



CASE STUDY 3

**THE DESIGN,  
DEVELOPMENT, &  
DEPLOYMENT**

**of an  
Electronic  
Immunization  
Registry in Vietnam:  
Reflections, guidance,  
& global similarities**



This case study was developed by the IDEAL-Vietnam project (Introducing Digital immunization information systems-Exchange And Learning from Vietnam), a collaboration of PATH, the Vietnam Ministry of Health, the Vietnam National Expanded Program on Immunization, and Viettel, and authored by team members from PATH and the National Expanded Program on Immunization.

We hope this report will contribute to ongoing discussions about immunization logistics, and we welcome comments from interested parties.

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# ABBREVIATIONS

<b>API</b>	application program interface
<b>BID Initiative</b>	Better Immunization Data Initiative
<b>EDCD</b>	European Centre for Disease Prevention and Control
<b>EIR</b>	Electronic Immunization Registry
<b>EVM</b>	Effective Vaccine Management
<b>GDPM</b>	General Department of Preventive Medicine
<b>ImmReg</b>	Immunization Registry
<b>MOH</b>	Ministry of Health
<b>NEPI</b>	National Expanded Program on Immunization
<b>NIIS</b>	National Immunization Information System
<b>PPMC</b>	Provincial Preventive Medicine Centers
<b>TOT</b>	training of trainers
<b>TWG</b>	Technical Working Group
<b>VaxTrak</b>	Vaccine supply chain management system
<b>WHO</b>	World Health Organization

## Introduction

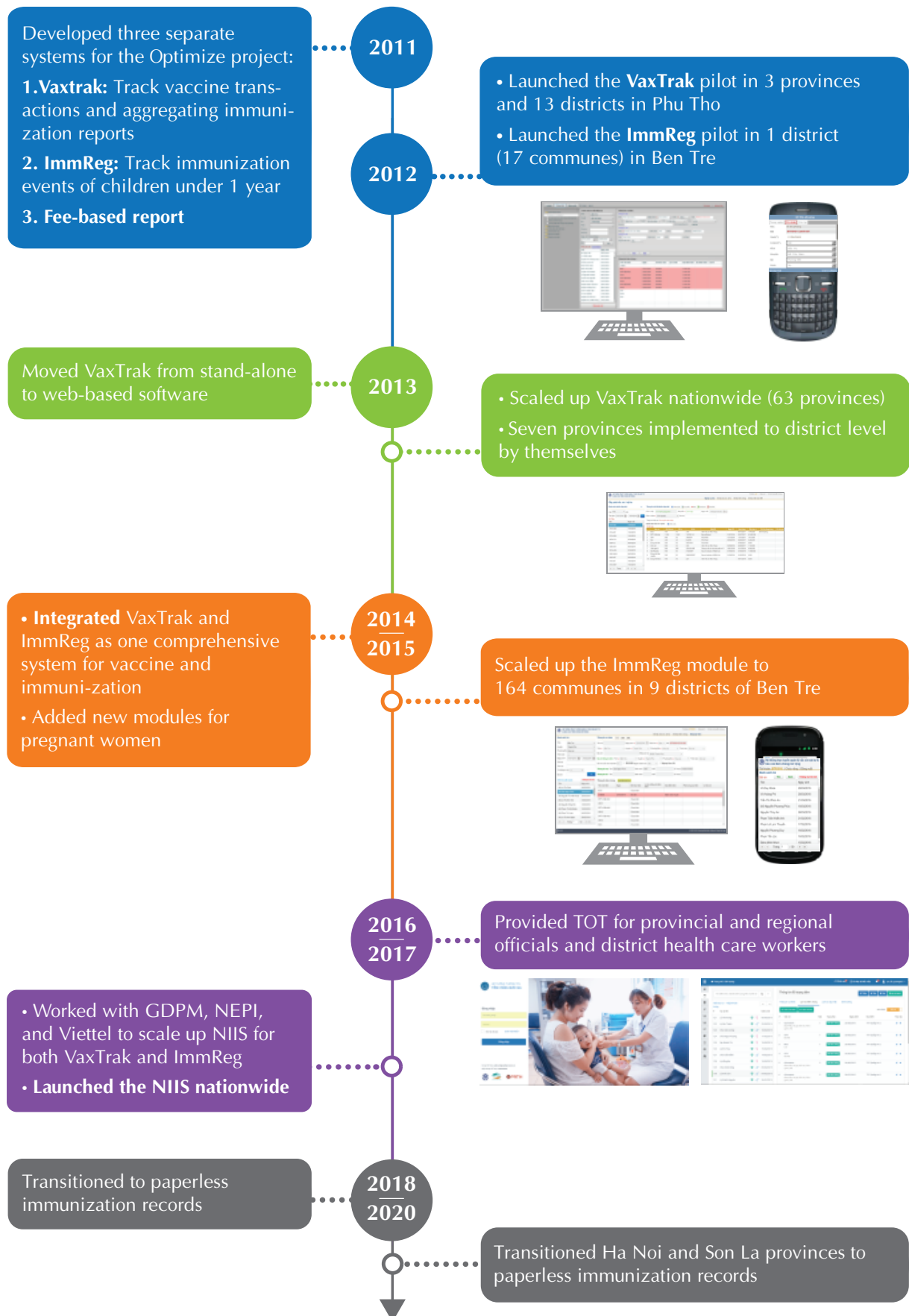
Designing, developing, and deploying an electronic immunization information system can help to increase vaccination coverage, reduce burden on health care workers, and improve health outcomes.<sup>1</sup> Globally, countries are investing in the digitalization of outdated paper-based systems to tackle challenges in vaccine delivery, reporting systems, health care worker burden, and immunization coverage. The process of introducing an electronic immunization registry (EIR) depends on a country's specific context (technology, government, population); however, there are also similar trends shared by implementers of EIRs worldwide. This case study presents the Vietnam experience at each stage of the EIR project implementation:

- **Design:** defining EIR requirements, based on end-user priorities and identified problems.
- **Development:** creating and testing of EIR software based on predetermined system needs and key functions.
- **Deployment:** introduction of the EIR system across relevant levels of the health system.

Additionally, the case study references guidance from the European Centre for Disease Prevention and Control (ECDC), the Better Immunization Data (BID) Initiative, and others to shine light on similarities and differences in a variety of settings. Combined, Vietnam's context and global guidance documents will formulate lessons learned for each stage.

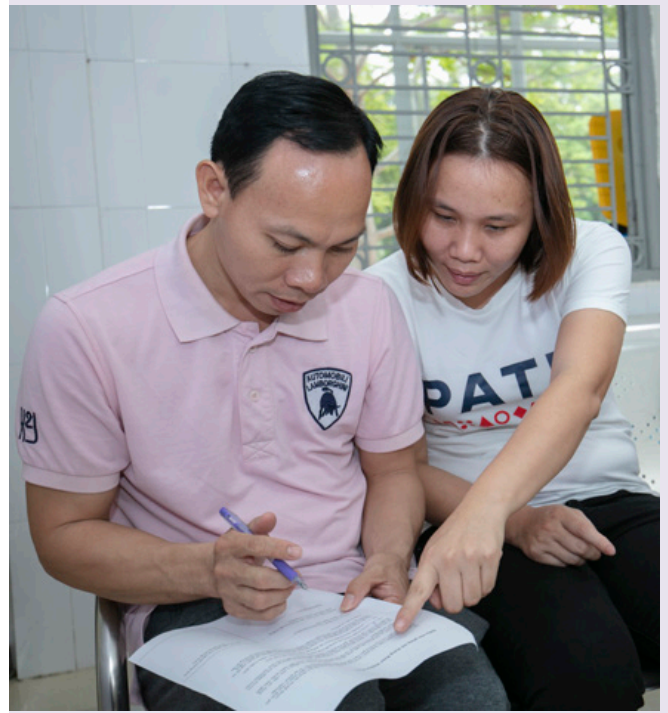


## History of scale-up and EIRs in Vietnam



The current EIR in Vietnam, the National Immunization Information System (NIIS), is an accumulation of three versions of electronic immunization record systems and vaccine-tracking tools. This system was developed by the National Expanded Program on Immunization (NEPI) and the Vietnam Ministry of Health (MOH) between 2009 and today, with support from partners including PATH and the mobile network operator Viettel, and resource funding from the Bill & Melinda Gates Foundation, the United Nations Foundation, GSK, and Save the Children.

**Optimize and ImmReg:** The first version, under the Optimize project, was a pilot collaboration between NEPI, PATH, and the World Health Organization (WHO). This version focused firstly on vaccine stock management but also assessed user needs and feasibility of an EIR with a district level immunization registry (ImmReg) pilot in Ben Tre, Vietnam. Information gathered from the Optimize project helped to shine light on a larger gap in Vietnam’s immunization registry and reporting and tracking mechanisms.



**ImmReg scale-up:** NEPI and PATH supported the scale-up of ImmReg to the entire province of Ben Tre and absorbed the vaccine supply chain management system (VaxTrak) into the immunization registry in 2014.

**NIIS:** As requested by the Vietnam MOH, these two systems were then integrated into the NIIS in 2017. The NIIS is a government run and operated national scale immunization registry and vaccine stock management system. The NIIS design differed from previous versions in that it needed to track all vaccinations, including those outside of the NEPI age range (0 through 3 years old), and needed to be available to a broader variety of health center providers (fee-based, private). The aim was now to track immunization records of all individuals in Vietnam from birth until the end of their lives. It was first piloted in five provinces: Quang Ninh, Bac Ninh, Ha Noi, Da Nang, and Ho Chi Minh in 2016 before being implemented nationally in 2017.

## STAGE 1:

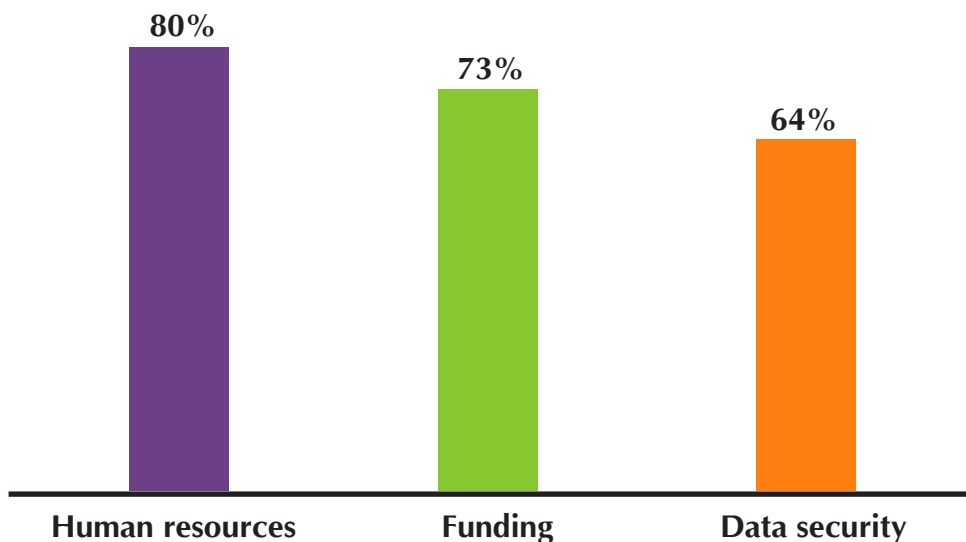
# EIR conception, planning, and design



The EIR conception, planning, and design phase should include a landscaping and/or baseline assessment, establishing a project team with clear leadership delegation, performing a costing analysis, and prioritizing user feedback.

*Challenges faced most frequently among EIR projects around the world during the design phase are as follows: lack of human resources, lack of funding, and issues related to data protection.<sup>2</sup>*

Challenges frequently faced in Stage 1





## Conduct landscape assessments that prioritize end-users

### Global experiences and recommendations

**Conduct initial assessments:** Identifying what already exists in-country as well as the gaps could help to establish the needs that the EIR aims to address and determine the main issues to be addressed. Landscape analyses can help determine the current status of the immunization record system, user and management challenges with the current system, and priorities for improvement. A business model could help to develop objectives for the project, detail a plan of how these objectives will be met, and determine the process that will be followed to scale the system. Initial assessments “also provide an opportunity to involve internal and external stakeholders and gain early input, which could inform system design, improve understanding of some of the internal and external challenges and increase project acceptance.” The BID Initiative in Tanzania worked with in-country partners to prioritize which data-collection problems should be focused on first, assess existing information systems, assess financial ramifications, and understand existing strategies and policies.<sup>2</sup>

**Prioritize end-user feedback:** Developing a system that addresses the user, as well as provides a technically feasible system/data structure, could help to conceptualize the system and enable the testing of prototypes that promote feedback and are easily modified to meet both ends needs.<sup>2</sup>

In 2009, the Optimize project, in collaboration with WHO, designed the first version of the current EIR. As a first step, the project team met with government leaders to determine top priorities for interventions. After categorizing the needs of the government, the project assessed what the current status of the immunization system was in Vietnam, which end users would benefit from an EIR intervention, and what the end users’ top priorities were in system design. Key areas of investigation were: (1) strengths and weaknesses of the existing vaccine management system at the commune level; (2) current use and flow of data and information for vaccine and injection supplies at commune, district, province, regional, and national levels of NEPI; (3) current systems for management of birth and immunization registration at all levels.

Prior to the Optimize project, multiple stand-alone EIRs had been piloted but had not conducted a user-acceptance phase, and therefore functions of these systems did not meet the needs or expectations of the health facility staff. To avoid this mistake, prior to the design of the Optimize pilot, the project team collaborated with NEPI and the IT company iBase on the immunization registry component and ANZ Solutions, a Vietnam-based consultancy company, on the vaccine supply chain management component to conduct multiple assessments to identify specific technical options to strengthen the vaccine management and immunization information systems nationwide. These options were then discussed with the National Institute of Hygiene and Epidemiology to determine the acceptability and feasibility of a demonstration project/pilot.<sup>3</sup>

In 2009, the Optimize project used the Effective Vaccine Management (EVM) assessment created by WHO.<sup>4</sup> This systematic assessment tool helps countries identify and focus on areas in need of improvement in the form of a structured questionnaire. The EVM tool was used to assess VaxTrak using a range of data sources: (1) key informant interviews (all health levels include EPI managers, EPI officers, vaccine storekeepers, and information system managers at provincial and district levels and commune health workers), (2) physical vaccine stock counts, and (3) report and ledger analysis.

The EVM<sup>4</sup> revealed that the current reporting system was functioning as intended for the most part; however, the burden on health care workers was high, and there was a high turnover rate of health and leadership staff, as well as inadequate training and support. While some software systems had been piloted, no software was consistently used or implemented throughout the system, and there was incomplete or delayed reporting from some health centers. Also, data quality and difficulties in monitoring vaccine stocks were major concerns. This pointed toward an EIR as a solution to these challenges and provided a starting point to define the system's data needs and required functionalities.

The baseline assessment also provided the key information including infrastructure, IT knowledge of health care workers, and lessons learned from both success and failure of software implemented before. In addition, it is important to develop mechanisms to communicate between the national system and the siloed systems; the number of fee-based facilities increased rapidly in Vietnam, many of which use their own system to enter immunization data.

## Establish a project team with clear leadership delegation

### Global experiences and recommendations

A project team should be established as soon as possible; the team should be as diverse and interdisciplinary as possible to involve a range of skill sets and expertise with a common goal. Within the project team it is important to clearly determine the person or organization to lead the design. The leader of the project may change at different stages of the EIR development, design, and implementation. It is best to be as transparent as possible in establishing roles and to clearly update other partners if there are leadership changes.<sup>2</sup> Formally documenting partners' commitment to the project and defining roles as early as possible may help to reduce confusion later in the project.

The NIIS was planned and designed for national scale instead of just one district, like the Optimize pilot and therefore, demanded significantly more human resources. As a government-led system, the NIIS team requires representatives from appropriate agencies. To date, this includes key members from the General Department of Preventive Medicine (GDPM) and NEPI. Viettel was chosen to develop the technical components of the system because of their longstanding relationship with the Vietnamese government. The NIIS Technical Working Group (TWG) was thus formed to finalize and maintain the user-friendliness of the NIIS system, to collaborate on meeting end-user needs, and to generate reports for high-level decision-making.

## The NIIS TWG in Vietnam

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

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

**Viettel:** (technology expert) develops and maintains system.

**PATH:** (technical partner) provides technical support to and advises all stakeholders-serving as the connection between immunizations, general health, and technology sectors; serves as focal point for global standards/goods; as well as facilitates communication between TWG members.

## Perform a costing analysis

### Global experiences and recommendations

Costing analyses can help to plan and estimate costs for implementation, operation, and maintenance. Considering the types of benefits an EIR can deliver, including cost savings, “the funding model should ensure the sustainability of the project. The budget needs to include formative research and the development, implementation, and maintenance of the system.”<sup>2</sup> Funding sources can change through various stages, and a financial model should be produced for each funding source at each stage of the EIR project.

**Scale:** The number of future users and the cost per user to deploy it are the most important variables. The cost per user depends on the way in which users will access the system (for example, desktop computer, mobile phone, or paper) and their training needs.<sup>2</sup>



The ImmReg pilot scale-up was designed for scale using the feedback and information from the baseline assessments conducted during the Optimize pilot implementation. PATH conducted a cost modeling to assess the feasibility of scaling up to a national level, as well as the financial resources needed to implement and register the ImmReg system across provinces.

In 2015, with technical support from WHO and a group of experts from Johns Hopkins University (Baltimore, Maryland, United States), the project team developed a financial tool to build a business model that helped to predict the cost of ImmReg implementation and scale-up. These predictions were projected from actual costs of the ImmReg implementation in all 164 communes in Ben Tre Province during the pilot from 2014 to 2015. Additionally, the model considered the annual fluctuation of both general market indices and subjective NEPI goals, including inflation rate, initial investment, and expansion/scaling-up rate. Utilizing this model, the costs were estimated for scaling to 40 provinces with 450 districts and 9,000 communes during a five-year period (2014 through 2018). The model generated a scaling-up cost for each year and each level: commune, district, and province. It also estimated that with the total amount of \$548,881.05 over the period of five years, immunization record and management of about 3.6 million babies and 1.7 million pregnant women would be effectively covered in the system. The majority of project expenses are in monitoring, supportive supervision activities, and operation of the system (server renter, system management, renew supplies).<sup>5</sup>



## LESSONS LEARNED STAGE 1:

### **Landscape analyses and/or baseline assessments should be conducted before developing an**

**EIR:** In conjunction with global guidance, the landscape analysis in Vietnam helped to identify and understand the problem, review policies, and determine current technical capacity and infrastructure, providing a snapshot into the existing capacity and challenges for implementing an EIR. Assessments provided user feedback that helped to design a sustainable system.

**Supportive leadership can increase end-user commitment:** Globally, it was highlighted that partnerships are key and should be developed during the early stages of the design phase. In Vietnam, MOH leadership was supportive and took the initiative for the decision-making needed to scale up the EIR. This was based on acknowledged country need, proven pilot success, and data on the feasibility of scaling up to the national level, presented at a dissemination workshop conducted by PATH. 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 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.

**Forming a TWG or having a national technical support team is key:** In Vietnam, a TWG helped to communicate between expert groups and work with the system synergistically. Globally, it is suggested that roles be clearly defined and adapted as needed and staff turnover rates be addressed with clear guidelines. Vietnam found that it was important to maintain patience for learning curves and scheduling challenges. Key areas of expertise that should be included in the planning and design team are system competency, business models, data management, data flow, technical and advanced information technology, and program (immunization) experience and expertise.

**Cost-modeling for scale-up needs to be conducted:** The funding model should ensure the sustainability of the project. The budget needs to include formative research and the development, implementation, and maintenance of the system.<sup>2</sup> A budget should be allocated for continuous improvements, oversight, and system maintenance with clear roles delegated to partners.



# STAGE 2: Development of the EIR software



According to global guidelines, the development phase should be divided into three standard steps: defining requirements, mapping to standard, and testing.

### Global experiences and recommendations

The BID Initiative’s software development cycle focused on the development and adaptation EIRs to address key data-quality and data-use challenges. Many of the lessons learned with the software development cycle centered on greater and smarter involvement of key people in the process to ensure a product that will provide better access to information and the ability to build skills to improve data quality.<sup>6</sup>

The software development process can be divided into three standard steps:

- Defining requirements
- Mapping to standard
- Testing

Challenges faced most frequently in this stage are: defining the functions required by the system, lack of standards to provide a point of reference for developing the system, and defining the core data set of information to be collected.<sup>2</sup>

Challenges frequently faced in Stage 2



## Defining requirements

In Vietnam, a top-down system approach is applied, meaning the NIIS is led by the national government and governed by the MOH's GDPM. Although the development of the latest version of the NIIS benefited greatly from previous small-scale pilot versions, updates and decisions regarding the system are determined and organized at the national level. The development of the NIIS system, although preceding much of the global guidance noted, demonstrated synergistic methodologies.

### Global guidance

**Defining requirements:** The first step in the development of an EIR is to understand the current state of the challenges faced and the desired outcomes. This is done by collecting information on the critical requirements (functional and nonfunctional) for the information system. A comprehensive and early understanding of system requirements helps avoid many costly revisions later and identifies areas where interoperability with other information systems is critical.<sup>2</sup>

In 2009, PATH's Optimize project, in collaboration with WHO, designed the first version of the current EIR. As a first step, PATH met with government leaders and partners met to determine top priorities for interventions. After categorizing the needs of the government, the project team assessed the current status of immunization systems in Vietnam, key human resources populations that would benefit, and end users' top priorities.

The functional requirements for the Optimize pilot were fairly basic, as it was a small-scale pilot and focused solely on two main thematic areas: vaccine administration data and stock management. The ImmReg scale-up added immunization-registration searching methods, management, and a reporting mechanism to the functions of the immunization registry component of Optimize, complicating the functional requirements. When developing the NIIS, the system demanded even more comprehensive functional system requirements to address end-user feedback and to be ready for national scale. The NIIS integrated noted attributes from the pilot and scale-up and added additional requirement areas, creating 12 key functions: (1) register personal data and assign a unique ID to each child in the community; this took the form of a barcode (QRcode), which includes demographic information, information of caregivers, telephone number, immunization register place, name, address, date of birth, and other information; (2) search for every child and their immunization events/schedule using a barcode scanner or manual entry of unique ID/search criteria; (3) immunization planning to easily identify people due for vaccination for each scheduled immunization session; then send SMS reminders to parents of the immunization schedule and vaccines due; (4) data quality management during data entry by identifying and addressing duplications; (5) vaccine administration and stock management by listing lots and expiration data, and warning when vaccine stock is lower than minimum stock level and above the maximum level; (6) report indicators in the correct template provided by the National immunization program; (7) produce user-friendly dashboards and visualizations of the data; (8) allow for the monitoring and evaluation of the implementation; (9) manage the main themes of the system including

administration, facility mechanisms, vaccination and stock management, and immunization schedules; (10) user friendly for management; (11) ability to connect to other systems; (12) security mechanisms including proper authentication and log-in safety measures.

### Mapping to standard

**Global experiences and recommendations**

Digital health solutions need to adhere to standards that can be categorized into the **five C's**: Care guidelines, Content, Coding, Communications, and Confidentiality, privacy, and security. Many countries define the standards they want systems to follow, and it is important to align with any strategy or policy established by the government in this area.<sup>6</sup>

Data standards are the easiest way to generate high-quality, comparable data. Data standards are “documented agreements on representations, formats, and definitions of common data” (for example, structural standards and semantics), but also agreements on “rules to describe how data is recorded to ensure consistency across multiple sources.”<sup>6</sup> Without data standards and data quality, the future of interoperability is bleak.

Many fee-based and private facilities in Vietnam use their own system to enter immunization data, but it is important to develop mechanisms to communicate between these siloed systems and the government-run EIR to produce timely data representing the entire national population. Interoperability helps to track clients who have moved to a different facility, ensuring they are identified, and reducing duplications. However, the application program interface (API) currently in Vietnam needs some readjusting. There is inconsistency between information inputted into two systems, a lack of data, and/or an overload of data in servers of separated/owned systems. No required standards were identified in the beginning to ensure accurate data exchange across various health sectors. It is a major concern of using API. Today, Viettel is working with NEPI and PATH to develop the SOP for API which will include required standards for data exchange.







## Testing

### Global experiences and recommendations

Test cases that reflect clinical workflow scenarios are mapped to the functional requirements and should be developed in collaboration with the software developers to ensure each round of testing is consistent and comprehensive. The testing should be conducted with several audiences in a variety of environments. These should include facilities, in the context of the clinical workflow; user advisory group members, who can advise on changes during each iteration; and different levels of the health system to ensure that all data needs are met.<sup>2</sup>

The pilot versions of the system (Optimize, ImmReg) were tested with health care providers at several levels (provincial, district, and commune) to get feedback on the performance of software functions, whether they are sufficiently usable, and whether they respond correctly to all requirements. Feedback from NEPI was also collected. Based on their feedback, PATH and iBase revised the software before it was piloted in facilities.

In Vietnam, stress tests were conducted before the distribution of the final version of the software. In general, software developers should conduct stress tests based on the landscape analysis and test the number of end users who would potentially be using the system at the same time for each function. This helps to determine how fast the system responds and how many users can be using the system at any given time simultaneously.

## LESSONS LEARNED STAGE 2

### **Ensure functional requirements and system requirements of the system are developed based on end-user requirements:**

The baseline assessment findings identified many critical data-related challenges within the paper-based system that needed to be solved through the development of an EIR. These challenges were translated into system requirements to inform the development of the software. In Vietnam, three different stages of the current EIR were used to assess user feedback and ensure the key priorities from end users were heard and then updated as needed.

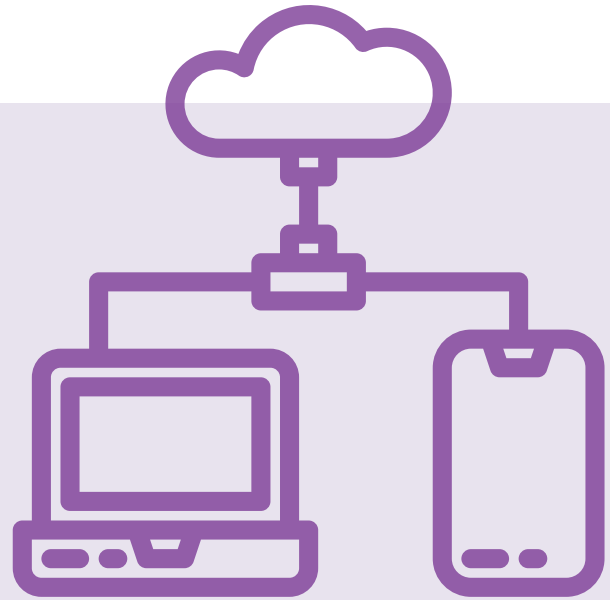
**Create or establish interoperability standards to govern an exchange between information systems is essential:** interoperability strategies, such as API, should be considered as early as possible during the development of the system. Following this, government leaders should develop policies to push facilities to connect to the system and exchange data.

**Consider the scalability of the system:** It is important to ensure that the EIR can support and sustain a large amount of data that continuously increase. Stress tests need to be done 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, like separating the database and the online portal into two servers, should also be explored as possibilities.

**Utilize lessons learned from previous versions of the system to save time in scale-up software development:** The national system only took around four months to design because it utilized the existing versions of EIRs, which served as examples of successful and comprehensive systems for scale-up. The development of the national system was quite natural after the EIR pilot, as it was possible to skip over essential foundational steps already taken by the pilot versions. The national system did not need to have a second landscape analysis performed before being designed; it was developed based on the existing data and structures of pilot versions, as well as comprehensive feedback from end users determined over years of assessments.

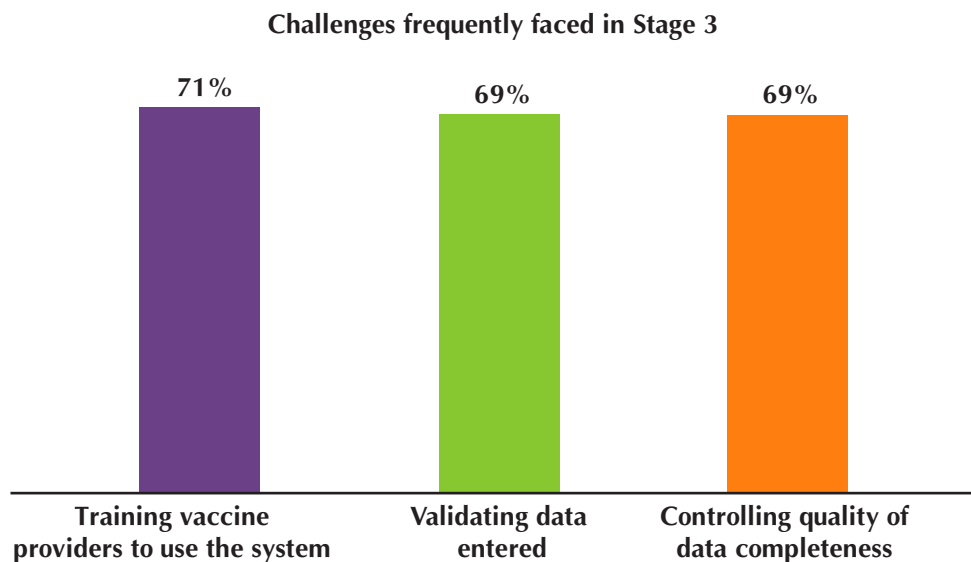


## STAGE 3: EIR deployment



The deployment includes the system rollout, pilots, and the human resources and training needed to ensure sustainability of the system.

Challenges faced globally during this stage include staff turnover rates requiring additional training, staff shortages where health care workers are stretched thin and working in multiple departments, and nervousness working with technology, especially in older staff. Challenges faced most frequently in this stage are as follows: training vaccine providers to use the system; validating data entered by different users; controlling quality of data completeness.<sup>2</sup>



A common challenge that Vietnam is experiencing is the current double burden that health care workers face during the transition to an entirely paperless system. Currently, many EIR projects are running parallel systems until the country is confident enough to remove paper altogether. Until then, health care workers are having to input data into both systems, which doubles their workload.<sup>5</sup>

## System rollout

### Global experiences and recommendations

**A variety of approaches are used for the system rollout and are based on differing variables in each country. Some examples of system roll-out strategies are:<sup>7</sup>**

- Piloting of new systems at a small geographic scale.
- Expanding existing systems.
- Staggering rollout, with modifications to the system made iteratively after each phase of the rollout.

The deployment of the three versions used a staggered approach and initial pilots to test the software being implemented in a small geographical area and learn from it before expansion. In 2011, version 1 (Optimize) was piloted in three provinces of Vietnam and 13 districts of Phu Tho Province, and then VaxTrak was scaled up nationwide in 2013. Version 2 (ImmReg) was initially piloted in one district of Ben Tre Province and then scaled up to the whole province in 2014. After successful pilots, these two versions were integrated and scaled up to version 3 (NIIS). The NIIS was first piloted in December 2016 to prioritize successful transition from version 2 (ImmReg) to the NIIS. A Dissemination Workshop was an instrumental tool in educating other health leaders so that they can share the EIR impact data and build a case for allocating budget funds toward implementing the EIR.<sup>8</sup> In 2017, version 3 was released nationally, with regulations from the MOH that mandated the use of the system in all health facilities. The regulation letter also clearly defined the roles of each level of the health system in the use of the NIIS system.

## Establishing human resources

### Global guidance

**Development team:** The development or customization of a software system is a specialized and time-limited role. Therefore, the development team normally needs external resources, such as IT contractors or technical assistants. The development function is most important in the pilot phase. However, during the scale-up phase, the development team will still need to fix any software problems and accommodate requirements not identified during the pilot phase. Even during the maintenance phase, development work may still be necessary, for example, because users require new reports. The skills in this team vary from very technical (such as database administrator) to more analytical (business analyst, for example).<sup>7</sup>

When establishing the human resources needed for pilot phases, it was noted that two main entities would need to be represented: (1) an already established immunization expert who was familiar with the NEPI system and (2) an IT expert to design and run the system. Expert knowledge of important areas (NEPI and IT) was far more important than the actual number of human resources for the pilot. This team then worked with the locality of the pilot at the provincial, district, and commune levels. Although key leadership was imperative to the development of the system, local partners were also needed in the deployment and testing of the system. At each health facility level, three people (one manager, one EPI officer, and one vaccine storekeeper) were allocated to this role.

The ImmReg software that was used for the pilot took four months to develop. The development of the NIIS took significantly longer because it was designed for nationwide scale. Altogether, it took around eight months to develop the NIIS. The NIIS would have taken much longer without the ImmReg pilot, which provided a business model and a technical guide. The NIIS development team was able to save time by integrating the knowledge and technology from the ImmReg pilot. Human resources for pilot version software development included four members from PATH and NEPI, and one from ANZ Solution, a Hanoi-based software development firm. Later, the development of the NIIS software demanded a larger team from GDPM, PATH, NEPI, and Viettel, for the development of software geared toward national-level implementation.



## Training

### Global experiences and recommendations

No matter what approach or approaches are used, universally it is agreed that training of system users is imperative to success of implementation. “Ensuring that the system users are adequately trained involves identifying users (at the input and output sides of the system), and then developing, implementing, and monitoring trainings. Training requires a sustained effort throughout past initial implementation, including training of new users and training of new features and functionalities.<sup>24</sup>”

Training approaches vary depending on country resources, time, and scale of the system. Some examples of approaches are continuous information sharing with health care providers, face-to-face or online courses for end users, training of trainers (TOT), or user support networks / hotlines / informational websites / e-learning.

Training protocols and plans were developed for each version based on the population targeted. For example, version 1 needed significantly fewer human resources than version 3 (NIIS) because of differences in scale.

The training approach in Vietnam aimed to ensure country ownership, sustainability, and adequate knowledge and skill sets at the end-user level to promote confidence in the implementation of the system. A training plan was developed that focused on five key actions:

- Review global guidance / lessons learned.
- Train mentors from provincial and district health facilities.
- Provide trainings to end users at facilities in their respective province or district.
- Have these mentors become focal points for technical support at each level and provide direct support to end users.
- Collect the feedback from end-users to report higher technical supporting groups.

Workshops and training sessions were held for health leaders at different levels to prepare Vietnam’s health system for the introduction of the NIIS. In Vietnam, PATH provided technical and financial assistance to develop TOT materials. National-, regional-, and provincial-level health care providers were trained to coach local agencies and facilities on the use of the NIIS. A total of 247 representatives from the national EPI, regional EPI, and Provincial Preventive Medicine Centers (PPMCs) attended three-day training sessions. In December 2016, the Quang Ninh PPMC conducted an NIIS TOT. Soon after, the Quang Ninh PPMC trained end users at the commune level on the proper use of the NIIS. In July and August 2017, PATH, the GDPM, and Viettel conducted three workshops to introduce the NIIS to national and regional institutes.

In 2017, training support was provided to 18 provinces that had limited resources to implement the system (the government leads training in all other provinces). Between January and April 2017, TOT courses were held for health care workers at provincial and district levels in provinces across all three regions of Vietnam. These trainers were then responsible for training other health care workers at communes, hospitals, and fee-based immunization facilities in their area. To ensure the system runs smoothly and data are updated to the system in a timely manner, each facility has at least two staff members trained on using the NIIS. A total of 410 trainers are trained and are taking the NIIS forward in their respective localities.<sup>8</sup>

The BID Initiative reported that on-the-job training for the entire health facility staff instead of just the immunization staff helped to raise the knowledge about using the system. Similar to the Vietnam context, the training methods used by the BID Initiative identified key champions within health facilities and at higher levels who served as mentors to facilitate training of new health care workers. Mentors helped other health care workers understand the system better while also demonstrating the sustainability and permanence of the system, instead of its being another temporary project pilot.<sup>2</sup>



## Implementation burden

### Global experience and recommendations

Entering all historical immunization data or data for a given period:<sup>6</sup>

- **Advantages:** the vaccine history of the population will be entered into the EIR information system; the system can be tested with real data, which can allow detection of flaws or deficiencies.
- **Disadvantages:** it requires additional effort, time, and resources on the part of health providers or other personnel hired to carry out this activity; it requires training for personnel who will enter historical records into the system; vaccine recipients can become frustrated if they are not included in the new system.

A challenge in Vietnam has been the burden on health care workers to input data from the previous reporting system. Health care workers need to spend extra time to ensure all historical data is inputted into the new system. Currently, children born in the last two years and pregnant women are entered in the system, which includes demographic information and immunization historical status. It is imperative that the EIR has all historical data in order to track and monitor the population and reduce duplications; however, the burden and extra work for already overworked health care workers is suboptimal.

## Data quality and data use

### Global experience and recommendations

Data quality assessments, of both paper-based and electronic information systems, play a key role in validating the information that the EPI, health authorities, and end users use and from which they analyze the immunization data and maintain a reliable source for proper decision-making and program management.<sup>9</sup>

#### **Key considerations for data quality:**

- There must be an established procedure for detection of duplicate records and for a de-duplication process as part of the data quality-assurance process.
- Health care workers should be involved in the de-duplication process, as they are the ones who know vaccine recipients best.
- Entries with errors should be returned to the local level for correction.

In Vietnam, data quality is regularly assessed through validation checks in the system. Additionally, there are mandatory fields in the system into which the end users cannot avoid entering data, including demographic information, vaccine name, and dose number. A readiness assessment conducted in 2019 reviewed the data between NIIS and the paper-based logbooks, revealing that although data quality has improved, there are still some issues that need to be addressed. Data quality and data use work synergistically together: as more people trust the quality of the data, more people use the data.<sup>9</sup>

## LESSONS LEARNED STAGE 3

**Before deployment of the system a pilot is often important to test the system in real situations:** As seen in other global guidance, the pilot of the system helps in early detection of bugs in the system, as well as in the acceptability from end users.

**Human resources need to be considered early on because of staff turnover or changes:** There should always be several employees that have the same level of knowledge and expertise of the EIR to ensure that work can continue should one person leave the team.<sup>1</sup> Documentation of the system is key so that, if leaders who know the system well leave the team, the system can be understood by the replacement staff.

**Allocating human resources from experienced nongovernmental organizations is a good way to save money and develop a well-balanced and experienced working team:** The eight years of experience from PATH in developing the EIRs with two piloted versions contributed important lessons learned and technical expertise in the deployment of a national system EIR.

**Refreshment training is still needed to improve the end users' knowledge and skills. With limited financial resources, e-learning is a useful source of training:** E-learning is a potential avenue to explore as a good training source to support the varying skill levels and turnover rates of health care workers.

**Protocols should be developed to recognize duplications between both systems.** Detailed SOPs for the detection of duplications were developed and training was provided for health care workers, with clear roles and responsibilities for each level of staff. The search function in the NIIS covers different key variables before a client's data are allowed to be entered into the system, to see if they are already registered and a unique ID has not been provided previously. Developing a de-duplication process (system algorithms to detect records suspected of being duplicated, determine who defines whether a record is duplicated, how to consolidate data from two or more registries, and determine who has clearance to make changes in the database) makes it possible to filter data and minimize duplications of records.

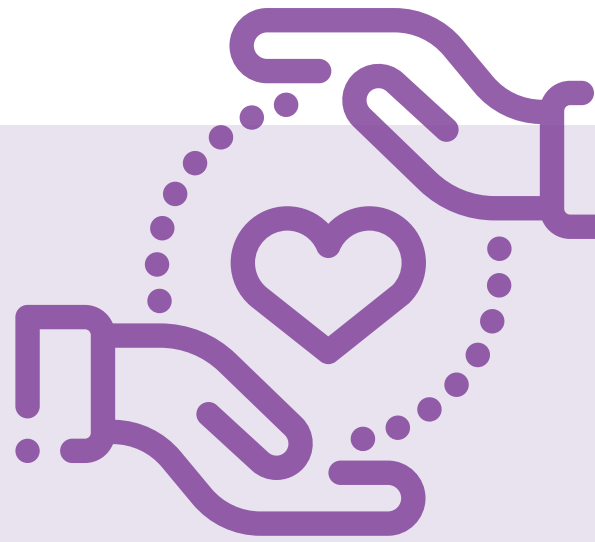
**Data quality should be ensured by monitoring and evaluation activities.** Routine review and data quality checks should be conducted regularly to ensure that all end users are entering the data into the system (on-time, complete, accurately). In Vietnam, a readiness assessment in 2019 helped to assess the data quality and determine the readiness to move to entirely paperless. Moving forward, local government and health leaders should emphasize the importance of data quality and enforce complete data input.





## POST-DEPLOYMENT:

### Sustained use of the system and the continuation to paperless



As Vietnam continues to move forward to a completely paperless immunization record system, it is important to continue monitoring user feedback and assess the acceptability of the system. The following factors should be continuously analyzed:

- Resistance to change.
- Workload brought on by the new data-entry procedure and by incorporation of the process into their established workflow (i.e., who will key in data, who will coordinate, who will review information).
- Necessary time to register a new vaccine recipient in the system.
- Use of reports by different user profiles.
- Low system uptake from fee-based facilities.
- Data quality.
- Duplication due to a lack of a unique client ID.
- Interoperability with other systems.



A major issue currently is the burden on health care workers to use both the paper-based system and the new NIIS system while health facilities gain more confidence in the final transition to an entirely digital system.

Since 2009, government leaders and partners have worked to identify, design, develop, and deploy the NIIS that is now used in 99.9 percent of health facilities in Vietnam today (fee-based and private facilities remain a challenge for full use). The final version that is implemented today is built upon the first two versions of the EIR and the important steps, guidance, partnerships, and learning from each stage in the process. There are no shortcuts when it comes to EIR projects; all stages presented valuable lessons learned for the success of the NIIS and provide invaluable guidance as Vietnam continues to move forward. The hope is that lessons learned from each stage presented in this case study will also help global audiences currently in any stage of an EIR project. Vietnam is now working to ensure successful transition to a completely paperless system by working with NEPI and the GDPM to conduct readiness assessments, improve data quality and data use, provide additional training and support, and remain active on the TWG. As Vietnam learns and becomes more competent in EIRs after each stage, Vietnam can make the leap more confidently into the exciting future of a country running completely on an EIR that is well maintained, supported, and forward moving.

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