

Estimating the additional cost for maintaining facility-based Routine Immunization programs in the context of COVID-19

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The COVID-19 pandemic has already disrupted immunization services that are critical to the prevention of morbidity and mortality from vaccine-preventable diseases in many low- and middle-income countries (LMICs).¹ In these settings, the health benefits associated with routine childhood immunization greatly outweigh the COVID-19 related health risks.² However, the conduct of routine vaccine delivery will need to be modified in order to be successfully implemented in the pandemic context. WHO and UNICEF have urged rapid resumption and continuation of routine immunization services³ with appropriate measures for protecting health workers and patients from COVID-19.⁴ Redesigning vaccine delivery to enable the routine immunization program to be carried out in the context of COVID-19 will mitigate the health impact of COVID-19 on vaccination program outcomes (vs. discontinuation or protracted postponement of routine health services), but will likely have an impact on the economic efficiency and budget requirements.

WHO's operational guidance for maintaining essential health services in the COVID-19 context indicates that routine immunization in fixed sites, outreach services, and mobile clinics should be maintained, with the following modifications:

- Train staff on infection prevention and control (IPC) and delivery protocols
- Provide facilities with adequate IPC equipment, including for waste management
- Plan several small sessions per day at different times to limit contact
- Limit the duration of stay in the health facility
- Modify session locations to ensure separation of immunization services from treatment areas, and proactively inform communities about this strategy while reinforcing the value of vaccination
- Establish a screening process before allowing entry to the vaccination area
- For outreach and mobile services, proactively engage with communities to identify open sites that allow physical distancing

In this brief, we analyze the resource requirements associated with modifications to routine immunization services at fixed sites such as primary health clinics. We considered the following four categories of costs:

1	• personal protective equipment (PPE) for health care workers
2	• modifications to patient waiting area to ensure physical distancing and handwashing • patient and caregiver symptom screening at intake and face covering where applicable
3	• health care worker hazard pay
4	• training health facility staff on new procedures • dissemination of information and mobilization of the community

Summary of Findings

Incremental financial cost of COVID-related modifications to routine immunization

One-time startup costs per facility range from \$400 per facility up to \$1,660 per facility, depending on the modifications adopted. Recurrent costs range from \$450 to just over \$1,000 per facility each month that modifications are in place, highlighting the importance not only of considering the scope of modifications required in a specific country context, but also the potential duration that they might be required. Combining startup and 12 months of recurrent costs would total \$6,000 to \$15,000 per health facility, depending on the program modifications implemented.

For LMICs, considering additional costs of PPE and training/social mobilization, the per-facility cost represents a 3–14% increase from baseline delivery costs, depending on the intensity of program modifications. When including the additional labor cost of crowd controller/intake screening personnel, the cost increases to 23–53% of baseline delivery costs. Finally, adding in the additional cost of hazard pay for health workers would translate to an approximately 36–94% increase over baseline delivery costs.

Methodology

Costs are reported per facility based on assumptions about the number of health care workers, immunization sessions, and patients per session. We partition facilities into low-, medium-, and high-volume facilities.

Costs are reported as either one-time costs or monthly costs that are assumed to recur as long as COVID-19 risk is present. Each cost category is presented as the incremental financial outlays required for the relevant adjustments.

Where possible, we grouped countries according to their Gavi co-financing status: initial self-financing, preparatory transition, accelerated transition. As these categories are highly correlated with income level, we otherwise grouped countries into low-income (LIC), i.e., gross national income (GNI) per capita of \$1,025 or less, or middle-income (MIC), i.e., GNI per capita of \$1,026 to \$12,375, according to World Bank income level in 2019.⁵

We assumed the cost of supplies and equipment were constant across settings. In general, we obtained unit costs for supplies and equipment from the WHO COVID-19 Essential Supplies Forecasting Tool (ESFT)⁶ or other established price lists.^{7,8}

For labor costs, we used nursing salaries in Honduras that were collected in a previous immunization costing exercise⁹ and assumed salaries varied in proportion to GNI per capita in 2018 (Table 1).⁵ We also noted that in studies from Honduras and Brazil, the salary level of nurse aides/assistants was about half the salary of registered nurses.

Table 1. Gross national income (GNI) per capita and annual salary averages by country group

Income Group (Gavi countries only)	GNI per capita	Annual Salary	
		Registered Nurse	Nurses' Aide
LIC	\$749	\$3,257	\$1,628
LMIC	\$1,766	\$7,685	\$3,843
Gavi country group			
Initial self-financing	\$666	\$2,896	\$1,448
Preparatory transition	\$1,638	\$7,125	\$3,563
Accelerated transition	\$2,013	\$8,760	\$4,380

Note: GNI = gross national income; LIC = low-income; LMIC = lower middle-income.

We estimated costs for some modifications that are more intensive than current WHO recommendations.⁴ We did so recognizing that the current WHO recommendations have been developed in the context of substantial global supply chain shortages for PPE, and may be adjusted over time.

We included hazard pay as a possible cost component, because in several countries there have been policy discussions about hazard pay for essential health workers in the COVID-19 response.

There are several modifications of immunization services that WHO recommends, for which we have not quantified resource needs. These include more frequent cleaning and sanitization of surfaces, combining multiple well-child services to minimize the number of visits needed per child, and changes to scheduling to spread immunization sessions throughout the day, so that patients and their caregivers are able to spend less time waiting and interacting with potentially ill persons. Additionally, to further limit exposure, WHO recommends that well-child services, including immunization, are delivered in a location within the facility that is physically separate from areas providing services to sick patients. It is not clear how these types of modifications to operational procedures will affect net cost in both direction and magnitude, so we left it out of our analysis.

WHO also recommends that if routine immunizations are disrupted by COVID-19, programs and facilities should plan to implement catch-up vaccination. While these catch-up activities would certainly have costs associated with them, these are addressed in companion analyses related to the cost of delivering vaccination campaigns and routine outreach, and not included here.^{10,11}

Category 1: Costs of PPE for health workers

For health worker PPE, we considered 3 scenarios with different levels of intensity, in terms of the amount of PPE measures employed (Table 2). In the low intensity scenario, no additional PPE was costed in line with WHO guidance for areas without widespread community transmission of COVID-19.⁴ In the medium intensity scenario, all workers wear 1 mask per day and vaccinators use 1 pump of hand sanitizer following each patient interaction (1 pump = 2 milliliters). In the high intensity scenario, Vaccinators wear goggles and use 1 pair of gloves per child vaccinated and non-vaccinator staff use 2 pairs of gloves per session. Goggles are reusable and assumed to last for 3 months.

Table 2. Health Worker PPE: Unit prices and quantities for each scenario

1. PPE for health workers	Unit Price	Unit multiplier	Quantity (by scenario)		
			Low	Medium	High
Mask	\$0.70	Per Worker Session	0	1	1
Hand sanitizer (1 liter)	\$8.30	Per Patient	0	0.002	0.002
Gloves (pair)	\$0.06	Per Non-vaccinator session	0	0	2
		Per Patient	0	0	1
Protective goggles (reusable)	\$2.80	Per Vaccinator-Quarter	0	0	1

Note: PPE = personal protective equipment.

Because some costs depend on the number of sessions and some costs depend on the number of patients, we considered low-, medium-, and high-volume facilities and different combinations of sessions and patients per session.

Table 3 presents the estimated results for monthly costs of PPE by facility volume and scenario intensity. In low-volume facilities (100–250 immunization visits per year), the monthly cost of PPE is between \$6 and \$17. In medium-volume facilities (500 immunization visits per year), the monthly cost of PPE is between \$10 and \$39. In high-volume facilities (1,000–3,750 immunization visits per year), the monthly cost is between \$20 and \$96.

Table 3. Health Care Worker PPE: Monthly cost per facility

Facility volume	Workers per session	Vaccinators	Sessions per week	Patients per session	Patient Visits per year	Monthly cost (by scenario)		
						Low	Medium	High
Low	2	1	1	2	100	\$0	\$6	\$10
	2	1	2	2	200	\$0	\$12	\$17
	2	1	1	5	250	\$0	\$6	\$11
Medium	3	2	1	10	500	\$0	\$10	\$19
	2	1	2	5	500	\$0	\$13	\$19
	2	1	5	2	500	\$0	\$31	\$39
High	3	2	2	10	1000	\$0	\$20	\$31
	3	2	5	10	2500	\$0	\$49	\$70
	4	2	5	15	3750	\$0	\$66	\$96

Note: PPE = personal protective equipment.

Category 2: Costs to manage physical distance

We assumed 3 types of costs to manage physical distance: one-time fixed costs of equipment, recurrent costs of equipment, and labor costs to hire additional personnel (Table 4). Equipment included items necessary for patient hygiene, screening, and physical distance. For labor costs, we assumed that personnel would be hired at the level of a nurse’s aide/assistant, which we assumed to have a salary equal to ½ registered nurse salary, adjusted from Honduras salary data⁹ proportional to GNI per capita.⁵ Table 5 presents the assumed unit prices for equipment described in Table 4. Table 6 presents the estimated results for one-time startup costs and recurrent monthly costs to manage physical distance by country group and scenario intensity.

Table 4. Patient hygiene, screening, and physical distance: Scenario assumptions

	Low	Medium	High	Notes
Physical distance	Tape	Tape Plexiglass	Tape Plexiglass Tent	1 roll tape/week 2 plexiglass sheets 1 tent
Hygiene	Bucket (x2) Soap Hand sanitizer	Bucket (x2) Soap Hand sanitizer	Basin Stand Soap Hand sanitizer	1 soap / week 6ml sanitizer per patient
Symptom Screening		Cough Face covering	Cough IR Thermo (x2) Face covering	20% of patients offered face covering
Labor	1 additional FTE	1 additional FTE	2 additional FTE	Nurse's aide/assistant Salary = ½ Registered Nurse Salary; adjusted from Honduras salary data, proportional to GNI per capita

Note: FTE = full time equivalent; IR = infrared.

Table 5. Patient hygiene, screening, and physical distance: Unit prices of items

	Unit Price
Plexiglass barrier (32" x 48")	\$114.72
Vaccination tent	\$150.00
Infrared thermometer	\$35.19
60-liter bucket	\$6.20
Hand washing stand	\$31.20
Basin	\$2.30
Masks for patients	\$0.70
Hand sanitizer (1 liter)	\$8.30
Soap	\$0.90
Tape (floor markings)	\$1.00

Table 6. Patient hygiene, screening, and physical distance: Costing results, by Gavi country group

	Low	Med	High
Capital Equipment (assume yearly)	\$12.40	\$241.84	\$495.72
Recurrent Supplies (monthly)	\$10.31	\$16.14	\$16.14
Recurrent Labor (monthly)			
Initial self-financing	\$121	\$121	\$241
Preparatory transition	\$297	\$297	\$594
Accelerated transition	\$365	\$365	\$730
Total Recurrent			
Initial self-financing	\$131	\$137	\$257
Preparatory transition	\$307	\$313	\$610
Accelerated transition	\$375	\$381	\$746
Annualized Monthly Cost - Total			
Initial self-financing	\$132	\$157	\$299
Preparatory transition	\$308	\$333	\$651
Accelerated transition	\$376	\$401	\$787

Note: Labor cost is proportional to GNI per capita.

Category 3: Costs of hazard pay for health workers

We assumed that countries may choose to pay health workers additional hazard pay to incentivize work during the COVID-19 pandemic. In some settings, such as South Africa, hazard pay is a fixed monthly amount that does not vary with salary level. In other settings, hazard pay has been proposed as a percentage of salary. We choose to model hazard pay rate as percentage of salary at the registered nurse level (Table 7), but also show the corresponding absolute monthly amount (Table 8). Since it is tied to salary, hazard pay was assumed to vary with GNI per capita (Table 9).

Table 7. Hazard pay rates by scenario intensity

	Low	Medium	High
Hazard pay rate as percentage of salary	10%	20%	30%

Table 8. Hazard pay for 1 registered nurse for 1 month

Gavi country group	Mean monthly amount (Range)		
	Low 10%	Medium 20%	High 30%
Initial self-financing	\$24 (\$10–42)	\$48 (\$20–74)	\$72 (\$30–111)
Preparatory transition	\$59 (\$44–116)	\$119 (\$88–231)	\$178 (\$133–347)
Accelerated transition	\$73 (\$42–93)	\$146 (\$84–186)	\$219 (\$126–280)

Table 9. Immunization staff hazard pay rate per facility, by pay level, facility size, and Gavi country group.

	10% hazard pay rate (Low intensity)			20% hazard pay rate (Medium intensity)			30% hazard pay rate (High intensity)		
	Low vol	Med vol	High vol	Low vol	Med vol	High vol	Low vol	Med vol	High vol
	FTE multiplier								
RN rate	1.00	1.33	2.00	1.00	1.33	2.00	1.00	1.33	2.00
Aide/assistant rate	1.00	1.00	1.33	1.00	1.00	1.33	1.00	1.00	1.33
Combined(RN-equivalent rate)	1.50	1.83	2.67	1.50	1.83	2.67	1.50	1.83	2.67
Total hazard pay per facility per month									
Initial self-financing	\$36	\$44	\$64	\$72	\$88	\$129	\$109	\$133	\$193
Preparatory transition	\$89	\$109	\$158	\$178	\$218	\$317	\$267	\$327	\$475
Accelerated transition	\$110	\$134	\$195	\$219	\$268	\$389	\$329	\$402	\$584

Note: FTE = full time equivalent.

Category 4: Other operational costs for service delivery

A. Staff Training on Modifications to Service Delivery Process for COVID-19

We examined 11 studies from the Immunization Delivery Cost Catalogue (IDCC)¹² of new and underutilized vaccine introductions (NUVI) and estimated a cost per facility from the reported training costs.¹³⁻²³ The mean cost per facility ranged from \$47–214 in LICs (mean \$175) and \$120–317 in MICs (\$430) (Table 10).

We considered a range from 50% to 150% of these mean NUVI training costs, as training for COVID-19 may be more (e.g., due to distancing and other protective measures, increased costs for some inputs) or less (e.g., due to other delivery modalities such as virtual) than a typical NUVI training.

B. Social Mobilization

We examined 12 studies from the IDCC¹² of new vaccine introduction and estimated the cost per facility for social mobilization.¹³⁻²⁴ The mean cost per facility ranged from \$47–272 in LICs (mean \$200) and \$92–314 in MICs (mean \$285) (Table 10).

For social mobilization, we assumed that communication with the public regarding routine immunization services amidst the COVID-19 pandemic will require between 100% and 300% of the resources required for a typical NUVI mobilization. As it is not clear what social mobilization and communication activities will be required, but recognizing that the activities may cover national, local, and facility-based efforts, we assumed a larger cost envelope for social mobilization compared to training modifications.

Table 10. Cost per facility (one-time cost)

	Training			Social mobilization		
	Low 0.5x	Medium 1.0x	High 1.5x	Low 1x	Medium 2x	High 3x
Mean	Mean			Mean		
LIC	\$88	\$175	\$263	\$200	\$400	\$600
MIC	\$215	\$430	\$645	\$285	\$570	\$856
Lower bound	25th percentile			25th percentile		
LIC	\$24	\$47	\$71	\$47	\$95	\$142
MIC	\$60	\$120	\$181	\$92	\$183	\$275
Upper bound	75th percentile			75th percentile		
LIC	\$107	\$214	\$321	\$272	\$544	\$816
MIC	\$159	\$317	\$476	\$314	\$629	\$943

Overall results

Table 11 shows the totals for each category and sub-category, by scenario intensity, as a per-facility average cost.

Table 11. Summary estimates for additional costs of routine vaccine delivery in the context of COVID-19, by cost category and scenario intensity

	Low intensity		Medium intensity		High intensity	
	One-time Startup	Monthly Recurrent	One-time Startup	Monthly Recurrent	One-time Startup	Monthly Recurrent
1: Health worker PPE				\$24		\$35
2: Physical distance, fixed	\$12		\$242		\$496	
2: Physical distance, recurrent		\$10		\$16		\$16
2: Physical distance, labor*		\$261		\$261		\$522
3: Health worker hazard pay*		\$178		\$356		\$534
4: Social mobilization	\$243		\$485		\$728	
4: Training	\$145		\$291		\$436	
Total	\$400	\$449	\$1,018	\$657	\$1,660	\$1,107

*labor and hazard pay rates depend on country GNI per capita. The average across Gavi countries is shown here.

Figure 1 on the next page shows the cumulative cost, depending on the duration of time that the modifications are necessary. The one-time costs of infrastructure modifications, training, and social mobilization would be between \$400 and \$1,660 per health facility, averaged across low-, medium-, and high-volume facilities. Adding to this one year of recurrent cost would result in a total of between \$6,000 and \$15,000 per health facility, depending on the level of intensity of COVID control measures implemented. Excluding hazard pay reduces the one-year cost to between \$4,000 and \$900 per health facility (Figure 2). Excluding all labor costs (i.e. excluding the additional nurses' aides hired to handle the patient intake process) would further reduce the annual cost to \$800 to \$2,600 per health facility, depending on intensity of measures (Figure 3).

Figure 1. Cumulative per-facility cost over time, by scenario:

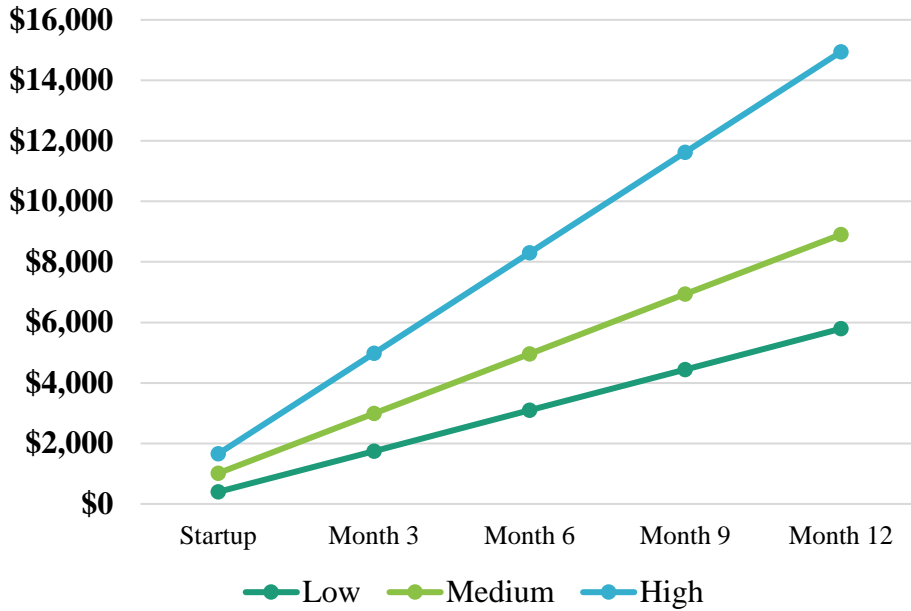


Figure 2. Cumulative per-facility cost over time, excluding hazard pay, by scenario:

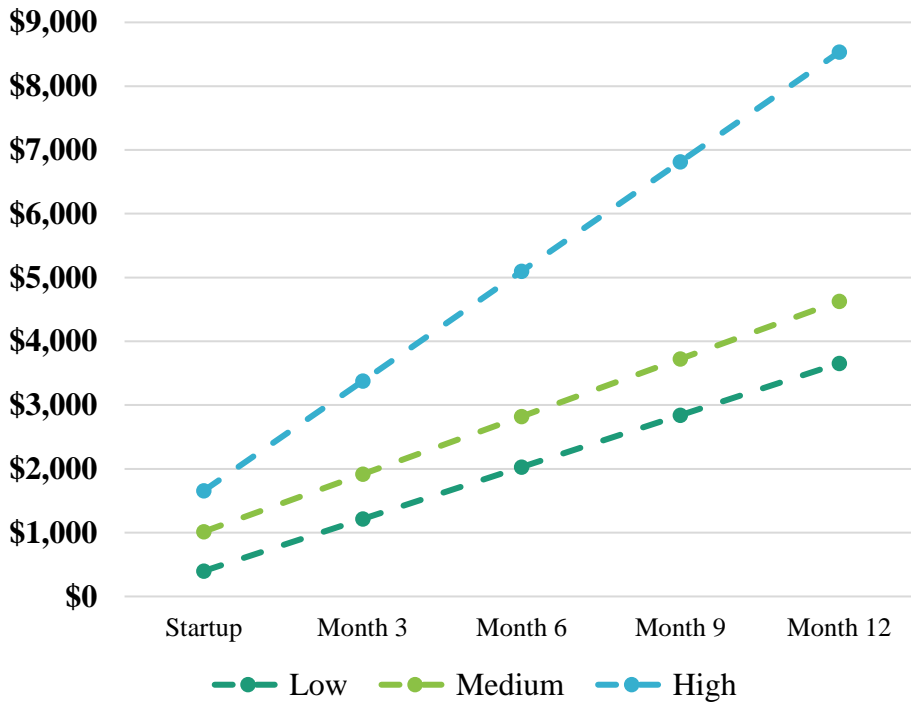


Figure 3. Cumulative per-facility cost over time, excluding all labor costs, by scenario:

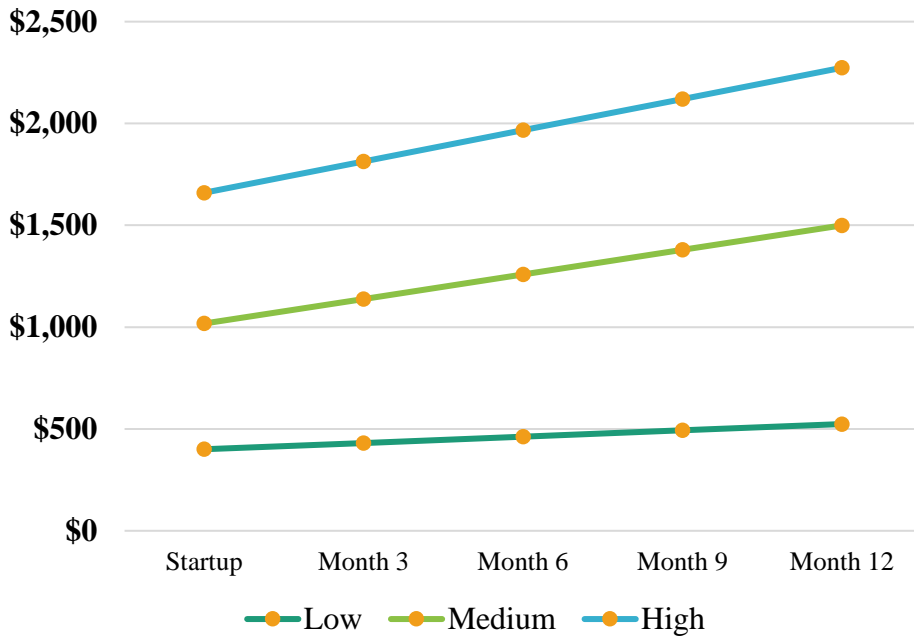


Figure 4. Average per-facility costs over time, including all cost categories, by scenario intensity.

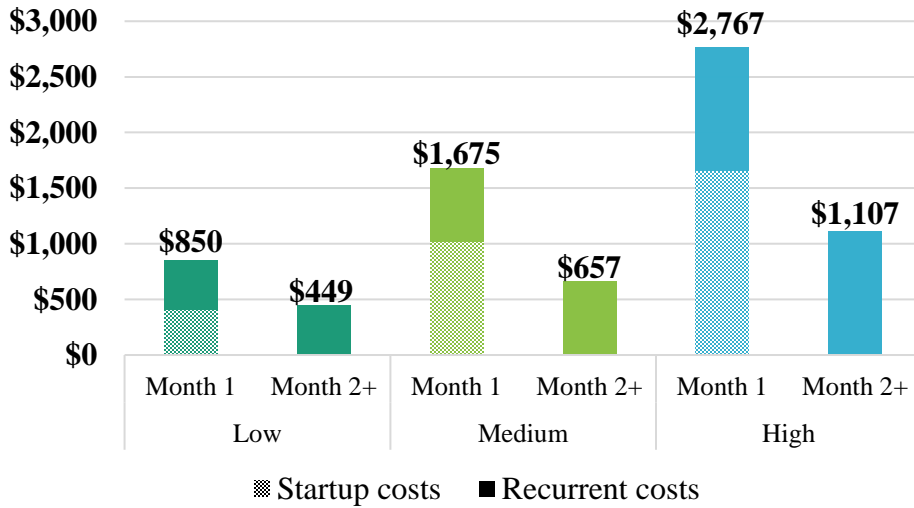
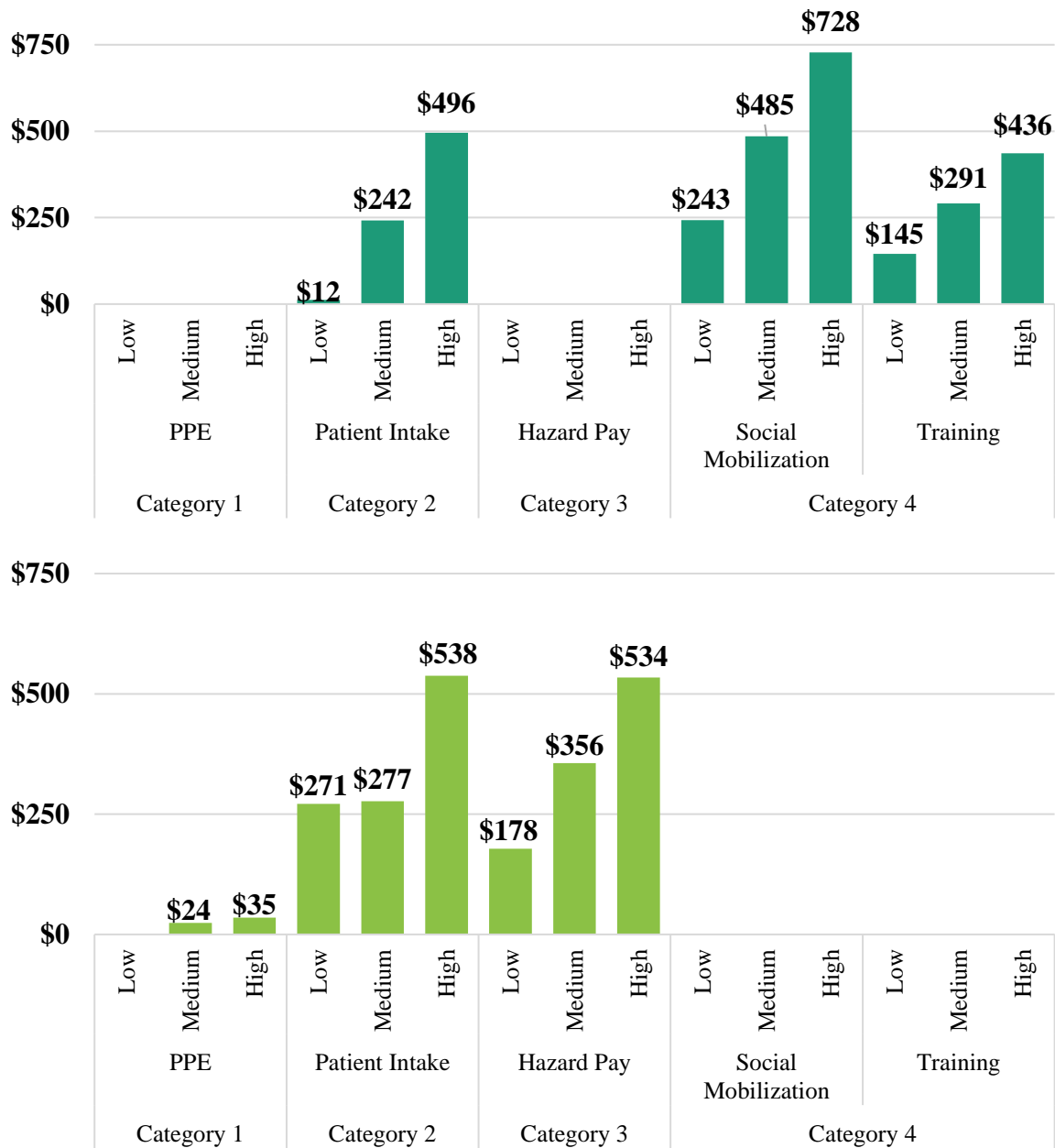


Figure 5. Average per-facility costs by cost category, including one-time and recurrent monthly costs.



Note: Costs averaged across low-, medium-, and high-volume facilities. Category 3 assumes an average of 4 health workers receiving hazard pay per month.

Limitations

The results of this analysis are meant to offer general guidance but should be interpreted with caution, as several limitations apply. First, the analysis relied on the data as reported by the authors, and several assumptions had to be made in the classification of certain costs, in the estimations of salaries, etc. Second, some of the prices for COVID-19 response materials are changing rapidly, which will affect the accuracy of the results over time. Third, we have not taken into account the changes to shared costs and/or potential efficiencies gained from more frequent cleaning and sanitization of surfaces, combining multiple well-child services to minimize the number of visits needed per child, changes to scheduling to spread immunization sessions throughout the day, and delivery of well-child services within the facility that is physically separate from areas providing services to sick patients. Overall, country-specific guidance and policies should be reviewed before translating these results to other country contexts.

Conclusion

Modifying routine immunization programs to safely maintain vaccination coverage in the context of COVID-19 is likely to have substantial financial costs. While our rapid analysis considers a range of scenarios that include program modifications that go beyond those recommended in WHO guidance, all the modifications we modeled are within the scope of what countries are considering. Basic enhancements to infection control such as increased use of hand sanitizer and PPE are relatively inexpensive. But, when combined with the likely need for training and social mobilization activities, and labor costs of additional personnel are needed to manage client intake, the delivery costs increase by as much as 50%. Likewise, hazard pay would add substantially to overall cost.

This rapid analysis is meant to illustrate a range of potential cost implications and provide general guidance for EPI managers developing COVID mitigation plans and preparing for mobilization of additional resources. Setting-specific analysis will be necessary to determine the appropriate COVID-related modifications needed to safely maintain routine immunization services and to precisely estimate the startup and monthly recurring resource requirements for those modifications. A country-specific calculator tool for tailoring results to specific countries relying on the methodology described in this report is currently under development to assist with more refine and detailed cost modeling (Figure 6). Additional analyses conducted by ThinkWell have assessed the cost implications for campaign and routine outreach immunization service delivery.^{10,11}

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