The Floating Clinics – Transforming Health Service Delivery through Electronic Medical Records

The Case Study of The Lake Clinic’s OpenMRS Distribution for Cambodia

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ACRONYMS

DI: Development Innovations
EMR: Electronic Medical Record
ICT: Information and Communications Technology
OpenMRS: Open Medical Record System
MKS: Mekom Solutions
MoH: Ministry of Health
TLC: The Lake Clinic
USAID: United States Agency for International Development
DEFINITION OF KEY TERMS

**Tech Whisperer**: A term for a technology specialist whose role is to coordinate between the clinicians and technology service provider to ensure the design and customization of the OpenMRS tool fits clinicians’ needs. This term can be used across various technology-enabled projects, and was coined by a Development Innovations assessment team in 2018.

**OpenMRS**: Open Medical Record System (OpenMRS) is an open source software platform that enables medical informatics and can be customized to the needs of various clinical institutions.

**OpenMRS Distribution for Cambodia**: The name of the system that The Lake Clinic customized for their use in Cambodia. It was customized from The Open Medical Record System (OpenMRS).

**Outreach Activities**: The services and activities that TLC provides to the floating villages population in addition to the out-patient care at the clinics. Community outreach activities include Mother Club, Child at Risk, Clean Water, School Health Check, Floating Gardens, Teenager Program and Domestic Violence.

**Human-Centered Design (HCD) or User-Centered Design (UCD)**: A multi-stage approach to the design of tools and services that focuses on developing empathy with users, understanding problems through their eyes and experiences, and making strategic decisions that are guided by empathy and understanding. HCD was created to help design solutions that respond to users’ needs and concerns, and in doing so solve complex problems in a sustainable way (IDEO.org, 2015).

**Inspiration Phase**: The first phase of HCD according to the IDEO model. During this phase the designer defines the communities of interest, studies the problems they are facing, and engages them in a creative process (IDEO.org, 2015).

**Ideation Phase**: The second phase of HCD, wherein the designer analyzes the data and findings obtained during the Inspiration Phase, brainstorms possible solutions with the design team, creates a prototype (or prototypes) and presents it to the target audience for feedback. During this phase, the designer will make changes and continue to iterate their prototype based on feedback from users (IDEO.org, 2015).

**Implementation Phase**: The third and final phase of HCD, where the designer launches and implements the solution. This includes piloting the tool, the human processes that make it work or that it feeds into, listening sessions to collect feedback from the target

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1 OpenMRS Inc., 2016. Who is OpenMRS?. Retrieved from https://openmrs.org/about/.
3 Ibid.
4 Ibid.
audience, and continual iteration as time and resources permit. By this stage, the designer will have a strong sense that the solution will solve the problem, given the high level of user engagement throughout the development of the project⁵ (IDEO.org, 2015).

**Iteration:** The process of improving a solution by testing it with users, making improvements based on user feedback, then testing and iterating again until a working solution is created.

**Information and Communications Technologies (ICTs):** Technologies that enable access to information through telecommunications such as the internet, wireless networks, cell phones, and other communication channels⁶.

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⁵ Ibid.

EXECUTIVE SUMMARY

Many resource-constrained clinics in Cambodia still use a paper-based system to manage and maintain patient information, including records of outpatient and inpatient services they provide. This paper-based system undermines the efficiency of healthcare service delivery as it is prone to loss and damage due to natural disaster, humidity, fire, and insects. Once patient records are lost, clinicians are unable to see medical histories – a crucial component of determining medical treatment. In addition, the time it takes the medical team to handwrite and organize these records could be spent treating more patients. In response to this problem, The Lake Clinic (TLC) partnered with a technology service provider, Mekom Solutions, through funding support from USAID’s Development Innovations, to digitize the patient management system. TLC customized a free and secure open source system called Open Medical Record System (OpenMRS).

The customized OpenMRS Distribution for Cambodia now provides TLC medical staff considerable benefits. Most importantly, it saves at least five minutes per patient and enables TLC staff to analyze and extract reports for the Ministry of Health (MoH) in one minute. This process previously took approximately four hours. There were several factors that contribute to the success of the OpenMRS Distribution for Cambodia. Employing a ‘Tech Whisperer’ to bridge the digital and communication gap between TLC and developers was critical. The TLC team’s flexibility, the clinician’s commitment to the transition and the user-centered design process used throughout implementation also contributed to the success of the project. The project also encountered a number of challenges ranging from unstable connectivity to unpredictable errors from the offline feature and limited reporting functionality.

These learnings have solidified recommendations for development practitioners looking to customize an open source system to improve health service delivery, or those interested in using OpenMRS Distribution for Cambodia. First, hire a Tech Whisperer to help with the technical component of the project and communicate with developers. Next, design the system to meet the clinicians’ needs. They are the main users and should therefore be integrated in the development process every step of the way. Similarly, make sure to prototype, test, and iterate until the system meets the needs of the clinics and its target users. This allows the developers to expand the system to fit those needs, making sustainability of the system much more likely. Fourth, think about connectivity issues at the onset. Addressing this problem early will alleviate the need for a back-and-forth between online and offline features. Fifth, build a strong relationship with developers that enable constant communication and customization. Finally, conduct regular trainings to keep users up-to-date speed on every feature of the system, preventing roadblocks when delivering care to patients.
INTRODUCTION

In 2017, The Lake Clinic (TLC) received funding support from the United States Agency for International Development (USAID) through the Development Innovations (DI) Project to implement the Clinic Management System for Remote Medical Clinics in Cambodia project. The purpose of the project is to customize the open source clinic management system—Open Medical Record System (OpenMRS)—a platform that allows the design and customization of electronic medical records. By digitizing the existing paper-based system, the project aimed to create more efficient and effective clinics that can better serve the population. The project also aims to bridge the digital gap among resource-constrained clinics and, thus, improve medical service delivery.

To date, more than 14 clinicians at TLC have used OpenMRS Distribution for Cambodia to deliver outpatient service across five floating clinics in eight villages in Siem Reap and Kampong Thom Province. The system has recorded more than 5,000 patients with 11,000 visits and 28,000 cases.

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To provide background, TLC was established in 2007 and is the only clinic that provides free medical care, outreach, and livelihood activities for people living in the remote floating villages on Tonle Sap Lake. Every week, TLC staff travel 4 hours from the head office in Siem Reap City to the floating clinics. In the floating clinics, TLC serves approximately 50-60 patients per day and 150 patients per week. The most common treatment needs of villagers on Tonle Sap Lake are non-communicable diseases, chronic diseases, trauma, and accidents.

This case study aims to demonstrate how OpenMRS was designed and customized to fit the needs of clinicians at TLC, helping to improve health service delivery in remote and floating clinics. This document also aims to give an overview of the project design process, success factors, challenges, lessons learned, and recommendations for development practitioners who want to customize OpenMRS to improve health service delivery.

Inspiration Phase

“Children who come with their mom get registered as one name, with their dad or grandma, another name. Only the mom knew the name she gave to the village chief and you end up having children [patients] over counted, because they have two or three records” - Jon F. Morgan, Director of The Lake Clinic.

Over the past ten years, TLC primarily operated using a paper-based system that decreased the efficiency of healthcare service delivery. Each week, TLC clinicians transported a considerable amount of paper records equivalent to 72 kilograms to their headquarters on a small boat. During the dry season, with low water levels, the boat was unable to accommodate the excessive weight. In addition, maintaining the paper records for multiple clinics is not an easy task. Papers are prone to damage by natural disaster, humidity, fire, and insects. This became even more difficult as TLC took on more and more patients.

Figure 2: Picture of the storage containers of paper-based records. Photo credit: The Lake Clinic Cambodia.

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8 The activities that TLC provides to the floating villages population in addition to the out-patient care at the clinics. Outreach activities include Mother Club, Child at Risk, Clean Water, School Health Check, Floating Gardens, Teenager Program and Domestic Violence.

To add to this, the paper-based registration was time consuming, labor-intensive, and prone to mistakes as the doctors and nurses had to handwrite patients’ information. On average, it took seven minutes for the medical staff to find the paper record for each patient. Sometimes, the paper records were lost and the clinician had to spend approximately 10 minutes per patient creating new paper records. This also happened when patients lost their ID cards, making it impossible for clinicians to locate their records. The new records created in response did not document the previous medical history, a critical component of evaluating the effectiveness of treatment and furthering a treatment plan. It is even more important for TLC as the visits mostly comprised of chronic diseases like hypertension and diabetes that require close monitoring and regular monthly visits. Finally, paper records made it challenging for the doctor to evaluate the treatment plan, as a patient may be handled by different doctors on rotating work shifts.

Recognizing the inefficiencies in maintaining paper-based records, the TLC team looked for a technology to digitize their medical records. The next decision was whether to build the software from scratch or use existing open source software. Because creating the software from scratch would require more time, and human and financial resources, the team chose to use an open source platform. The use of free open source software allows TLC to use a proven electronic medical record (EMR) platform, but customize the source code to fit with their own context and needs. In addition, the team was inspired by the open source EMR system used by other clinics in Laos and decided to utilize and customize the same system, OpenMRS. Other open source EMR solutions were also considered, however OpenMRS was chosen because it is cost-effective, secure, and regularly improved by the global technology community. On top of that, OpenMRS was easy to customize to meet the specific needs of TLC medical team.

Accordingly, TLC partnered with Mekom Solutions, a technology company based in Europe, to customize OpenMRS. Mekom Solutions was chosen because of its extensive experience in developing electronic medical record solutions for other healthcare facilities and understanding of the needs of TLC’s clinics. University of Research Co., LLC (URC) also provided guidance on the design of the registration form in accordance with their own Patient Management and Registration System (PMRS). In addition, Dr. Terry Clark, an international volunteer with a technology and medical background, helped advise TLC on
the design of the platform, medical terminology, and coding of diagnoses for reporting purposes.

Ideation Phase

Dashboard of the OpenMRS Distribution for Cambodia. Photo credit: The Lake Clinic Cambodia.

After choosing OpenMRS and a partner to customize that system, the team built partnerships with several healthcare professionals to inform the clinical informatics choices. The established network of healthcare professionals and institutions supported TLC by providing guidance on the customization of OpenMRS, giving feedback on the structure, workflow and content of the system. They also expressed interest in using OpenMRS Distribution for Cambodia once fully developed by TLC. The TLC team then worked with Mekom Solutions to customize and develop online features of OpenMRS for distribution in Cambodia. The system was developed in two languages, Khmer and English, providing access to local medical teams. At the same time, TLC recruited a volunteer ICT Coordinator to support the engineering of the project and help TLC communicate with Mekom Solutions’ developers about the clinicians’ requirements in the new system. This inclusive process led to the first prototype of the customized OpenMRS Distribution for Cambodia. This prototype was then tested among 14 clinicians at the TLC office. Testing is a critical step. It allowed clinicians to test the main functions and features in the system and give early feedback and suggestions to the developers to make changes and improvements to meet their clinical needs. Multiple rounds of user testing were conducted to build the improved prototype. It was then trialed at the floating clinics for further testing and real-time feedback. The ICT Coordinator observed the use of the system during this trial. He
took notes on the system’s errors, collected feedback from the clinicians, and communicated back to the developers to make further improvements.

This phase uncovered several issues that had to be addressed before implementation. During the trial of the online feature, the team discovered that connectivity was poor in most remote floating clinics, and the system was unable to perform the service as needed. Since internet connectivity was a recurring problem, TLC temporarily reverted to using paper-based medical records. This led to the development of an offline feature that enabled clinicians to collect data without a signal and then upload that data once the device was online again. Upon the development of the offline feature, the system was tested again. Based on the feedback from doctors, nurses and midwives, the offline feature worked to a certain extent, but did not fully address their needs. When used offline, the data did not synchronize immediately across devices. The registrar had to pass the same tablet to the doctors, and the doctor had to pass that same tablet to the dispensary. In addition, the offline system was unable to register multiple patients at once, creating an unpleasant experience for users. For example, clinicians could not edit the chief complaints and diagnoses section in the offline app. Through a few more rounds of user testing and feedback consolidation, the TLC team decided to use mobile hotspots for connectivity instead of using the offline feature, which proved to be the best solution.
At this time, TLC also developed Standards of Conduct that provided the healthcare team and clinicians with guidelines when using the system. This included information on how to set up a tablet, ensure security and privacy of medical records, manage data encryption, and configure the system when errors occurred.

**Implementation Phase**

“It took five minutes just to find and retrieve a patient’s file. It also took a similar amount of time to restore it back in the old place with the right filing order. It would take even more time to find it again. However, now it is done just within one or two minutes with the OpenMRS Distribution for Cambodia.” – Savann Ouk, Program Manager, TLC.

“[Before having this OpenMRS Distribution for Cambodia], it took on average 15 minutes to process our medical check procedure and deliver our service from patient check-in to check-out. However, with the use of the digital system, it takes us only around 5-10 minutes to complete our service delivery for each patient.” – Thourida Hun, Medical Doctor, TLC.

“We no longer have to carry too many paper documents on a small boat. The patients’ files are recorded and securely saved in the OpenMRS Distribution for Cambodia. For every village we go to, we now need to bring a couple of computers instead.” – TLC Medical Doctor.

Figure 5: Screenshots of the OpenMRS Distribution of Cambodia system. Photo credit: The Lake Clinic Cambodia
Through further customization and user testing, the system eventually fit the needs of TLC. The system now has a simple user interface and can record all the information from the paper-based system, as well as additional information that can inform healthcare service delivery. The new system includes patient registration and the results from the physician’s medical examination, including the patient’s chief complaint, past medical history, physical examination results, immunization history, allergies, vital signs, dental exam results, and referrals.

The collection process is as follows. When first visiting the clinic, the patient comes to the registrar to have their personal information and vitals recorded. With the OpenMRS Distribution for Cambodia, it takes them around one or two minutes to register (in contrast to five minutes using the paper records). The patient then takes a queuing number and waits for the doctor to call out his/her name. The system automatically sends the patient’s information to the examination room so that the doctor can view the record from the desktop. The doctor then examines the patient’s health and prescribes medication in the system, which notifies the dispensary. The data synchronizes in real-time, allowing the pharmacist to view the prescription online and prepare the medicine for when patient checks out. In short, the EMR system helps facilitate the flow of medical care and saves considerable amounts of time for clinicians and patients.

After the introduction of OpenMRS, clinicians were happy and positive about the simplicity of the system and how it enabled them to improve their health service delivery. They can now capture the medical history of each patient and better examine and evaluate diagnoses. At the same time, patients were happy to see the modern system being used at the floating clinics and were amazed that they did not have to carry paper records with them. They also appreciated the quick service they received. Finally, clinicians also reported that at least 5-10 minutes were saved per patient when the system was in operation. As a medical institution, TLC sends monthly report to the Ministry of Health. OpenMRS Distribution for Cambodia has a built-in function that allows TLC staff to extract reports in a MoH-compliant format in
1 minute (compared to the 4 hours it took with the paper-based system). The system also provides more accurate data than handwritten forms. Previously, due to the overwhelming number of patients at TLC and the limited capacity of paper-based system, a huge number of medical records were duplicated. TLC also had to create new registration forms for patients who lost their ID cards and the records for the same patient would pile up. This made the actual numbers of patients and the number recorded in the system mismatched. The new system was customized and built to meet the specific needs of resource-constrained clinics like TLC. At this point, it has not been scaled beyond TLC, but other clinics in Cambodia have shown interest in the system.
FACTORS FOR SUCCESS OF THE ELECTRONIC MEDICAL RECORDS SYSTEM

A Tech Whisperer Bridged the Digital Gap
The ICT Coordinator—in other words the tech whisperer—played a critical role in the design, development and implementation of the clinic management system for remote medical clinics. The Tech Whisperer was fluent in technical vocabulary, had expertise in user-centered design, and understood the social elements of the project. Mekom Solutions recruited the ICT Coordinator as a tech whisperer at the beginning of the project to facilitate communications and bridge the digital gap between resource-constrained clinics and Mekom Solutions. The TLC team and clinicians, many of whom had a limited technology background, specifically electronic medical record systems, appreciated the ICT Coordinator’s facilitation and support. They indicated that it would have been difficult to follow through with implementation without him.

The TLC team mentioned that it was often difficult to communicate with software developers based outside Cambodia about their requirements for the system. Additionally, as the system was further developed, it was often difficult for clinicians to understand its new features and how to use them. However, the ICT Coordinator helped pinpoint the problems faced by clinicians and simplify the tech language coming from Mekom Solutions. The ICT Coordinator also observed errors in the EMR system in offline mode, communicating back to Mekom Solutions to find appropriate solutions. In addition, the ICT Coordinator understood the clinicians’ critical needs and helped test the system, consolidate feedback, and communicate back to Mekom Solutions for iteration. He also trained the clinicians once a week in order to ensure that they were familiar with the updated system.

Strong team work, Buy-in and Adaptability Facilitated Success
Dedicated teamwork was a critical part of the success of this project. The TLC team and clinicians realized that paper-based records undermined efficiency. The team was inspired by the open source system used at the other clinics and wanted to adapt and customize it for their own use. This motivation drove all relevant actors, including the TLC program team, clinicians, the ICT Coordinator and Mekom Solutions to work together to design and develop an appropriate system that responded to clinicians’ needs.

The TLC team also demonstrated a willingness to embrace change. Their flexibility and patience throughout the process meant they were not discouraged by the year-long transition time. A great example of this flexibility was their approach to the flawed offline version of the system, which was unable to synchronize due to technical errors. However, instead of forgoing the project completely, the team brainstormed a solution and willingly switched to using a mobile hotspot and identified an appropriate mobile network with wide coverage to support the system’s online features.
**User-centered Design Helped Solve Users’ Problems**

Designing a digital tool that meets the needs of users is not a simple task. The ICT Coordinator played a critical role in facilitating the human-centered design process throughout the project, immersing himself in the lives of the system’s target users. He worked with TLC team to assess clinicians’ problems and critical needs to design medical forms and workflows. After understanding the problems with paper-based records, the developers and the ICT Coordinator worked together to customize the system, designing a user-friendly interface and reporting format that met the needs of users.

Clinicians, as the primary users, were central to the design process. By shadowing their work, the ICT Coordinator was able to constantly iterate throughout the design process. For example, after the prototype was developed, the ICT Coordinator consolidated feedback from clinicians and communicated this feedback back to the developers. Minor changes—such as edits to a medical form or removal of a duplicate diagnosis—were quickly fixed through this iterative process. The TLC team pointed out that it took them a while to test and improve the system, requiring flexibility and patience from users.
CHALLENGES AND LESSONS LEARNED

Unstable Connectivity and Errors of Offline Features
The OpenMRS system cannot function without the internet. Since clinics operate in remote villages on Tonle Sap Lake, where there is limited mobile internet connectivity, this proved to be one of the project’s key challenges. Three out of five clinics do not have adequate connectivity. At first, the project used modems; when they did not work, they resorted to using shared hotspots from TLC staff’s mobile phones. Sometimes, they had to tie their phones to tree branches to ensure that the OpenMRS system worked.

In order to tackle connectivity-related challenges, the team developed an offline system that did not require constant internet connectivity, since it allowed TLC staff to sync their data when they reconnected to the internet at the head office in Siem Reap. Unfortunately, the offline function did not work as expected due to a number of unforeseen technical errors. Clinicians reported that 75 cases were lost because data did not synchronize. This error also occurred when internet connectivity failed while TLC staffs were engaged in inputting patient data, thereby increasing their workload. The staffs were forced to hand-write patient information on paper and then input it into the system when they were connected at the head office.

Another key challenge was that whenever Mekom Solutions fixed the system, TLC staffs were unable to access the system. Therefore, they frequently went back to completing patient records on paper. TLC reported these system outages to the ICT Coordinator, who in turn communicated them to Mekom Solutions.

The team assessed the system’s connectivity problems and explored several solutions. They decided to use a mobile hotspot solution using a mobile network that has wide coverage. While this was a better solution, using the mobile hotspot required the team to pass the tablet around from the registrar to the physician, from physician to the pharmacist, and from the pharmacist to checkout. This workflow cannot serve multiple patients at once. Recently, mobile network companies have improved and expanded their coverage to the floating villages, which enabled TLC to use the modem and connect the system for online operation. At the same time, the team is looking to identify additional solutions that can serve as an internal server to store data while the system is offline.

Limited Reporting Functions in the System
“For instance there are 150 visits a week, if we want to know the exact number of women, men or children among that visits; we could not extract report based on categories. We need to look at the report and count manually.” - TLC Doctor, 2019.

Even though the system is able to easily generate a number of reports to meet the immediate demands of the medical team, the reporting functionality does not fully meet the needs of TLC team. They no longer need to spend four hours generating reports for MoH, since the system allows them to extract reports in a matter of minutes. However, while the
system. The system successfully generates reports in an MoH-compliant format, doctors have to spend a significant amount of time analyzing and synthesizing the data for their own needs, since there is only one format of report available in the system. The system does not allow users to extract data separately based on categories, such as number female patients or the numbers of children visiting the clinics. Therefore, in order to find out the exact numbers of children visiting the clinics monthly, they are forced to manually count records generated by MoH-compliant reports. This is labor intensive, which is why they want to expand the reporting function for the deployment of OpenMRS.

Health data is also very important for TLC, not only for reporting purposes, but also for informing their decisions about current interventions and understanding the prevalence of disease outbreak. Currently, a lot of data, such as information about children at risk, is not yet accessible to clinicians. The system also does not capture indicators—such as familial relationships or outreach activities—that could be useful to health managers. Being able to generate data, customize reports, and disaggregate data is critical for health managers, enabling them to take appropriate measures to improve health interventions.
RECOMMENDATIONS FOR PRACTITIONERS

**Employ a Tech Whisperer to Bridge the Communication Gap**

Developing a digital system requires knowledge about how technology works and user-centered design. In many cases, development organizations and NGOs have trouble communicating with technologists about their project requirements, because technologists focus primarily on technical solutions and often have a limited understanding of the development organizations’ goals or the surrounding development challenges. Therefore, a translator or tech whisperer plays an important role in bridging the communication gap between these two fields. For instance, the tech whisperer can help simplify the technology-related language that is communicated from software developers to the program team. In addition, a tech whisperer can facilitate the identification of problems prior to the design of the tool, brainstorm appropriate iterations, and training users when the system is fully developed.

**Design the System to Meet the User’s Needs**

Prior to the development of the system, the project team should focus on understanding the problems that target users are facing. Understanding users’ needs and continuously listening to those users is important. In TLC’s case, the service provider was able to adapt after listening to feedback. For example, according to the TLC staff, at first the digital consultation screening took too long to complete. Based on feedback, the developers made changes to the form to reduce the number of clicks and replace text entry questions with multiple choice selections.

In addition, the system itself should incentivize usage. The system should not increase the clinicians’ burden, but instead improve their quality of work so they want to use it. Users should be engaged through the design phase by giving them space to voice their feedback, and test prototypes before the system is fully developed. Regular training on the system is also important, especially for some users who are not technology natives.

**Use an Iterative Process when Developing the System**

The TLC team completed multiple rounds of iteration to make the EMR system fully functional. Developing a digital system does not happen overnight. It takes time and effort to prototype, test, integrate feedback and improve the system. In this case, the system was initially developed online based on the assumption that all floating clinics had good connectivity. However, when the first version of the system was rolled out to the floating clinics, the team identified that two out of five clinics did not have stable connectivity. The team underwent many rounds of testing, helping them test multiple possible solutions to the connectivity challenge until they found the most appropriate one. The process of assessing the problems the target users are facing, exploring potential solutions, prototyping, testing and iterating multiple times can help ensure that the proposed system meets the needs of the users.
Connectivity Is Key: Consider Other Potential Solutions to Fit Your Need
In Cambodia, connectivity is often unstable, especially in remote areas. Prior to developing the system, the project team should assess network connections in the target area and consider exploring other solutions that can be used offline. For remote clinics like TLC, connectivity is a major issue. When exploring similar project design, development practitioners should research multiple solutions, and be ready to identify workarounds. For example, Hub-and-Spoke models allow the system to function offline and send and store data in an internal server. It is important to study and test the system before implementation and consider portable servers and satellites to enable an offline system.

Consider Confidentiality and User Privacy
OpenMRS is used to record patients’ personal information as well as medical histories. That information is kept confidential and used only for the purpose of providing medical care. Apart from TLC, Mekom Solutions also has access to that data, but ensured it was kept confidential. For many TLC patients, data confidentiality is not an important issue, especially in villages where people live closely and know so much about one another. Not all Cambodian citizens have a strong understanding of the importance of data confidentiality matters. However, clinics seeking to customize OpenMRS in the future will need to consider patients’ privacy and data security, ensuring that both developers and implementers use the data responsibly and patients are protected.

Build Relationships with the Developers
Even though OpenMRS is an established system, TLC needed to customize it in order to address users’ needs and match with TLC context. Therefore, establishing a good relationship between the developers and users is important. During the iteration process, there were several rounds of communication between the developers and clinicians, and some miscommunication, highlighting the need for an ICT Coordinator to bridge the gap between these two groups. In this case, since the developers were not based in Cambodia, the ICT Coordinator was recruited and stationed in Cambodia, in order to better understand and translate the TLC context.

Conduct Regular Trainings for Users of the System
No matter how user-friendly a system may be, regular training is a necessary component that enables successful use of the system. The clinicians, as the end users, will need to understand the system as a whole and how it operates on a more granular level. This enables them to identify problems as they arise and fix minor issues if possible. The staffs also need to be trained on newly-introduced features as the system adapts. Training is especially important at TLC clinics, because they have volunteers who cycle in and out on a regular basis.
Expand the System for Further Use and Replication

This system has the potential to scale to other clinics. Development practitioners and healthcare clinics who want to use OpenMRS Distribution for Cambodia should consider replicating TLC’s customized system before developing a new one. OpenMRS is simple, easy to use, and fits with Cambodian context. The system also meets the requirements of the MoH.

Even though the system is currently working well for TLC, there are areas for improvement and expansion. For example, the system needs to expand the reporting feature to improve the analysis of health data. When designing the reporting function, the team should carefully consider what kind of data is needed. The team should then prototype the reporting function based on these specific needs. If the system is scaled up to the other clinics, patient invoice/billing and inventory management should be considered as an additional function. Before developing anything from scratch, explore other open source solutions or systems that have already been developed and used by the tech community.
ADDITIONAL RESOURCES

