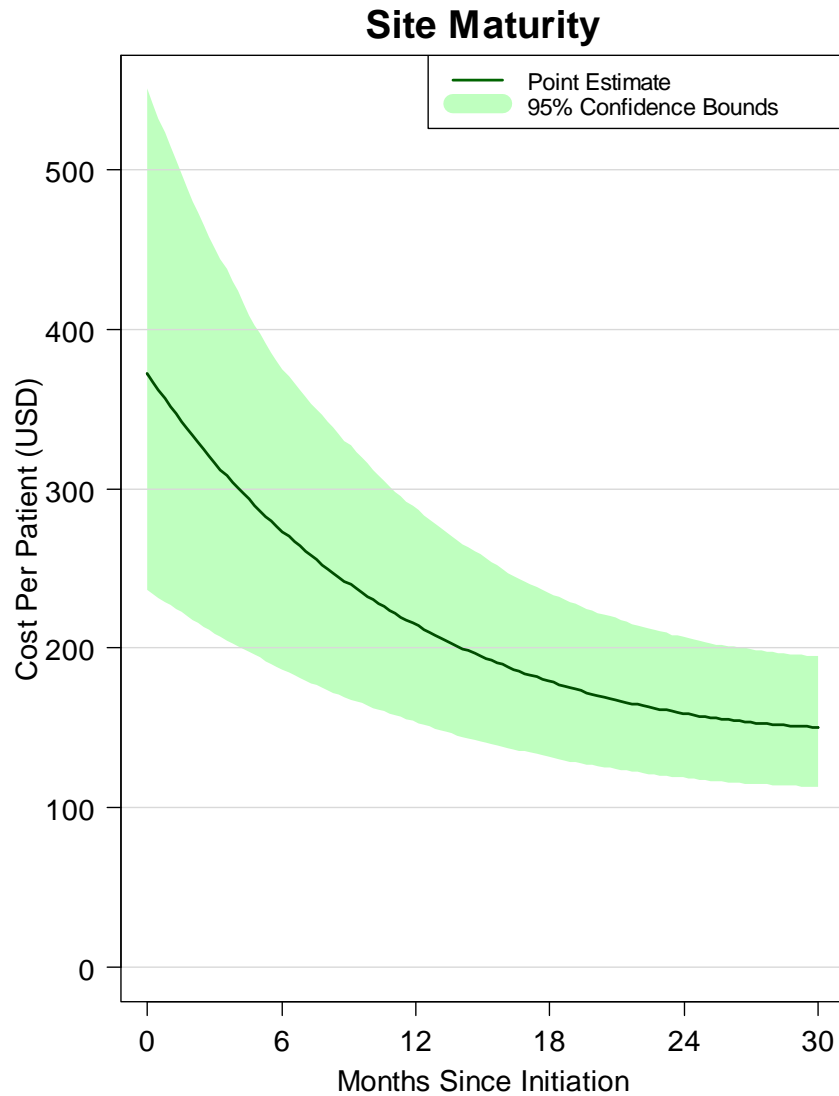
Regression also includes intercept and dummy variables for patient type (reference = established adult ART), coefficients not shown. Regression coefficients relate to logged per-patient costs. '\*\*\*' denotes  $p < 0.001$ , '\*\*' denote  $p < 0.01$ , and '\*' denotes  $p < 0.05$ .

## Implications of Regression Results

Change in Site Characteristic (first difference)	Percentage Change in Per-Patient Cost
Site matures from 0 to 12 months	-41% (-52%, -28%)
Site matures from 12 to 24 months	-25% (-35%, -15%)
Patient volume increases from 500 to 5,000	-43% (-63%, -18%)
Patient volume increases from 5,000 to 10,000	-28% (-47%, -6.3%)
Per-capita GDP rises from \$500 to \$1,500	37% (6.1%, 73%)
Per-capita GDP rises from \$1,500 to \$5,000	41% (6.7%, 83%)
One additional clinic visit per year	1.8% (1.3%, 2.4%)
One additional CD4 test per year	9.7% (7.7%, 12%)
One additional clinician per 1,000 patients	1.1% (0.7%, 1.4%)

Each comparison shows the consequence of change in a single variable, holding all other variables at their mean values.

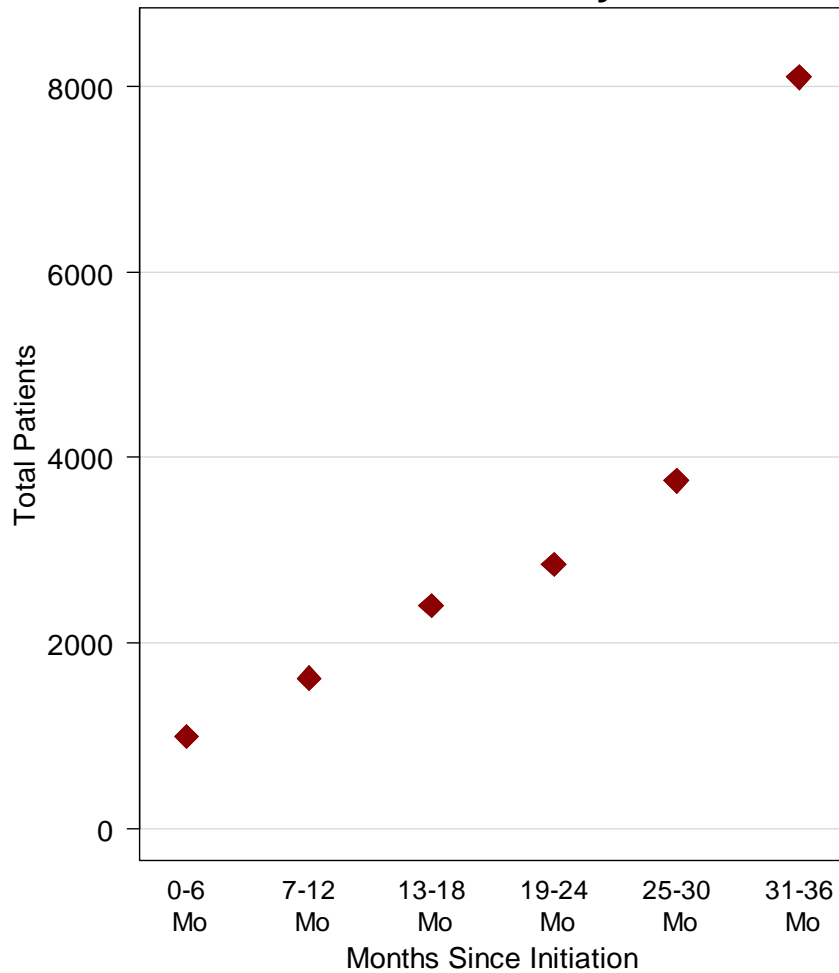
# Adult ART Cost vs. Site Maturity & Patient Volume



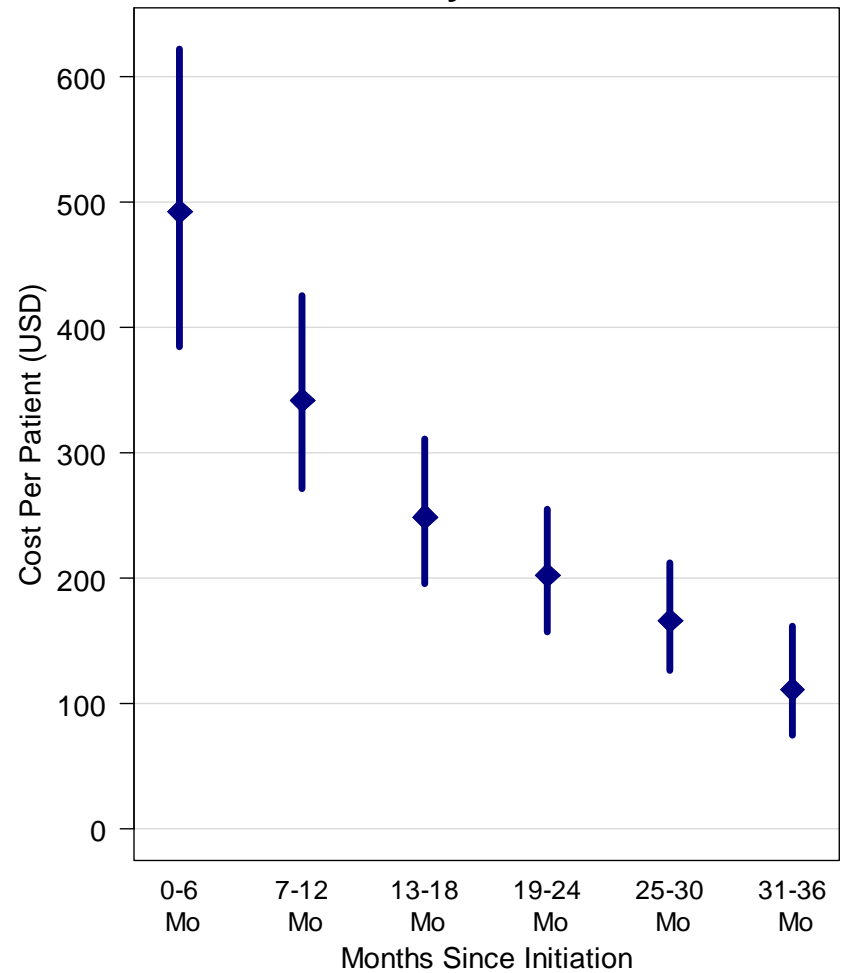


# Adult ART Cost vs. Site Maturity & Patient Volume

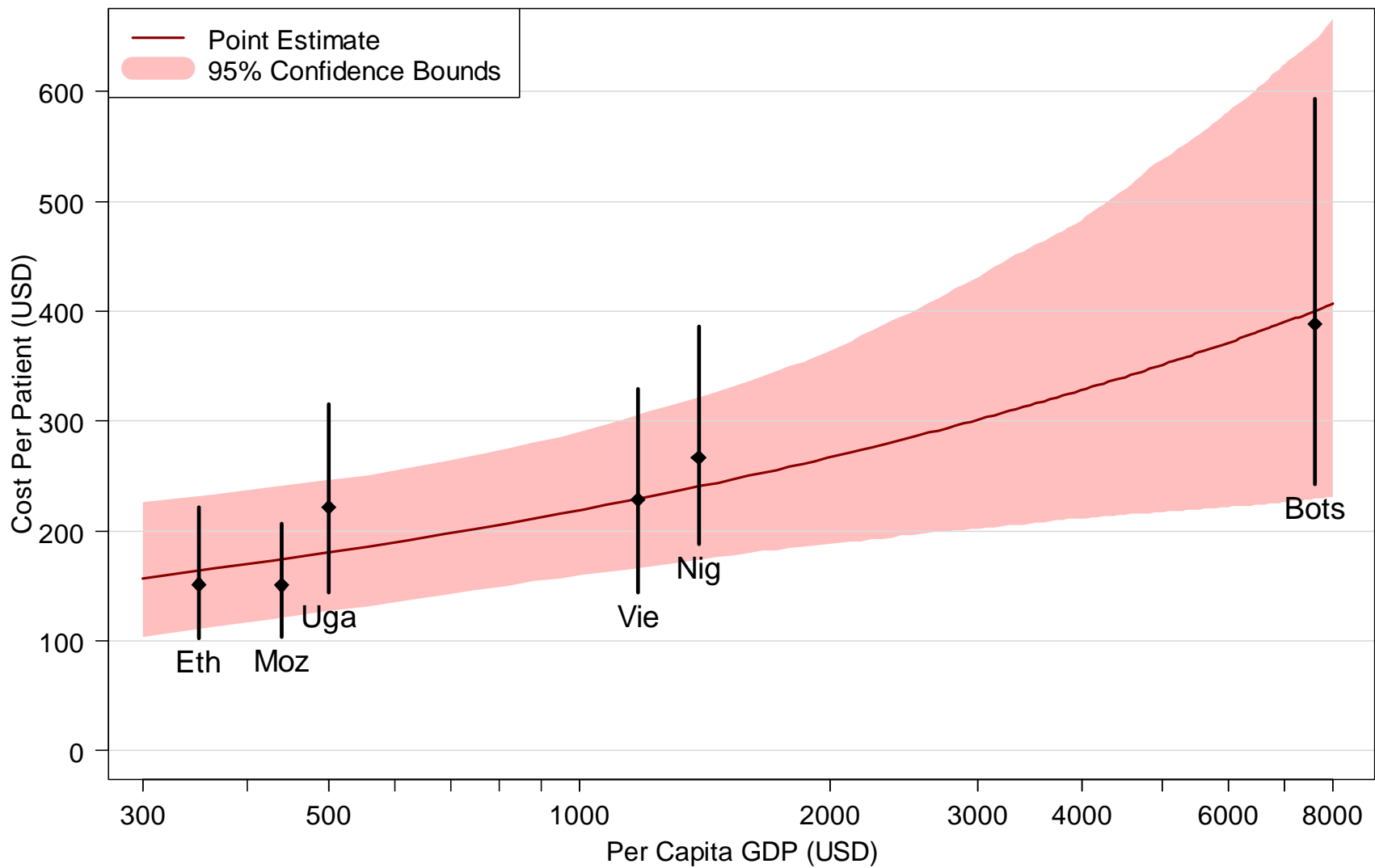
## Patient Volume vs. Site Maturity



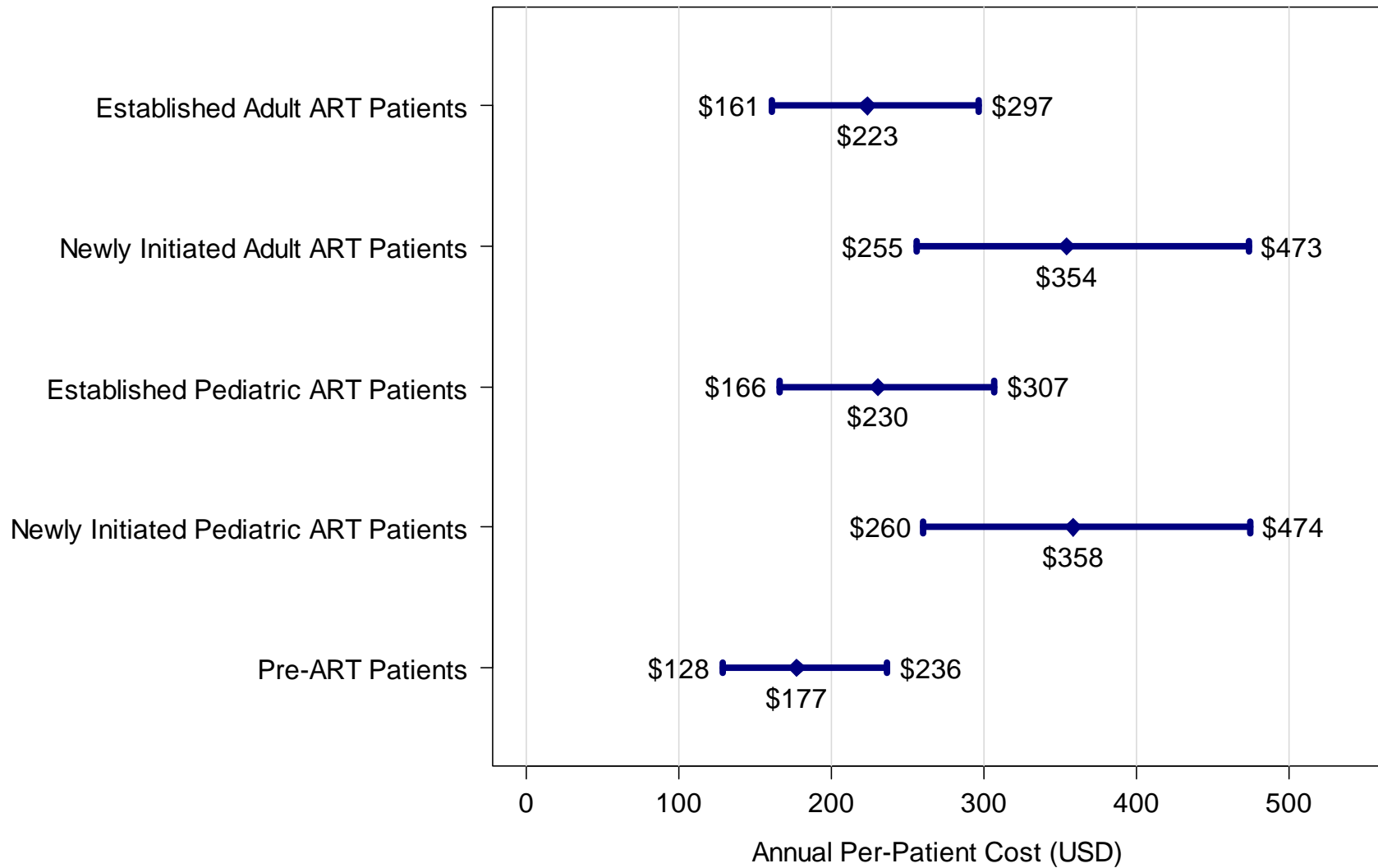
## Combined Effect of Pt Volume and Site Maturity on Per-Pt Cost



# Adult ART Cost vs. Per Capita GDP



# Average Per-Patient Costs, by Patient Type



## Results: Per-Patient Costs vs. Distal Determinants

	Coefficient	Std. Error
<b>Specification 1: distal determinants plus patient type fixed effects</b>		
Secondary Site	0.17	0.32
Tertiary Site	-0.20	0.31
Urban	-0.01	0.25
Govt Run	0.24	0.34
<b>Specification 2: distal determinants plus patient type, site maturity, and patient volume</b>		
Secondary Site	0.56	0.32
Tertiary Site	0.38	0.33
Urban	-0.08	0.26
Govt Run	0.14	0.34
<b>Specification 3: distal determinants plus all proximal determinants</b>		
Secondary Site	0.18	0.29
Tertiary Site	0.32	0.30
Urban	-0.11	0.24
Govt Run	0.11	0.31

Distal determinants include health system level (primary vs. secondary vs. tertiary), location (urban vs. non-urban), and type of administration (government vs. other). Regression coefficients relate to logged per-patient costs. '\*\*\*\*' denotes  $p < 0.001$ , '\*\*\*' denote  $p < 0.01$ , and '\*\*' denotes  $p < 0.05$ .

→ *Nothing significant*

## Conclusions

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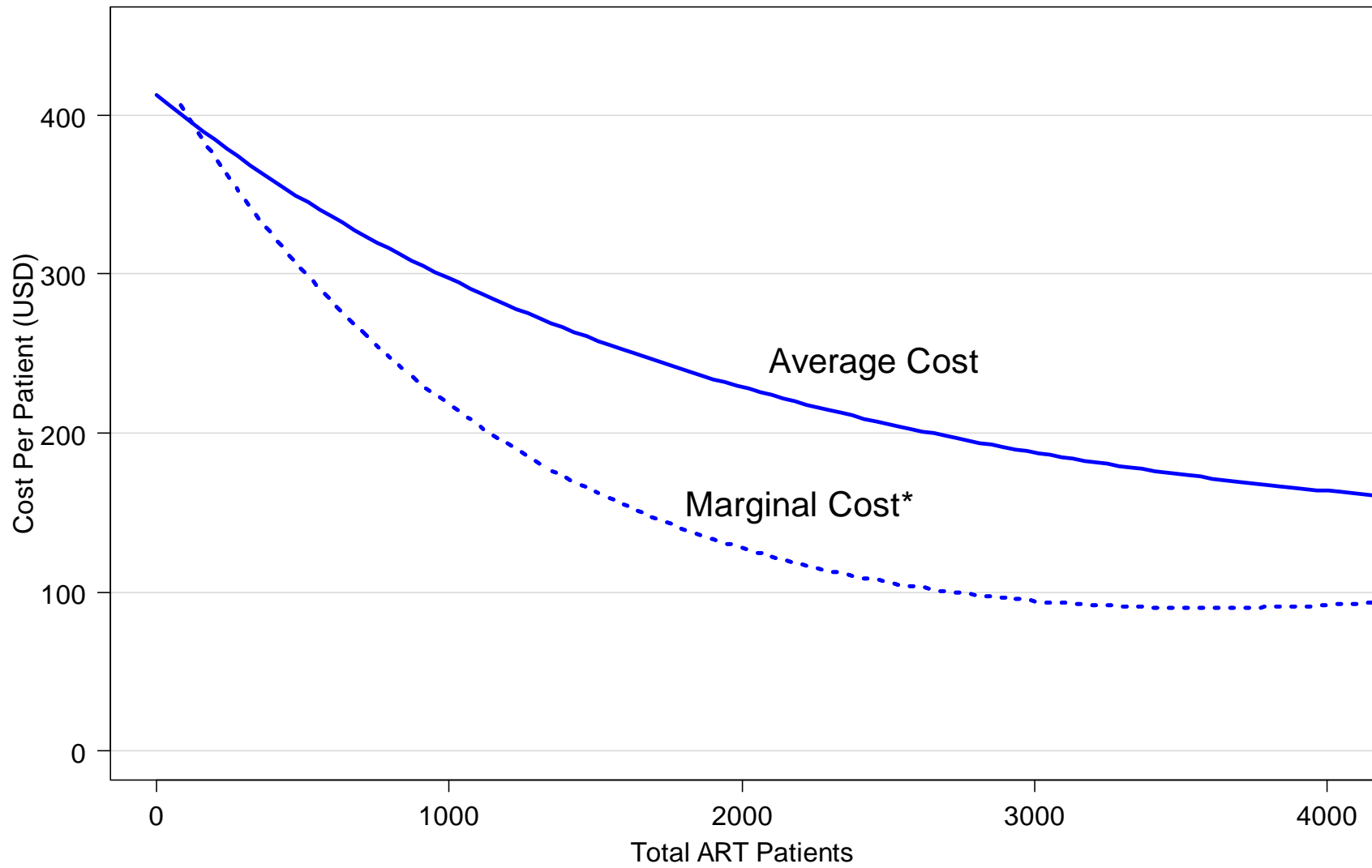
- ❑ Site maturity, patient volume, and price levels appear statistically significant and influential determinants of per-patient service delivery costs
- ❑ Major cost savings may accrue 'automatically' as sites expand and mature
- ❑ Scale-up strategies that favor many, smaller sites may be more costly (though trade-off for more equitable access)
- ❑ Calculating cost per patient as average across sites will overestimate overall average per-patient cost

## Limitations

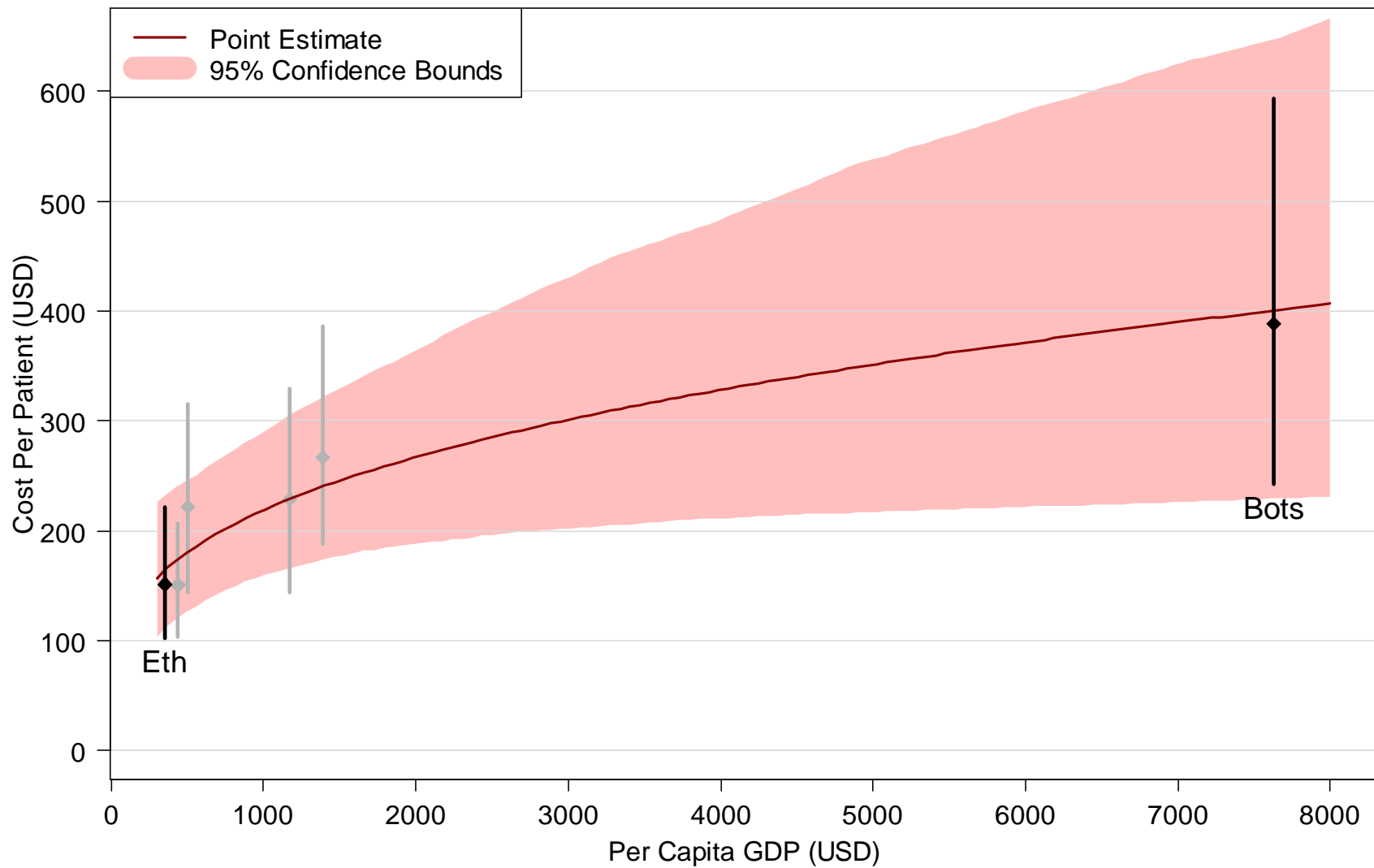
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- ❑ Observational data → any causal interpretation requires faith
- ❑ Only looked at site-level service delivery costs, while total treatment cost includes ARVs, higher-level management, and administrative support
- ❑ Did not consider treatment quality – some possible changes to improve efficiency might reduce cost but also quality

## Average vs. Marginal Cost with Site Scale-Up



# Adult ART Cost vs. Per Capita GDP (x-axis untransformed)





## Index of care services

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- ❑ Sum of services provided by site:
  - Onsite TB treatment
  - Isoniazid preventive therapy for TB
  - STI treatment
  - Cotrimoxazole prophylaxis
  - Provision of insecticide treated bednets
  - Provision of water sanitation products
  - Psychosocial support
  - Pain management
  - End of life care
  - Availability of viral load testing
  - Community follow-up of patients missing appointments
  
- ❑ Index varied from 2 to 10 with a mean of 6.4.