

The Costs of Deploying and Maintaining Digital Health Interventions to Improve Immunization and Vaccine Logistics Data Management in Low- and Middle- Income Countries.

A multi-country study in Guinea, Honduras, Rwanda and Tanzania.

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GATES *foundation*



- Digital health interventions (DHIs) for provision and demand for health services in LMICs → International agenda
- World Health Assembly Resolution on Digital Health recognized value of DHI to achieve UHC and meet SDGs (2018)
- Proliferation of short-lived implementations and overwhelming diversity of digital tools
- Several DHIs implemented but robust evidence scarce → call for more rigorous evaluations of efficacy, effectiveness and cost-effectiveness

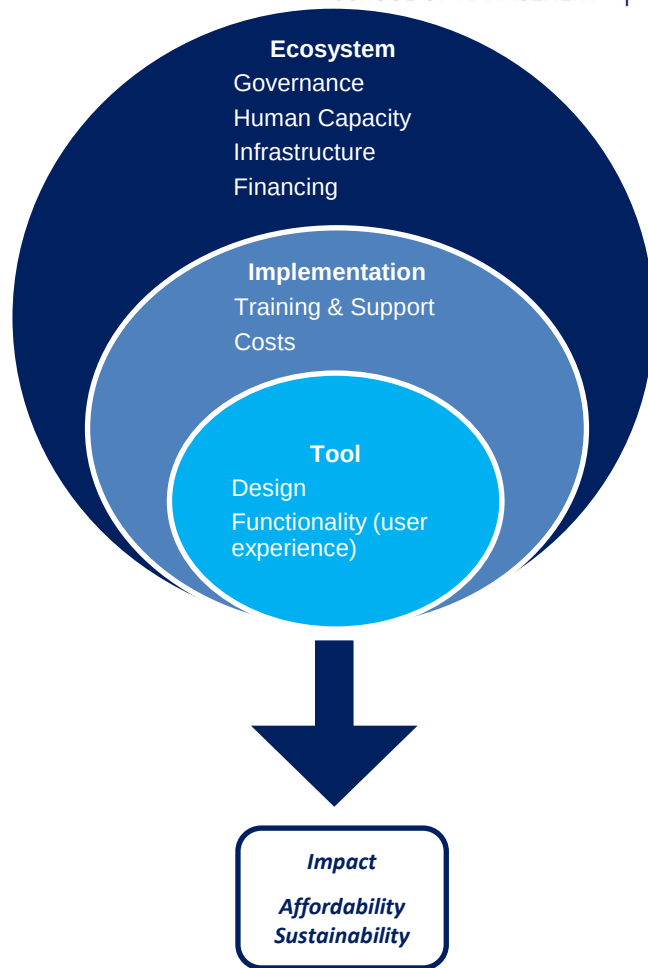
electronic Immunization Registry (eIR)

- Individualized child immunization track records
- Digital, accessible, permanent
- Allow for coverage estimation and follow-up

electronic Logistics Management Information System (eLMIS)

- End-to-end visibility of vaccine supply chain
- Data elements: stock on hand, losses and adjustments, consumption, demand issues, shipment status, and information about the cost of commodities
- Allows for monitoring and management of vaccine logistics

- *Evaluating the impact of electronic Logistics Management Information Systems (eLMIS) and electronic Immunization Registries (eIR) in low- and middle-income countries*
- Evaluation across 6 domains:
 - Ecosystem;
 - Tools;
 - Implementation;
 - Impact;
 - **Costs;**
 - **Affordability and Sustainability**
- Project timeline: June 2020 – December 2022



- Primary data collection: Purposive sampling with strata considered (i.e., rural/urban, type of facility, implementation status of eIR/eLMIS)

	Honduras (eIR)	Rwanda (eIR)	Tanzania (eIR/eLMIS)	Guinea (eLMIS)
Health Facility	80	24	61	43
District Health Office	-	12	30	7
Regional Health Office	8	-	10	-
Total	88	36	101	50

Methods: Cost analysis

	1. Financial expenditures	2. Routine operating costs of users	3. Cost impact	4. Financial sustainability	5. Simulation of a fully electronic system
Scope of analysis	Design & development and roll-out expenditures of the systems	Costs related to the use of the tools for the management of immunization and/or vaccine stock data	Difference in the operating costs of managing immunization data and/or vaccine stock data with the electronic tools as compared to not using the tools	Affordability of the tools relative to country's health or immunization expenditures (total and domestic)	Simulating the impact on costs of the transition to a paperless registry
Type of analysis	Descriptive analysis	Activity Based Costing analysis	Cross-sectional or before and after depending on implementation status	Operating costs against macro-economic and immunization-specific indicators	Scenario analysis
Sources of data	Financial reports/data from implementing partners	Surveys, other in-country secondary data (i.e., from HMIS)	Surveys, other in-country secondary data	International Monetary Fund (IMF), WHO and country reports (i.e., cMYP)	Primary and secondary data from questionnaires

Types of input: Direct costs (labour, consumables, durable goods, services) and indirect costs (overhead)

Results:

Upfront costs*, I\$ 2021

	Honduras	Rwanda	Tanzania		Guinea
System	eIR	eIR	eIR	eLMIS	eLMIS
Design & Development	33,949	317,649	3,968,986	3,826,829	639,105
Roll-out	5,399,946	4,411,877	21,768,297	3,445,021	1,067,563
Total	5,433,894	4,729,526	33,009,132		1,706,667
Cost per Health Facility	4,393	8,725	9,926		3,843

**The reported costs are primarily accounted for by external funders, except for the Honduras estimate which excludes donor funds*

Results:

Routine operating costs[^], I\$ 2021 (95% CrI*)

	Honduras (eIR)	Rwanda (eIR)	Tanzania (eIR + eLMIS)	Guinea (eLMIS)
Annual operating cost per user facility	5,342 (4,753; 5,930)	1,211 (1,047; 1,376)	4,002 (3,166; 4,835)	679 (188; 1,170)
Total annual operating cost for the country ⁺	6,610,512	872,359	26,997,565	327,646
Affordability, % of annual immunization expenditures (% domestic expenditures)	15% (16%)	1.1% (9%)	6.5% (11.3%)	1.9%

*CrI: Credible interval; ^ Cost of performing immunization and/or vaccine stock data management activities;

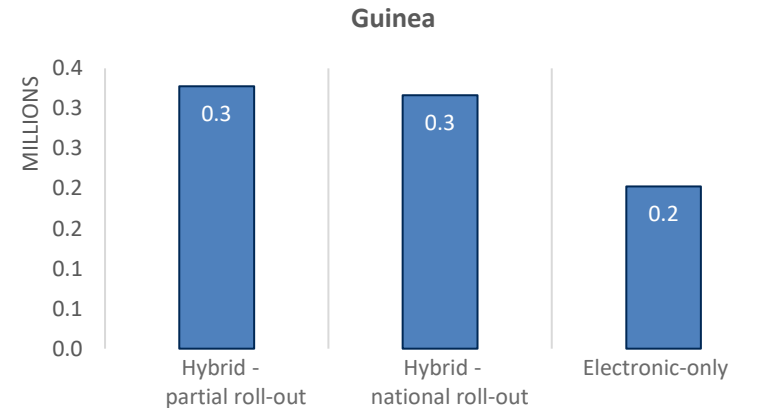
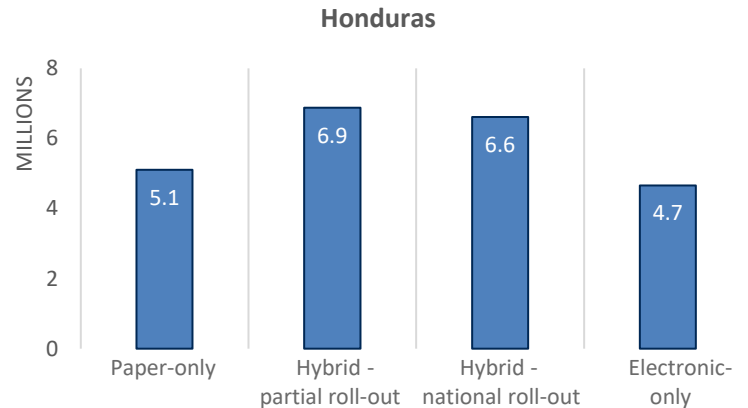
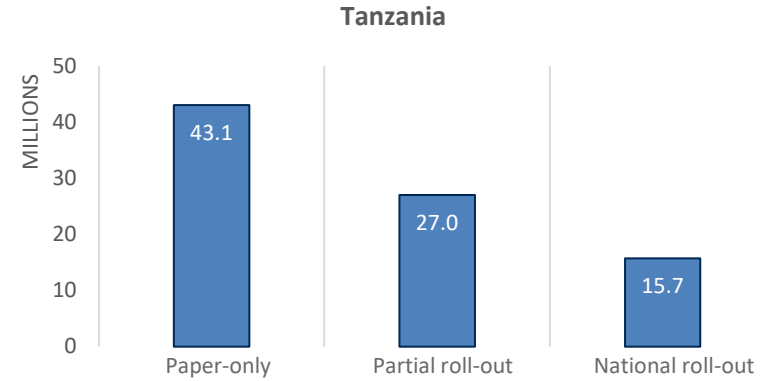
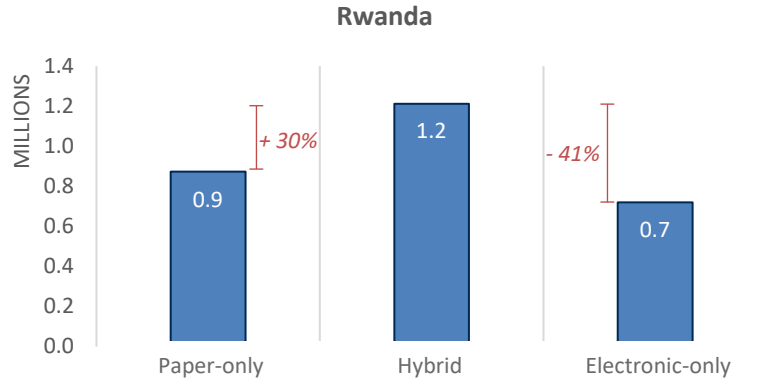
⁺ As per current implementation status

Results:

Cost impact, I\$ 2021 (95% CrI)

	Honduras (eIR)	Rwanda (eIR)	Tanzania (eIR + eLMIS)	Guinea (eLMIS)
Comparator	Paper-based system	Paper-based system	Paper immunization registries and eLMIS	Paper version of eLMIS system
Cost impact per Health Facility compared to non-users of electronic systems	535 (441; 702)	278 (75; 482)	-1,770 (-2,990; -550)	-36 (-176; 102)

Results: Assumption-based cost simulations of scale-up and digital transition, I\$ 2021



- The cost of managing immunization and vaccine stock data with the electronic tools was found to be higher in Honduras and Rwanda, lower in Tanzania and negligible in Guinea compared to paper-based systems.
- Variations observed across different contexts of implementation and systems → findings not generalizable to other countries.
- Micro-costing study in the region of Arusha, Tanzania, Mvundura et al. (2020) reported cost-savings of USD 10,236 per facility/year (95% CI USD 7,606-14,123) → higher than the savings estimated here (~USD 1,800).
- Parallel use of legacy systems and poor use of electronic systems at Health Facilities is associated with higher costs.
- Simulations suggested that **nationwide scale up and elimination of paper processes** can lead to cost-savings of up to 40% of current costs for data management.

- eIR and eLMIS are **complex interventions**
 - Implementation is context-specific
 - Dependent on quality of infrastructure, political will, IT literacy etc.
 - Timing of evaluation → informative based on scale of intervention
- **eIR and eLMIS can be more costly than paper systems.** If funded through immunization budget, decision to invest must be assessed against other potential uses of same limited resources
- Retrospective, observational design unlikely to provide conclusive evidence on either costs or effectiveness → need for implementation research alongside intervention to carefully plan evidence collection at the onset.

Thank you



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ANNEXES

Context: Tools evaluated and implementation status

	Guinea (eLMIS)	Honduras (eIR)	Rwanda (eIR)	Tanzania (eIR + eLMIS)
Name	eSIGL	SINOVA	e-Tracker	Tanzania Immunization Registry – TimR (eIR) Vaccine Information Management System – VIMS (eLMIS)
IT platform	OpenLMIS	Custom development	DHIS2 Tracker	SantelIMS (eIR) OpenLMIS (eLMIS)
Implementation start date	2015 as pilot outside NIP 2018 in NIP	2012	2019	2014 (eIR) 2015 (eLMIS)
Scale	Paper forms and process: Nationwide Digital: 59/444 facilities (at the time of the evaluation) 253/444 as per December 2022	Paper forms and process: Nationwide Digital: A regional and municipal level only	Nationwide	15/26 regions (eIR+eLMIS) Nationwide, down to district level (eLMIS)
Implementation status <i>*Note: Electronic data are not the 'official' source of immunization data for decision-making in any country</i>	Dual paper-electronic reporting process. Paper forms used nationwide at HFs with data digitized in eLMIS if HF had computer available. eLMIS used at district and regional levels, but National Immunization Program (NIP) still reliant on legacy paper/Excel tools (i.e., SMT)	Data digitized either at HF level (mid-level primary care centers) or at regional offices. No electronic tools exist at lower- level HFs.	System used solely by NIP. Varied use at HF level with parallel paper process. Data digitized by data clerks; data entry being transitioned to clinical HWs/vaccinators. Transitioned to fully electronic system on 1 Oct. 2022.	System used solely by NIP. VIMS implemented down to district level; eIR down to HF level providing interface with VIMS. In many instances abandoned; one third of HFs visited anticipated to be using the eR were no longer using it. Parallel paper processes still in place.
Integration and interoperability with other HMIS	System shared across 9 health programs (5 more to be rolled out). Interoperable with DHIS2 at central level.	System used solely by NIP. No inter-operability with eLMIS nor CRVS.	System used solely by NIP. Interoperable with CRVS and RapidSMS (client reminder system) as of 1 Oct. 2022.	System used solely by NIP. eIR and eLMIS interoperable (with challenges). eIR not yet interoperable with CRVS.

Methods: Examples of activities considered in Activity-Based-Costing

Activity	Description
Vaccination session execution: Child registration	Time spent on entering details and data regarding a new child registration (including service provision and data management, finding client folder and event recording).
Defaulter identification	Reviewing registry to identify children who missed appointments, making list of defaulters
Defaulter contacting	Contacting defaulters to remind caregivers of missed vaccinations
Organizing outreach sessions	Preparation for the delivery of immunizations in outreach settings
Identifying performance gaps	Reviewing data to find performance gaps (such as HFs not being on track for coverage goals)
Report generation	Time taken to search for and record data that will be included in the regular reports on immunization services and stock management.
Report transportation	Physical transport of weekly/monthly reports to higher administrative level for submission
Vaccine quality control/ monitoring	Physical counting, recording, and checking of closed vaccine vials for expiry dates or temperature excursions; Physical counting, recording, and checking of any open vials
Cold Chain monitoring	Data entry of records of the refrigerator or freezer temperatures
Determining quantities of vaccine to order	Data mining and information extraction from dispensing/vaccine use and storage system and processing it to prepare the next order
Refresher trainings	Recurrent trainings provided to HF staff on recording and reporting of immunization data, whether on paper or electronically
Technical and/or administrative support visits	Recurring visits from higher health system levels for supportive supervision and technical assistance in immunization service delivery