



# **WHAT DRIVES PRODUCTIVITY AND COSTS OF ROUTINE IMMUNIZATION SERVICES IN ZAMBIA ?**

Anthony Kinghorn

Mott MacDonald, Johannesburg, South Africa

Carl Schutte

SDC Consulting, Pietermaritzburg, South Africa

Edmore Marinda

Mott MacDonald, Johannesburg, South Africa

Collins Chansa

Consultant, Lusaka, Zambia

This presentation is based on research funded by the Bill & Melinda Gates Foundation. The findings and conclusions reported are those of the authors and do not necessarily reflect positions or policies of the Bill & Melinda Gates Foundation

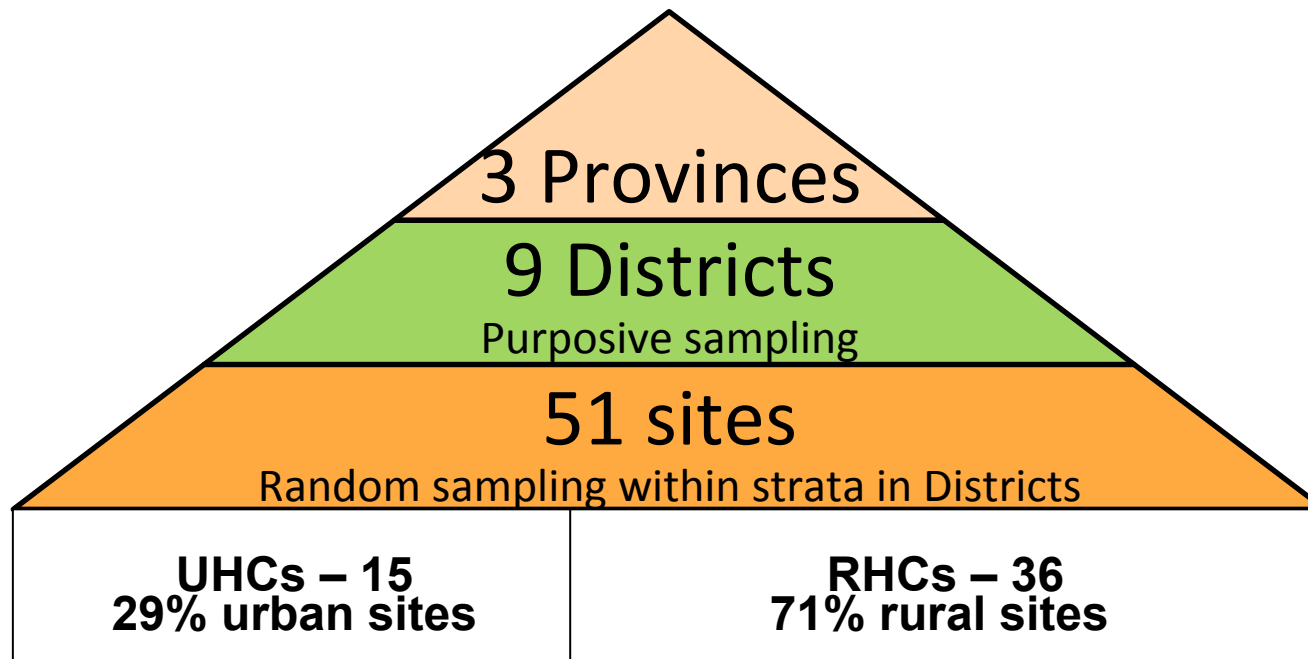
# OBJECTIVE

Identify determinants of productivity and total costs of routine immunization

- Limited previous statistical analysis of productivity and costs of immunization and other primary care services in Africa
- Part of **EPIC**, a multi-country study on costs of routine immunization with a Common Approach methodology to explore cost issues

# METHODS (1)

- **Stratified sample:**



- **Costing:**

- Ingredients-based approach to quantify economic costs of facility-level immunization services based on inputs, prices and outputs
- Consistent with WHO/GAVI guidelines

# METHODS (2) - ANALYSIS

- Scatter plots and adjusted multivariate log normal regression models explored association of supply, demand & environment variables with facility productivity and costs. STATA (v12) model was of form:

$$\log(y_{i}) = \beta_{0} + \beta_{1} \log(x_{1i}) + \beta_{2} \log(x_{2i}) + \dots \beta_{p} \log(x_{pi}) + \varepsilon_{i}$$

- Total number of doses and DTP3 doses administered - proxies for facility productivity
- Cost determinant models examined associations with indicators of quantity, quality, price, capital investment and context
- Selection of variables was guided by analyzing unit costs, previous research and plausible economic reasoning

# REGRESSION ANALYSIS PRODUCTIVITY MODELS

	Ln Total number of DTP3 children	Ln Total number of facility doses
Variable	Model - 1 $\beta$ (p-value)	Model - 1 $\beta$ (err) p-value
Ln FTE Immunisation staff	0.22 (0.16)	0.26 (0.12)
Ln # Community health workers	-0.004 (0.91)	0.01 (0.85)
Ln # <u>Zones</u> supported	<b>0.62 (&lt;0.01**)</b>	<b>0.57 (&lt;0.01**)</b>
Ln Distance vaccine collection point (km)	-0.01 (0.89)	0.01 (0.83)
<u>Facility type</u> : Urban Rural	Reference <b>-1.04 (&lt;0.01**)</b>	Reference <b>-1.12 (&lt;0.01**)</b>
Ln District <u>poverty</u> index	<b>-0.12 (0.04*)</b>	<b>-0.14 (0.03*)</b>
<u>Roads</u> : Good/Fair Poor/very poor	Reference 0.23 (0.23)	Reference 0.36 (0.08)
R – squared (adjusted R <sup>2</sup> )	0.75	0.74

- Catchment Population and Total Attendances are highly correlated (Pearson 0.87-0.92) with dependent DPT3 and Dose variables so excluded from models
- Their correlations are potentially useful for planning

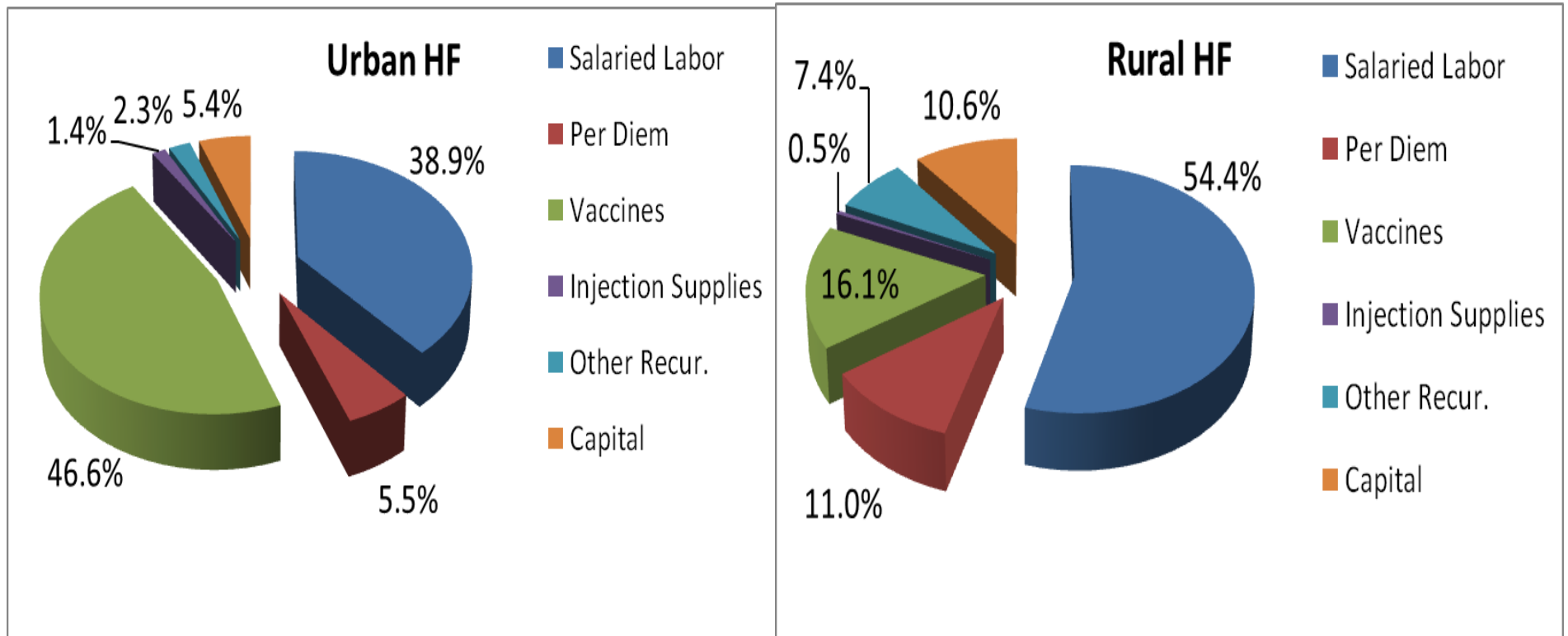
\* significant at 5% level \*\* significant at 1% level . # refers to number of

# FACILITY-LEVEL ECONOMIC UNIT COSTS IN ZAMBIA (\$2011)

Facility statistics and unit costs	Urban (UHC)	Rural (RHC)	All Facilities
Number of facilities (n)	15	36	
Total child doses delivered	13 325	2 974	7 066
Total DTP3 vaccinated Children	1 271	330	702
<b>Total facility costs:</b>			
Cost per dose	3.73	9.43	7.18
Cost per DTP3 vaccinated child	33.38	87.14	65.89
<b>Service delivery costs (excludes vaccine)*:</b>			
Cost per dose	2.43	8.07	5.84
Cost per DTP3 vaccinated child	21.07	74.72	53.51

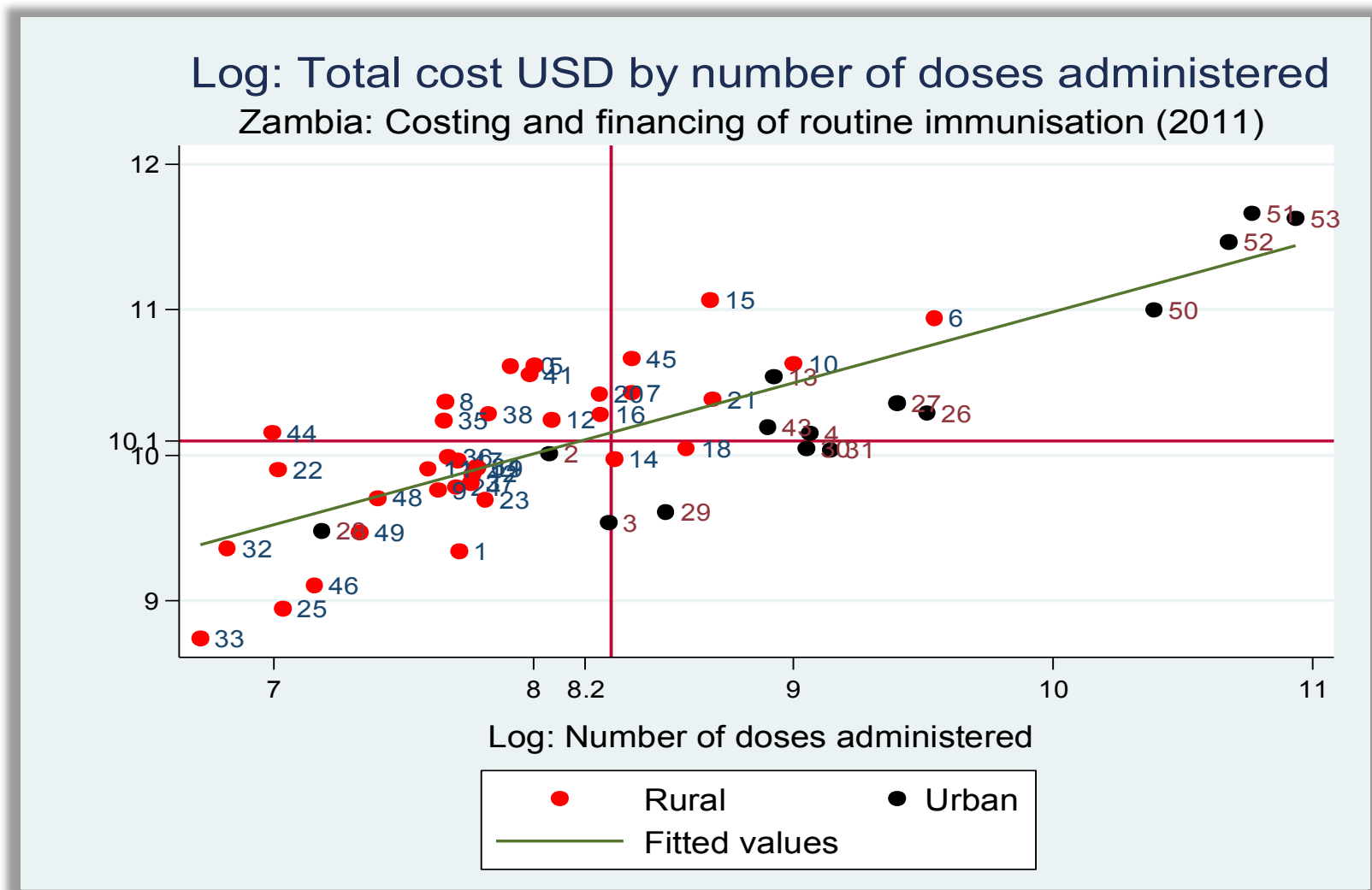
\* Service delivery costs = total facility cost – vaccines – safe injection supplies

# DISTRIBUTION OF COST DRIVERS – URBAN VS. RURAL HF



- UHC: Biggest drivers are vaccines, HR and travel allowances
  - Facility-based services contribute more than outreach
- RHC: HR biggest cost driver; vaccines a lower proportion and lower absolute value; much lower volumes in RHC on average
  - Outreach activities a higher proportion than facility based services
- Capital costs lower than expected

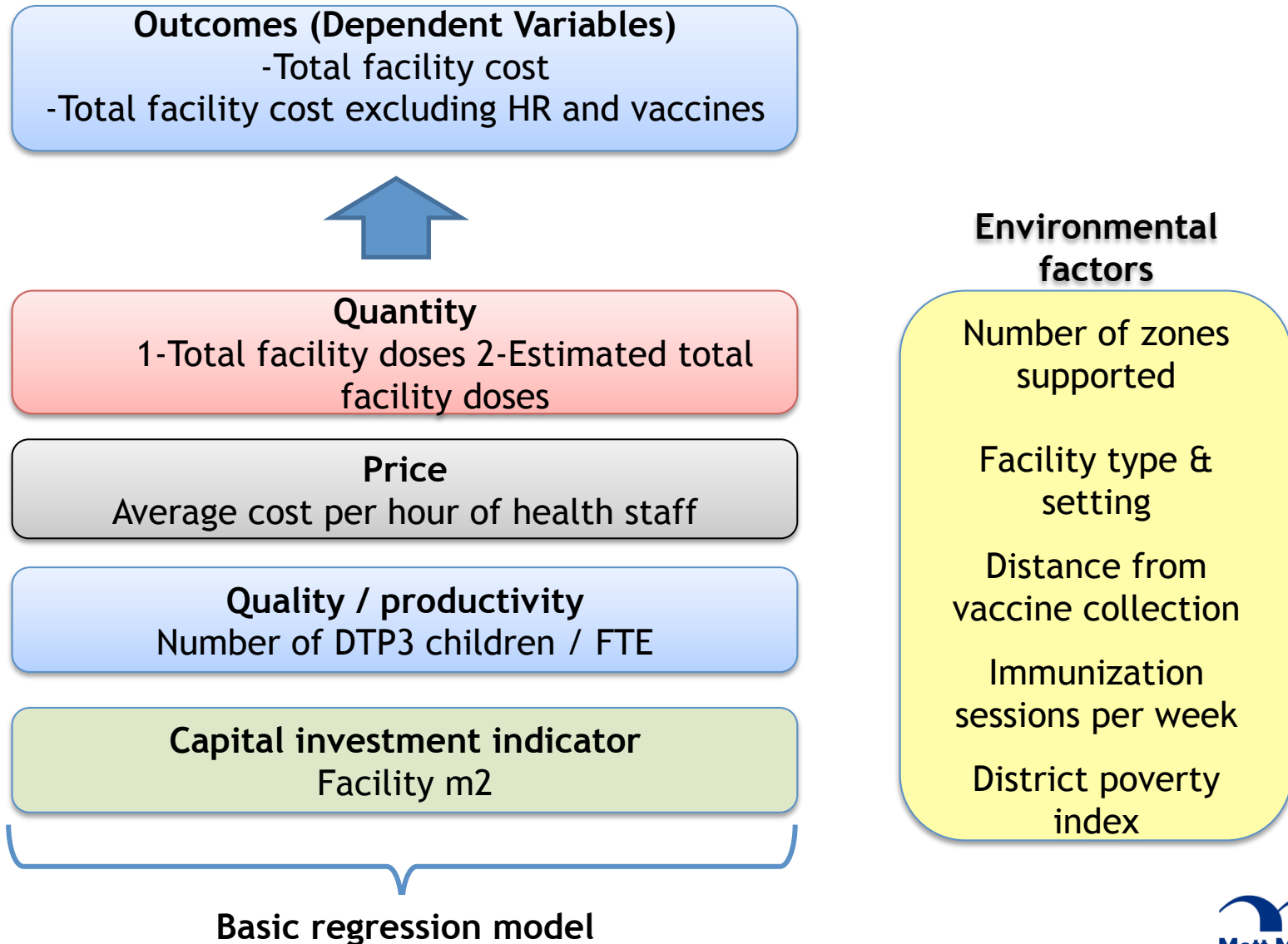
# Total facility costs by total number of annual doses



- UHC appear to generally be more efficient than rural.
- Outliers facilities 15 and 29 illustrate effects of factors such as outreach, distance, staff levels and remoteness



# REGRESSION ANALYSIS - TOTAL COST MODELS FOR ROUTINE IMMUNISATION



## REGRESSION ANALYSIS - TOTAL COST MODELS

	Ln Total facility cost (n=51)	
	Model 1*	Model 4*
Quantity <i>Ln Dose</i>	<b>0.75 (&lt;0.01**)</b>	<b>0.55 (&lt; 0.01**)</b>
Quality <i>Ln DTP3 / FTE</i>	<b>-0.49 (&lt; 0.01**)</b>	
Price <i>Ln cost / FTE Hour</i>	0.17 (0.50)	-0.58 (0.10)
Capital <i>Ln SQM</i>	<b>0.19 (&lt;0.01**)</b>	0.13 (0.11)
Facility type Urban Rural		Ref <b>0.43 (0.01**)</b>
Distance to vaccine collection		-0.01 (0.76)
R-Squared	0.89	0.76

\* significant at 5% level \*\* significant at 1% level

- Model is not predictive if *remove quantity* and introduce *facility type* (R-squared 0.38)
- *Facility type* can represent *size and quality/HR* (model 4)
- Price & distance to get vaccine not associated with total cost in any model

# KEY FINDINGS TOTAL COST REGRESSIONS

## *Total costs excluding HR and vaccines*

- Significant associations remain with:
  - Quantity variable - cost increase up to 4.9% if 10% more doses
  - Size of the facility -up to 6.5% for 10% more m<sup>2</sup>
- Model less predictive when removing quantity variable and introducing facility type
  - R-squared 0.48 vs 0.56. No significant association with facility type if quantity variable removed
- Association with facility type replaces association with quality variable when quantity variable is re-introduced
- Negative association with the price variable – uncertain reason
- Distance to vaccine collection point not significant

# KEY FINDINGS & IMPLICATIONS

1. Valuable information on underlying reasons for variations in outputs and facility level costs
2. Large cost and productivity variation in strata not easily explained
3. Facility type/ setting (RHC and UHC) appear to be proxies for a range of environmental, demand and service factors
4. Models of a) total facility cost and b) total service delivery cost excluding vaccines and labour, produce similar patterns.
  - Large vaccine or HR costs do not obscure other major associations
5. Improved coverage using small RHCs is likely to be costly
  - Higher RHC unit costs seem to indicate inflexible staff costs and low demand. Higher volume improves efficiency but reaches a threshold
6. Regression models may be useful to update immunization planning and budgeting tools, and resource allocation
  - Traditional planning approaches based on e.g. average costs by facility type or average staff cost can potentially be improved

# ACKNOWLEDGEMENTS

- Bill and Melinda Gates Foundation for funding of EPIC studies
- Ministry of Community Development, Maternal and Child Health, Republic of Zambia
- Ministry of Health, Republic of Zambia
- Dr Penny Kalesha, Logan Brenzel, Damian Walker, Darwin Young, Project Steering Committee, data collection and entry team
- GAVI and development partners