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20 Years of Challenging Transition

Analyses of Costs and Financing of the Routine Immunization Program and New Vaccine Introduction in the Republic of Moldova

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

- The methods were derived from a Common Approach developed for this exercise

Country Context

- Population: 3,559,500
- Area: 33,846 km^2
- GDP P/C(PPP): $3,415 (2012)

Health Spending (2011)

- THE-% GDP: 11.7%
- GGHE-%THE: 45.8%
- P/C THE (PPP): $350

Introduction

Organization of immunization services-Facility Taxonomy

- **FMC** - Family Medicine Centres serve a population ranging from 40,000 to 80,000 inhabitants
- **HC** - Health Centres usually established for 4,500 inhabitants
- **OFD –** Office of a Family Doctor serve between 900-3,000 inhabitants
- **HO -** Health Offices serve up to 900 residents

In all primary health care facilities immunization is delivered as a fixed strategy, no outreach activities are being carried out

Methods: Selection of facilities:

Multi-stage stratified random sampling

I stage: selection of districts

- Districts were stratified into three groups by number of total doses delivered in 2011 (Low, medium and high doses administered)

- In each stratum two districts were chosen by a simple random sampling approach

In total 6 districts out of 37 : 2 with low doses, 2 medium and 2 high doses

Methods: Selection of facilities:

- **II stage: selection of facilities**

- Proportions of urban/peri-urban and rural facilities from the total number of facilities in the sampled districts were estimated

- These proportions were applied to calculate the number of rural and urban/peri-urban facilities to be included in the sample

- One peri-urban facility was chosen in each sampled district and three urban facilities were randomly selected in the capital city

- If more than one peri-urban facility existed in a district, simple random sampling approach was used

- Rural facilities were selected using systematic random sampling

In total 50 PHC facilities: 8 urban/peri-urban and 42 rural facilities
5 FMCs, 10 HCs, 23 OFDs and 12 HOs

Methods: Summary of facility selection

District	Sampled Urban facilities	Total Urban Facilities in a District/Municipality	% of total urban facilities sampled	Sampled Rural facilities	Total Rural Facilities in a District/Municipality	% of total rural facilities sampled
Briceni	1	2	50%	7	31	22%
Calarasi	1	1	100%	8	35	22%
Chisinau	3	26	11%	2	9	22%
Leova	1	2	50%	7	32	21%
Ungheni	1	2	50%	17	70	24%
Vulcanesti	1	1	100%	1	4	25%
Total	**8**	**34**	**24%**	**42**	**181**	**23%**

Methods: Data collection

- **Duration:** October 3rd 2012 to January 14th 2013
- Structured questionnaires
- Questionnaires were field-tested and adjustments incorporated
- **Data collection methods:**
  - Key informant interviews
  - Facility observation
  - Record review

EPI Costing

Cost analysis

- Costs were calculated retrospectively for 2011
- Ingredient costing approach
- Financial and Economic costs
  - **Financial cost** -capital costs were annualized using straight line depreciation method
  - **Economic cost-** capital costs were annualized using a 3% discount rate
- Country specific useful life years for different capital items were applied

Cost analysis

Different cost allocation methods:

- **Labour cost-** percentage of staff time spent on immunization in a given facility
- **Cost of vehicles and vehicle maintenance costs** - proportion of km travelled for routine immunization out of total km travelled in 2011
- **Building costs** - proportion of square meters designated for routine immunization (where vaccines are administered, stored) out of total facility space.

Cost analysis

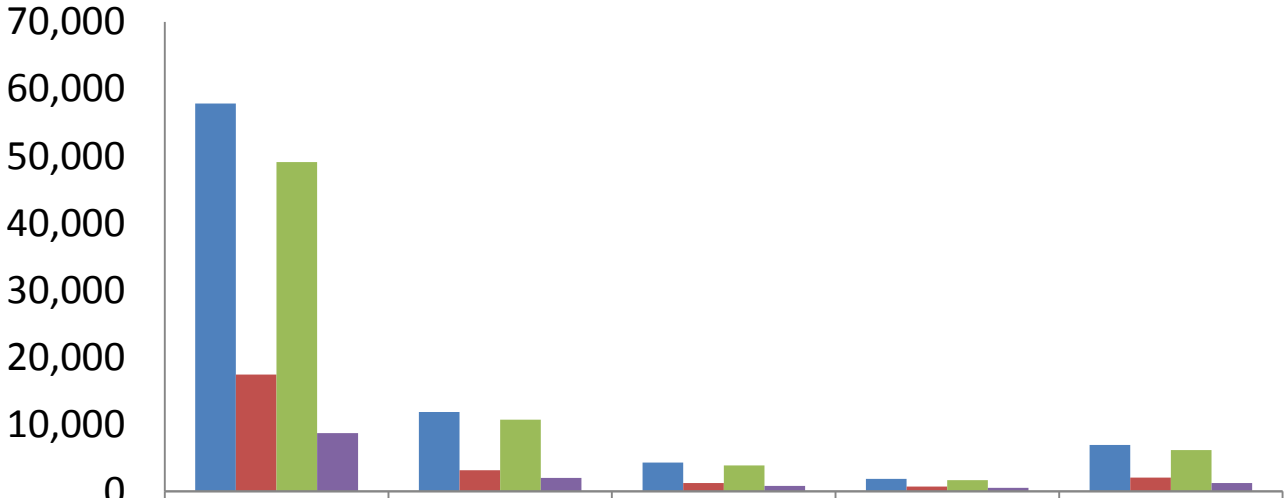
Unit costs:

- ***Total Unit Cost*** **(TUC)-** includes salaries for shared labour
- ***Unit Costs*** **(UC) -**without salaries
  - **Cost per dose delivered**
  - **Cost per FIC**
    - FIC-child < 1, who received DTP 3 doses
  - **Cost per Infant**
  - **Cost per capita**
- **Total Delivery Unit Cost-** Total Unit Cost without vaccines and injection supplies
- **Delivery Unit cost-** Unit Cost without vaccines and injection supplies
-

Results

Total facility costs and their variation

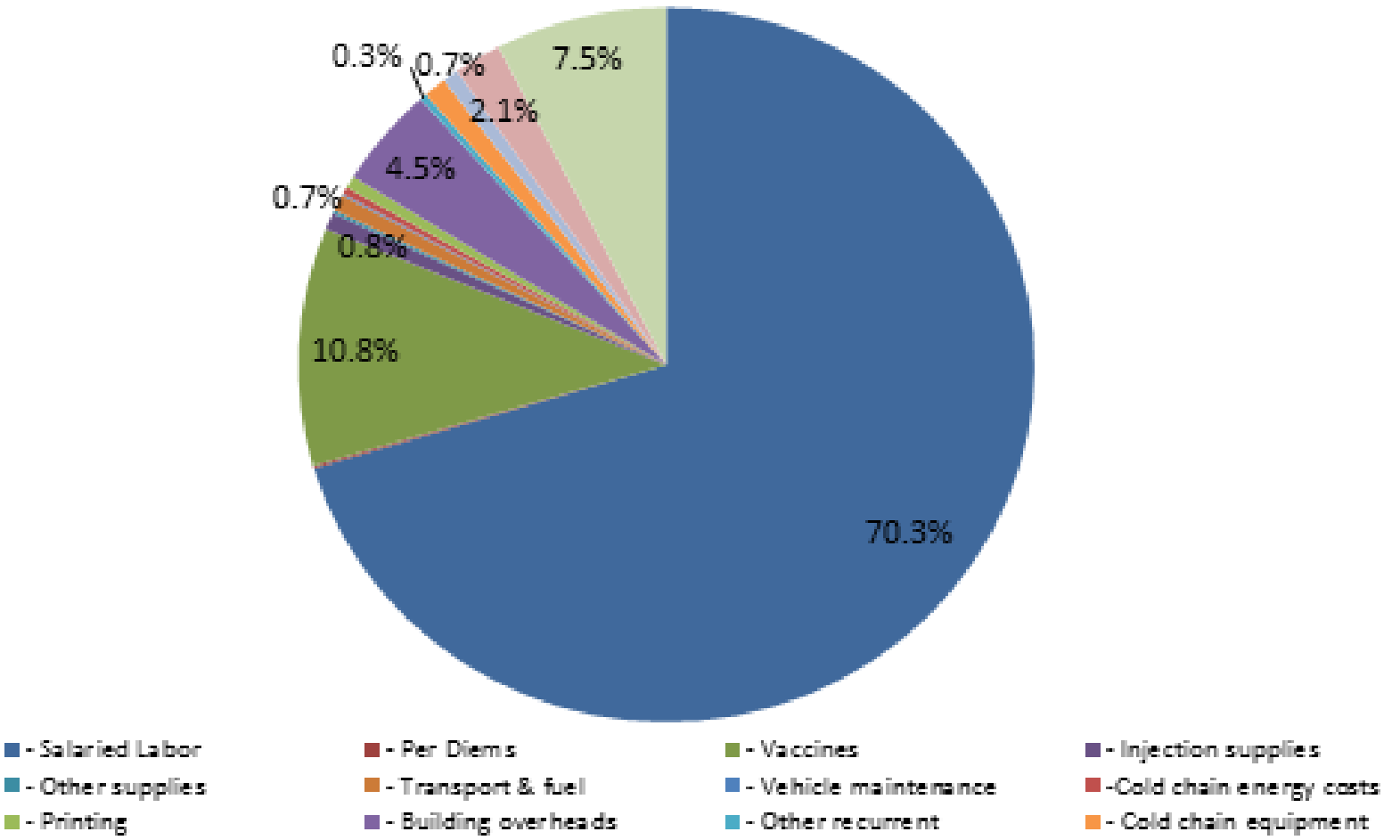
Weighted average total facility economic costs and delivery costs by facility type $2011



	FMC	HC	OFD	HO	Total for all facilities
Total Cost US$	57,869	11,849	4,298	1,881	6,964
Total, Non-HR Cost US$	17,448	3,151	1,264	728	2,066
Delivery Cost US$	49,132	10,715	3,875	1,715	6,160
Total, Non-HR Delivery Cost US$	8,711	2,017	841	562	1,263

The average total facility level immunization cost varied between 1,881$US and 57,869 $US; mean – 6, 964 $US

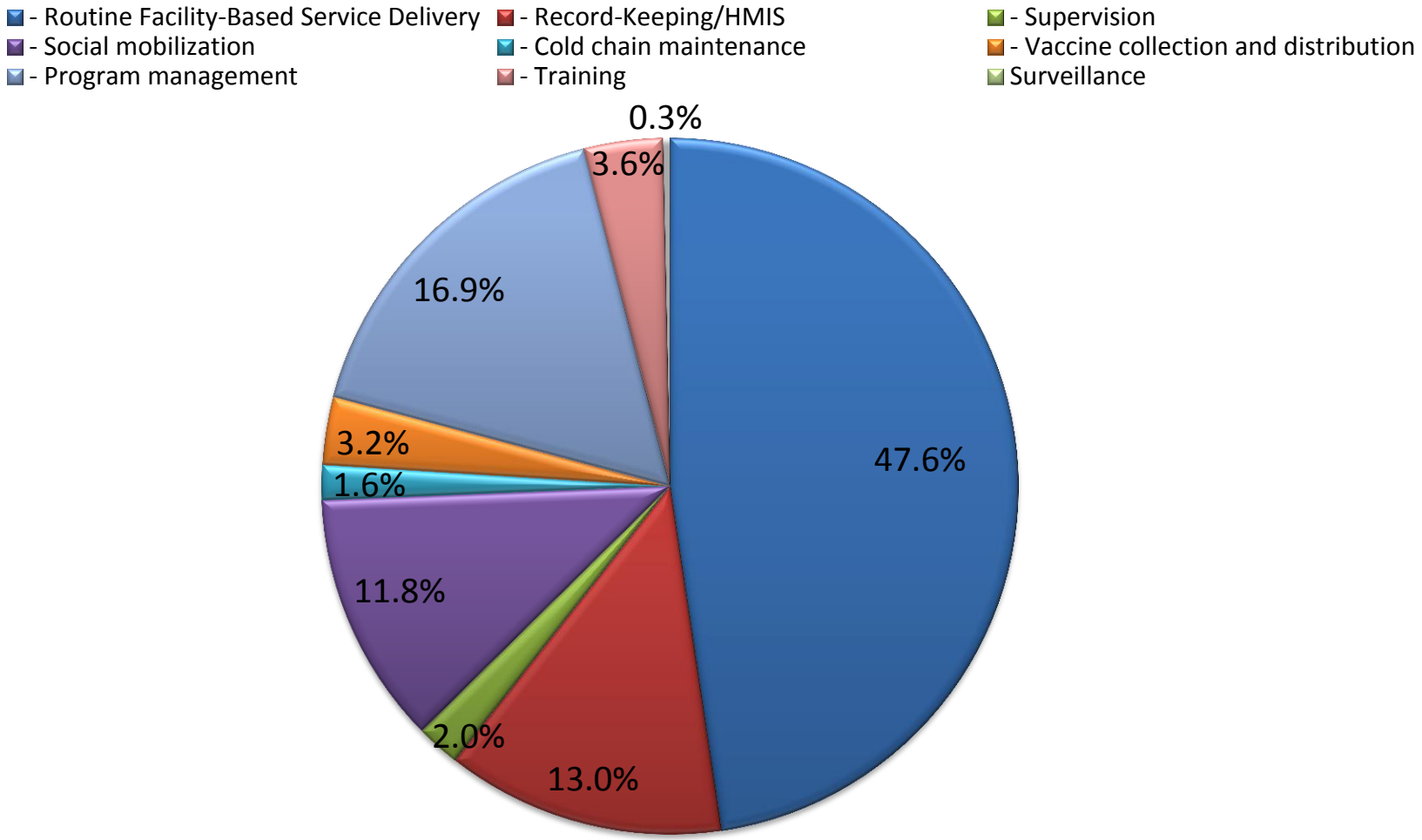
Distribution of total facility level economic costs by line item



Labour cost is a main cost driver-immunization is labour intensive in Moldova

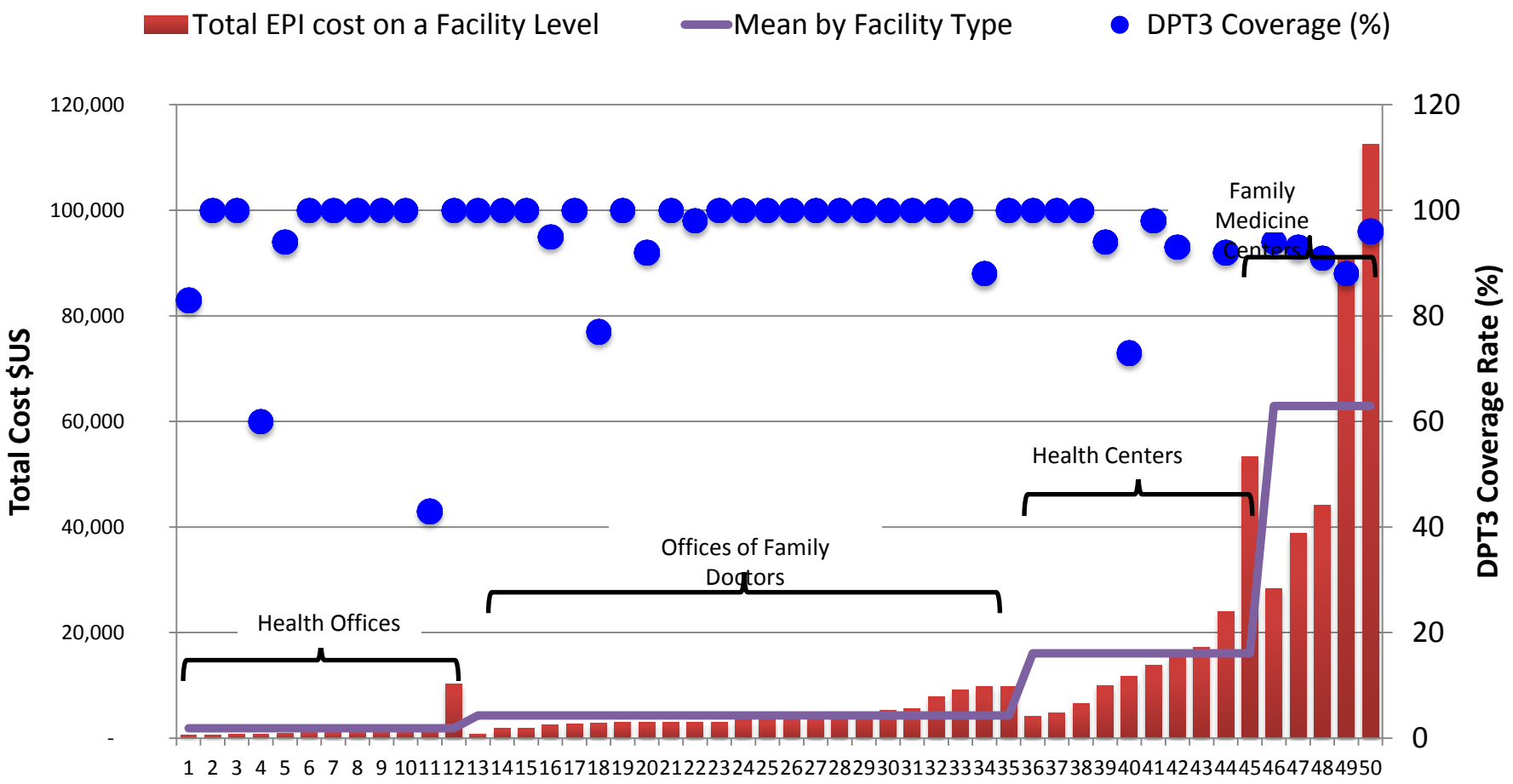
Vaccines are the second largest component of the immunization cost

Distribution of total routine immunization economic costs by activity



Main portion of the costs comes to the facility based service delivery (47.6%), followed by program management (16.9%) and HMIS (13%)

Total economic costs by facility type and average DTP3 coverage (%)



- Total facility cost varied by facility type, size of the facility and number of infants
- Total facility level costs grew from HOs that are the smallest to FMCs that are the largest
- HCs and OFDs achieve the highest DTP3 coverage rate , HOs has poorest performance

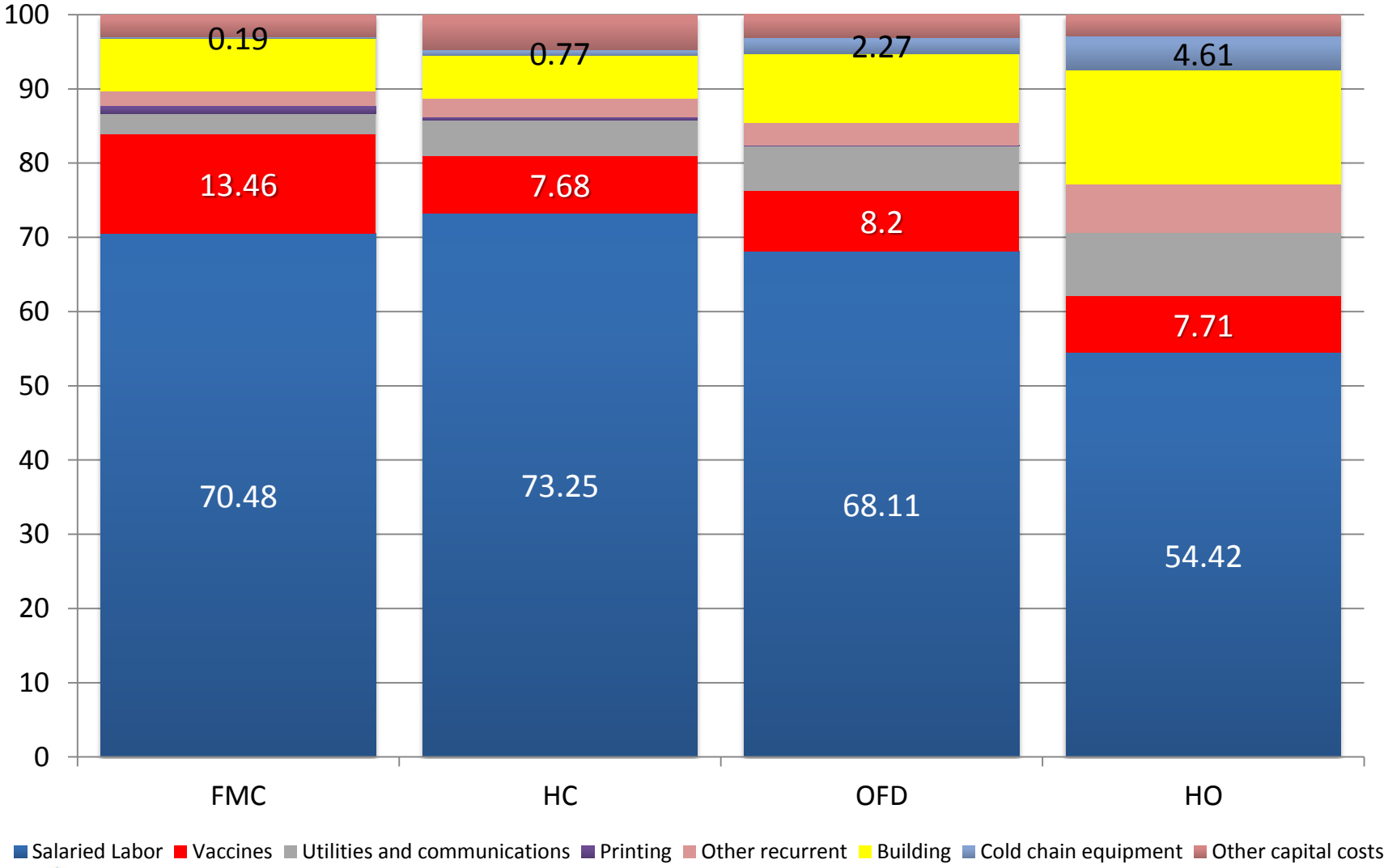
Facility staffing and communities where facilities operate

Facility type	# of infants in catchment area	Population in catchment area	Staffing
FMCs	430 (95%CI: 372-487)	32,616	Doctors and Nurses
HCs	47 (95%CI: 39-54)	3,737	Doctors and Nurses
OFDs	17 (95%CI: 16.1 – 18.3)	1,555	Doctors and Nurses
HOs	7 (95%CI: 6.7-7.9)	535	Only nurses

Results

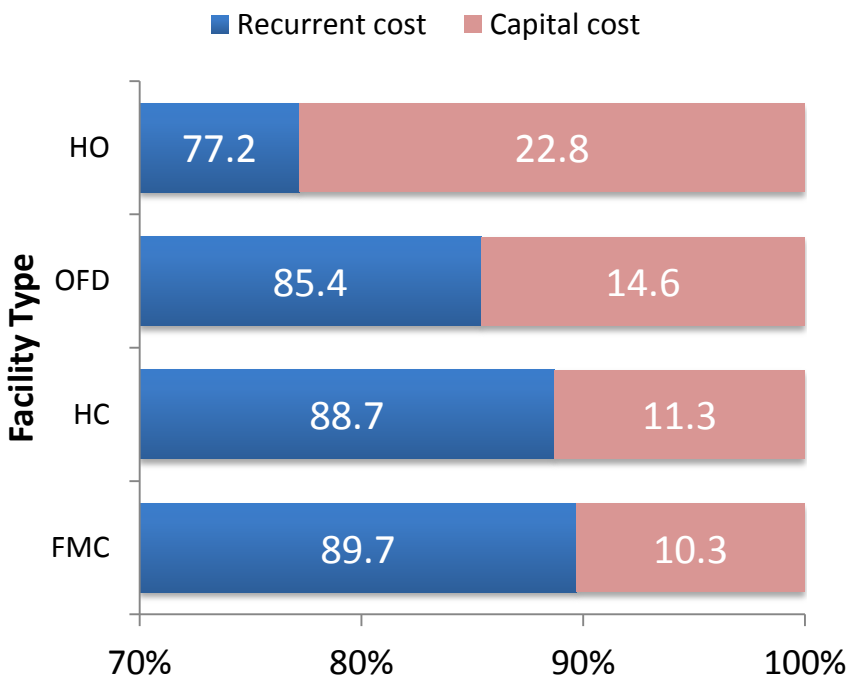
Unit cost structure

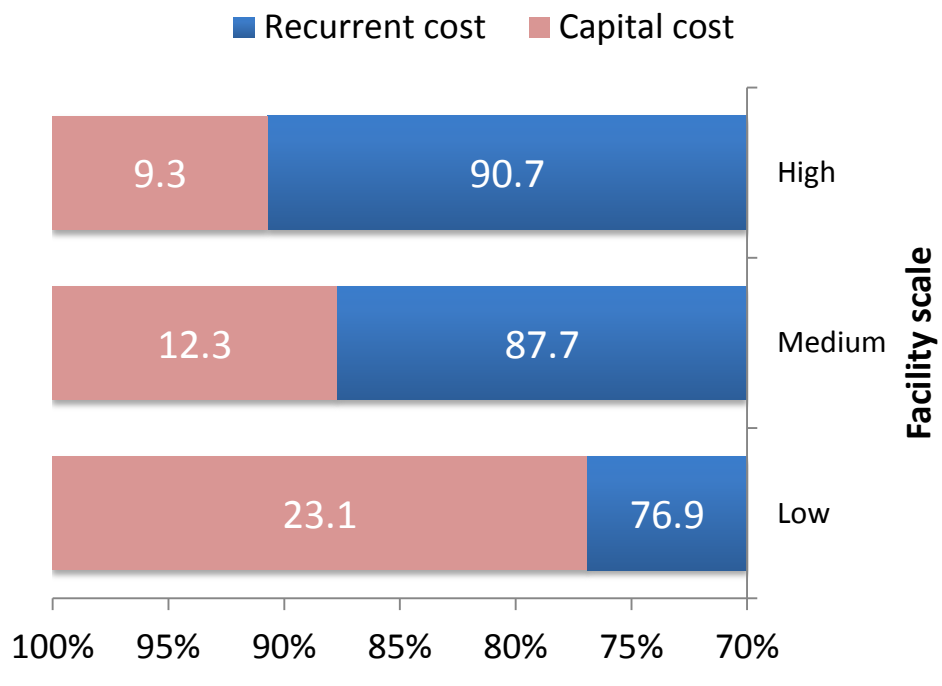
Unit Cost Structure by facility type



Results

Unit Cost Structure by facility type and scale



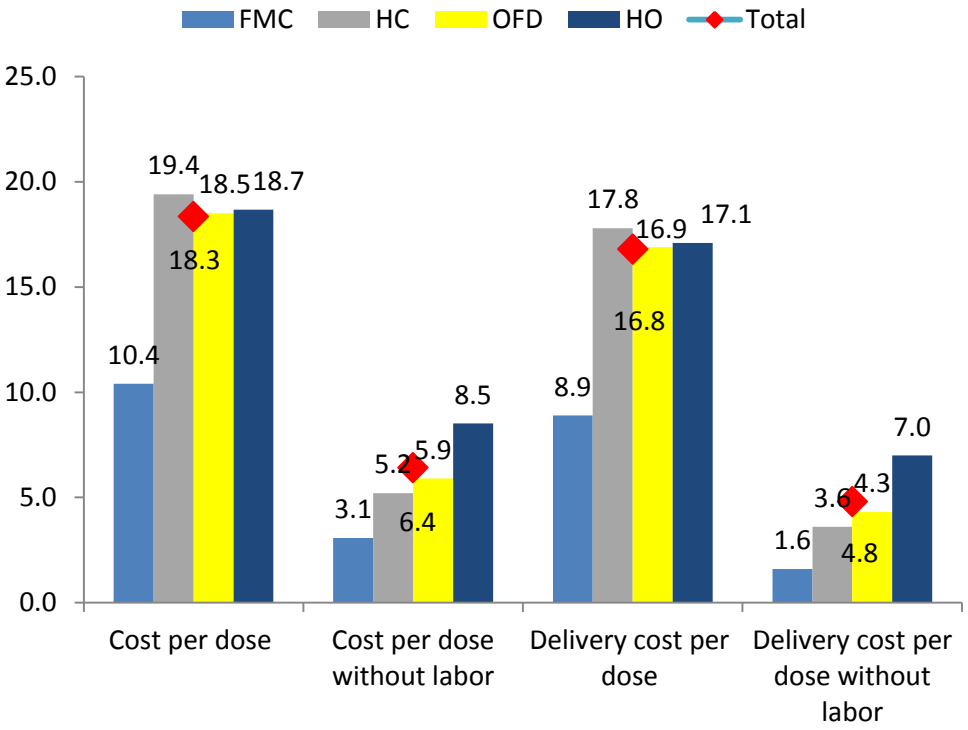


- Share of recurrent and capital costs vary across type of providers and by facility scale
- Share of capital costs in a unit cost of FMCs is lowest and highest in HOs, lowest in high scale facilities and highest in low scale facilities

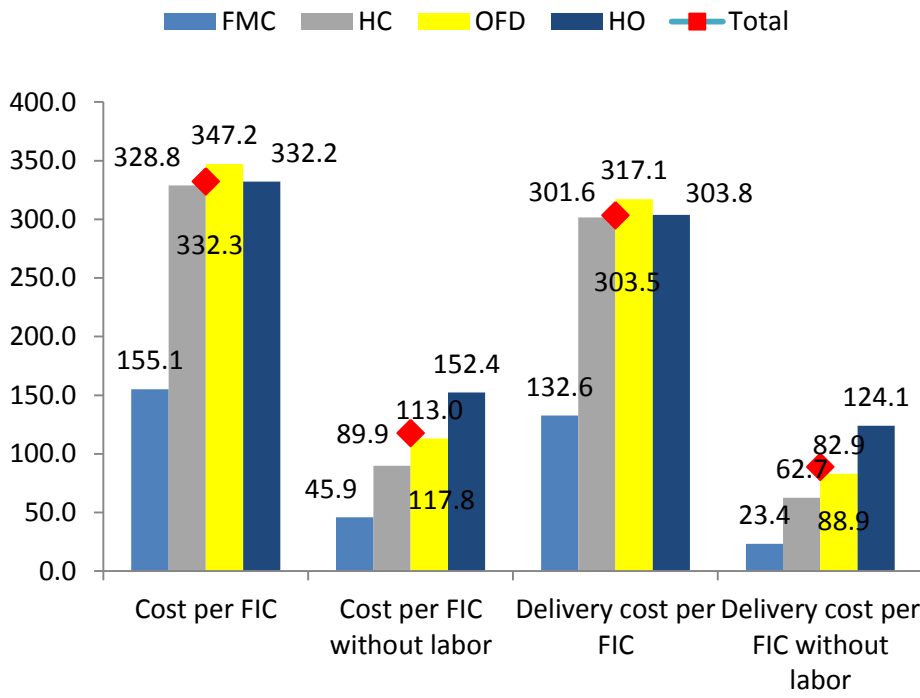
Results

Unit costs and their variation

Economic cost per dose by facility type

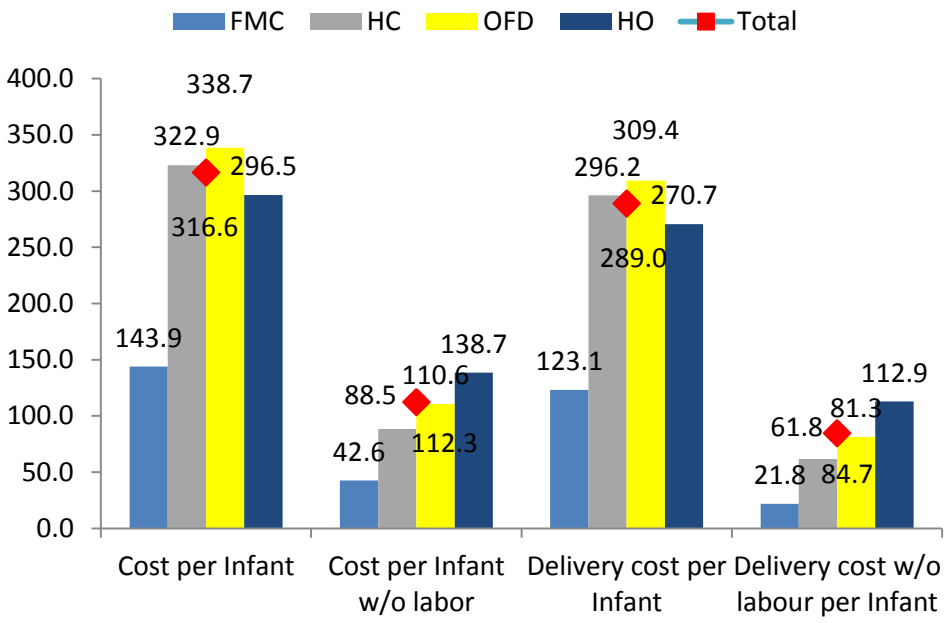


Economic cost per FIC by facility type

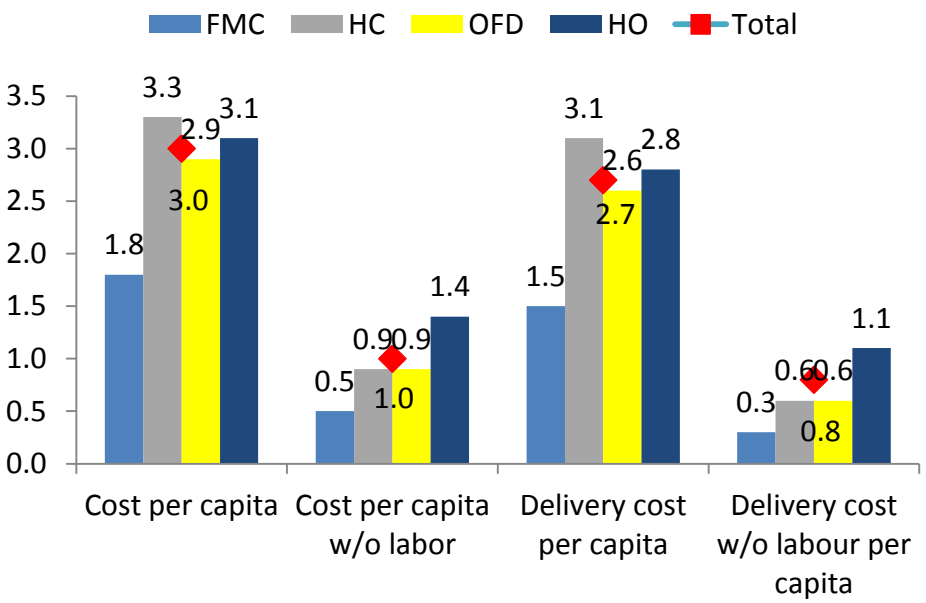


- Unit costs increase when facility size declines- statistically significant only when shared labour costs are removed
- Mean costs in HCs and OFDs are in the same range and almost two times higher compared to unit costs in FMCs.
- Contribution of labour costs in the unit cost declines in smaller facilities

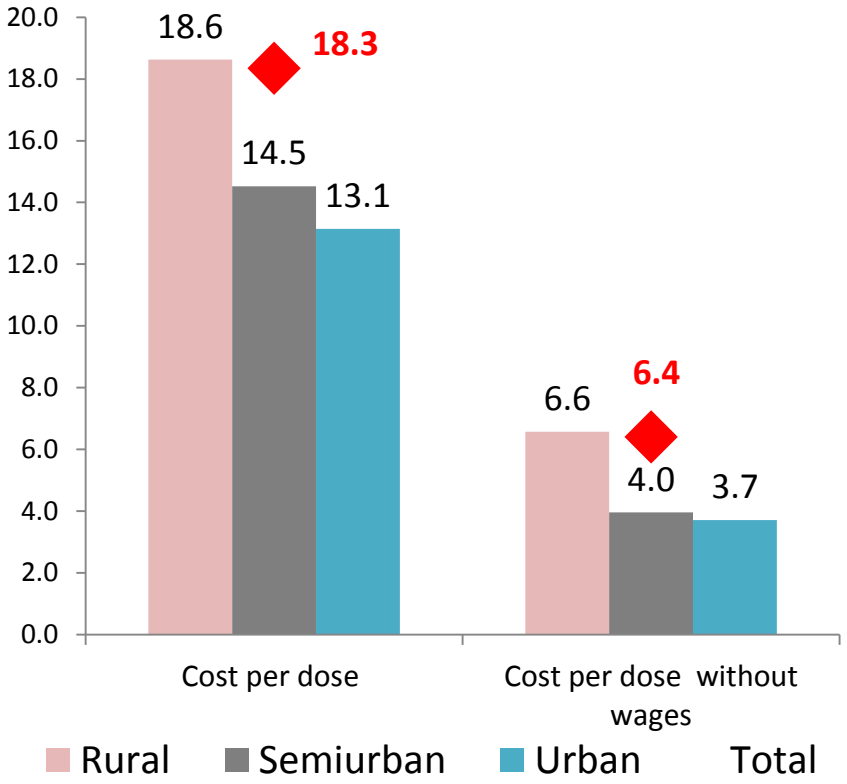
Economic cost per infant by facility type



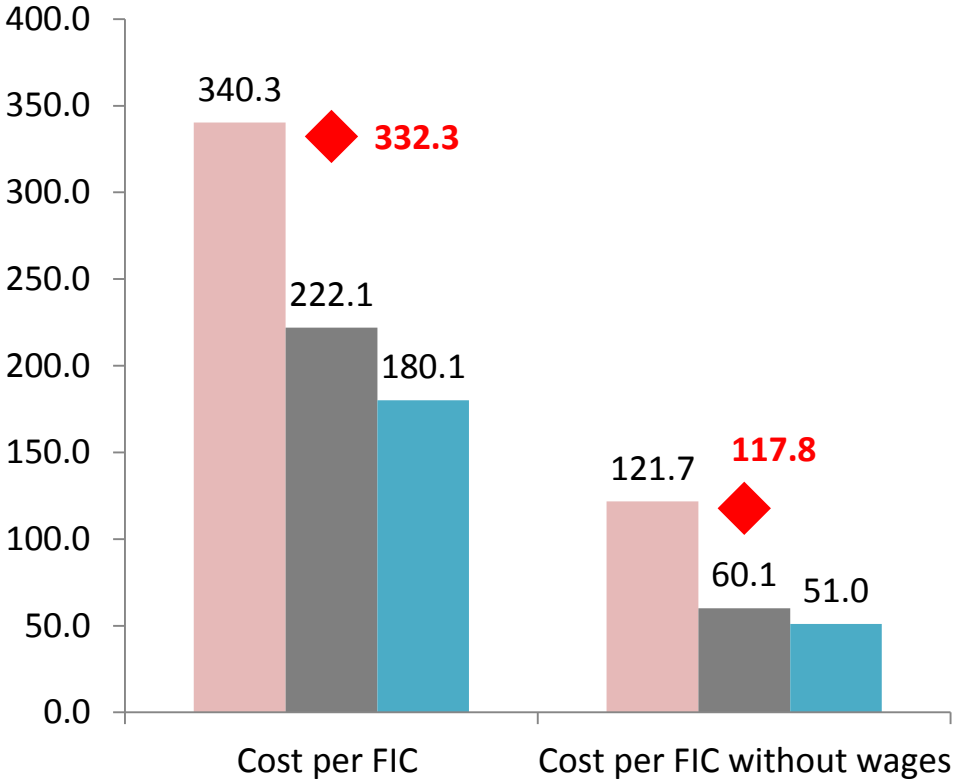
Economic cost per capita by facility type



Cost per dose by location

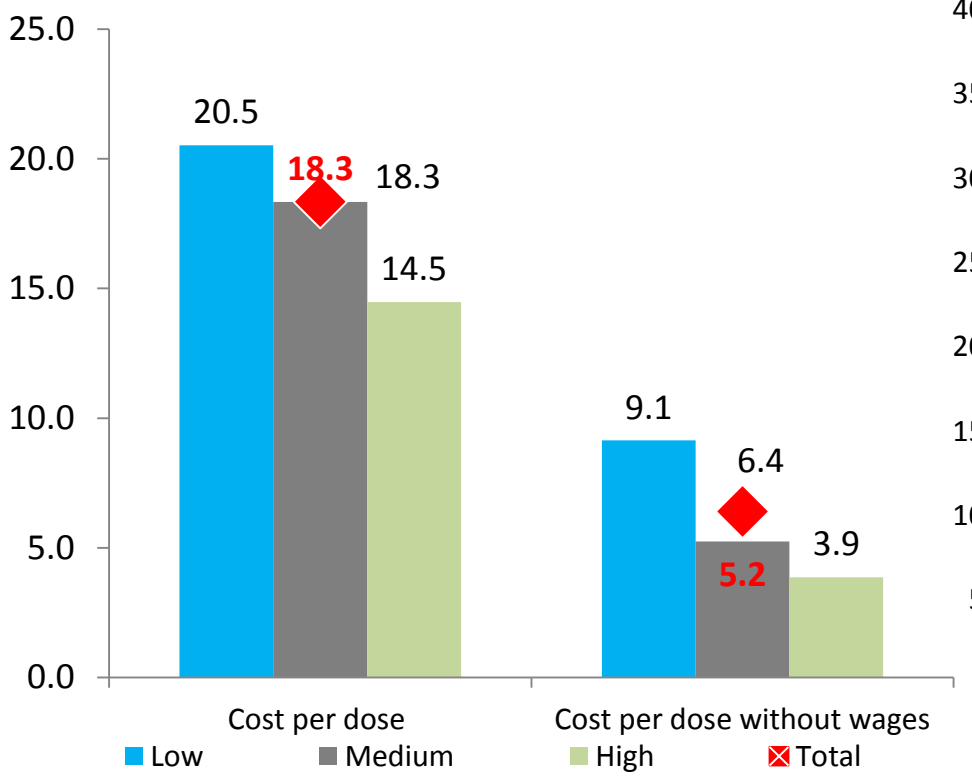


Cost per FIC by location

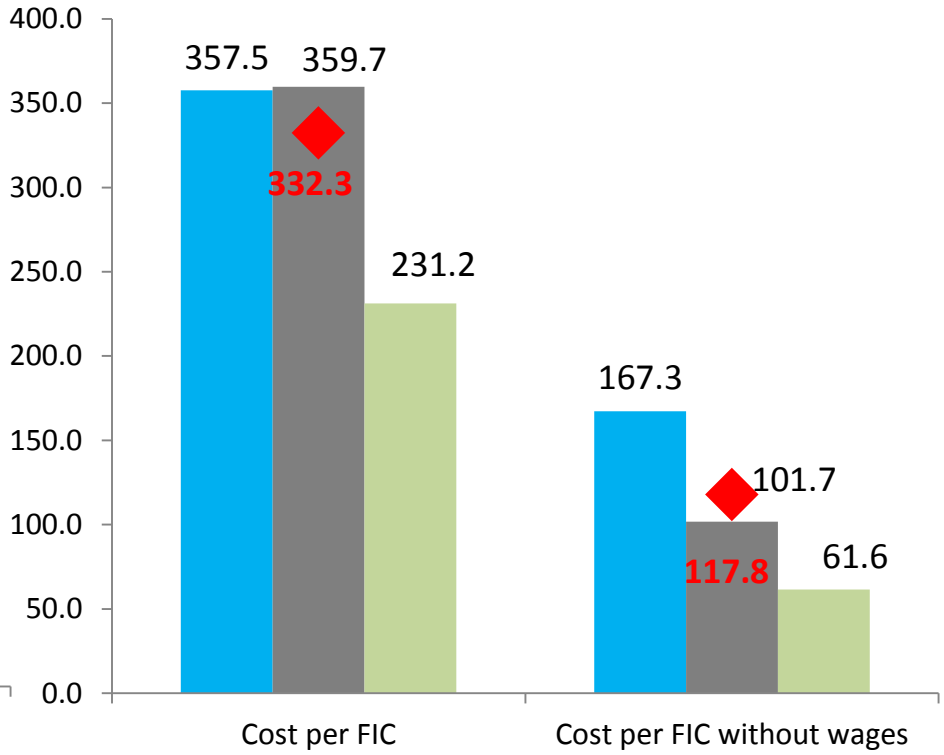


- **Unit costs decline from rural to urban facilities but differences are not statistically significant**

Cost/dose by facility scale $2011

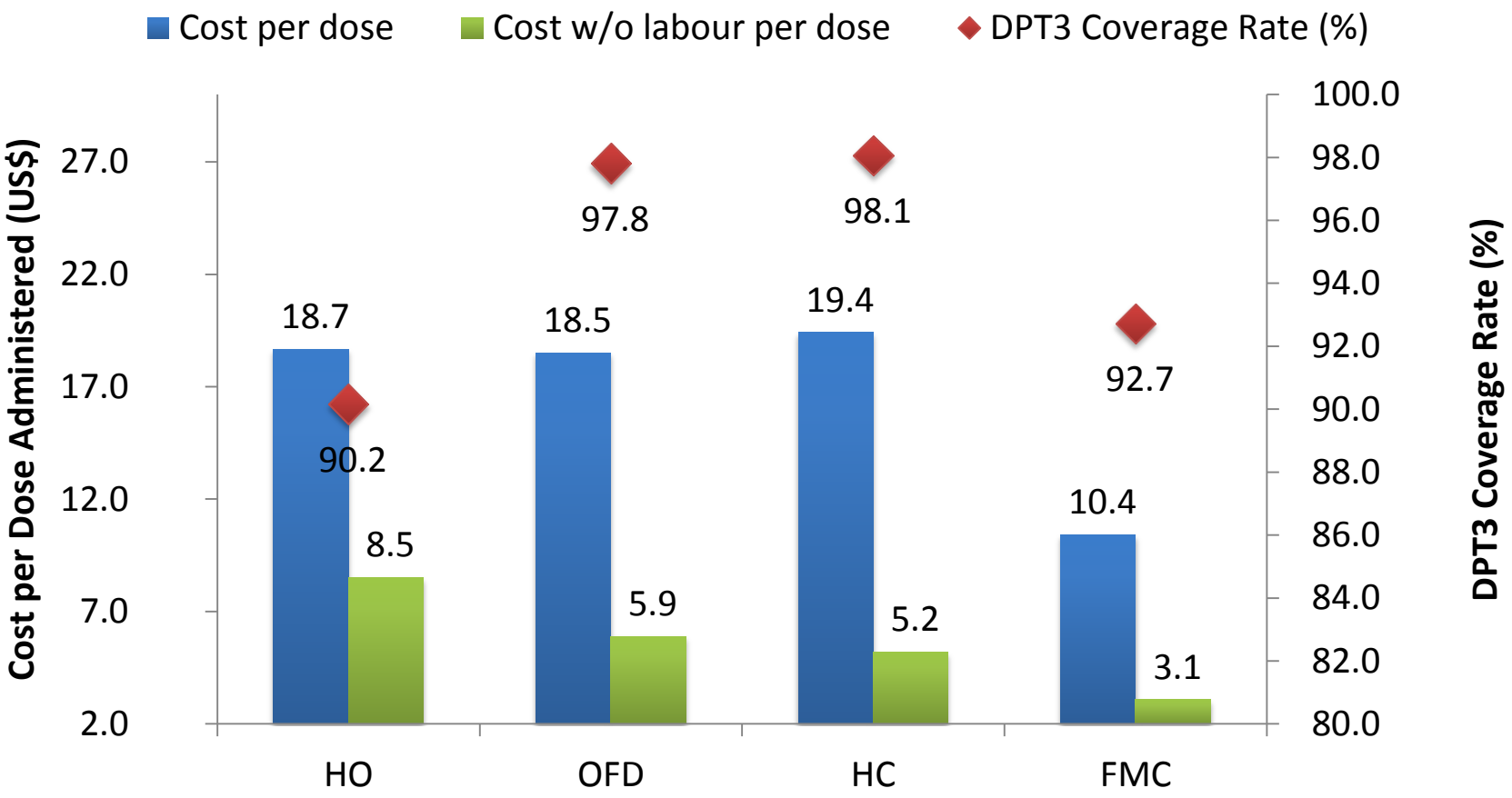


Cost/FIC by facility scale$2011



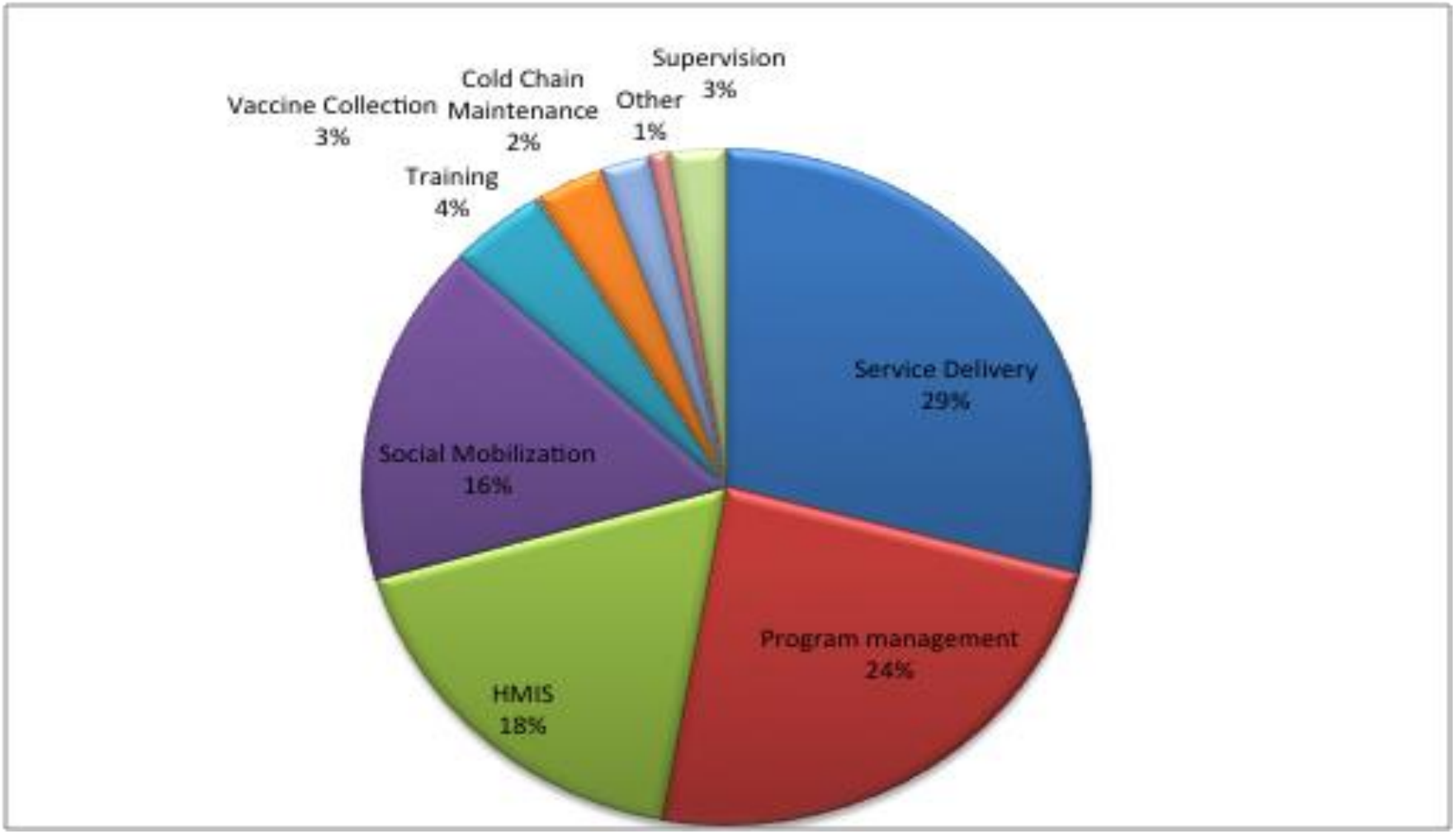
- The higher the scale the lower unit costs.
- When shared labour cost are considered difference in unit costs between facilities with low and medium scale is marginal.
- When shared personnel costs are removed difference increases and becomes statistically significant (at 99% level)

Unit Costs and Immunization Program Performance



- HCs spend highest amount per dose but also achieve highest coverage rates
- HOs spend comparable amount per dose with OFDs and HCs, but have lowest DTP3 coverage
- FMCs deliver immunization at a lowest cost per dose, but coverage is relatively low

Staff time by immunization specific functions for the sample



COST AGGREGATION

Cost Element	Economic Costs	Financial Costs	Difference
Average facility cost without vaccines and injection supplies	$ 6,160	$ 5,906	$ 254
Total number of facilities in the country	1318	1318	
Total facility level immunization program cost without vaccines and injection supplies	$ 8,119,394	$ 7,784,266	$ 335,128
Average district cost without vaccines and injection supplies	$ 14,497	$ 13,360	$ 1,137
Total number of districts	37	37	
Total district cost without vaccines and injection supplies	$ 536,404	$ 494,335	$ 42,069
National cost without vaccines and injection supplies	$ 142,063	$ 132,489	$ 9,574
Cost of vaccines and injection supplies	$ 1,058,706	$ 1,058,706	-
Total National level immunization economic cost with vaccines and injection supplies	**$ 9,856,567**	**$ 9,469,796**	**$ 386,771**

Main Conclusions and Policy Implications

Main conclusions

- Labour inputs are significant cost drivers of a unit costs and consequently to the total cost of the immunization program
- Vaccines are the second major component of the cost
- Unit costs are related to the size and scale of the facility
  - Unit costs decline
    - From rural to urban facilities, but not significant
    - From smallest to largest facilities
    - From low scale facilities to high scale/Facilities with a grater scale are able to deliver services more efficiently
- Smaller facilities seem to utilize capital less effectively compared to bigger facilities

Main conclusions

- Facility characteristics have influence on facility performance measured by achieved DTP 3 coverage

  - Small size of catchment population allows HCs and OFDs to better identify, plan and follow-up infants and achieve higher coverage rates

  - Due to large size of catchment population FMCs may face challenges in finding and immunizing children

How to increase effectiveness?

•**Context:** Moldova is focusing on increasing health system efficiency through various means, including infrastructure optimization

•**Based on our study findings** reducing staff time spent on immunization could help increase efficiency of the program

- Delegating certain immunization related tasks from doctors to nurses
- Reducing time spend on management and/or record-keeping functions→ **design and include immunization modules in new e-health system that is being developed**

How to increase coverage?

✓ Place more importance on FMCs rather than HOs

- Increasing coverage in HOs will be **more costly** and **marginal impact on the overall program performance will be minimal** due to low number of children covered by these facilities and also low number of underperforming facilities

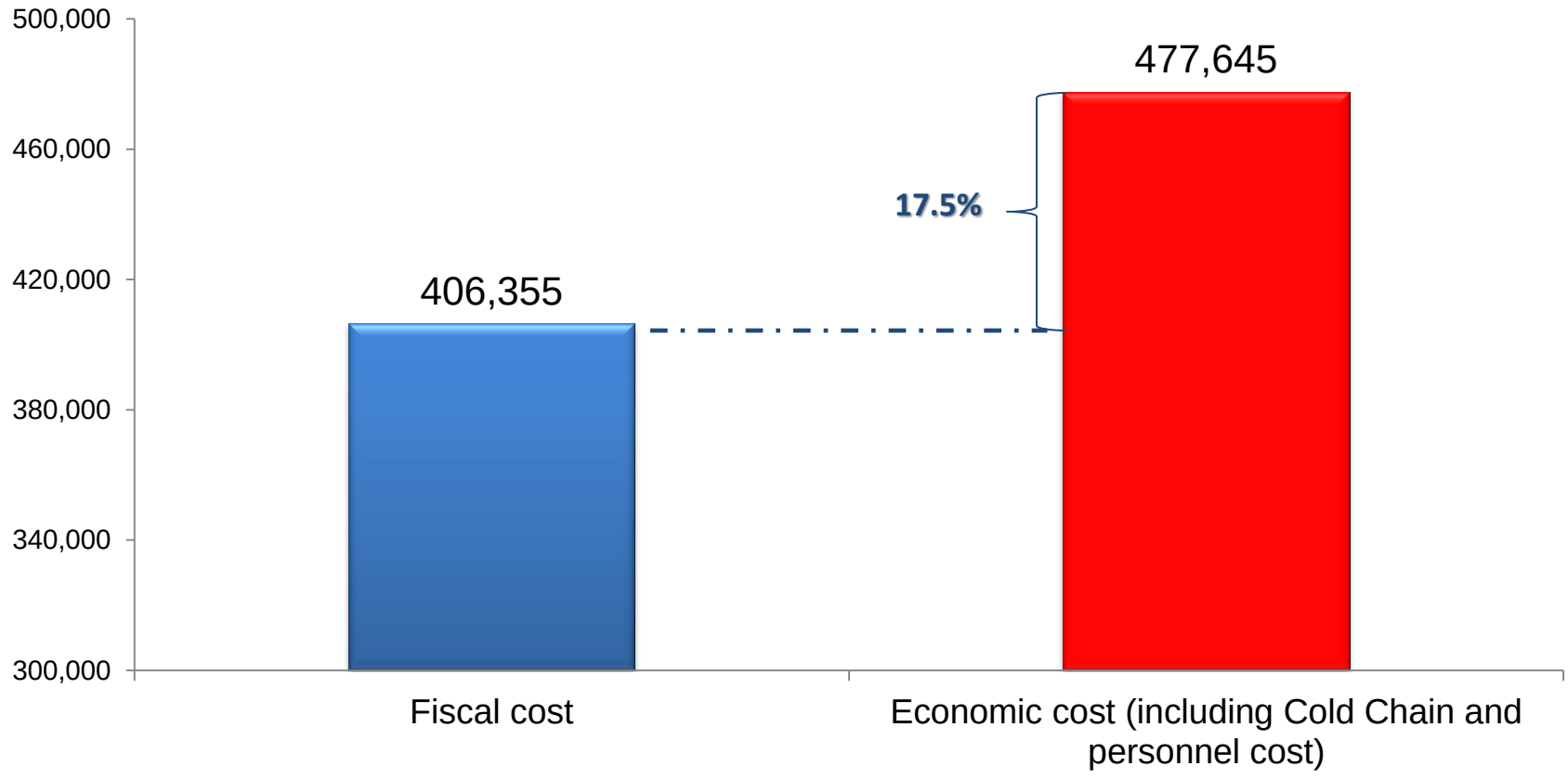
- Improving performance of FMCs will be **less costly** due to lowest cost per dose and per FIC **and overall impact on the national program performance is expected to be greater**

NUVI COST

Introduction

- Rotarix –one dose vial vaccine was introduced in July 2012
- Price per dose-2.5 $ US
- Prospective costing
    - Costs were estimated based on data six month prior and six month after introduction
- Fiscal/actual payment and Economic costs

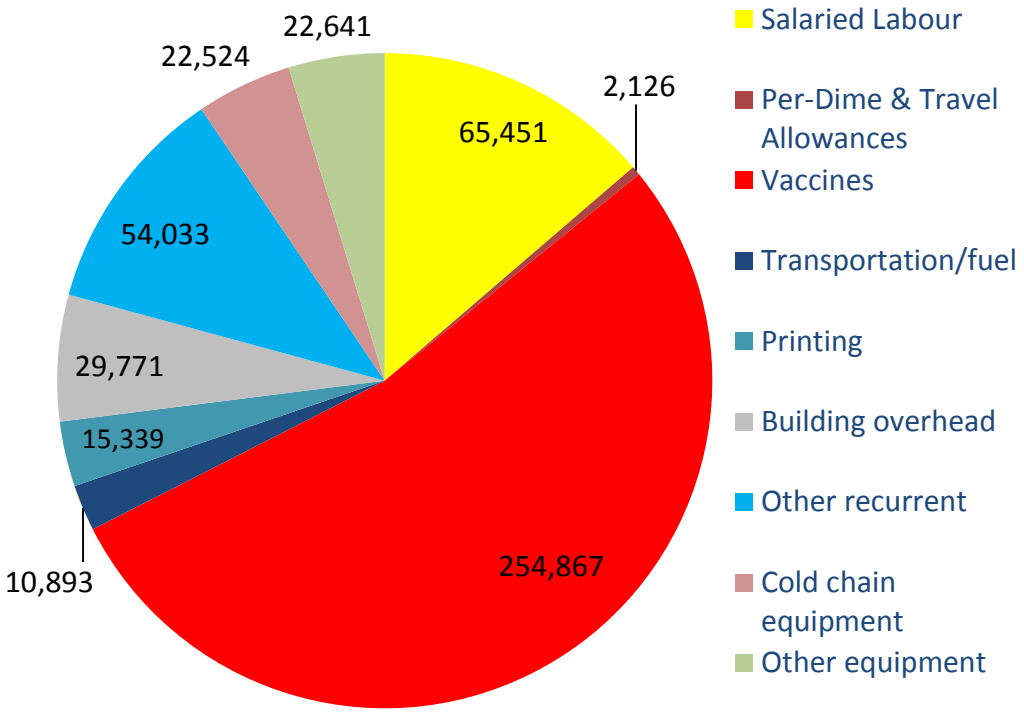
Fiscal and Economic Costs of Rota vaccine Introduction ($US)



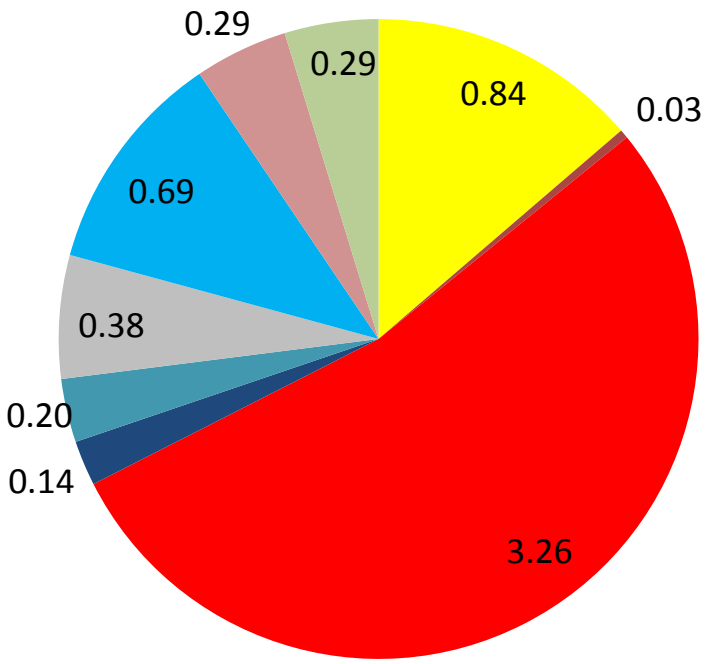
- **Fiscal cost for Rota introduction was marginal due to available spare capacity of cold chain and human resources on a PHC**
- **Out of the total incremental fiscal costs, only 151,489$ (37%) spent on immunization delivery and the remaining 63% used for vaccine procurement**

Rota vaccine introduction economic cost by line item

Total economic cost $ US

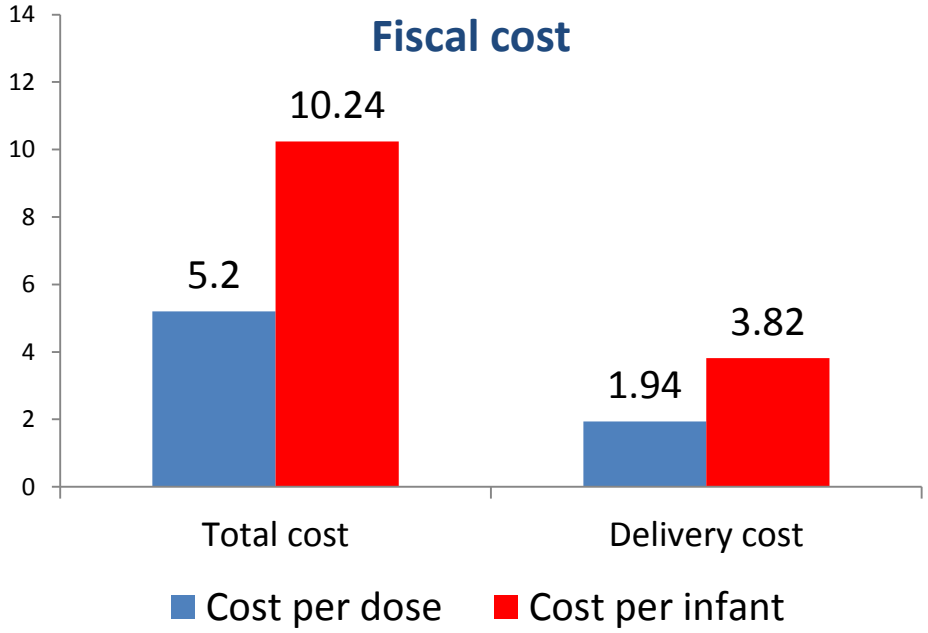


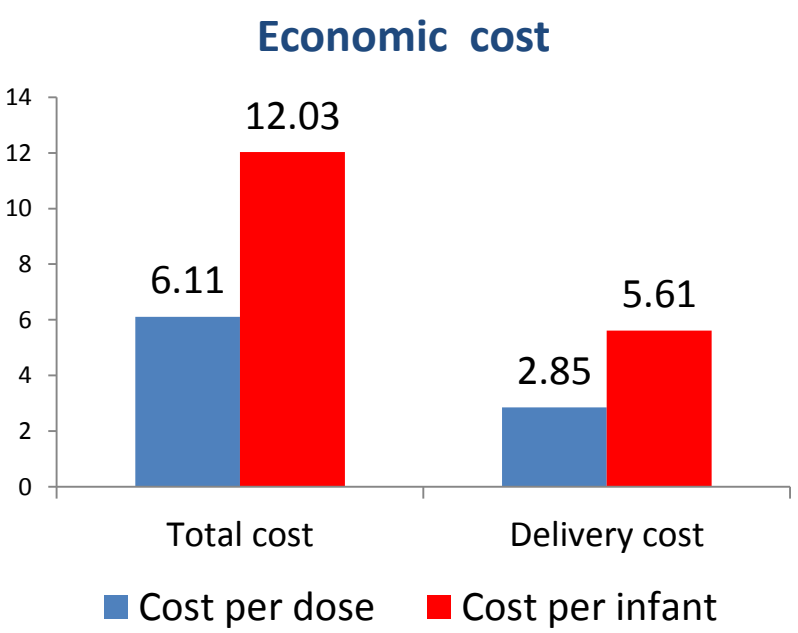
Economic cost per dose $ US



Vaccine costs are the main cost drivers of the NUVI cost

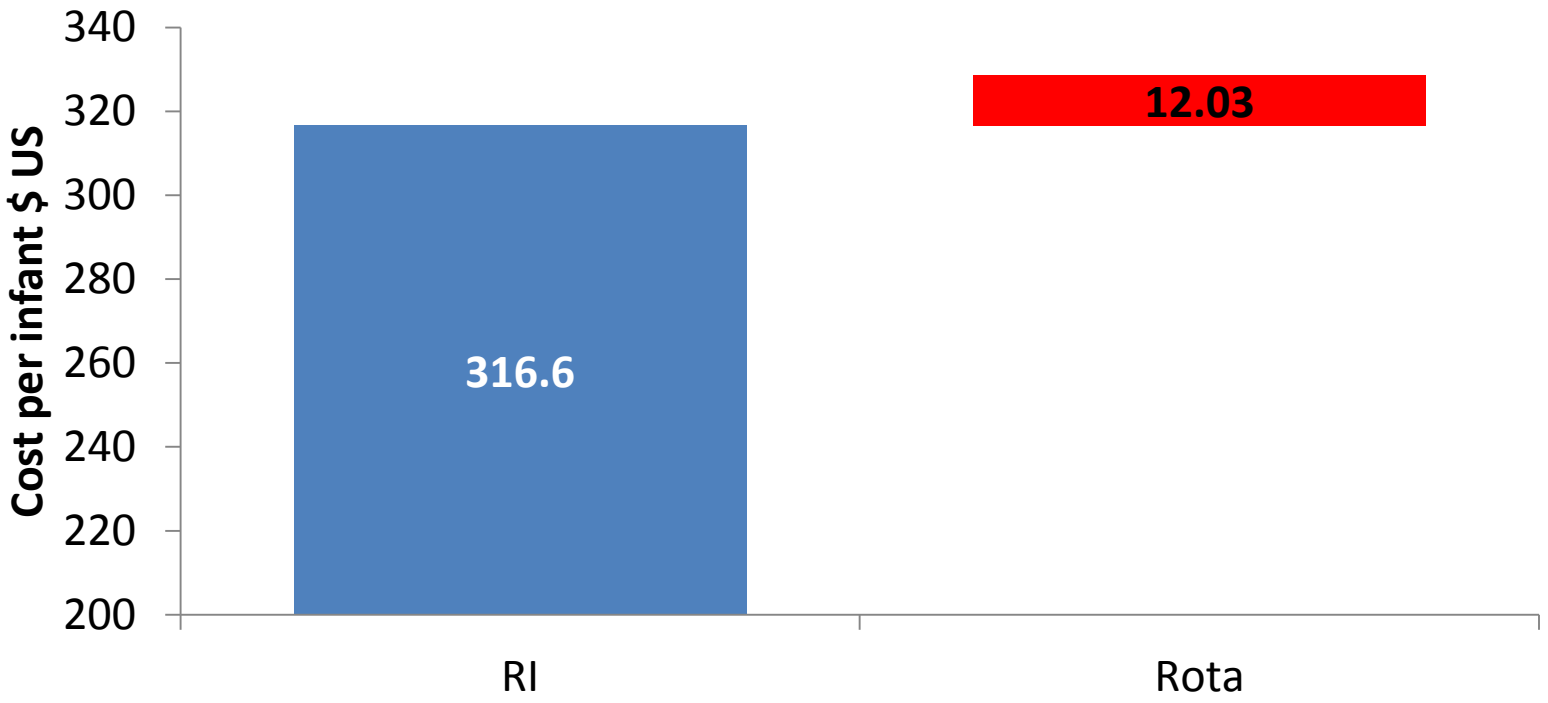
Fiscal and Economic cost per dose and Cost per Infant





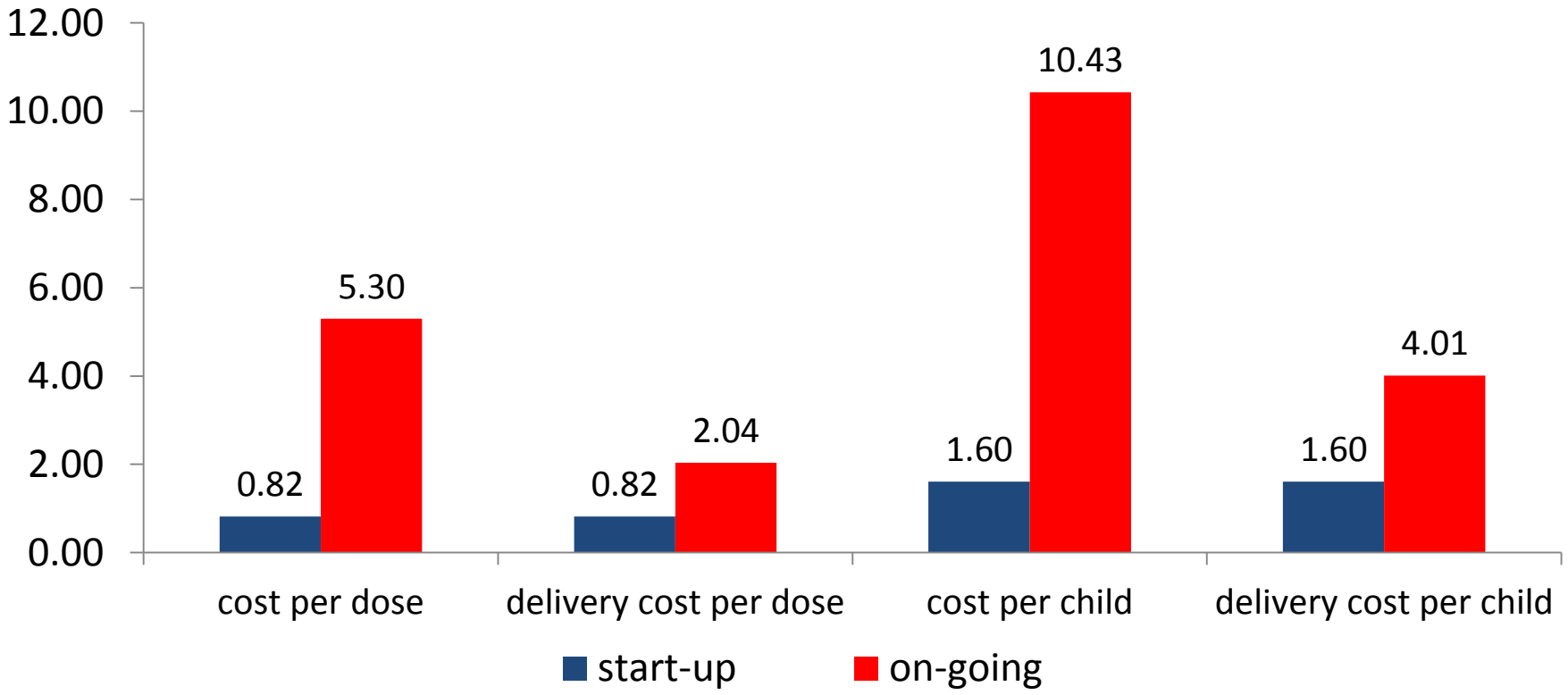
Incremental fiscal cost per infant (without vaccine) estimated at 3.82 $ is 4.7 times higher than 80 cents established per infant under GAVI vaccine introduction grant policies

Economic cost per infant for RI and NUVI



Economic cost per infant went up to 12.03 $US (including vaccine costs), which is a 3.8% increase in the current estimated cost per infant of the national immunization schedule of $316.6.

Start-up and on-going economic costs per dose and per infant $US



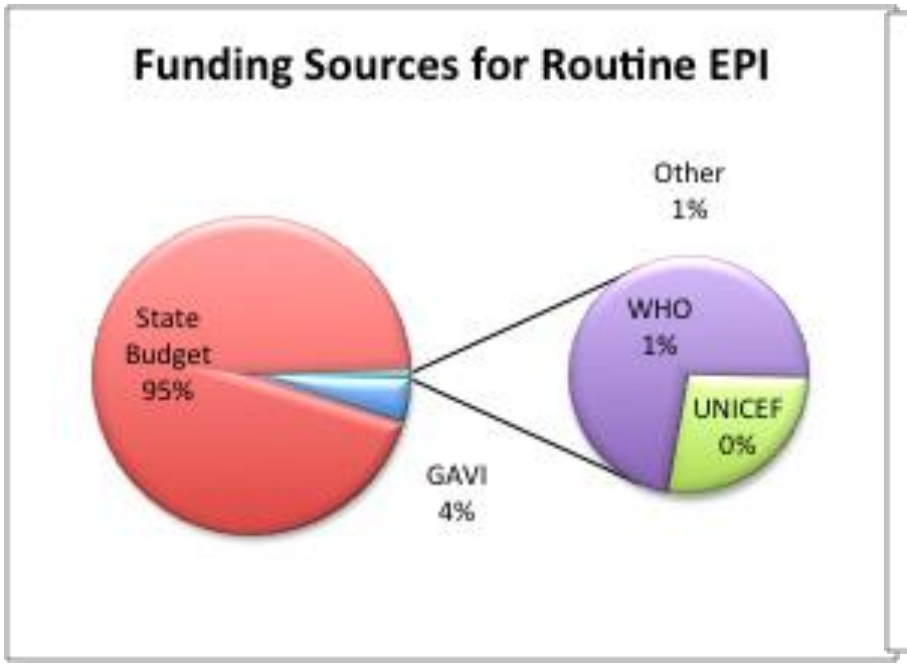
Share of the on-going costs in the total incremental unit costs is 86% and this share decreases to 71% when vaccine costs are not accounted.

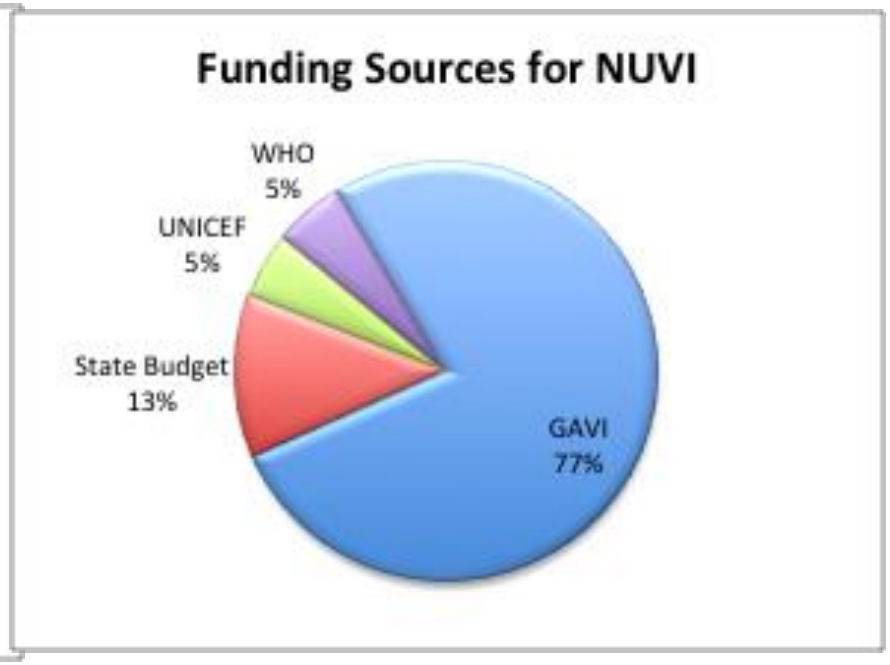
Comparison of study results with the Plan and VIG

- **NUVI Plan**-227,000 $ US
- **Vaccine Introduction Grant**-100,000 $ US
- **Costing study**-151,488 $ US

Actual expenditure was less by 33% than estimated financial requirements and by 51% more compared to vaccine introduction grant

Funding the Routine Immunization and NUVI





- Reliance of the RI on external funding is marginal, however
- When labor costs are removed, the role of external funded increases up to 20%
- 87% of the Rota introduction is funded by donors

Major Conclusions

1. incremental fiscal cost per infant (without vaccine) was estimated at 3.82 $ is 4.4 times higher than 80 cents established per infant under GAVI vaccine introduction grant policies

2. Rota vaccine introduction costs in Moldova were low because the country had spare cold chain capacity on the national and district level and was able to meet increased vaccine volume needs without additional investments

3. The largest driver of new vaccine introduction is cost of vaccine - 63%. Therefore, any reduction in suppliers' prices resulting from positive market dynamics will be beneficial for new vaccine introduction.

What is important to consider when designing new policies?

Context: Moldova is considering reforms after graduating from the GAVI. Namely, it may decentralize vaccine procurement responsibilities due to mandates imposed in the national legislation/regulation.

Based on our findings: centralized model of immunization service delivery, when national level controls the prices/costs of centrally provided or regulated inputs seems most effective

Decentralization in vaccine purchase and delivery may increase overall EPI costs significantly

Sustainability Issues/ what is important to consider when graduating from GAVI?

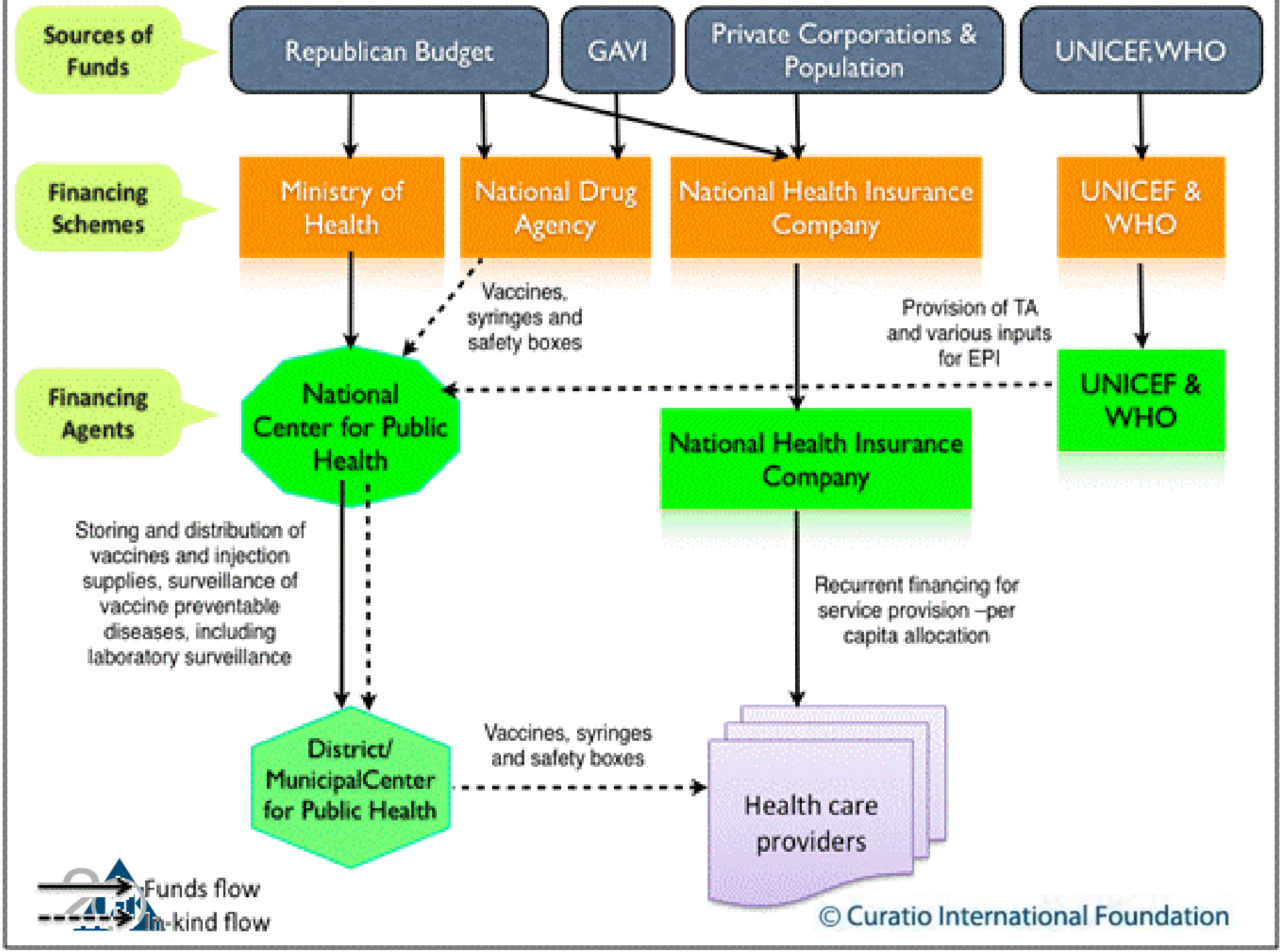
- The total cost of the immunization program amounts to only 2.4% of recurrent public financing for health

- After Moldova graduates from GAVI, due to New Funding Model country will also receive significantly reduced financing for its national HIV/AIDS and Tuberculosis programs

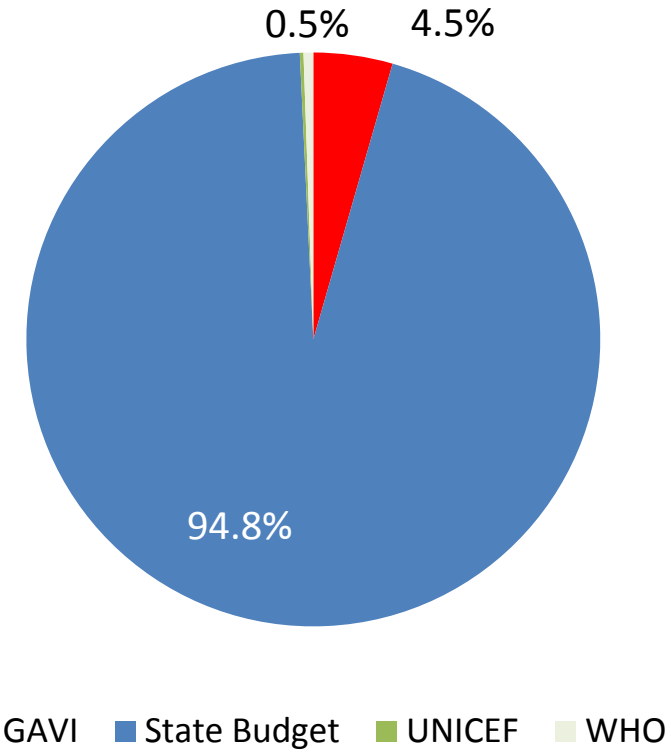
- The concurrent reduction/graduation from the GF and GAVI is expected to increase pressure on the national budget significantly
  - by 2.4 times in 2016 compared to 2011 level

- limited fiscal space and weak economic growth prospects could pose significant challenges for the government during the coming years and may put at risk adequate financing of the immunization, TB and HIV/AIDS programs

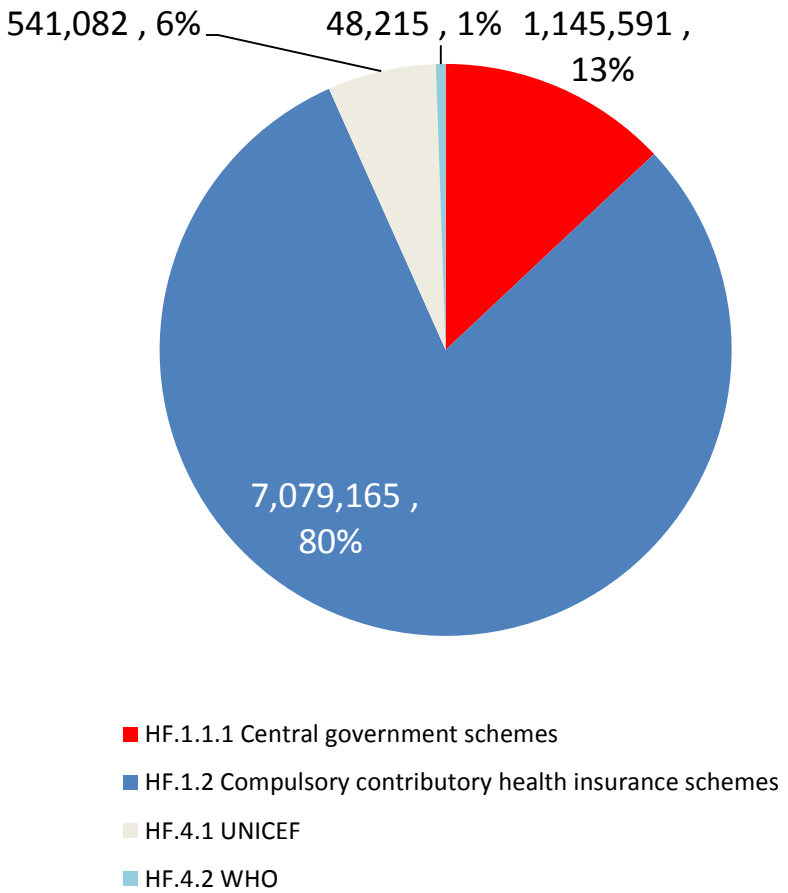
Financial flow analysis


Sources of Funds
Republican Budget
GAVI
Private Corporations & Population
UNICEF,WHO
Financing Schemes
Ministry of Health
National Drug Agency
National Health Insurance Company
UNICEF & WHO
Vaccines, syringes and safety boxes
Provision of TA and various inputs for EPI
Financing Agents
National Center for Public Health
National Health Insurance Company
UNICEF & WHO
Storing and distribution of vaccines and injection supplies, surveillance of vaccine preventable diseases, including laboratory surveillance
Recurrent financing for service provision –per capita allocation
District/ MunicipalCenter for Public Health
Vaccines, syringes and safety boxes
Health care providers
Funds flow
In-kind flow
© Curatio International Foundation

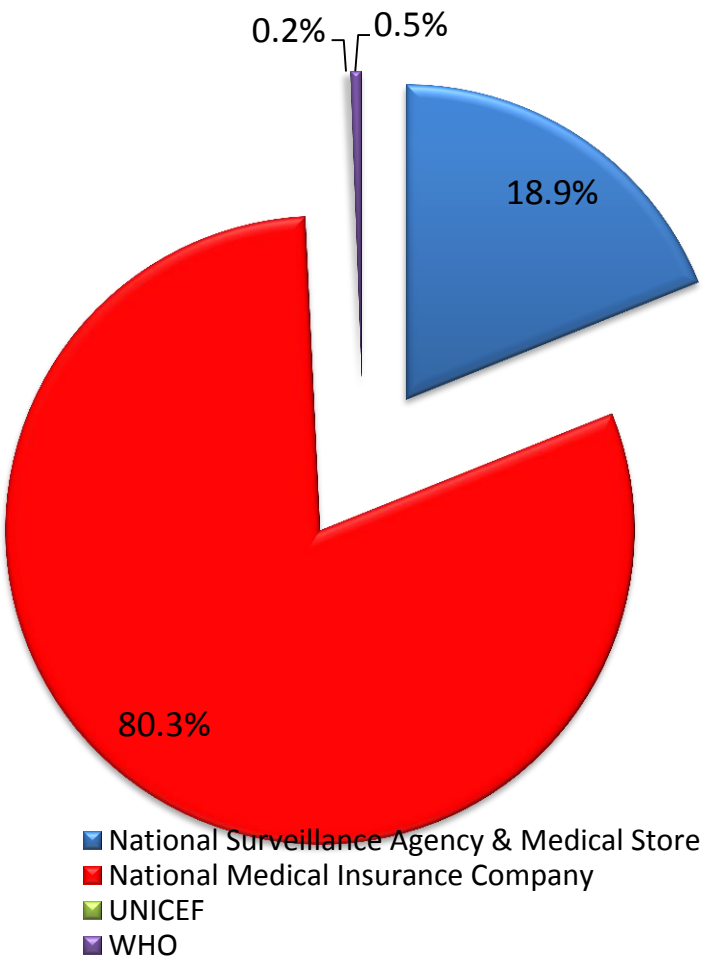
Sources of Funds



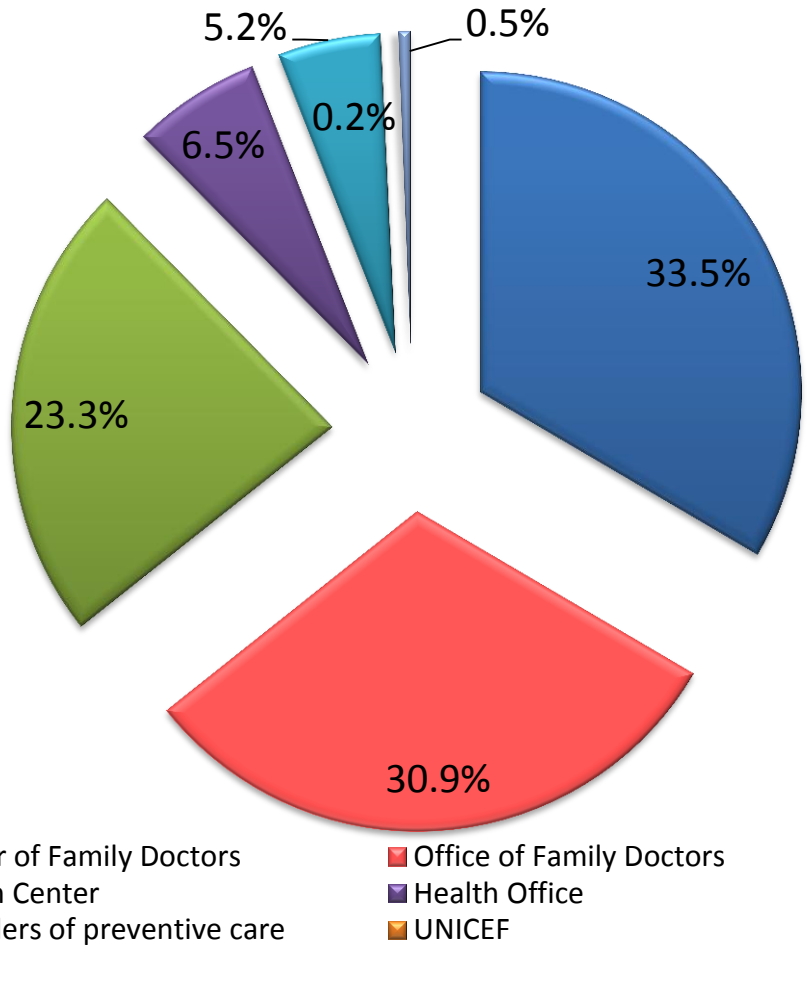
Financing Schemes



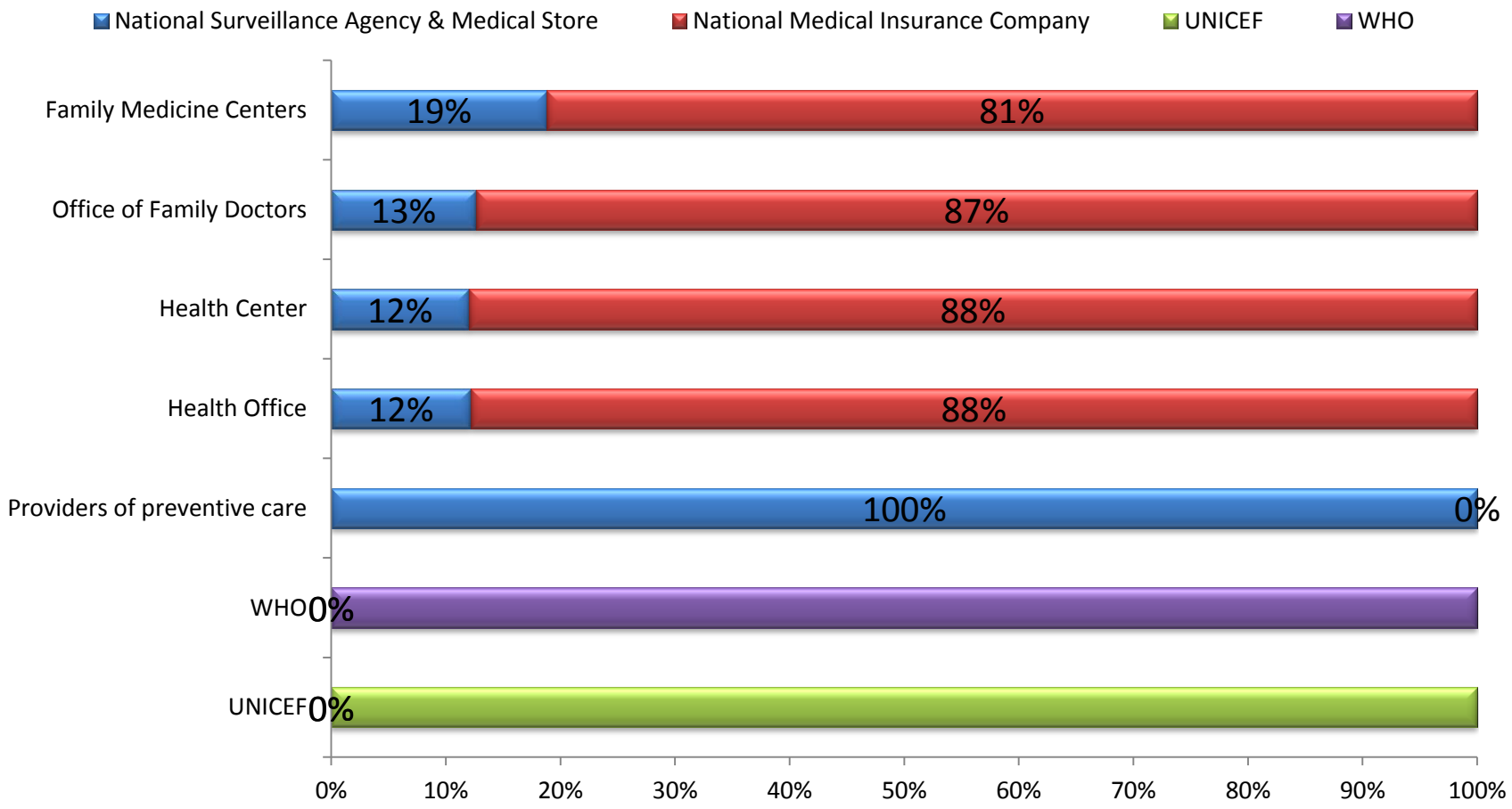
Financing Agents



Providers of Services

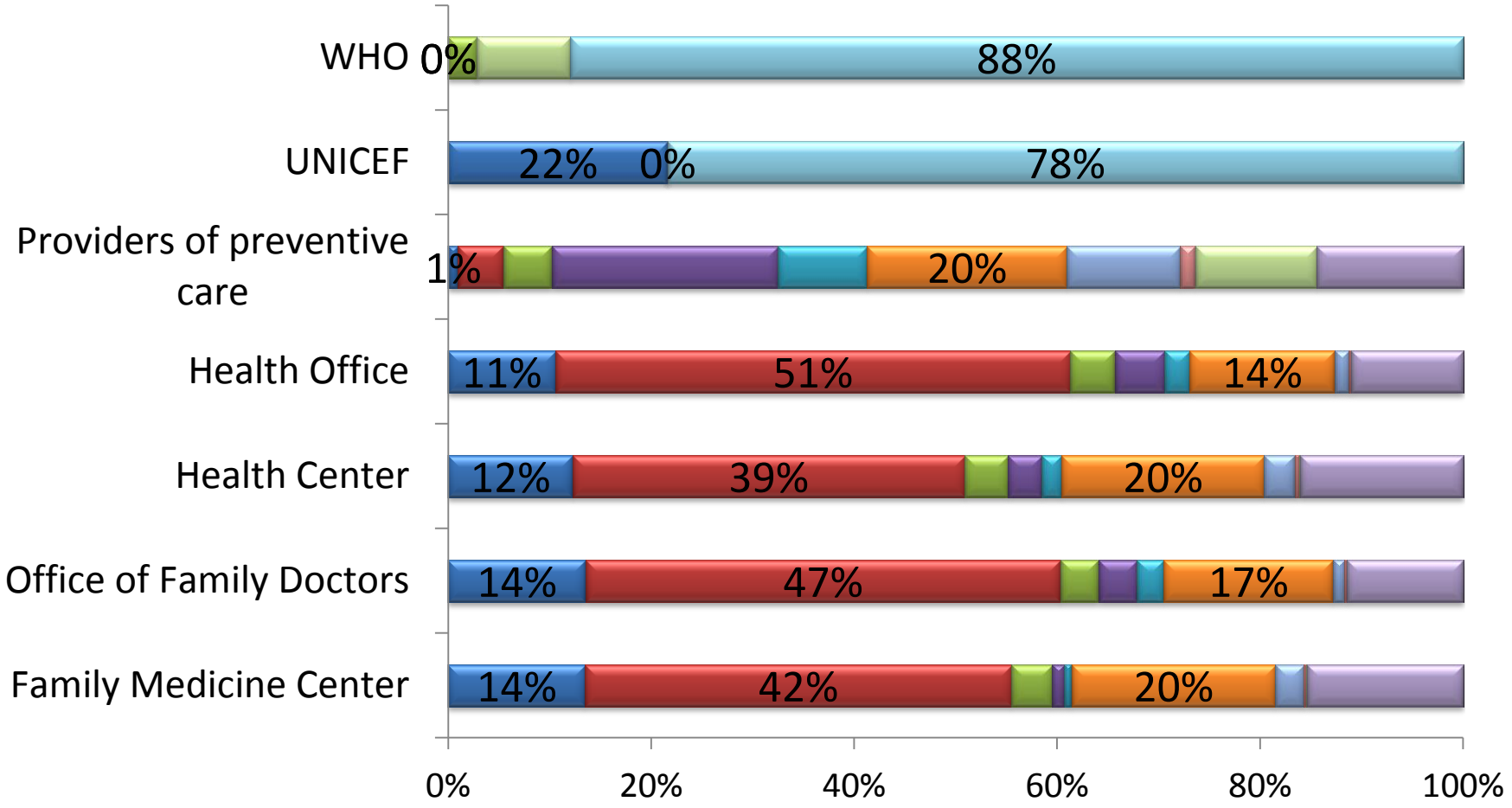


Providers of Services by Financing Agents

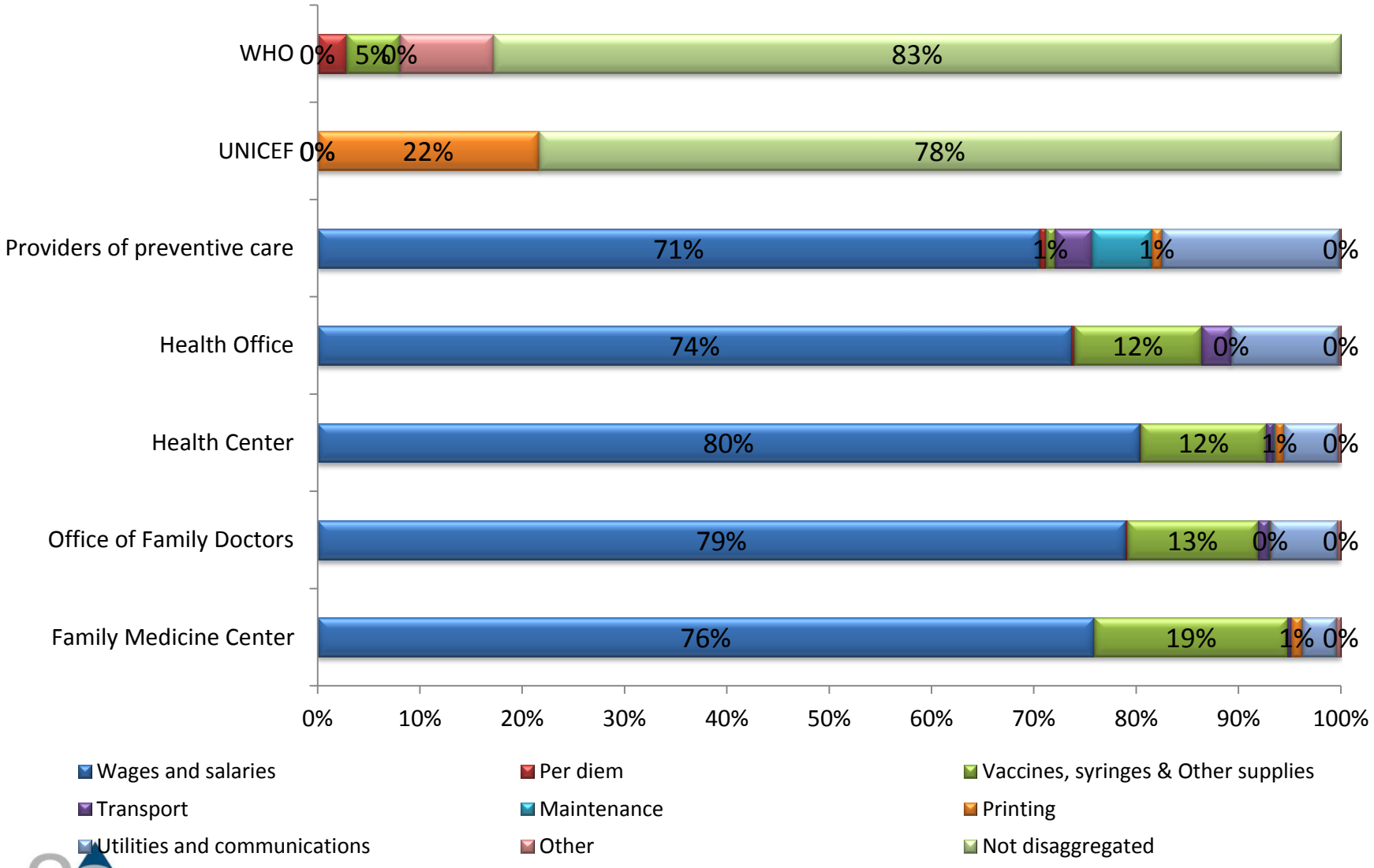


Major financier of a PHC care provider was CNAM, which provided 81-88% of the funds used for the immunization services.

Providers of Services by Functions



Providers of Services by Inputs



Conclusions

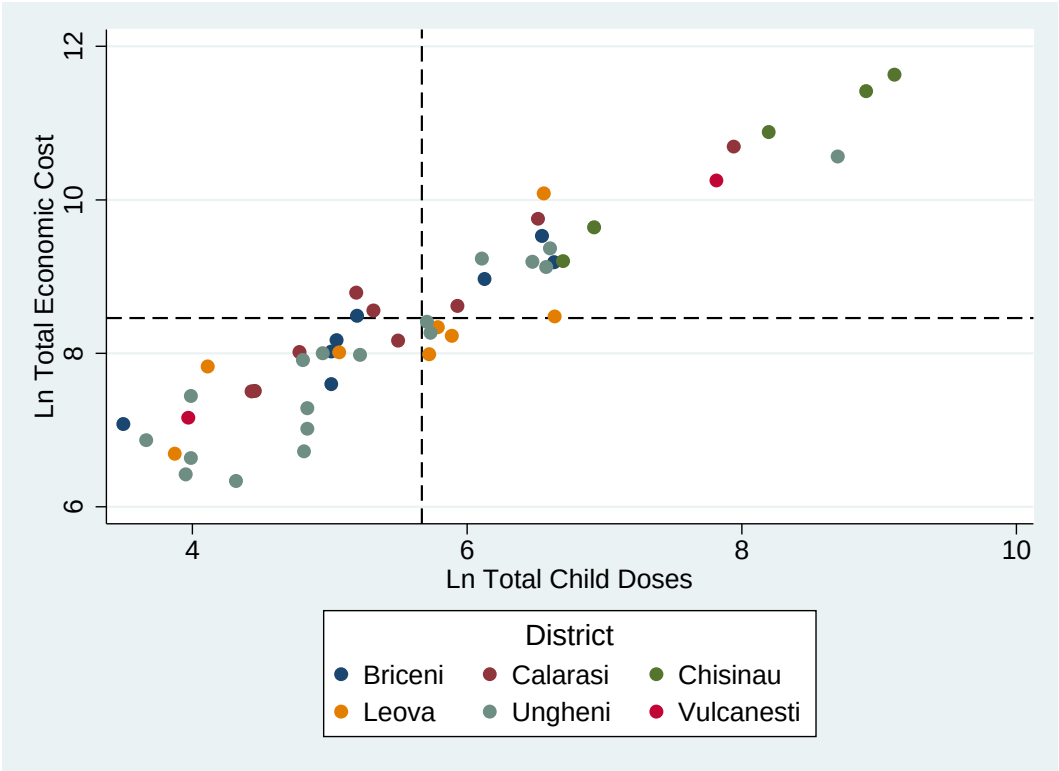
- Funding estimates for the immunization program in Moldova were 8.81 $US million, which amounts to approximately 1.27% of the *TNHE* for 2011 or 2.4% of recurrent public financing for health

- This estimate is 15% higher than the secured and probable funds estimated in the cMYP for 2011

- While the role of the external sources in the overall funding for the NIP is marginal – 5.2%, when external funding is related to only direct immunization inputs their share increases up to 20% and especially for the GAVI inputs they reach 17%.

Cost determinants and productivity

Quadrant analysis, Total Economic Cost vs Total Child Doses

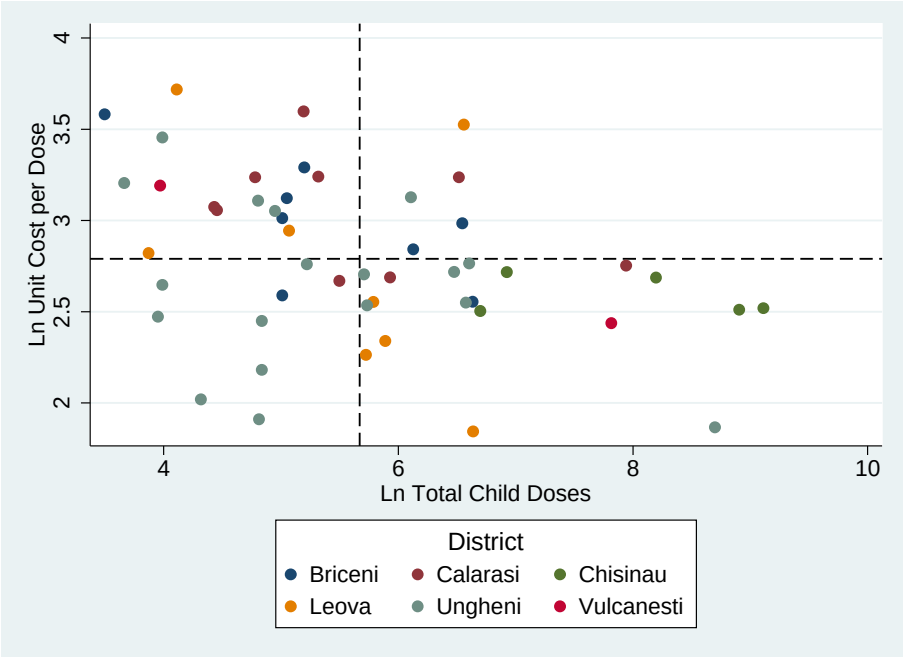


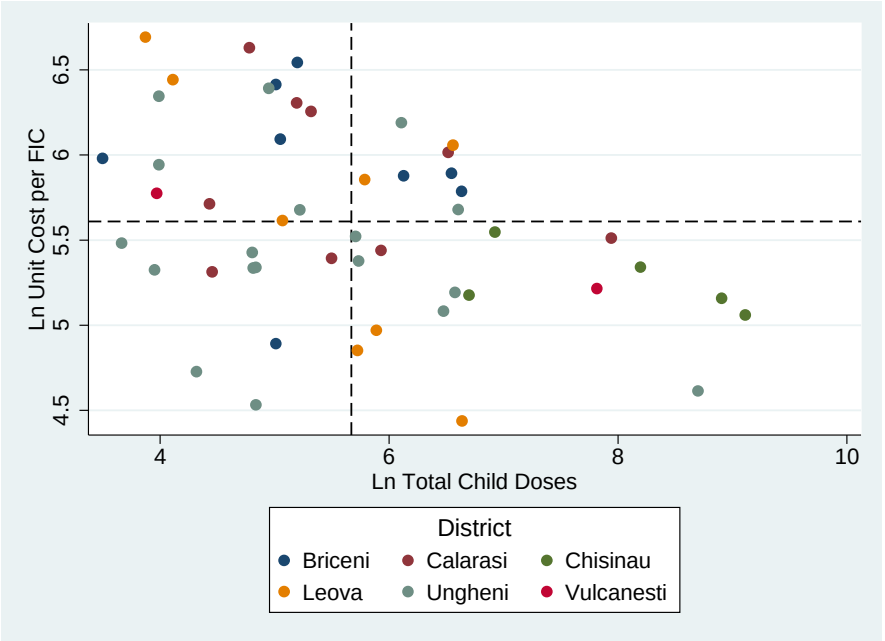
- There is a clear positive relationship between Total Economic Cost and Total Child Doses at facility level.

- This result is robust when we replace Total Child Doses for DTP 3 Vaccinated Children and Total Infants.

- Some facilities of Leova seem to be more efficient than the average, while some of Calarasi seem to be less efficient.

Quadrant analysis, Unit Cost per dose (and per FIC) vs Total Child Doses





- The relationship between the variables is less clear, although there is evidence of a slight negative relationship (economies of scale?).

- Arises the need for a multivariate analysis of cost determinants.

Research Questions and methodology

Estimation strategy considers two steps.

- 1st. Step: Determinants of main production indicators/outputs: ***Fully Immunized Child (FIC),*** and ***total number of doses administered on a facility level***?

$$Q_i = \alpha_1 \ln A_i + \alpha_2 \ln L_i + \alpha_3 \ln K_i - \alpha_4 \ln W_i$$

- **where:** *Q is the output indicator (FIC, number of doses administered) for facility "i",*
- *L and K are multiplicative vectors of production factors, with participation α1, α2)*
- *A is the scale of infants present in the catchment area.*
- *wastage rate (-W), which weighted the productivity of each factor.*

- Semilog implementation reflect data characteristics and facilitates the use of ordinary least square estimation techniques, and allows identification of production semi-elasticities with respect to each input indicator(s).

Research Questions and methodology

2nd Step: ***What determines the cost of immunization services?***

Dependent variable: ***Economic Cost for Fully Immunized Child-*** at a facility level -as well as at district and national levels.

$$ln\, CQ_i = ln\, FIC_i + \alpha_1\, ln\, w_i + ln\, r_i + ln\, P_i$$

Where:

CQ is the vector of cost specification for facility i,

FIC is the scale factor,

L & K are vectors for labor-related & infrastructure-related inputs characteristics,

P represents demand-side and quality shifter variables (education, wastage rates, facility characteristics.

Traditional hypotheses:

* presence of economies of scale in the provision of immunization
* verify labor intensive bias of vaccination services.
* identify relevance of family participation (education, income, formal health coverage) in immunization costs.
* Differences in cost determinants at facility, district and national level.

Summary statistics, unweighted sample

Production indicators ***Economic cost indicators*** ***Facility level inputs*** ***Input prices***

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
Fully Immunized Child (FIC)	50	60,88	135,16	1	714
Total number of doses administered	50	895,20	1844,43	33	9060
Total Economic Cost, Facility Level	50	11942	21743	565	112548
Total Economic Cost, Facility + District Level	50	12502,23	22404,94	627,75	115062
Total Economic Cost, Facility + District + National Level	50	12663,11	22723,92	641,27	116657
Share of staff time spent in the facility for immunization in % (FTE)	50	1,32	2,01	0	10,20
Total working hours	50	51,22	12,12	8	71
Total facility square meters	50	577,76	1173,18	20	5820
Cold chain capital index (Cold chain economic cost at facility level, in USD)	50	72,86	22,20	7,79	136,14
Hourly wage, mid career nurse (USD)	50	1,82	0,16	1,45	2,28
Refrigerator unit price (USD)	50	0,76	0,36	0,01	2,13
Total number of infants in the facility catchment area	50	66,06	149,98	1	810
Share of population with university education in %	50	6,46	5,38	2,90	24,40
Dummy Facility Type (1=1 if FMC)	50	0,10	0	0	1
Dummy Doctor at the facility (1=1 Yes)	50	0,88	0,33	0	1
Dummy Facility Location (1=1 if Urban)	50	0,06	0,24	0	1
Distance from the facility to the vaccine collection point	50	19,60	13,14	0	50
Overall Wastage Rate in % (from total number of doses administered)	50	17,01	8,89	4,90	36,90

Proxy for managerial effectiveness ***Proxy for logistics*** ***Dummies at facility level*** ***Socio-economic characteristics***

Determinants of Production (I)

	Ln Fully Immunized Children (FIC)								
	(1)			(2)			(3)		
	b	se	p	b	se	p	b	se	p
Total working hours	0.0311*	0.012	0.014	0.0330**	0.011	0.006	0.0315**	0.011	0.008
Total facility square meters	0.000507*	0	0.026	-	-	-	0.000461*	0	0.04
Cold chain capital index	-	-	-	0.0109	0.007	0.135	0.00955	0.007	0.183
Total number of infants in the facility catchment area	0.00636**	0.002	0.005	0.00577*	0.003	0.041	0.00547*	0.002	0.017
Dummy Facility Type (1=1 if FMC)	-1.708	1.123	0.136	-0.0152	1.04	0.988	-1.62	1.152	0.167
Dummy Doctor at the facility (1=Yes)	0.585**	0.209	0.008	0.676**	0.239	0.007	0.627*	0.235	0.011
Distance from the facility to the vaccine collection point	0.0036	0.009	0.685	0.00553	0.009	0.562	0.00583	0.009	0.532
Overal Wastage Rate	-0.0387***	0.011	0.001	-0.0399***	0.01	0	-0.0402***	0.01	0
Constant	0.703	0.823	0.398	-0.119	1.147	0.918	0.0121	1.135	0.992
R2	0.721			0.714			0.735		
Degrees of freedom	42			42			41		
F test model	17.63			18.18			15.18		
Prob > F	0.000			0.000			0.000		

Notes: Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Statistical relevance of facility level inputs (+), size of population in a facility catchment area (+), doctor at the facility (+), and wastage rate (-), not in the case of dummy facility type (+), and distance to the vaccine collection point (+).

Determinants of Production (II)

	Ln Total Dose								
	(4)			(5)			(6)		
	b	se	p	b	se	p	b	se	p
Total working hours	0.0249**	0.009	0.006	0.0269***	0.007	0.001	0.0254**	0.007	0.001
Total facility square meters	0.000523*	0	0.017	-	-	-	0.000459*	0	0.03
Cold chain capital index	-	-	-	0.0147*	0.006	0.014	0.0133*	0.006	0.021
Total number of infants in the facility catchment area	0.00538**	0.002	0.003	0.00444	0.002	0.06	0.00413*	0.002	0.021
Dummy Facility Type (=1 if FMC)	-1.529	0.944	0.113	0.192	0.884	0.829	-1.407	0.968	0.153
Dummy Doctor at the facility (=1 Yes)	0.702**	0.213	0.002	0.809***	0.219	0.001	0.760**	0.22	0.001
Distance from the facility to the vaccine collection point	-0.00031	0.007	0.962	0.0025	0.007	0.726	0.0028	0.007	0.678
Overal Wastage Rate	-0.0460***	0.01	0	-0.0478***	0.01	0	-0.0481***	0.009	0
Constant	3.982***	0.663	0	2.888***	0.796	0.001	3.018***	0.779	0
R2	0.779			0.787			0.811		
Degrees of freedom	42			42			41		
F test model	21.7			26.78			20.92		
Prob > F	0.000			0.000			0.000		

Notes: Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Same signs and similar magnitudes in all specifications.

Determinants of Total Economic Cost, Facility Level

	(5)			(6)			(7)			(8)		
	b	se	p	b	se	p	b	se	p	b	se	p
Ln Fully Immunized Children (FIC)	0.615***	0.075	0	-	-	-	0.616***	0.164	0.001	-	-	-
Ln FIC Est.	-	-	-	0.694***	0.15	0	-	-	-	1.720***	0.218	0
Ln FIC2	-	-	-	-	-	-	-0.000218	0.03	0.994	-	-	-
Ln FIC2 Est.	-	-	-	-	-	-	-	-	-	-0.139***	0.027	0
Ln Hourly wage, mid career nurse	1.05	0.986	0.295	1.395*	0.593	0.025	1.05	0.999	0.301	1.628*	0.619	0.013
Ln Refrigerator unit price	-0.0651	0.137	0.638	0.132	0.133	0.328	-0.0651	0.139	0.644	0.132	0.112	0.251
Ln Ice pack unit price	-1.468	0.947	0.131	-0.667	1.111	0.553	-1.469	1.007	0.155	-0.934	0.904	0.31
Ln Share of population with university education	0.618**	0.186	0.002	0.447	0.229	0.059	0.619*	0.264	0.026	0.692***	0.174	0
Ln Overall Wastage Rate	-0.00933	0.175	0.958	-0.0188	0.2	0.925	-0.00945	0.181	0.959	0.21	0.156	0.189
Constant	0.842	2.924	0.775	3.13	3.279	0.347	0.837	3.187	0.795	-0.283	2.839	0.921
R2		0.859			0.811			0.859			0.891	
Degrees of freedom		31			31			30			30	
F test model		68.14			29.66			60.08			56.54	
Prob > F		0.000			0.000			0.000			0.000	

Notes: Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Statistical relevance of scale factor (FIC/FIC Est.), economies of scale (FIC 2 Est.), and demand-side variable (share of pop. with university edu.), not conclusive in the case of input prices.

Determinants of Total Economic Cost, Facility + District, and Facility + District + National Level

	Facility + District Level						Facility + District + National Level					
	(3)			(4)			(7)			(8)		
	b	se	p	b	se	p	b	se	p	b	se	p
Ln Fully Immunized Children (FIC)	0.609***	0.16	0.001	-	-	-	0.608***	0.159	0.001	-	-	-
Ln FIC Est.	-	-	-	1.719***	0.204	0	-	-	-	1.717***	0.202	0
Ln FIC2	0.00274	0.029	0.924	-	-	-	0.00329	0.028	0.909	-	-	-
Ln FIC2 Est.	-	-	-	-0.138***	0.025	0	-	-	-	-0.137***	0.025	0
Ln Hourly wage, mid career nurse	0.979	0.964	0.318	1.561*	0.61	0.016	0.971	0.956	0.318	1.553*	0.608	0.016
Ln Refrigerator unit price	-0.049	0.132	0.712	0.151	0.106	0.166	-0.0471	0.131	0.721	0.153	0.105	0.156
Ln Ice pack unit price	-1.355	0.958	0.168	-0.817	0.87	0.355	-1.342	0.951	0.168	-0.804	0.866	0.361
Ln Share of population with university education	0.579*	0.256	0.031	0.661***	0.168	0	0.574*	0.254	0.032	0.658***	0.167	0
Ln Overal Wastage Rate	-0.0205	0.182	0.911	0.195	0.15	0.203	-0.0216	0.182	0.906	0.193	0.149	0.205
Constant	1.35	3.048	0.661	0.234	2.723	0.932	1.413	3.025	0.644	0.302	2.707	0.912
R2	0.869			0.899			0.871			0.9		
Degrees of freedom	30			30			30			30		
F test model	67.88			62.38			69.72			63.5		
Prob > F	0.000			0.000			0.000			0.000		

Notes: Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Similar results are obtained at these levels, providing robustness to our findings.

Sensitivity analysis, Total Economic Cost (Weighted sample)

Scenarios	Weighted Average ($)	Change from Baseline $	Change from Baseline %
Baseline	6963.66	-	-
Salary (% increase)			
5	7208.52	244.86	3.52
10	7453.38	489.73	7.03
15	7698.25	734.59	10.55
20	7943.11	979.45	14.07
Vaccine (% increase)			
5	7001.15	37.49	0.54
10	7038.65	74.99	1.08
15	7076.14	112.48	1.62
20	7113.63	149.98	2.15
Building (% increase)			
5	6989.92	26.26	0.38
10	7016.17	52.52	0.75
15	7042.43	78.78	1.13
20	7068.69	105.03	1.51

- Mayor participation of human resources in the overall costs function, followed by vaccines and building costs.

- Increasing 5% wages affects total costs in 3,5%, while 7%, 11%, 14% respectively are the reactions to increments of 10, 15 and 20%.

- Both building and vaccines cost increments do not affect total disbursements in more than 2.2 % in the more inflationary scenario.

Sensitivity analysis, Unit Cost (Weighted sample)

Unit Cost per Dose Adm. (Weighted Sample)

Scenarios	Weighted Average ($)	Change from Baseline $	Change from Baseline %
Baseline	18.35	-	-
Salary (% increase)			
5	18.95	0.60	3.25
10	19.54	1.19	6.51
15	20.14	1.79	9.76
20	20.74	2.39	13.02
Vaccine (% increase)			
5	18.42	0.07	0.41
10	18.50	0.15	0.81
15	18.57	0.22	1.22
20	18.65	0.30	1.63
Building (% increase)			
5	18.44	0.10	0.52
10	18.54	0.19	1.04
15	18.63	0.29	1.56
20	18.73	0.38	2.07

Unit Cost per FIC (Weighted Sample)

Scenarios	Weighted Average ($)	Change from Baseline $	Change from Baseline %
Baseline	332.31	-	-
Salary (% increase)			
5	343.04	10.73	3.23
10	353.77	21.46	6.46
15	364.49	32.18	9.68
20	375.22	42.91	12.91
Vaccine (% increase)			
5	333.66	1.35	0.41
10	335.01	2.70	0.81
15	336.35	4.04	1.22
20	337.70	5.39	1.62
Building (% increase)			
5	334.11	1.80	0.54
10	335.92	3.61	1.09
15	337.72	5.41	1.63
20	339.53	7.21	2.17

Similar percentage change using unit cost per dose adm. and per FIC.

Conclusions (I)

- Relevance of HHRR in the success of vaccination coverage (FIC and total doses administered) in comparison to facility infrastructure.

- Research support the importance of population scale in allowing cost savings at the same level of production.

- Differences in performance by production factors across facility types do not necessarily involve uneven productivity, but gaps within different context, such as scale of the center, and population location.

- Econometric analysis does not identify strong equity and efficiency issues across providers, although more in-depth qualitative research is suggested.

Conclusions (II)

- Community related (demand-side) variables are particularly relevant to reach a successful immunization plan, particularly when outreach activities are not part of the usual coverage strategy

- Prices do not show to be relevant cost shifters at the facility level, associated to the centralized process of contracting and purchasing

- Analysis identifies three different factors affecting immunization outputs:
  - operative capacity at the facility level,
  - managerial efficiency of vaccines,
  - population scale.

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