VIETNAM'S SCALE-UP FROM A DISTRICT-LEVEL PILOT TO A NATIONAL-SCALE ELECTRONIC IMMUNIZATION REGISTRY (EIR)

LESSONS LEARNED FROM VIETNAM

CASE 2

Cover Photo: PATH

Suggested Citation: PATH/NEPI. Vietnam's Scale-Up from a District-Level Pilot to a National-Scale Electronic Immunization Registry (EIR). Hanoi; 2020

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Vietnam's scale-up from a district-level pilot to a national-scale electronic immunization registry (EIR)

ABBREVIATIONS

AI   Artificial Intelligence

API   Application Programming Interface

EIR   Electronic Immunization Registry

GDPM   General Department of Preventive Medicine

ImmReg   Digital Immunization Registry System

INGO   International Non-governmental Organization

IT   Information Technology

M&E   Monitoring and Evaluation

MAPS   mHealth Assessment and Planning for Scale

MNO   Mobile Network Operator

MOH   Ministry of Health

MOU   Memorandum of Understanding

NEPI   National Expanded Program on Immunization

NGO   Non-governmental Organization

NIIS   National Immunization Information System

SOP   Standard Operating Procedure

TOT   Training of Trainers

TWG   Technical Working Group

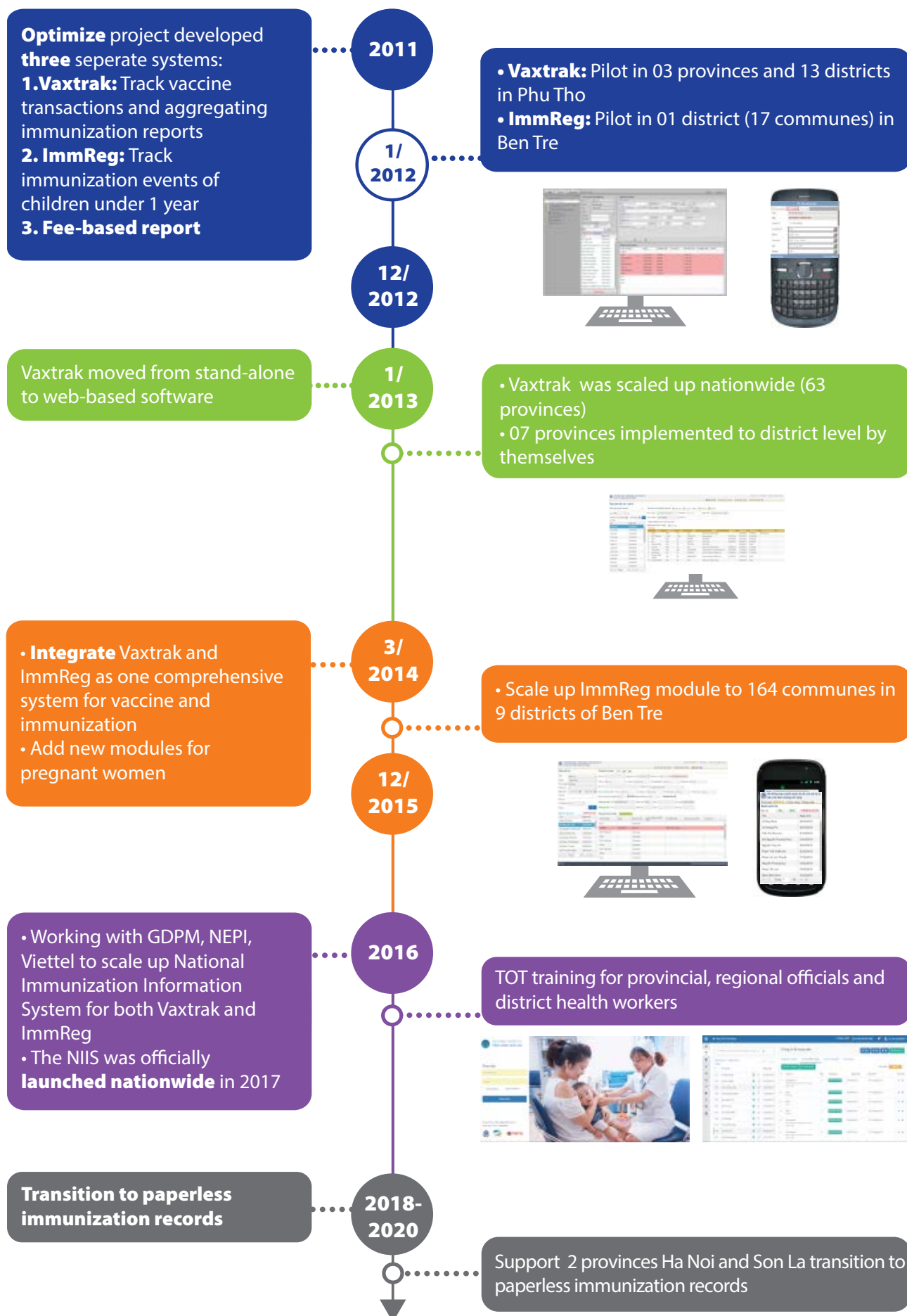**WHO**   World Health Organization

INTRODUCTION

The foundations for a national-scale electronic immunization registry

> *Vietnam's scale-up from a district-level pilot to a national-scale electronic immunization registry is a notable example of intentional planning, awareness of challenges, and dedicated partners. The story illuminates valuable lessons for audiences worldwide on how a country can scale digital health initiatives nationally and address the many associated challenges to ensure success.*

Vietnam's immunization registry system prior to 2009 was a paper-based logbook that was prone to errors, time-consuming, and burdensome for health workers. The country was still relatively new to internet use, but national interest in technology and mobile phones presented a unique and promising opportunity to explore ways to improve health outcomes and immunization rates. Starting in 2009, the Vietnam National Expanded Program on Immunization (NEPI) and their partner PATH began visualizing the possibilities and benefits that a national-scale electronic immunization registry (EIR) and vaccine-stock-management system could bring to Vietnam. In 2017, the National Immunization Information System (NIIS)—a sustainably planned, government-run, nationwide EIR system—was officially launched along with national mandates on system use. The NIIS in Vietnam is the culmination of the strengths of three early stages of the current system, now together into one.

History of EIR development in Vietnam

Optimize project developed **three** seperate systems:
1.Vaxtrak: Track vaccine transactions and aggregating immunization reports
2. ImmReg: Track immunization events of children under 1 year
3. Fee-based report

2011

1/ 2012

• **Vaxtrak:** Pilot in 03 provinces and 13 districts in Phu Tho
• **ImmReg:** Pilot in 01 district (17 communes) in Ben Tre

12/ 2012

Vaxtrak moved from stand-alone to web-based software

1/ 2013

• Vaxtrak was scaled up nationwide (63 provinces)
• 07 provinces implemented to district level by themselves

• **Integrate** Vaxtrak and ImmReg as one comprehensive system for vaccine and immunization
• Add new modules for pregnant women

3/ 2014

• Scale up ImmReg module to 164 communes in 9 districts of Ben Tre

12/ 2015

• Working with GDPM, NEPI, Viettel to scale up National Immunization Information System for both Vaxtrak and ImmReg
• The NIIS was officially **launched nationwide** in 2017

2016

TOT training for provincial, regional officials and district health workers

Transition to paperless immunization records

2018- 2020

Support 2 provinces Ha Noi and Son La transition to paperless immunization records

About this case study

Much of the success of the scale-up of the Vietnam EIR can be attributed to three key factors: (a) planning for scale from the beginning, (b) commitment from the government, and (c) technical partnerships. The story of scaling up, however, did not come without challenges and hurdles. This case study reviews Vietnam's journey from district pilot to national-level EIR. This case study provides a retrospective analysis of Vietnam's scale-up from pilot to nationwide implementation. It highlights facilitators, barriers, and lessons learned.

This case study used the axes outlined in the *mHealth Assessment and Planning for Scale (MAPS) Toolkit*[1] as a framework to compare Vietnam's experience with global guidance materials. The toolkit offers a semiquantitative approach for project managers to assess a program's readiness for scale.[2] Although the Vietnam scale-up preceded this reference document, this case study used MAPS axes to describe the process of scale-up from a pilot to a national-level EIR. In addition, the MAPS Toolkit was used retrospectively to determine what literature reviews and key informant interviews were necessary to understand the true story of the EIR scale-up in Vietnam in a global context.

Axes in the MAPS Toolkit include groundwork, partnerships, financial health, technology and architecture, operations, and monitoring and evaluation (M&E).[1] Due to limited data availability in the Vietnam context, this case study consolidates review of financial health into the section on groundwork and partnerships. Additionally, this document adds a sustainability section, as the Vietnam EIR is moving toward a completely digital system and strengthening data quality and data usage.

This document refers to the Vietnam stages of scale-up:

1 **PILOT (PROJECT OPTIMIZE):** Project Optimize was a pilot collaboration between NEPI and PATH, with technical assistance from the World Health Organization (WHO). The project focused first on vaccine stock management (VaxTrak); it also piloted a separate immunization registry at district level (the Digital Immunization Registry System or ImmReg) based on an assessment of user needs. Information gathered from Project Optimize helped to identify a larger gap in Vietnam's immunization registry, as well as gaps in reporting and tracking mechanisms.

2 **INTEGRATION AND SCALE-UP:** NEPI and PATH expanded the ImmReg pilot to the entire province of Ben Tre and absorbed the VaxTrak system in 2014.

3 **NATIONAL SCALE-UP AND GOVERNMENT OWNERSHIP (NIIS):** The Ministry of Health (MOH) requested that the design of the VaxTrak and ImmReg systems be integrated into the NIIS; this process began in 2016. The NIIS was designed to be a government-run and government-operated, national-scale immunization registry and vaccine-stock-management system. The MOH asked PATH to continue to support the pilot software government to integrate version 2 (ImmReg) into the new nationally scaled system (version 3, the NIIS). In the design of the NIIS, PATH and Viettel ensured that specific health worker needs and other stakeholder priorities were translated into technical specifications by the programmers. The NIIS design differed from previous versions in that it needed to track all vaccinations, including those outside of the NEPI age range (0 to 3 years old), and needed to be available to a broader variety of health center providers (fee based, private).

"This system aims to contribute to the effective management of immunization by the government by providing a comprehensive tool. The software will help to track individual immunization information over the course of a person's whole life from birth and will provide this information in an effective and timely manner to individuals and communities, and health facilities"

Letter from the Vietnam MOH to PATH, May 2016.

1. GROUNDWORK AND PARTNERSHIPS

1.1. Groundwork: The first steps taken in a project to establish essential components and determine the plan for scaling up.

Facilitators that helped Vietnam to establish the groundwork and foundation to scale up multiple stages into the current EIR

In November 2009, Project Optimize sought to understand the current systems for birth and immunization registration management at all levels in Vietnam by conducting an information system assessment. The Vietnam National Institute of Hygiene and Epidemiology collaborated with PATH on a series of activities to assess the opportunities and needs for strengthening the immunization system in Vietnam. The end goal of the assessment was to determine specific technical options that might strengthen the vaccine management and immunization information system nationwide.[3]

A landscape analysis provided a snapshot of technical capacities, policies, and health information systems that were already in place or under development. This analysis helped to identify the advantages and disadvantages for implementing an EIR.

Project Optimize demonstrated to NEPI the benefits of using computer and mobile phone technology to record immunization registry data, track individual children due for immunizations, and record the vaccinations children have received. The goal was to evaluate how a digital registry might improve the ability to track children due for vaccinations and how it might shorten the time required for recording and reporting immunizations compared to a paper-based registry.[3]

The assessment also explored what software had already been piloted and why these had been unsuccessful. The key was to understand the needs and challenges of end users (health workers interfacing with the EIR), as these could differ drastically from the needs of management and higher-level authorities. Findings from the assessment identified data-related challenges, heavy burdens on health care workers, high turnover rates of health care workers, and the difficulties in monitoring vaccine and supply stock. It was apparent from the assessment that there were major challenges with the paper-based system. Findings were used to develop a software system based on end-user needs to facilitate a long-term sustainable system and scale-up.

The assessment revealed that health facilities in Vietnam at the provincial and district levels had computers and internet and that, in general, the population was becoming more computer literate. Staff in district- and higher-level centers already had some exposure to computer systems, and other software programs had been introduced in the past. There was a high level of interest among leaders at the regional and national levels in exploring new information systems for managing processes and tracking the vaccine supplies used in the immunization program, as well as in developing a digital registry system for target populations within the immunization program.

A business model framework was a useful guide for the scale-up.

After a small-scale pilot (ImmReg), the feasibility and acceptability of implementing the system across all health facilities in Vietnam was assessed. The assessment used the Business Model Canvas, which was developed by Alex Osterwalder as a strategic management tool for modeling partners, activities, customer value propositions, and ideal targets for businesses.[4] This model, developed during Project Optimize, provided an overview of the proposed key partners, resources, and activities for scaling the immunization registry system to all of the districts in Ben Tre Province and ensuring the system's sustainability. In order to inform scale-up efforts, a costing model was created during the pilot to determine the financial resources needed to implement and register the system across scale-up provinces in Vietnam; this would ensure the appropriate allocation of funds.

Pilots provided evidence of success to encourage investments in the system/software.

The three key benefits from the previous pilot EIRs were proven in the endline evaluation of ImmReg: time needed to generate immunization reports decreased, on-time vaccination rates improved, and immunization coverages increased in the first year of life. In addition, the feedback from end users of the pilot system was very positive.[5] Vietnam's MOH requested that PATH use these quantifiable successes to support the development of a comprehensive, nationwide NIIS.

Government priorities from the beginning catalyzed the scale of the NIIS.

National-level stakeholders within the Vietnam government played an essential role in advocating for the NIIS to lower-level government leaders; they showcased successes and thus spiked commitment to the system. The government became invested, which pushed end users and managers to use the system.

PATH presented the ImmReg software pilot results during a dissemination workshop (2015) that involved government leaders from a variety of agencies. After the pilot was shown as a successful system, the MOH decided to establish ownership of the EIR, which catalyzed development and deployment to a national scale.

The MOH assigned the General Department of Preventive Medicine (GDPM) to serve as the lead organization, NEPI as implementer, and mobile network operator (MNO) Viettel as technical expert. PATH was asked to stay on as a partner to provide technical support and act as a liaison between all partners. This enabled the government to own and run the system, as well as to work with supportive partners and developers as a team to advance the success of the scale-up.

Foundational guidelines and standard operating procedures provided useful frameworks for end users in order to standardize use of the system.

Initially, NEPI and PATH developed implementation guidelines with basic standard operating procedures (SOPs). These were first introduced during the pilot phase. As the system was scaled up and the number of people who used the system increased, feedback guided implementers to redesign and update SOPs in order to evolve with the system. The national SOP was revised

for the national implementation of the NIIS. In 2019, PATH supported NEPI to update the SOPs to add more details and make the SOPs more reader friendly to increase system use.

A costing analysis painted a forecasting picture of scale-up.

After the Project Optimize pilot in one district in Ben Tre Province, PATH, with technical support from WHO, developed a financial tool to help predict the costs of ImmReg implementation in Vietnam. This breakdown of the cost of the ImmReg pilot in Ben Tre was used to estimate the cost of scaling up to all 40 provinces in a five-year period from 2014 through 2018.[6]
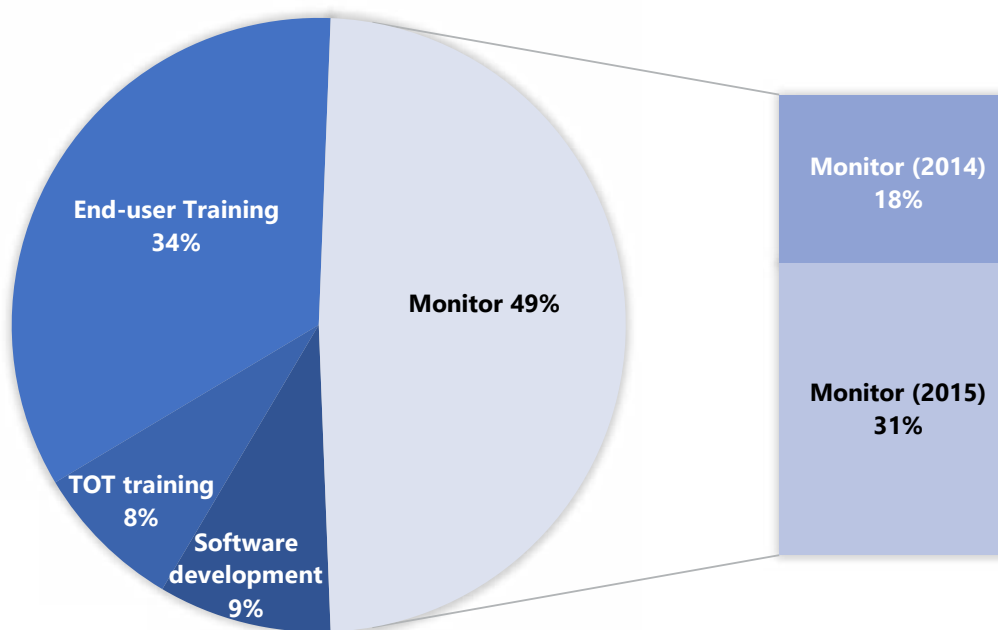

Figure 1: Breakdown of total cost for ImmRef implementation in Ben Tre (2014-2015)

Challenges during the groundwork stage of scaling

More time was needed than anticipated at each stage.

Development and introduction of each stage took longer than anticipated. It took longer than planned to bring together users to provide input into the system and review the deliverables from the software developer, and there were other small delays. All of this contributed to a postponement of the launch date.

Poor infrastructure and computer literacy gaps needed to be addressed before implementation.

While infrastructure had been improving each year, some health centers, especially in mountainous areas, were not fully equipped with the technology needed to run the NIIS; this included but was not limited to lack of computers and internet connections. Ideally, there would be enough computers available to input data into the system during the immunization session instead of after the session. It has been shown that real-time data input is correlated with a decrease in errors and reduction in time spent on data entry. Additionally, health workers often

had limited information technology (IT) knowledge, especially at the commune levels. This dramatically increased the learning curve that had to be overcome to fully use the system.

National policies were not developed at the beginning of the pilot.

During the Project Optimize pilot (2009), there were no formal policies or guidelines for use of digital tools in health facilities. It was a challenge for the project team to gain the full cooperation of health care providers and local governments to implement a digital tool. The project team was concerned that, without a mandate, it would be difficult to successfully or sustainably implement a health information system.

Not estimating cost for scale-up led to funding gaps.

Although costing models were created to anticipate cost for limited scale-up of pilot versions such as ImmReg, no costing analysis was performed for the NIIS. Therefore, during national scale-up implementation, necessary resources—such as training, supervision, and M&E activities—could not be anticipated and/or allocated as needed.

Population growth was not factored into the scale-up.

The number of people registered in the NIIS is growing rapidly.[3] Ideally, this would have been considered when designing the capacity of the system. The MNO (Viettel) that created the server for the NIIS did not foresee how big the dataset would be. At times, this has led to the NIIS system being overloaded. This has caused the system to run very slowly, increased the frequency of necessary updates, and strained the server's bandwidth.

Lessons learned:

1. Assessments (literature reviews, baseline analysis, cost analysis, landscape assessments) during the groundwork phase provide helpful snapshots of the current technical, policy, and electronic health environments of the target population, which is helpful for deciding what is best for end users and preventing duplication of systems. This in turn can help determine strategy, resource allocation, and a feasible architecture of the system. Population-growth modeling can anticipate how many clients will be registered into the system each year, and financial necessity assessments can foresee any financial challenges.

2. Demonstrating the success of pilots helps to engage the government and elicit its commitment. The government should feel confident in investing in the system, allocating the necessary resources and tools to run and manage the system effectively at all levels, and mandating the system be used nationwide, with recommendations and clear roles of system users at all levels.

3. Evidence-based feedback from end users is imperative for making the correct improvements as scale-up proceeds and is essential for successful uptake and long-term use of the system. After the pilot, end-user feedback should help to guide the development of detailed SOPs for standardized best practices, allowing for scale and anticipating challenges.

1.2   Partnerships: Collaborations with external groups to support the process of scaling up, including strategies for identifying, developing, and sustaining fruitful partnerships.

Facilitators for partnership development in Vietnam

Support from government partners built a foundation of commitment to the system.

Formation of key partnerships with government stakeholders and the MNO was key to ensuring sustainability of the system. The government's engagement and collaboration from the beginning were sparked by initial pilot success; they were strengthened by the foundational trusting relationship established between the MOH and PATH. The NIIS Technical Working Group (TWG) was formed to finalize and maintain the user-friendliness of the NIIS system, to collaborate on meeting end-user needs with regard to client and vaccine-tracking capabilities, and to generate reports for high-level decision-making.

The NIIS Technical Working Group

The TWG comprises a critical set of diverse partners that contribute to the sustainability and technical implementation of the NIIS in Vietnam[7]:

NEPI: (Immunization expert) acts as technical lead on immunization workflows and develops user requirements, reporting systems, and reporting mechanisms.

MOH/GDPM: (Management authority) coordinates connection among all stakeholders, provides administration support, and pushes for provincial implementation and policy change.

Viettel: (Technology expert) develops and maintains the system.

PATH (international nongovernmental organization or INGO): (Technical partner) provides technical support to and advises all stakeholders; serves as the connection between the immunization, general health, and technology sectors; serves as focal point for global standards/goods; as well as facilitates communication between TWG members.

> *"Engaging the government from the beginning made it so that they were involved and invested in all stages."*
>
> *Interview with Dr. Vu Minh Huong, Asia Region Technical Advisor, PATH*

Developing a partnership with a technology expert as a service provider instead of a handover system helps to reduce costs.

When the GDPM asked Viettel to develop the NIIS, mechanisms were set up so that Viettel provided key development, storage, and maintenance services rather than only software developer services that would be handed over to the government to run. This helped to establish the software as a sustainable system.

Barriers to partnership development

It took time and patience for partners to develop shared language, understanding, and expertise to support the NIIS.

All partners in the scale-up experienced some degree of a learning curve, as each partner came with different levels of expertise. Partners found that initial conversations about the health outcome goals of the project were difficult due to a drastic variance of experience with health and immunization terminology, financial matters, and technology. The translation of information from highly technical teams, such as those from the MOH and NEPI to Viettel and vice versa, took time, patience, and collaboration. Learning curves were eventually reduced as communication strengthened between partners and as Viettel understood more about the vaccination and immunization field and business chains. This helped Viettel to acknowledge what IT can do to help improve the work of health workers. Health focused–partners, on the other hand, gained knowledge of what IT was capable of bringing to the table. This solidified communication and the partners were able to move forward as a collaboration. An INGO, such as PATH in the Vietnam context, helped to facilitate and maintain communication between partners and served as a liaison between expert groups to bridge gaps.

A lack of formal contracts between partners made it difficult to maintain clear roles and responsibilities.

The Vietnam government designated the MNO Viettel to work with the MOH when needed. When the NIIS was brought to scale, the MOH requested PATH support in the development and implementation of the NIIS due to PATH's expertise and experience; the two parties entered into a memorandum of understanding (MOU).

Since the government asked Viettel to support the NIIS, PATH and Viettel did not enter into a direct contract or MOU. This has created a more siloed designation of tasks, as there is no standard contract or MOU between all partners of the TWG.

Lessons learned

1. Engaging the government at all stages—from system design, to early pilot, through to evaluation and scaling up—builds strong commitments from government partners. Building capacity and a network of support at provincial and district levels is essential for successful uptake and long-term use of the system.

2. Forming a TWG or having a national technical support team is key. However, their roles should be clearly defined and adapted as needed. Allow for learning curves, busy schedules, and staff turnover; provide clear guidelines; and make formal agreements between all parties as early and as specifically as possible.

3. Partnership with a strong and well-established MNO can aid in implementation in hard-to-reach areas and ensure capacity needs are met.
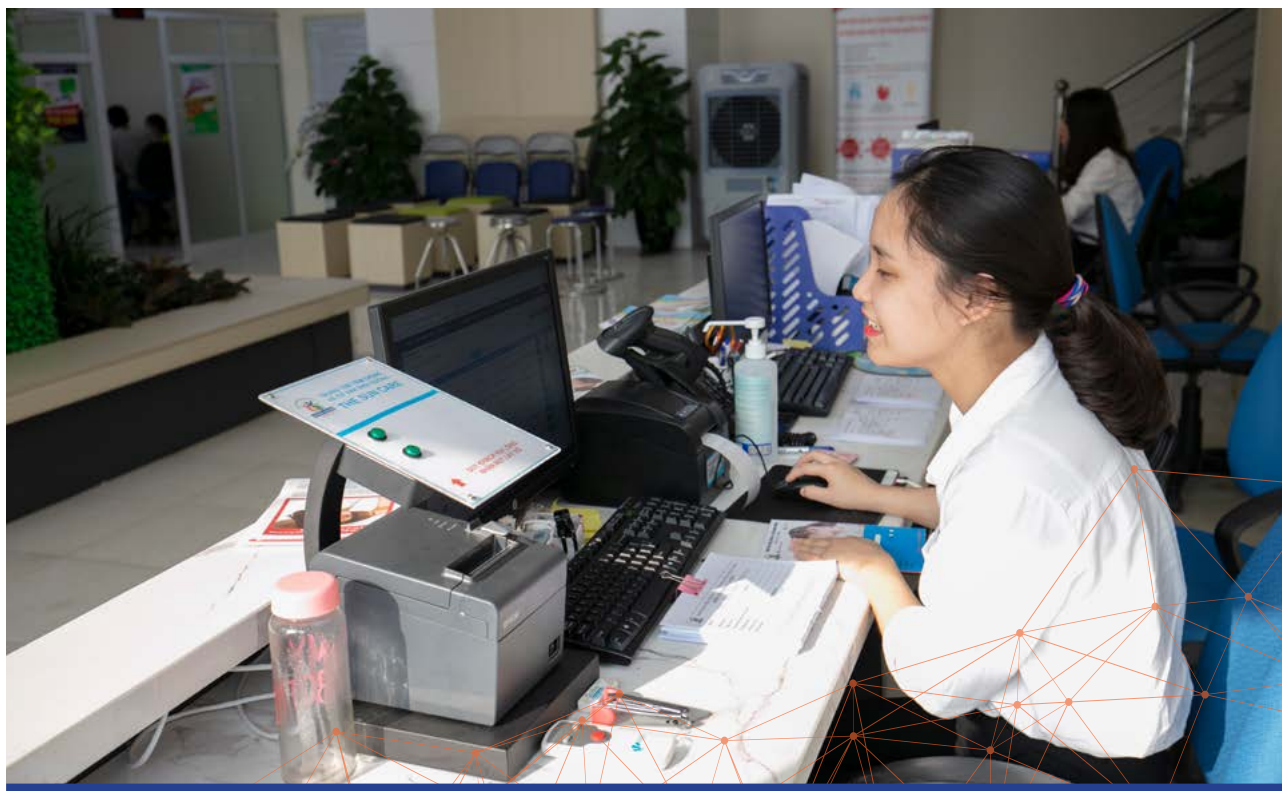
2. TECHNOLOGY

The technical aspects of developing an optimal digital health product for scale-up based on purpose, user needs, and interoperability.

Facilitators that enabled the technology development for scale-up of the EIR in Vietnam

MNO selection should be based on capacity and trust to sustain the system in the long term.

Viettel, a state-run organization, has a well-established relationship with the government of Vietnam, and the MOH has confidence in Viettel's data security. Viettel is also the largest MNO in Vietnam, with a large network of mobile services and expansive network range, capacity, and core support infrastructure.[7]

Sustainable technical leadership should be established.

Currently in Vietnam, NEPI is taking the technical immunization lead with support from PATH, while Viettel leads the back-end technology support of the NIIS, such as monitoring and controlling the system. This creates a role based on specialty for each partner. NEPI and PATH gather feedback from end users and send requests to Viettel, which then operates the system.

Design of the system should be based on feasibility and acceptability among end users.

During Project Optimize and the implementation of ImmReg, PATH developed each stage of the system based on its acceptability among end users. End users in Vietnam reported that top priorities were to improve mechanisms to track the target population, increase the availability of ready-for-use immunization data, improve supportive supervision activities, and reduce the time needed to record and report immunization records and vaccine information. In addition, factors of feasibility were assessed, such as the availability of computers and internet connections, and the skills of health workers. This enabled the development of a friendly system based on the needs of end users.

Data security and quality are ensured by Viettel.

Viettel currently maintains the security of the data with a security department. Data are stored in a cloud server that Viettel controls. At the ground level, the system provides security to health workers by requiring a username and using a log-in mechanism that is password protected. If the system is idle for too long, the system will log the user out of the system, whereupon the user will have to log back in and start again. Any changes to data in the system are tracked, and users who make edits are transparent to Expanded Program on Immunization managers and other supervisors. When end users enter data into the system, there are mechanisms set up to flag any duplications. If there is a duplication, an alert is sent to the user—which the user needs to click out of before continuing. Additional training is needed to reinforce the process for handling this alert.

The software should not be designed for handover but should be maintained by a collaboration of partners invested from the beginning.

Viettel was enlisted to provide services not just in regard to the NIIS software but also as a partner in decision-making. PATH and other supportive partners were enlisted to remain as technical advisors and active members of the TWG. This creates a relationship between organizations based on historical involvement with the system, which boosts system expertise and knowledge. This allows partners to work together whenever anything needs to be changed or updated in the system. In a handover system, there is not sustained work or involvement from developers of the earlier versions of the system.

Developing an application programming interface supports interoperability across public and private systems.

Viettel developed an application programming interface (API) to open the NIIS to communicate and connect with systems that fee-based facilities use independently of the NIIS. Fee-based and private facilities tend to use their own systems, but it is important to develop mechanisms to communicate with these systems so that all data from the population can be pulled from the national, mandated system as needed. Additionally, if clients move to a different facility, they can be tracked easily and identified, thus reducing duplications.

Barriers in technology in the scale-up of EIRs in Vietnam

**Lack of a national ID created delays in synchronization.**

Viettel is currently working to develop a health information system that integrates all health information systems into one. However, the general population has not fully acknowledged the importance of a unique ID and the benefits it can bring, making it difficult to create a nationally used unique ID system for children. Without a standardized unique ID system, the challenges of tracking and monitoring mobile populations and duplication remain.

Large datasets created delays in the system and require frequent upgrades.

One challenge that Viettel came across was that they did not foresee just how large the dataset would actually be. Today, there are around 20 million clients in the system, and the servers constantly need upgrades. The system is sometimes very slow because of how many clients are stored in the system and how many end users are using the system (online).

Fee-based and private facilities do not use or only partially use the system.

Currently, many fee-based and private-sector facilities in Vietnam use their own systems and do not want to update data in the NIIS on top of their already heavy workload of inputting data into their own systems. Additionally, fee-based and private-sector facilities are hesitant to use the NIIS if there is not enough information in their systems to exchange information between them and the NIIS. Additionally, when the NIIS asks for more information than the other systems can provide, it creates a heavier workload for their health workers. PATH is working with Viettel to address these issues and continue to improve APIs to better communicate between systems.
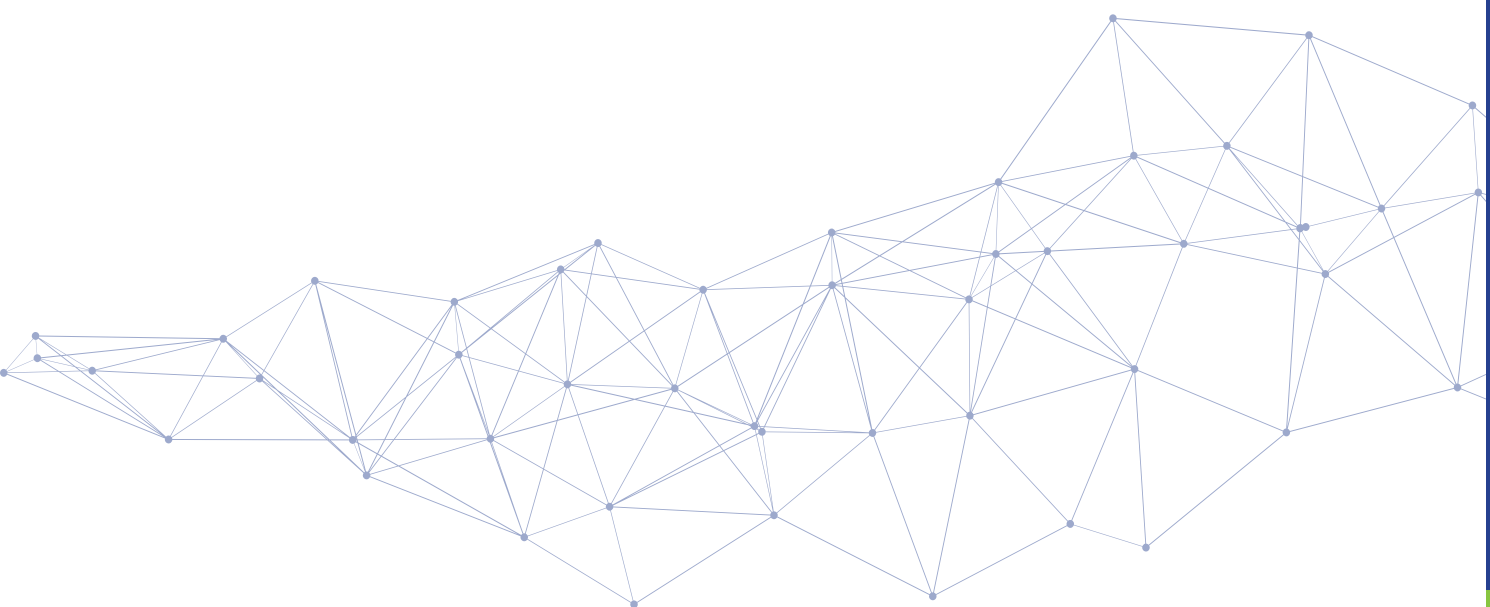
Lessons learned

1. Be prepared for and anticipate data expansion. A population-prediction analysis before scaling up is a useful tool. Stress tests should be conducted during scale-up to anticipate how many clients the system can store without slowing down the system and burdening end users who are using the system online. Additional developments, such as separating the database and the online portal into two servers, could also be explored as possibilities.

2. It is hard for just one nongovernmental organization (NGO) or small company to develop the technical requirements of a system alone; collaboration and user feedback are key.

3. SOPs should be developed that clearly state protocols to ensure data quality at the time of data entry, highlight the importance of avoiding duplications, standardize duplication avoidance procedures, and provide frequent M&E activities.

4. The EIR should be designed to be interoperable with other country information systems. APIs should be developed to communicate with independent software systems and to integrate data into one national database. Local governments should make it expensive to upgrade independent systems used at fee-based and private-sector facilities to encourage these facilities to use the government software (NIIS).

5. A universal unique ID provided for each newborn could help to integrate existing systems, increase interoperability, and ensure data quality. This would prevent duplication and serve as a key for individual vaccination monitoring.

3. OPERATIONS

Organizational and programmatic measures for supporting the implementation, use, and maintenance of the product throughout the scaling-up process.

3.1. Training and supervision

Training of trainers was a sustainable method for training large populations.

Training of Trainers was a sustainable method for training large populations.

Trained health workers acted as mentors and teachers to train other staff at the same facility on the system. There also were established district-level focal points to work with the data daily and train lower-level health workers as needed. This ensured that at least two staff members were trained to use the system at each facility.

PATH provided training support to all levels of the health system.

PATH has been involved since the beginning in the development of multiple phases of systems (VaxTrak, ImmReg) that helped to form the current NIIS. Therefore, PATH serves as a valuable resource to guide training from pilot to scale and provide methodologies, training materials,

training sessions, and limited financial support for provincial training sessions.

Training provincial and district staff provides sustainable layers of technical support.

Select provincial and district health staff were chosen as mentors and trained using the training of trainers (TOT) method. This enabled these mentors to take the learnings from their training and provide trainings to end users at provincial and district health facilities. The mentors also serve as focal points for technical support at each health level and provide direct support to end users. This approach works in Vietnam to foster country ownership and sustainability. It also ensures that end users maintain adequate knowledge and skills.

Technical support should be planned for long-term sustainability.

Implementation of software technologies requires long-term technical support to be sustainable. There needs to be a system in place to provide support at each level. This requires a strong commitment from the MOH, correct budget allocation, and management guidance. Using popular social media applications (in Vietnam, Zalo) aids in forming technical support groups that can be queried easily about technical issues without contacting higher-up leaders. Hotlines are also useful for providing technical support to end users.

In Vietnam, there is both a telephone hotline number and an artificial intelligence (AI) chatbot in the NIIS system. Users in Vietnam prefer the telephone hotline over the AI. This could mean that the AI needs to be improved in the future to move the heavy burden off the phone line, which is currently overworked.

The *WHO Recommendations on Digital Interventions for Health System Strengthening*[8] highlights the importance of a digital health workforce to increase sustainability of systems. Recently, in a readiness assessment about the scale-up, sustainability, and expansion of the NIIS model to other health information systems, PATH and NEPI asked interview questions to gauge motivation and commitment for digital health systems in the workforce.

Inputted data in the system can be used to determine supervision priorities.

When higher-level facilities open the data entered into the NIIS, they can see which lower-level health facilities are having trouble with system use and technology and are creating duplications and inconsistent data quality. This enables the higher-level facilities to single out lower-level health facilities that might need extra supervision or training in the future for improvement.

Barriers that presented training and supervision challenges in Vietnam

More time was needed for TOTs than anticipated.

The IT knowledge of provincial and district health workers was limited during the ImmReg TOT activities, and facility-level health workers' knowledge was even more limited. This demanded more time, as all three levels first needed to be trained in basic computer literacy before even addressing ImmReg software requirements, such as popular bugs and solutions, advanced Excel, communication tools, and use of remote IT support for end users at the facility level instead of phone or on-site support (chatbot). Additionally, poor infrastructure, such as old

computers and unstable and low-speed internet connections, added more time to training sessions.

There is a lack of funding for EIR-specific supervision visits.

Low budgets for implementation were mentioned in most provinces of Vietnam as a barrier for successful uptake of the NIIS. This makes it difficult for provincial- and district-level trainers to conduct timely supervision of end users and, therefore, jeopardizes the quality of data entered into the system, user compliance, and overall usage rates.

Supervisors do not have enough time to prioritize the NIIS system supervision.

Currently, NIIS supervision is often integrated with other immunization supervision activities under NEPI. This means that supervisors at NEPI do not have enough time to prioritize the NIIS and make supervision visits that are dedicated to the system.

SOPs for supportive supervision and pre- and post-training tests have not been developed.

Currently, the SOPs for supportive supervision for the NIIS have not been developed. This makes the quality of supportive supervision visits inconsistent. No guidelines exist for monitoring the quality of data, ensuring the adequate availability of essential supplies, and increasing adherence to other guidelines when using the NIIS.

Lessons learned:

1. INGOs/NGOs like PATH can help develop training plans, facilitate trainings, and provide additional financial support as a backup source. A detailed training plan helps in providing training for all levels of health facilities and end users at all levels of technological literacy.

2. Technology support should be provided at each level, with a cascade effect. It is unrealistic for commune health workers to look to national-level experts for technical support but feasible for them to contact district-level staff, who provide more approachable mechanisms that can help fill gaps in learning. Some mechanisms, such as group-chat smartphone applications (e.g., Zalo), can help normalize, and speed up responses to, technical support queries and support end users remotely.

3. SOPs for supervision should be developed to standardize, organize, and motivate supervisors to conduct quality supervision visits. Additionally, a budget should be allocated from the local governments for supervision visits.

3.2. Personnel and outreach

Facilitators for personnel and outreach in Vietnam

MOH, NEPI, and end-user buy-in to the EIR promotes system use.

End users expressed, during feedback, that the NIIS helped make their jobs easier, improved their ability to register and track children, and helped them plan more effectively. For NEPI and the MOH, the NIIS increased the availability of immunization data, which reduced the time needed for recording and reporting data.[6]

Supportive leadership encourages the country to use the system.

The MOH was able to clearly identify the importance of a digital health intervention for immunization and vaccine registries and was committed to scaling the intervention by integrating the existing systems into one successful national system. Supportive leadership can help to increase end-user commitment by mandating usage of the system at all levels, allocating resources where necessary, and planning for the future.

Partner organizations support and amplify scaling-up efforts.

INGOs or NGOs like PATH can play a key role in scale-up efforts. PATH supported the scale-up process in Vietnam during every stage, not only with technical support but also, when needed, with financial support. PATH continues to provide TOTs, helps to organize TWG meetings, and works with all agencies on the next steps to maintain, improve, and finalize the system as Vietnam continues to scale to areas with low usage rates and moves to an entirely paperless system.

Barriers for personnel and outreach in Vietnam scale-up

There is frequent staff rotation and a high staff turnover rate.

Using the system was a challenge for facilities with frequent staff rotation, as it is not easy to train new staff on using the system. Ensuring that at least two staff are competent in using the system at each facility helps to cover sick staff members. It also serves as backup before training can be provided to new staff members. Training that is immediately available can help to reduce this barrier, as well. Vietnam is currently exploring e-learning options so that new staff members can be trained on the system as soon as possible.

There is limited capacity in software use, data analysis, and data use among health workers.

Some health care workers at the lowest level of the health system, especially during Project Optimize in 2009, were not well versed in computer usage, including basic computer functions (typing, Microsoft Office, etc.). Therefore, they did not know how to use the data to calculate indicators and interpret results for decision-making, planning, and prioritizing supervision.

There is a lack of funding for refresher training.

During the pilot stages (2009 and 2012), computers were still relatively new to health facilities, and a steep learning curve was discovered for all aspects of technology. It was especially apparent in older staff members. It was also apparent that there needed to be additional funding for refresher training courses to increase health workers' knowledge and skills on using the system and address any challenges or gaps.

At the commune level, health workers are often overworked and busy, and work independently from Expanded Program on Immunization staff.

Health workers are overburdened with tasks and are often in charge of multiple health care programs. This causes delays in inputting data into the NIIS.

There is the heavy burden of dual reporting.

Today, because a completely digital system is not mandated by the government, end users are tasked with using both the paper-based system and the NIIS to ensure data accuracy in both systems.

Lessons learned

1. Training multiple levels of health care workers can help new staff, facilities with high staff turnover, and facilities in need of refresher trainings receive the training that they need as fast as possible.

2. Local governments should allocate financial and human resources to maintain the system.

3. Monitoring visits by committed supervision leaders are needed to ensure data quality in the system and support facilities' transition to an entirely paperless reporting system.

4. Advocating for local authorities to plan appropriately to remove the paper-based system would reduce the burden of dual reporting and reduce the workload for end users.

4. MONITORING & EVALUATION

Decisions and activities that enable effective process monitoring and in-depth outcome evaluation, based on project and stakeholder needs.

Facilitators for M&E in the scale-up of the system in Vietnam

M&E framework development is at an early stage.

Prior to designing and implementing the software during the pilot phase, an M&E framework was developed to identify the indicators that were of interest for measuring, such as evaluating the accuracy of vaccine and immunization data before and after the data input.

Barriers to M&E in the scale-up of the system in Vietnam

Few resources are available for monitoring.

Local governments do not allocate the budget for M&E; some do not even have supervision budgets. This means that, many times, M&E has to be integrated with other programs, and resources need to be mobilized from outside sources such as NGOs and other funding organizations.

Inconsistent data quality remains an issue.

Currently, it is hard to use electronic data for monitoring activities because health facilities at the national scale are inconsistent with inputting data into the NIIS system.

Lessons learned

1. Allocate a budget and resources for M&E as early in the scale-up as possible, adapting as needed.

2. Develop an M&E framework for the pilot stage and beyond to track the implementation of the system and evaluate the impact of the system on health outcomes.

3. Create monitoring tools and reporting systems to track the progress of system use. Conduct comprehensive analysis to evaluate the effectiveness of the system.

5. SUSTAINABILITY

The system was designed for scale and sustainability in Vietnam. Lessons learned during the decade of development and implementation have led to continued work to improve and expand the NIIS system.

In Vietnam, feedback from end users was critical at all stages of scale-up. The MOH's commitment and priorities ensured that the project was, and continues to be, maintained. The merging of the pilot software into the government-owned and government-run EIR ensured the government's continual commitment to the system. The fact that the developers of the pilot (PATH) and the partner that helped to develop the NIIS (Viettel) continue to work with the system is key. The foundational belief that software should not be designed as a handover-only system but should be designed for sustained and continual commitment from all partners involved ensured a solid partnership and enabled synergistic decision-making. This methodology additionally works as a safety mechanism, as each partner becomes more of an expert in the system, fueling deeper commitment and dedication.

Creating a system with end users in mind and prioritizing their feedback further highlight the benefits of the system to the end user after implementation. This generates end-user enthusiasm, allows leaders to facilitate and encourage use of the system, drives scale-up momentum, and promotes system sustainability.

As Vietnam moves forward, the possibility to expand the software to other sectors sparks growth and forward thinking.

Increasing data linkages between the NIIS and other health information systems will enable consolidation of large immunization datasets, which will most likely result in more complete immunization histories, increased coverage, improved support during disease outbreaks, and decreased costs due to efficiencies gained through better use of resources (such as not over-vaccinating). Continual additions to the system to improve end-user acceptance and usage are always on the table for discussion with the partners of the NIIS (MOH, NEPI, Viettel, and PATH). Recently, GDPM, NEPI, and PATH worked with Viettel to develop an online portal application that will expand the functionality of the NIIS to empower the public to manage their own immunization schedules.[7]

Additionally, PATH, in 2016, conducted several meetings with NIIS partners to discuss the development of a nutrition component that could connect with the system. This would enable health workers to track nutrition indicators of children at the same time as tracking immunization data. Partners of the NIIS are incredibly supportive of this decision. This shows that it is possible to expand even after scale-up.[7]

Sustainability does not come without challenges and barriers.

Fee-based and private-sector facilities are becoming more and more popular in Vietnam. The challenge is, however, that these facilities tend to use their own internal systems instead of the NIIS. Even when the government mandated use of the NIIS, fee-based and private-sector facilities only complied enough to avoid being reprimanded: of 1,000 clients that a facility's workers might see in a day, they would only input 200 into the NIIS, causing massive data inconsistencies and tracking difficulties. Moving forward, the local governments should mandate these non-NIIS-compliant facilities to commit fully to using the national system or to minimally input the required information into the NIIS in addition to their own separate systems. Viettel, GDPM, NEPI, and PATH are exploring the option of a newly developed API to catalyze the connections and allow sharing of data between separately run systems and the NIIS.

Paper-based systems are no doubt time-consuming, burdensome, and prone to errors. The pilots run in Vietnam have clearly demonstrated the improvements that moving to a digital system can provide to health facilities in these areas and beyond. However, moving from paper-based systems to an entirely digital one actually demands more work than before from end users. First, during the pilot, health workers needed to input all data of the data of children who had been born prior to the software implementation so that there would be a full dataset in the system. This is an incredibly time-consuming task that fell on already burdened and busy health workers who were, in some cases, still working with limited computer literacy.

Second, the pilot did not fully estimate the poor status of, and inaccuracies in, the preexisting data in the paper-based immunization logbooks. For example, one benefit of the digital system is its ability to track children as they move from commune to commune. The lack of this function was a major problem with the paper-based system, which was highlighted when it was reviewed. It caused significant workload to find these duplications, correct them, and accurately

input them into the system. Therefore, the challenge today is to build enough confidence in the NIIS data at the health facility level to completely eliminate paper-based records. PATH has implemented a readiness assessment to understand where Vietnam is in this transition. Until the readiness to transition is secure, health facilities are burdened with running both systems in parallel.

Lessons learned

1. Even after scale-up, there are always more work to be done and improvements to be made. It is ideal if all partners remain in communication and work together to ensure sustainability and commitment to the system.

2. Fee-based and private-sector facilities should be mandated to use the system and should incur a penalty if they fail to comply. APIs should be explored as a good way to make communication between multiple systems easier, which would thus improve compliance.

3. Feedback is imperative not only at the pilot stage but at every stage of the scale-up. Even after a system is implemented nationally, feedback from end users is the number one way to ensure sustainability and acceptance of the system and to rectify gaps, challenges, and hesitations from the population.

4. A successful system with the right partnerships and commitment can be continuously scaled up to include more systems and fields of interest, such as other health sectors and ID tracking areas, and can aid in working toward a national unique ID.

5. A detailed plan for the transition to paperless needs to be developed from an early stage to ensure good data quality (timeliness, completeness, and accuracy) and reduce the workload for health workers.

CLOSING REMARKS

Vietnam presents an exploratory example of a successful scale-up of an EIR from pilot to nationwide application. The successful process of moving from small- to large-scale operation was due in part to from-the-start planning, key partnerships, government commitment, and sustained collaboration. This, however, did not come without barriers and challenges, such as poor infrastructure, limited computer literacy, steep learning curves, and the burden of dual reporting.

Countries in any phase of EIR implementation that are interested in scaling up should prepare for scale-up by:

- Conducting assessments.
- Putting a lot of weight on user feedback.
- Ensuring government commitment and resource allocation.
- Forming key partnerships with defined roles.
- Designating a technology expert/service provider with a large enough capacity to sustain the system.
- Building capacity at all levels to provide technology support to sequentially lower levels.
- Considering a TOT approach to ensure sustainability of training.
- Developing an M&E plan.
- Working from the start to ensure sustainability even after scale-up.

As Vietnam continues to close gaps in the national system and scale up to include more noncompliant facilities, increase usage, and eliminate paper entirely, the focus will be on continuing the commitment from government leaders, strengthening the partnerships developed, and sharing communication and guidance from global implementors worldwide.

Vietnam's scale-up from a district-level pilot to a national-scale electronic immunization registry (EIR)

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