

2013

KENYAEMR

PRELIMINARY PROCESS EVALUATION

Table of Contents

ACRONYMS.....	iv
EXECUTIVE SUMMARY	v
1.0 INTRODUCTION AND PROGRAM OVERVIEW	1
2.0 KENYA VISIT OBJECTIVES AND QUESTIONS	4
3.0 INFORMATION GATHERING METHODS	5
4.0 MAIN FINDINGS	6
4.1 KenyaEMR “inputs”	6
4.2 KenyaEMR Process and outputs.....	21
4.3 Transitioning KenyaEMR implementation.....	24
5.0 DISCUSSION.....	27
6.0 CONCLUSIONS AND RECOMMENDATIONS	33
References:.....	36
Appendix 1: Figures and Tables	37
Table 1: I-TECH Kenya and MOH collaboration on Digitalization of Medical Records in Kenya.	37
Table 2: KenyaEMR Model Sites (as of 15 Sept 2013)	39
Table 3: Evaluation Objectives and Questions.....	41
Table 4: Information Gathering Methods	45
Table 5: Documents Reviewed.....	46
Table 6: Implementing Partners	47
Table 7: A Theoretical Framework for Supporting KenyaEMR End-users	48
Table 8: Challenges, lessons learned and best practices by each year of implementation	49
Appendix 2: Revised Tools (21 August 2013).....	55
Facility Questionnaire.....	57
Interview Guides.....	62
Appendix 3 Suggestions for Future Evaluations.....	76

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ACRONYMS

ART	Antiretroviral therapy
CCC	Comprehensive Care Centre
CDC	Centers of Disease Control and Prevention
CHMT	County Health Management Team
CHRIO	County Health Records and Information Officer
DHIS	District Health Information Software
EMR	Electronic Medical Record
FACES	Family AIDS Care and Education Services
HCPs	Health Care Providers
HIS	Health Information Systems
HIV	Human Immunodeficiency Virus
HRIO	Health Records and Information Officers
ICs	Implementation Coordinators, I-TECH Kenya
ICT	Information Communication Technology
IPRS	Integrated Population Registration Services
IT	Information Technology
I-TECH	International Training and Education Center for Health
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KenyaEMR	Open source EMR system customized for Kenya
LAN	Local Area Network
LIMS	Laboratory information management systems
M&E	Monitoring and Evaluation
MDT	Multi-disciplinary Teams
MFL	Master Health Facility List number
MSF	Médecins Sans Frontières
MOH	Ministries of Health
NASCOP	Kenya National AIDS and STI Control Program
NGO	Non-Governmental Organization
NHIF	National Health Insurance Fund
NUPI	National Unique Patient Identifier
OEC	Open EMR Connect
OpenMRS	Open source EMR system
PHC	Primary Health Care
PHMT	Provincial Health Management Team
PHRIO	Provincial Health Records and Information Officers
PIS	Pharmacy Information Systems
PMTCT	Prevention of Mother to Child Transmission
POC	Point of Care mode of data capture
PRISM	Practical, Robust Implementation and Sustainability Model
REACH	Regional East African Center for Health
SOPs	Standard Operating Procedures
TB	Tuberculosis
TWG	Technical Working Group
UPS	Uninterruptible Power Supplies
USG	United States Government

EXECUTIVE SUMMARY

Since 2010, the International Training and Education Center for Health (I-TECH) in Kenya has supported the Kenyan Ministries of Health's (MOH) efforts to establish electronic health information systems. In 2012, the MOH charged I-TECH Kenya with developing a standards-based electronic medical system (EMR) and implementing it as in 315 health care facilities in North Rift, Nyanza, Central, and Western Provinces. The MOH is responsible for selecting sites for KenyaEMR implementation. I-TECH Kenya adapted and improved functionality of the OpenMRS open-source EMR system in creating a system called "KenyaEMR." In coordination with provincial and county-level MOH units and other implementing partners, I-TECH supports assessment of site readiness for KenyaEMR implementation and use. The health care facility, implementing partners, and I-TECH then undertake to meet infrastructure, training, and data migration needs for successful KenyaEMR implementation. I-TECH installs KenyaEMR on local computers in the facility, and "Champion Mentors" within the facility provide on-going support to colleagues for KenyaEMR use.

KenyaEMR implementation is supported by routine monitoring and evaluation (M&E) activities to continually improve processes. I-TECH Kenya requested I-TECH headquarters staff to make an exploratory visit to learn about KenyaEMR implementation processes and provide an unbiased view that informs program improvement, strategic planning, and evaluation development.

Kenya Visit Objectives and Methods

The trip to I-TECH Kenya head office and select KenyaEMR implementation sites was conducted from 12-23 August, 2013, by I-TECH Kenya headquarters staff based in Liverpool.

The visit's objective was to pretest tools and procedures to be used with I-TECH staff in order to:

- Evaluate KenyaEMR implementation processes and outcomes in model sites.
- Provide a snapshot of the best practices and lessons for KenyaEMR implementation.

Eight individual, one dyad, and one group interviews were conducted with purposively selected I-TECH staff using an open-ended interview guide that allowed respondents to express their perceptions in their own words and ensured consistency on the covered topics (n=10). A dyad interview occurred with an implementing partner and three group interviews were conducted at health care facilities with the available personnel, at their convenience and without the use of any referential interview guides (n=4). Opportunistic observations included that on work and patient flow in three health care facilities, a facility-based training, a provincial KenyaEMR technical working group meeting, I-TECH Kenya program management meeting, and packaging of procured materials at I-TECH offices (n=7). I-TECH Kenya reports and supporting documents covering the period from April 1, 2010 to September 30, 2013 were also reviewed to gather information on processes, outputs and lessons learned (n=30).

This report summarizes the information gathered through formal and informal interviews, observations and document review using the framework provided by the proposed KenyaEMR process and outcome evaluation objectives and specific questions. This report should not be taken to be conclusive. The analyses and interpretation herein are those of the sole I-TECH headquarters staff and are based on limited observations and unsystematic information gathering. Nonetheless, it provides some insights into the challenges, lessons learned and best practices during KenyaEMR implementation and suggests a line of inquiry for future evaluations.

Main Findings

Organizational support

The governance of KenyaEMR implementation activities is strong, with active involvement of the Provincial/County Health Records and Information Officer (P/CHRIO), facility level management, implementing partners, and I-TECH Kenya leadership, management and coordinators. The structures these organizations form – Technical Working Groups (TWG) and EMR committees – facilitate joint information gathering, planning, implementation, review and continuous improvements in the software, quality and speed of inputs, and end-user support. Quarterly meetings between I-TECH staff, MOH, and implementing partners cement relationships and further KenyaEMR implementation. With the MOH devolution, implementation and supervision is shifting from the province to county level; this has increased the complexity of the partnerships as the number of counties far exceeds the number of provinces.

The US government (USG) has provided adequate funding to I-TECH to deliver the KenyaEMR product; however, KenyaEMR implementation requires leveraging resources from MOH and other partners for the full spectrum of inputs required. Limited resources mean that physical infrastructure, hardware, repair, maintenance, servicing and replacement costs may be only partially covered by I-TECH. I-TECH has been transparent about its available budget and allowable costs to facilitate implementation. The MOH currently shares staff and transport resources for technical assistance, while sites and partners bear many of the costs for site preparation, data migration, and system maintenance.

Site assessments have transitioned to the MOH and implementing partners, and training has transitioned to tertiary institutions (though with continued inputs from I-TECH such as logistical support, per diems, printing services), with plans to further devolve to Champions at facility level. Efficiencies are being sought for training of end-users as implementation scale-up continues. Post-installation technical support is planned to be transitioned to the MOH and implementing partners. As transition occurs, processes could be organic or spontaneous. However, supporting SOPs and handover by more experienced ICs may make processes smoother. This will require better knowledge management and documentation at I-TECH. Currently, KenyaEMR implementation depends on collaborations between the MOH, I-TECH and implementing partners. Implementing partners are limited by their own scopes of work and deliverables. Also, the MOH will have to absorb the incidental and administrative costs for transport, staff and committees currently borne by I-TECH. The MOH needs guidance on the role and function of the various cadres in KenyaEMR implementation.

Software and deployment

The initial implementations of KenyaEMR provided lessons that have streamlined the development of software, site assessments to inform material and training needs, procurement of hardware, and installation and upgrade of software. Bugs and downtime—which can be present in any electronic data system—can make KenyaEMR inaccessible. Also, staff is still required to maintain notebooks, registers, diaries, and logs (legacy tools from paper-based systems which may or may not be redundant with KenyaEMR). Staff may enter data on paper forms due to interruptions in electricity supply. As a result, staff may not consistently use point-of-care (POC) data entry. Delayed infrastructure upgrades and security measures have led to the strategy of interim data migration and retrospective entry as long as one secure room is identified to place the server. Validation of the assessment form and its standardized application are needed to ensure that information on electricity supply is accurately captured during site assessments; and that, batteries on computers and UPS work; and, that back-up power is reliable. Until electricity supply can be assured, facilities will not go paperless. Data is backed up and anti-virus software is available at sites; their use, viability and physical security need to be assured.

KenyaEMR software is under continuous development to ensure that all data fields from standard MOH paper tools exist within the software modules, to minimize bugs/errors, and to enhance functionality. As of August 2013, KenyaEMR had modules only for HIV/TB, but not all fields from standard MOH paper forms were available. The module for Maternal and Child Health, covering prevention of maternal to child HIV transmission (PMTCT) and

care for HIV-exposed infants (HEI), was in development. The I-TECH Kenya software development team is guided by a roadmap that directs each release, and software development work is monitored using a cross-team tracking tool and bug reporting tools. Software releases are tested by the I-TECH team in Nairobi and Seattle, by regional Implementation Coordinators (ICs), and by end-users before final deployment. “Help desk” tools and procedures remain informal. Currently, end-users start troubleshooting with peers, Champions, facility-level HRIO and the PHRIO, before consulting I-TECH’s ICs or software developers. With use and through observations, end-users are learning how to resolve some technical and computer-use related problems. Implementing partners and Champions will also be trained on providing technical support. The KenyaEMR software is based on a software platform developed by OpenMRS, an open source medical records software community. Kenya is fortunate to have access to an international online OpenMRS forum and plans to emulate it to form a KenyaEMR forum to troubleshoot technical problems.

Staff capacity, data management, and data use

Champions and managers are critical to supporting training, data demand and problem solving. The health managers’ orientation promotes facility-level buy-in and user support. Champions have been identified from among competent computer users and enthusiasts. They may be centrally trained and then expected to train all end-users at their facility. Implementing partners and the P/CHRIO will provide back-up to the Champions.

Facility managers, Champions and end-users are highly motivated to use KenyaEMR. They apply their orientation/training during data entry. Though some end-users may be initially resistant or anxious, they quickly embrace KenyaEMR (first two weeks to three months). They find KenyaEMR user-friendly and particularly like that patient data can be retrieved even if patients do not present with the MOH 257 health information card. They report that dropdown menus and automated reporting functions save time. The generation of random numbers removes the risk of duplication of unique numbers for HIV patients. Inbuilt validation checks reduce errors at POC data entry. Errors can be easily addressed because the data enterer can be identified by login information. The data provides patient history at a glance enabling clinical decision-making based on trends in CD4 count, weight and appointments missed. Interoperability with the District Health Information Software (DHIS) is necessary to submit required reports. In the interim, facilities generate automated reports to fill reporting forms, check on patient trends and data quality. As KenyaEMR gains incremental functionality and new modules are introduced, Kenya will need content experts, curriculum developers, adult learning experts, e-learning experts and master trainers.

For returning patients, demographic and specific historical clinical data must be migrated from paper to KenyaEMR to allow POC entry. Implementing partners have been invaluable in supporting this process. Some facilities demonstrate best practices by setting targets and ensuring that the data is entered just in time for the next patient visit. While data quality at POC entry has inbuilt validation checks, there are few for retrospective data entry. Hence, at data migration and during retrospective data entry, recording errors may be found and transcription errors may occur. Guidance on the essential data elements that must be migrated or the number of years of the legacy data that should be captured; data cleaning procedures; and, documentation of corrections is needed. The Kisumu District Hospital can serve as a model site for this and other data related best practices. Interoperability with other EMRs could reduce the burden of data migration for sites with prior use of EMRs. Currently, data are not complete due to phased data migration, occasional retrospective entry and some unavailable fields in KenyaEMR. Definitions of indicators may vary by MOH and implementing partner needs and some data fields may be misunderstood (for example, clinic number and unique patient number), making for some inconsistent data. Implementing partners’ informational needs should be considered when creating data fields.

Challenges

Interruptions in disbursement in I-TECH funding due to pending formalities sometimes delay implementation. Human resources too are stretched, and only few have the skills and experience needed for EMR implementation and training in the country. As staffing is a tightly controlled resource, alternatives such as the use of interns and

cost sharing with implementing partners are being explored. Simultaneously, I-TECH Kenya has experienced staff turnover, which has underscored the need for more robust and explicit standard operating procedures (SOPs) for assuring continuity and quality of KenyaEMR related activities.

Organizational support for implementation: While the partnership model has been a great strength of the KenyaEMR project, this is also an area of great vulnerability as scale-up progresses. I-TECH does not have resources to “do it all”, partners have other priorities, and long-term sustainability must be considered.

Recommendations:

- Find sustainable approaches for MOH involvement within capacity building and oversight teams, with standardized I-TECH policy for covering MOH incidental and transport costs related to assessments, supervision and committee meetings.
- Integrate EMR committees with existing site-level Multi-Disciplinary Teams, and develop standard I-TECH policy for provision of sitting fees for EMR Committees.
- Consider providing travel per diems and EMR Committee sitting fees during a time-limited number of months, such as two months before installation and six months after.
- Provide standard binders and support materials for EMR committees.
- Establish clear roles and functions for I-TECH and partners, and establish regular meetings with partners.

Software development: While there is much strength to the KenyaEMR, it is still missing important functionality, especially to facilitate data migration and reporting.

Recommendations:

- Ensure there is a data entry interface for both front and back of the MOH 257 health information card (blue card).
- Ensure all MOH standard reports can be generated.
- Definitions for data fields (especially from the blue card) are not available on the KenyaEMR screen and should be added (e.g. through rollover text or other pop-ups).
- Need to ensure procedures for bug and issue reporting are disseminated and partners are engaged in using these procedures to express their on-going needs with respect to the software functionality.

Infrastructure assessment and set-up: Some sites implementing KenyaEMR are still struggling with power supply issues despite the assessment and infrastructure set-up process. This hampers their potential to successfully move to POC KenyaEMR use.

Recommendations:

- Need to better understand power supply issues to identify solutions.
- Regularize procurement and inventory management, including documentation. Establish SOPs and reinforce consistent application of the procedures.
- MOH guidance on minimum patient load and other criteria to justify EMR implementation exists but is evolving in its application. I-TECH needs to “lead from behind” on the evolution of the site selection criteria based on successes and challenges in implementations to date.

Implementation procedures: Implementation of KenyaEMR following installation is a highly complex endeavor and can leave sites struggling with data migration, entry, management and use. I-TECH needs to assure responsive technical assistance as well as disseminate and support practices most likely to lead to successful implementation.

Recommendations:

- SOPs are needed for areas of implementation other than software development and deployment, such as for data migration, data cleaning and validation during migration, data cleaning and document change, data back-up, reporting and data collection. These will help ICs and standardize I-TECH’s approaches during scale up.

Data management and data use: There can be a large gap between simply having functional hardware and software, and having a functional system populated with high quality data which are regularly used for decision-making. I-TECH’s technical assistance is critical to bridge this gap.

Recommendations:

- Guidance on data migration (standards, best practices) is needed. In particular, sites need guidance on what data should be migrated for high-volume patient records and on best practices in handling data migration. I-TECH should work with MOH and “lead from behind” on this.
- Adapt and share the data quality assurance protocol from Kisumu District Hospital or MOH and advocate for allocation of staff to permit this type of protocol to be applied in all areas. Include content on the data quality assurance protocol in the Champion Mentor training.
- Establish SOPs for system maintenance and clarify partner roles in applying the procedures.
- Create a performance checklist for measuring and monitoring success in POC EMR use, and integrate this within I-TECH’s “implementation dashboard” (see *On-going monitoring and evaluation* section below) .

Staff capacity and training: With the shift in I-TECH’s training strategy, there are new opportunities and threats.

Recommendations:

- Champions need a way to train users at sites on a demonstration version of the system, rather than on the production version. The existing solution needs to be fully disseminated and made reliable for all Champions.
- Clarification of partner roles in fulfilling the new training strategy is needed. There is a need for SOPs that clearly express purpose, role definition, materials needed, procedures, and deliverables in applying the training strategy.
- Existing M&E tools, especially for mentoring and tracking mentee progress, have been inconsistently used. We need to modify existing tools for efficient yet illuminating M&E of capacity building efforts.

On-going monitoring and evaluation: As I-TECH proceeds with scale-up and adapts implementation approaches, processes and progress must be continually monitored and documented for constant learning and program improvement. Staff turnover can lead to loss of important knowledge of project history, context, and lessons learned.

Recommendations:

- Routine M&E tools and processes by I-TECH need to be revisited to retain “implementation history”.
- Need to ensure that an impartial observer goes to sites where the new training strategy is being applied, even if nothing being done at the site by any trainer/mentor, to identify problems.
- Need to establish indicators for transition-readiness (when KenyaEMR use is considered stable), but also have systems for rapidly identifying and responding to sites that are experiencing new or on-going struggles.
- Need to feed information on patterns, best practices, and lessons learned back to partners and stakeholders to motivate further M&E related data collection and documentation.

1.0 INTRODUCTION AND PROGRAM OVERVIEW

Though electronic medical record (EMR) systems have been in existence since 1972, only recently have governments worldwide begun to encourage digitalization of medical records.¹ In Kenya, the Ministries of Health (MOH), i.e., the Ministry of Medical Services and the Ministry of Public Health and Sanitation, are actively promoting the standard implementation of EMR systems² with the aim of improving health care delivery, health systems management and patient health outcomes.³⁻⁵ Several EMR systems exist in Kenya to collect and manage data, analyze data, manage patients or hospitals, provide administrative/ management support and to manage external systems such as supply chain management.⁶ Some of these systems have been limited by lack of coordination, inability to share information, software problems, inadequate numbers of personnel skilled in information technology (IT), and organizational cultures that do not support information generation and use.^{2, 6} In an attempt to address these shortcomings, the MOH established the policy environment and standards for the development, implementation, and use of EMR systems in Kenya via a 2012 publication titled *Standards and Guidelines for EMR Systems in Kenya*.^{2, 6}

As shown in **Table 1** in **Appendix 1**, the International Center for Training and Education for Health (I-TECH) has supported the MOH with the standardization of EMR Systems, capacity building for EMR use, and in the configuration of open source EMR for use in Kenya since April 2010. In 2012, the MOH, with support from the United States Government (USG) Centers of Disease Control and Prevention (CDC), charged I-TECH and the Futures Group to implement four standardized EMR systems in over 600 MOH supported health facilities. Specifically, I-TECH was asked to:

1. Customize and configure an open source EMR system (OpenMRS) to meet MOH requirements;
2. Demonstrate the standard implementation of OpenMRS as outlined by the MOH *Standards* in 15 “model sites” in the North Rift, Nyanza and Western Provinces of Kenya;⁶ and,
3. Rollout OpenMRS to 300 additional sites in 4 Provinces while incrementally transitioning elements of EMR systems implementation to the MOH.

Site selection for KenyaEMR implementation has been handled by the Kenya MOH. Model sites are MOH-selected healthcare facilities where KenyaEMR was to be initiated and which were to serve as demonstration sites to other healthcare facilities adopting KenyaEMR. I-TECH suggested these be facilities with HIV clinics that server >500 patients. However, the evaluator did not find any MOH selection criteria.

In the *Standards and Guidelines for EMR Systems in Kenya*, the MOH recommends breaking the standard implementation process for EMR systems into pre-implementation, implementation and post-implementation phases. Accordingly, I-TECH has pursued the following broad activities for the three phases at the 15 model sites and has initiated similar activities at additional scale up sites:

Pre-implementation:

- 1) Developed ‘KenyaEMR’, an OpenMRS system customized and configured to meet MOH standards for EMR systems, HIV patient management, and related recording and reporting requirements;
- 2) Conducted sensitization and planning meetings with the County Health information Officers;
- 3) Assessed sites for readiness to adopt an EMR system in conjunction with the MOH, other partners supporting these sites and facility staff⁷⁻⁹ for KenyaEMR implementation at the 15 model sites selected by the MOH by identifying existing human resource, technical, infrastructural and structural capacity; and,
- 4) Trained master trainers at two training institutions, Jomo Kenyatta University of Agriculture and Technology (JKUAT) and the Regional East African Center for Health (REACH), along with whom, I-TECH oriented health managers on KenyaEMR;

Implementation:

- 5) Addressed identified capacity gaps to prepare model sites for KenyaEMR implementation alongside the MOH, facility administration, and other implementing partners that support these sites;

- 6) Trained primary EMR systems users on KenyaEMR along with master trainers from the two training institutions;
- 7) Identified and trained expert and enthusiastic computer users as Champion Mentors to serve as advocates, systems administrators and troubleshooters, and possibly trainers/mentors at their facilities;
- 8) Installed hardware and software to support KenyaEMR implementation; and,
- 9) Supported data migration/reconstruction in KenyaEMR.

Post-implementation:

- 10) Used a stepwise design⁵ to incrementally introduce improved functionalities in KenyaEMR;
- 11) Additional system users trained by Champion Mentors post-implementation
- 12) Provided KenyaEMR system support;
- 13) Liaised with the district and county supportive supervision teams to address ongoing issues;
- 14) Formalized electronic tools to monitor KenyaEMR implementation; and,
- 15) Set up facility EMR committees.

Though linear in presentation, KenyaEMR implementation is at different phases in various facilities. I-TECH Kenya paced the phases to match the technical and absorptive capacity¹⁰ of the MOH, health care facilities, and other organizations that support HIV care and treatment at each model site. The first implementations of KenyaEMR occurred in December, 2012 in North Rift, Nyanza, and Western Provinces.

In 2013, the MOH and CDC advised I-TECH to accelerate the pace of KenyaEMR implementation. As one of the strategies to accelerate implementation, I-TECH has begun sharing procedures with other organizations so that they can support KenyaEMR implementation in the roll-out sites. I-TECH also continuously seeks ways to incorporate efficiencies into KenyaEMR implementation; for example, I-TECH and its partners have enhanced the process of data capturing during EMR readiness assessment. The information is being captured on hand-held android tablets, to permit real-time analysis and planning for site preparation. Another important shift in 2013 to meet the accelerated scale-up pace involved a shift in I-TECH's training strategy, for cost efficiency. The revised strategy involves training an on-site Champion Mentor at each facility and empowering this individual to conduct cascade-level on-site training to other EMR users at each facility. Regional teams comprised of MOH, implementing partners, and I-TECH Implementation Coordinators (ICs) are available to support and back up the on-site Champion Mentors. This strategy is intended to minimize the number of people who are pulled away from their sites for participation in multi-day training workshops, and to improve the availability of an on-site expert to support new system users.

As of September 2013, KenyaEMR had been implemented in all 15 model sites (see **Table 2** in **Appendix 1**). Site readiness assessments had been conducted in 200 sites and the KenyaEMR was implemented in a total of 103 sites. The MOH and CDC also provided a mandate and funding to expand I-TECH's scope of activity to incorporate further work on: supporting MOH to develop national standards and certification criteria for primary health care EMRs, laboratory information management systems (LIMS), and pharmacy information systems (PIS); demonstrating integration of a national unique patient identifier (NUPI) endorsed by the government of Kenya within health information systems (HIS); demonstrating integration of patient-held smartcards as part of the HIS; and expanding implementation of the Open EMR Connect (OEC) solution for establishing interoperability between EMR, LIMS, and PIS. This expanded activity builds upon I-TECH's previous support to the MOH to conduct a review of 17 EMRs implemented in Kenya to certify them against national EMR standards, and in supporting pilot implementation of OEC within Nyanza Province (see **Table 1** in **Appendix 1**).

Process Evaluation

I-TECH Kenya proposed the conduct of a process evaluation in order to guide program improvements, by identifying best practices and lessons learned during KenyaEMR implementation at the 15 model sites and beyond. The findings were intended to guide adjustments to I-TECH's technical assistance activities to support KenyaEMR scale-up in a total of 315 health care institutions. The goal of the proposed process evaluation was to assess software development, training and mentoring and other implementation activities, in order to address shortcomings, increase productivity and facilitate the transfer of implementation support to the MOH.

Results from the evaluation activities described in this report were expected to help I-TECH support:

- Improvements in procedures and workflow for software development;
- Efficient procurement, deployment, storage and maintenance of IT hardware and infrastructure;
- Refinements of the training content for optimal skills development for various types of stakeholders and users of the KenyaEMR;
- Refinements of the mode of training delivery, with increased integration of “eLearning” tools, for greater efficiency of training delivery at large scale;
- MOHs’ increasing role in the efficient and effective implementation, rollout, and maintenance of KenyaEMR;
- Identification of tools and methods that could be applied in further evaluation of health informatics implementation work carried out directly by the MOH or by other partners.

The evaluation described in this report did not attempt to address the following:

- Successful integration of NUPI and smartcard technology within facility-level HIS;
- Refinements of the site readiness assessment framework;
- Definition of cost-efficient KenyaEMR implementation, with explicit details on human and material resources needed;



2.0 Guiding Questions for Process Evaluation

The purpose of the visit to Kenya from August 12-23, 2013, was to pilot the tools and procedures developed for the proposed process evaluation of KenyaEMR implementation in model sites. The proposed evaluation objectives and related questions are presented in **Table 3** in **Appendix 1**.

The findings from the visit aim to provide preliminary answers to the following evaluation questions:

1. Process evaluation of IT products, services, and standards (Evaluation Objective 1)
 - a. What are the processes used to develop and deliver software, and what process steps are needed to maximize efficiency in software development?
 - b. How do users perceive the technical features of KenyaEMR (e.g. patient registration and look-up, patient summary, screens for health care visit data capture, reports, interoperability with other systems, etc.)
 - c. How is KenyaEMR used for data retrieval, data collection, and program documentation and reporting?
 - d. What features of KenyaEMR support or impede data retrieval, data collection, and program documentation and reporting?
 - e. What is the level of completeness, timeliness, and accuracy of KenyaEMR data?
 - f. What affects the quality of data in: a) patient medical records; and b) aggregate facility reports?
 - g. What are the ongoing technical assistance needs to support MOHs' KenyaEMR implementation?
2. Implementation process evaluation (Evaluation Objectives 1, 2, and 3)
 - a. How is the type of KenyaEMR implementation (point-of-care/retrospective) determined?
 - b. What actions and structures are needed for sustainable implementation of KenyaEMR at the institutional level?
 - c. What are the mechanisms to identify and resolve problems and how well have these mechanisms worked?
 - d. How has readiness to transition been determined for various elements (steps, processes or procedures) of KenyaEMR implementation?
 - e. For which process has transition of various elements of KenyaEMR implementation occurred?
 - f. How have problems been identified and addressed while implementing transitioned elements of KenyaEMR implementation?
 - g. What are the results of transition of each of the various elements to the MOH in the 4 provinces? (pace, changes in internal operations, staffing, and resource allocation)
 - h. What are best practices and lessons learned related to transition of KenyaEMR implementation?
 - i. What practices are commonly identified by stakeholders as helpful for KenyaEMR adoption and use?
 - j. What staffing roles and responsibilities are needed to support these practices?
 - k. How do individual skills and motivation, peer influence, social support and leadership skills and motivation affect KenyaEMR adoption?

How this report is organized

Section 3.0 describes the methods used to test tools, processes and to gather the preliminary information presented in **Section 4.0** in relation to the key evaluation questions. In **Section 5.0** we compare current KenyaEMR implementation practices with the guidance provided in the *Standards and Guidelines for EMR Systems in Kenya* incorporating into the steps lessons learned from the field. **Section 6.0** concludes this report with suggestions and recommendations for KenyaEMR implementation and its evaluation based on these observations arising from interview, discussion, and field notes.

3.0 INFORMATION GATHERING METHODS

The visit, conducted from 12th to 23rd of August, allowed for formal individual interviews (n=8), formal and informal dyad interviews (1 each), formal (n=1) and informal group interviews (n=3), and opportunistic observations (n=7) (See **Table 4** in **Appendix 1**). I-TECH Kenya reports and documents covering the period from April 1, 2010 to September 30, 2013 were also reviewed to gather information on processes, outputs and lessons learned (n=30) (See **Table 5** in **Appendix 1**).

Eight formal interviews were held with I-TECH Kenya leadership, management and implementers. Two software developers agreed to a dyad interview. Five I-TECH Kenya ICs discussed their experience with KenyaEMR implementation as a group.

Visits to the Central, Nyanza, and Western Provinces of Kenya provided the opportunity to meet with MOH and other implementing partners. Visits to four health care facilities led to three informal group discussions with 18 MOH staff including KenyaEMR Champions, mentors, users and Health Records and Information Officers (HRIOs). Two staff from an implementing partner organization in Nyanza Province met with the visiting team.

Three health care facilities were toured to understand patient flow and data capture/use. In the fourth, the last day of a 4-days training was observed. A Technical Working Group (n=4) meeting was observed in Central Province. At the I-TECH offices, a project management meeting was observed as well as the packaging of materials to be sent to the Provinces.

Six quarterly reports and their attachments were subjected to content analysis.

Procedures

Formal interviews were by appointment and proceeded after an explanation of the purpose of the interview and the use of the results.

The Provincial Health Records and Information Officers (PHRIOs) in each province either accompanied or met the I-TECH visiting team at the healthcare facility. In each health facility, meetings began only after introductions and with permission of key facility-level staff. Questions were open-ended and designed to generate conversation. In the absence of clear CDC guidance on allowable evaluation activities, no evaluation-specific tools, with the exception of those developed for use with I-TECH staff, were used. The facility tour was usually at the end of the meeting.

Information management and analysis

All I-TECH Kenya interviews and focus groups were digitally recorded. The recordings and their transcription (if any) are saved in a password protected folder. All other interview and group notes are entered into Microsoft Word and saved in the same folder. All notes and transcriptions were read and sorted for themes using the evaluation questions and respondent types as the organizing framework.

Limitations

This report only provides a snapshot in time and attempts to capture the historical context through report and document review, interviews and observations.

4.0 MAIN FINDINGS

This section is arranged to answer the main Evaluation Objectives 1-3 which are based on the Practical, Robust Implementation and Sustainability Model (PRISM) (see **Figure 1** in **Appendix 1**).

1. Identify best practices and lessons learned with respect to “Inputs” component of the PRISM model:
 - a. Organizational (determination of type of, structures to support and propel implementation),
 - b. Technical factors (software development, complementary technologies, technical features and support, infrastructure procurement and maintenance) and,
 - c. Behavioral (role and function, use, capacity building).
2. Assess use and performance of KenyaEMR in actual practice to support clinical and programmatic decision-making (addressing “Process” and “Outputs” components of the PRISM model) including data quality.
3. Identify requirements and strategies for transition of systems to MOH leadership for long-term sustainability.

4.1 KenyaEMR Inputs: Organizational, Technical, Behavioral Factors

Inputs in the PRISM Model refer to organizational, technical, and behavioral factors that support EMR performance and use (see **Figure 1** in **Appendix 1**). Organizational factors include governance, planning, finances and resources, supervision, and information distribution and culture; technical factors include data collection, report formats, HIS and software design, IT infrastructure, and maintenance; and behavioral factors include, training, data demand, quality, problem solving and user confidence.

Synergies between these three factors lend themselves to successful implementations of KenyaEMR. In coordination with the Provincial MOH and other implementing partners, MOH-selected health care facilities report their material and training needs for KenyaEMR implementation and use. The health care facility, implementing partners and I-TECH undertake to meet material needs for successful KenyaEMR implementation. Partner training institutions coach end users on KenyaEMR. I-TECH installs KenyaEMR in servers and deploys the system to be used on virtual machines in the facility. Facilities are expected to migrate data from paper to KenyaEMR and, during consultation, enter patient information directly into the database. Clinicians are expected to use the data for clinical decision-making and clinic managers are expected to use the data to improve health systems management. Provincial and County level staff should be able to use the information to make decisions to improve public health in their catchment areas.

Organizational Factors

The evaluation questions of interest here include the actions and structures needed for sustainable implementation of KenyaEMR at the institutional level, organization of the software development process, and mechanisms to identify and resolve problems.

The KenyaEMR project encompasses organizational structures and capacity which are both general to eHealth and specific to KenyaEMR. I-TECH’s ability and resources to influence the general eHealth capacity are somewhat limited. As described below, I-TECH’s strategies attempt to both rely upon and nurture general eHealth capacity.

- **Actions and structures needed for sustainable implementation of KenyaEMR**

The sustainability of any EMR system depends on its relevance for the health care provider and public health system as well as appropriate and timely investments in its customization, installation, maintenance and use. Specific actions need articulation and structural support to ensure well executed pre-implementation, implementation, and post-implementation processes that lead to the desired results of data use for clinical and managerial decision-making.

Pre-implementation

1) Standards-based software development

In November 2010 and into 2011, there appears to be coordinated effort between I-TECH, Kenya National AIDS and STI Control Program (NAS COP), CDC Kenya, PHRIOs and other regional coordinators to coordinate monitoring and evaluation (M&E) activities, launch the *Standards* document and develop guidelines for the integration of cohort reporting into EMR systems. The guidelines for the integration of cohort reporting define the various terms used and provide guidance towards retrieving cohort data from EMR system datasets. The I-TECH progress report of November 2012 indicated that Western Province stressed that the KenyaEMR should communicate with the District Health Information Software (DHIS). There does not appear to be any documentation of subsequent meetings to determine the architecture of KenyaEMR or to define the limits of I-TECH Kenya involvement in KenyaEMR implementation. Similarly, it is not clear whether the various TWGs recommended by the National Health Information System Coordinating Committee (see the 004/2011 minutes of the 10 November 2011 meeting) are functional and guiding processes related to:

- i. Harmonisation of the software systems and innovations
- ii. Performance monitoring, indicators and tools
- iii. Policy standards
- iv. Harmonisation and integration of tools, minimum data sets and indicators
- v. District Health Information Software
- vi. Electronic Health Records
- vii. Research, Other statistical constituencies and knowledge management

As noted in the report of 24 April 2013, other than KenyaEMR, I-TECH Kenya has been involved in the development of standards and guidelines for HIS, PIS, LIMS, Primary Health Care (PHC) and the interoperability with the DHIS.

2) Site Selection

Clear criteria for site selection are needed. Clearly with HIV/TB being the only available modules at the minimum, sites must have HIV care and treatment services in a facility – a recognized ART site with a fully-fledged Comprehensive Care Centre (CCC). However, the criteria requiring minimum patient load (≥ 500 patients actively receiving care) appears to be flexible with some facilities having approximately 75 patients. Also, when a facility has a EMR system that is not recommended by the MOH, the facility is considered to not have an EMR system. The January 2012 EMR site assessment reports show that one facility used FunSoft while two others used systems not recommended by the MOH. For the latter cases, the project had to consider the feasibility of migrating data from the existing EMR system to KenyaEMR, its efficiency and returns on investment. However, the final decision on how to proceed and the decision-making process were not documented. Additionally, the integration of KenyaEMR with existing tools and the transition from existing tools to KenyaEMR was not addressed by the project at the time of the evaluation.

3) Site Preparation

Pre-implementation preparation of sites is extremely important to the later adaptation and use of any EMR. From the early implementations, the MOH selected the sites to be assessed for readiness for KenyaEMR implementation. Site

assessments were done in coordination with the Provincial Health Management Team (PHMT). During the project period, the Kenya public health structures devolved such that the PHMT/ PHRIO role was delegated down to the County Health Management Team (CHMT)/CHRIO.

As documented in the October 2012-September 2013 Quarterly Report, sensitization meetings with the CHMT, where they are functional, facilitates the selection and prioritization of health facilities for KenyaEMR implementation. Otherwise work continues with the PHMT. In subsequent meetings, site assessment teams that are answerable to the Provincial TWG are formed. To optimize use of resources, teams consisting of the MOH, facility staff, and implementing partners are formed and deployed for site assessments to assess facility capacity to receive, secure, maintain and use computer hard- and software; facility upgrade to address capacity gaps identified during the site assessment, and software installation. The TWG remains involved and informed throughout the KenyaEMR implementation process, investing resources and problem-solving to ensure successful implementation and KenyaEMR use. As per the June 4 TWG meeting minutes, I-TECH encourages and is willing to support innovative approaches to enhance the KenyaEMR implementation process such as regional conventions, exchange programs, review meetings, and TWG visits.

I-TECH has provided health manager orientations (HMO) in all geographic areas of KenyaEMR implementation. Together with site readiness assessments, the HMO sessions have built buy-in and understanding among local leaders for the steps in Kenya EMR implementation and have been crucial to the success of EMR adoption and use. The site visit report of 6 February 2013 shows that sites where the management was sensitized had clear plans for the migration of data and active use of KenyaEMR, making the mandated switch to KenyaEMR/POC more successful. At these sites, mentors too appeared to be motivated to provide end-user support. The reverse was true of sites where the managers had not participated in HMO sessions or had not embraced KenyaEMR.

The managers conduct the facility assessment along with the site assessment team and assist in the selection of trainees and, initially of mentees among end users. Mentees are currently selected from among end-users who are comfortable with computers and enthusiastic about EMRs. The CHMTs/TWGs remain abreast of technical and logistical decisions taken at facility level for informational and coordination purposes. In facilities where there is no pre-existing EMR, guidance is needed to ensure adequate resource allocation, workflow analysis, and change management. This includes a consideration of planned non-EMR changes to determine timing and resources invested in KenyaEMR implementation. For instance, knowing if another partner is slated to support EMR or more work space will be built can better help plan and implement infrastructure upgrades. Facility-level management are also important in determining the workflow changes needed due to KenyaEMR implementation with regards to scheduling appointments (may need to slow visits to ensure data migration), rearrangement of rooms for security reasons, and to determine the number of POC requiring installation of virtual machines.

Other than health managers, EMR committees and champions are crucial to the adoption and use of KenyaEMR. These structures guide the implementation, provide oversight and solve problems. They liaise with the wider facility management to ensure that KenyaEMR related implementation at the clinic is supported and coordinated with facility-level plans. I-TECH aims to work closely with the health facilities to operationalize EMR committees and to provide guidance for more proactive participation in the entire implementation process from facility-readiness to post implementation use. EMR committees and champions could provide the support and momentum needed to strengthen ownership of KenyaEMR implementations at health care facilities. However, there is need for guidance on the role, scope of work, and incentives for both EMR committees and champions.

Implementing partners (**Table 6 in Appendix 1**) play an important role in all stages of KenyaEMR implementation because they are closely involved with the clinic, reliant on some of the data from the clinic and can access resources to support the early implementation, adoption and use of KenyaEMR. Partners have been instrumental in ensuring facility upgrade, transfer of legacy data, and in providing technical support to users including the configuration of KenyaEMR.

The most important considerations for site readiness are power availability and adequate security. Sites needing the least upgrades may be prioritized over those needing more intensive inputs in order of implementation.

4) Training

The training structure and activities were in process of being changed at the time of the visit. Specifically, using external training institutions (JKUAT and REACH) to hold off-site training workshops to meet all training needs was seen as expensive. The idea that training delivery by these third party institutions would rapidly transition to an income-generation model, rather than being fully donor-funded, did not materialize.

At the time of this process evaluation, MOH, NASCOP, JKUAT and REACH facilitated off-site health manager orientations and select end user training. Initially trainees for end-user and mentor trainings were selected by the facility management. Later, promising end users, rather than pre-selected staff, were further trained as “Champions” to support end users who may or may not have attended an end-user training workshop. Some mentors went on to champion KenyaEMR. Some Champions, not trained as mentors but enthusiastic and expert in computers, assumed de facto mentoring roles. The proposed modification to the training strategy invests in on-site “Champion Mentors” with merged champion and mentor roles to build capacity of other staff at the site in KenyaEMR use. Greater integration of “eLearning” approaches within the training curriculum is seen as integral to this strategy, since development of these materials will give structure as champion mentors work with staff to gain proficiency in system use. This strategy may make the scaling up of the delivery of effective training for system users to more than 300 KenyaEMR implementation sites more feasible.

I-TECH does not offer a recommended model for training new, temporary or rotational staff; though the implicitly Champion Mentors are expected to assure continuity in training. No systematic mechanisms for retraining were observed at the facilities visited. While facility-level staff demand for offsite training appears to have reduced, mechanisms are needed to ensure the new and temporary staff is trained on KenyaEMR in a timely manner that is not disruptive to patient care. Often staff rotates through departments and clinics. Substitute clinicians need training, an investment with potentially little returns. The efficiency of site-by-site vs. cross-facility training needs to continue to be evaluated for retraining and training updates.

There will be continuing need to have a mechanism/structure including content area experts to update training materials with accurate and appropriate technical content that address the specific needs of each cadre of personnel including those from among implementing partners. As documented in October 2012-September 2013 Annual Report, development of new features as well as improvements made to existing functionality in KenyaEMR has to be supplemented by an update of existing job aids, both paper and video versions. IT/system administrator training materials are yet to be developed (see I-TECH Annual Report October 2010-Sept 2011 EMR Curriculum-Content Experts workshops 1 & 2 for recommended steps to develop training materials). Additionally continuous review of training approaches is required. Similar to the approach to building the cadre of software developers, curriculum development and related short courses are being incorporated into the business model of training institutions. As new or modified information emerges, Champion Mentors will need familiarization/training (e- or blended learning) to be able to support their colleagues. The MOH/implementing partner staff is proposed as technical support and mentors to the EMR Champions. However, they too may need familiarization and training to meet facility-level needs.

Implementation

5) Facility upgrade and installation of hardware and software

Facility upgrade particularly related to security and networking must occur before installation of the hardware. At the site assessment, various players commit to completion of the facility upgrade within a two-month timeframe as is evident in the reports. The regular TWG meeting minutes show discussions on the progress towards meeting these commitments and problem solving on delays. The lag time between procurement and delivery has been reduced by making bulk purchases in anticipation of need. The end to end delivery mechanisms with all the required sign-offs is being implemented successfully.

Implementing partners may find that they cannot meet costs or that some costs are not allowed. Also, with the shift in the Kenyan Public Health Structure, they find that they have to change their agreements to the County level. This can delay action. Some facilities may find it difficult to support infrastructure upgrades especially since they can no longer charge maternity fees, a major source of income for these facilities. Also, with the new structure for the National Health Insurance Fund (NHIF) where category B patients get free health care and category C patients co-pay, the facilities have smaller budgets. Other sources of funding may be the Rural Health Project 4.

I-TECH procures the Information Communication Technology (ICT) as determined by the site assessment reports. The software is installed in the server by the software developers at the I-TECH Kenya office, who test it before sending it to facilities. They determine how new releases will be deployed.

6) Supported data migration/reconstruction in KenyaEMR

Once the server is installed, legacy data is migrated onto the EMR system with sites encouraged to expedite the process by clearly setting up a plan for data migration, estimating the workload they have (paper charts in form of blue cards) as well as setting up the targets for a specified timeframe.

As noted in the January 2012 EMR site assessment reports, successful conversion of existing paper record into an electronic system depends on many processes and factors. One of the key considerations is the nature and completeness of the data captured in the facilities on paper-based charts and registers. Most facilities have incomplete data requiring time to fill in the gaps by reconstructing the data, usually by asking the patients themselves. Sometimes accompanying reports are incomplete and inconsistent data or inaccurate notations may also require reconstruction of data.

Motivating timely entry of demographic data (migration) with quality assurances (which may lead to reconstruction) requires facility leadership and staff fees for additional work. However, engaging facility staff promotes ownership and practice with KenyaEMR. Certainly, there is an example of Makuyu health center where the pharmacist has taken the lead and has pulled together a commendable team of 6 others to make much progress in data migration. If necessary due to high volume of data, I-TECH and other implementing partners assist in the temporary hire of additional data clerks. In practice, when data migration is not initiated or is slow, then additional training and incentives are offered. There are not currently explicit criteria to guide decisions on level of assistance from I-TECH to sites on data migration. This represents a gap.

I-TECH Kenya is considering software Capricity to automate and accelerate data migration from paper records to KenyaEMR. This software application allows paper-based data to be scanned, while ‘shredding’ it to protect privacy of electronic patient information. The “shredded” data are then “reassembled” in an automated manner when imported to fill the EMR data base. If seen as viable in terms of both cost and privacy protections, then discussions will be needed with all stakeholders to determine organizational roles and responsibilities in implementing this method of data migration. .

Post-implementation

7) User support

User support begins with the orientation of health managers. At the orientation, the health managers voice their fears, for example, fears related to KenyaEMR sustainability, power and data backup, lack of infrastructure and IT skills. Through this process, they raise the expectation that they will learn more about KenyaEMR, its use, data quality and about getting more involved in KenyaEMR implementation. Evaluations show that these expectations are met.

On-going user support draws upon presence of helpers on site or nearby. The revised training strategy emphasizes the role of Champion Mentors to provide first-line, in person user support. User support needs can escalate to ICs, PHRIOs and I-TECH’s central staff for resolution, as needed. I-TECH has conceptualized a help desk; however, a triage and referral system may still be needed for answering end user support needs. End users may feel most comfortable seeking support from a known person rather than contacting a help desk for technical support at a distance. Resources do not permit creation of a permanent, well-staffed help desk which could eventually transition to MOH, for coverage of all end user support needs.

8) System support

Technical support has greatly improved due to closer follow up and better communication especially between mentors and end users supplemented by advanced technical help from I-TECH and other implementing partners. A helpdesk is being set-up to assist with system errors.

The Kisumu District Hospital refers to a users' feedback form, developed by the EMR committee. Users fill the form whenever a problem is encountered to include a brief history of events leading to the error. The exact error message is recorded. The DHRIO settles the problem immediately, calling on the PHRIO only if unable to resolve the issue.

9) Supportive supervision

There is only one observation in the 17th September TWG meeting minutes of a request for the DHRIO to provide supervision to a data clerk at the Kiganjo HC for data migration. However, from the visit documented herein, it is evident that the P/CHRIOs are closely involved with KenyaEMR implementation and their presence greatly supports KenyaEMR implementation. Similarly, involving the hospital or larger facilities Medical Officer can help speed processes and help with rollout of KenyaEMR throughout the facility as additional modules are introduced into the system. The CCC-in-charge provides the most immediate support to end-users working in conjunction with the HRIO.

The supervisory and oversight roles for KenyaEMR within the county structure still require greater clarification.

10) Continuous quality improvement initiatives

Software problems/bugs are addressed as they are identified in order of priority. Quarterly meetings with ICs also aim at continuous improvements in the product and software development processes.

I-TECH together with the MOH is keen on continuous feedback regarding system adoption/use and any kind of challenges. The post implementation review meetings and site feedback are considered as key platforms for feedback and improvements. During these meetings, I-TECH seeks to (i) provide a feedback to county/regional teams regarding KenyaEMR implementation (ii) give a status progress regarding EMR implementations as well as suggestions for continued improvements to the EMR system/implementation

Key activities related to transitioning the new approach to training include:-

- Sensitizing key stakeholders, including MOH at all administrative levels, partners, and current facilitators;
- Preparing MOH at the regional/county level as well as partners to support and strengthen Champion Mentors, and indirectly, users at a facility, through orientation workshops;
- Revising current user training materials to accommodate the capacity building needs of Champion Mentors.

I-TECH also meets with implementing partners to learn from their observations at facilities and their experiences with KenyaEMR.

- **Organization of software design and development process**

Team composition of the software development team is important. The software development team needs a project manager to ensure that the specifications for the desired end product are understood. The project manager ensures and that the work is guided by a high level roadmap with the main goals, release date and content specified; that work is completed as per plans; and, that the roadmap is updated to guide ongoing work. Other management and communication tools are needed to ensure there are no gaps and duplication in the work assigned to the software developers. The team needs a clinician to provide information on the blue card, definitions, and to provide clinical interpretation for the programmers to ensure a user-friendly interface. I-TECH is exploring the option of having clinical consultants for this purpose. Finally, the team needs experienced software developers who must have technical support, such as the contractor I-TECH has in Rwanda; and staff must be retained to avoid loss in knowledge/experience and cost of recruitment and training.

Though there are software developers in Kenya and formal education is available in IT, I-TECH with another implementing partner (Family AIDS Care and Education Services (FACES)) has supported the intensive implementation of OpenMRS curricula, training and practice at the University of Nairobi to move beyond didactic learning on OpenMRS to intensive engagement and problem-solving with KenyaEMR. Twenty students were engaged with funds and training provided by I-TECH. I-TECH is also considering working through interns who are then absorbed into the software development and EMR implementation.

Though not verified against documentation, the software developers said that MOH/stakeholders communicate their EMR needs to the I-TECH Kenya Country Director, who along with the Deputy Director leads the scope analysis. The scope of the work and the roadmap to achieving deliverables in time are determined by the software development teams in Kenya, Seattle and the sole consultant based in Rwanda. The group generates the design. The software developers actualize the design by conducting a very basic level of analysis based on user needs and machine codes to produce a mock-up. These are reviewed by the Country Director (the users' representative). The code is reviewed by the consultant in Rwanda. The internal I-TECH group tests each element of the product. Then, clinicians, ICs and users also test new releases. Involvement of end users in the testing process has not been formalized and routinized. Feedback from both processes shows what to fix and then re-test so that the release has minimum/no errors.

There has been very limited engagement of stakeholders and end users in software design. Feedback from new deployments is encouraged; these have been very basic requests. (KDH confirmed that their feedback has gone into the new release; they had identified bugs during use and variables that were not being accepted or were omitted). The I-TECH software development team uses Redmine, a tool for project management and bug tracking. Use of Redmine by a broader set of stakeholders has not yet been defined or put into practice, as required for sustainability and transition to MOH.

High staff turnover create inefficiencies which could be minimized through more formal front-end training on KenyaEMR for new I-TECH software development staff. Inefficiencies occur when one person's delay, sometimes due to competing tasks or field visits/impromptu meetings, creates delays in others' production. Changing requirements also means over-processing/re-producing work. One example was that KenyaEMR on-screen data field did not match the fields in paper-based forms. This made retrospective entry difficult for non-clinicians. . The consultant in Rwanda had to visit to help decide what to do. Procuring the concept dictionary in time from yet another consultant was a challenge which needed the Implementation Manager's intervention. Weekly calls were inefficient when no interim actions had taken place or when e-mail communication could suffice; and retrieving discussions and decisions archived in google group and google documents cost time because there was no organizing system. Also, accessing the documents was dependent on having the link, so knowledge management was problematic.

The option of having and then absorbing interns is being considered as a way to build the software development pool in Kenya.

- **Organizational mechanisms to identify and resolve problems**

The ICs are invaluable in facilitating all processes on the ground. Staff turnover has been high, possibly related to workload, untenable hours and environment, and perception of limited tenure as implementations transition to MOH. As such institutional memory particularly on model sites has been lost. The pace of implementation does not allow for proper induction of new staff and the absence of SOPs and guidance means that new processes are created or old mistakes may be repeated. On the positive side, staff has autonomy to make decisions that accommodate differences in the operational context of provinces and within facilities. Team building exercises are incorporated into the quarterly planning and review meetings. The quarterly implementation conventions allow for continuous quality improvement and innovations. However, knowledge management is weak and there is no consistent project/program management/coordination tool that can be used to capture the dynamic nature of the program. As KenyaEMR evolves and implementation transitions to the MOH, professional development and other opportunities to absorb staff should be considered.

As elucidated in the sections above, several TWGs, committees, collaborations, and offices/positions are involved in the identification and resolution of problems from site selection to data use for clinical and managerial decision-making. While these relationships are grounded in transparency and a genuine desire to ensure good quality data to provide the information needed to make critical decisions, the rate of resolution of problems appears to be slow. Reasons for these delays include a) ignoring foresight – many problems were foreseen by various levels of management (for example, lack of technical skills, lack of guidance for data migration) across the different stakeholders – but, no steps appear to have been taken to minimize them; b) rushing implementation – some problems were not anticipated as stakeholders focused on the immediate actions rather than on forward planning (for example, determination of what data should be migrated); c) no formal agreements on roles and functions across stakeholders costing time on consultative meetings, consensus building, formalizing agreements and mobilizing resources; d) competing priorities –implementing partners’ mandate does not include KenyaEMR implementation; and, e) devolution of the MOH structure without corresponding assignments of roles and functions within the HIS. With the devolution, several counties replace a single province in supporting EMR implementation with a corresponding increase in time, effort, collaboration, relationship building, and compensation.

There is a tension created by high variability of organizational roles on a site-by-site and county-by-county basis. Every instance differs to some degree with respect to I-TECH’s role, partners’ roles, and MOH roles. There is also a lack of SOPs. On the one hand, this is strength in that it allows flexibility; on the other hand, it places a heavy burden for all parties to negotiate roles and agreements in identifying and resolving problems. This could challenge the efficiency of scale up and even sustainability.

Technical Factors

The evaluation questions of interest here include those on software development, delivery and efficiencies; availability, stability, and security of the HIS infrastructure; timely delivery and maintenance of hardware and HIS infrastructure; determination on type of KenyaEMR implementation; users perceptions of the technical features of KenyaEMR, critical technical support services; practices helpful for KenyaEMR development, installation and maintenance; And integration of complementary technologies, such as national unique patient identifier (NUPI), and smartcard technology, into a facility-level health information systems.

Most of this information can also be found in the sub-section on organizational factors, particularly, the actions and structures needed for KenyaEMR implementation; below it is presented more in-depth.

- **Availability, stability, and security of the HIS infrastructure**

Availability and stability are affected by bugs in the KenyaEMR system, user errors and power fluctuations/ outage. In Bungoma, some users could not access their accounts. This later self-resolved with no apparent action taken. During the observation on a training day, KenyaEMR defaulted to not allowing privilege to a staff member with access rights. It took several tries before the problem was serendipitously resolved by a facility staff member who spotted that the box that overrode all privileges had been enabled. Once disabled, the staff member was able to save work on KenyaEMR.

As already mentioned power fluctuations/outages, dysfunctional back-up generators, and faulty UPS make the system unstable. Sometimes, the reverse is true, where the UPS provides the coverage needed by the lapse between loss of power and start-up of the generator (for example, in St. Matias Mulumba). Power fluctuations can burn out equipment, for example, switches in Bungoma, necessitating an upgrade to better quality products. Additionally, it would appear that broken cables are a common enough problem such that it is proposed that ICs should be equipped with a networking toolkit.

Security measures and the lack thereof are already mentioned. Certainly, one facility had five computers stolen which they had to replace. Facilities are responsible for all materials/ equipment on-site. The cost of insurance is prohibitive enough that it is likely that the MOH rather replace at cost than cover insurance. Conversely, hospitals have taken care to ensure that grills and anti-theft locks are in place. Sometimes there may be a delay between

setting up the server and providing the external hard drive for backing up data. Some facilities have an automatic daily back-up system that is housed in a separate building. This separation provides additional protection from theft or damage that may occur in the clinic.

Confidentiality of data is protected by having restricted rights of access to the computer, KenyaEMR, various modules and administrative rights. Anti-virus measures are in place though applied variably and with no clear documented plan for upgrades. I-TECH has back-up and recovery procedures for network and server configurations.

- **Delivery and maintenance of quality hardware and HIS infrastructure**

I-TECH uses the site assessment and action plan to procure materials. MOH ability to meet commitments to conduct the site assessments and deliver on agreed procurements is variable. Facilities are investing from their own budgets. However, as explained before, facilities have smaller budgets under the new structure for the NHIF. Some CCCs have actively discussed and decided upon their KenyaEMR related needs and then present it to the facility health management team for budgetary allocation. Funding from the health sector budget is difficult being only 3.5% of the national budget.

The main concern with infrastructure upgrades is physical/environmental security and usually rooms need grills on windows and doors as captured in the June 4 2013 TWG meeting minutes. Sometimes ICs are told that the facility is ready, only to find insufficient security measures in place. They then identify one secure room to set up the server. Without security for the virtual machines, work stations are not set up. Power outages during deployment itself can hamper activities; and, weather conditions may impede deliveries.

The biggest impediment to procurement has been lack of specifications attached to requests; for example, a wall hanging switch may be delivered instead of a rack switch due to a new model release in the market. This has been remedied. The earlier plan to 'buy local' had to be revised due to quality and timeliness issues. Sourcing from Nairobi is both cheaper and more reliable in terms of quality. Equipment and supplies are sourced from contracted vendors on an as-needed basis or in anticipation of upcoming KenyaEMR implementations to reduce lag time between request and delivery. Products are delivered within 48 days to the Nairobi office where operations personnel inspect the goods. The vendors then distribute the goods/supplies into packing boxes labeled specific facilities (without I-TECH oversight, reducing a step in the delivery process). Computers and servers are unpacked and software installed. All equipment and supplies are stored on I-TECH Kenya premises until they are deployed to the facilities or to the Kisumu District Hospital for storage until distribution within Nyanza and Western Provinces. Renovations and the purchase of cabinets to facilitate storage are under discussion. The PHRIO arrange for pick-up and delivery from the Kisumu District Hospital or facilities may receive the delivery without requiring IC presence. In these cases, it is unclear when purchases are engraved. Issues of engraving materials/equipment with ownership information were not verified/explored during this trip. In the West Rift, distances are vast and there are some unsafe territories. Use of MOH vehicles can reduce costs and increase safety; however, these are not always available when needed necessitating alternative and sometimes expensive transport options to make deliveries.

The 21 August 2013 I-TECH Managers' Meeting Minutes document more than a tripling of the cost for servers procured by I-TECH due to a shift to more appropriate hardware with a smarter endpoint security system. Bungoma Health Centre mentioned the need for air-conditioned environment for the server, which the hospital has agreed to buy. Bungoma identified start-up investments as heavy but believed that running and maintenance costs were more manageable. St. Matia Mulumba has experienced otherwise and is realizing that the servicing costs are high. In Bungoma, the CCC works on LAN. When the system is facility-wide to include primary services, other options will be needed. In Bungoma, power fluctuations have burned switches and new more sophisticated switches are needed. Some demands for additional computers were not substantiated by impartial observations or projections. Also last minute changes in facility plans or to the site assessment reports can mean that the wrong products or more of a product (e.g., networking cables) may be needed.

Procurement needs include those for networking and power connections, which preferably should be installed after hours. This requires coordination with the facility. Several items must be purchased to complete a task. For example for networking, the electrical connection must be grounded, wires must be in trunking, cable lines need to be in conduits, data ports need labeling etc. Such efforts require procurement, coordination and monies. There is need for checklists and standard operating procedures (SOPs) to ensure that these tasks are implemented correctly and

completely. Additionally, partners have worked together to develop standards to ensure quality Local Area Network (LAN) installations.

- **Determining type of KenyaEMR implementation (point-of-care/retrospective)**

According to the January 2012 EMR site assessment report, the type of EMR implementation includes 3 choices:

- i. Point-of-care (POC) data capture mode;
- ii. Retrospective data capture mode; and
- iii. Mixed (Both POC and Retrospective data) mode.

The choice is determined by the availability of crucial requirements including:

- i. Desired infrastructure;
- ii. Adequate security, support and maintenance protocols and systems;
- iii. Availability of power supply;
- iv. Trained personnel; and
- v. Accessible managerial support.

The preferred implementation is for POC where data is directly captured in KenyaEMR by the health care provider during a patient visit. The consideration to endorse the POC approach is particularly based upon the availability of uninterruptible power supplies (UPS). This is defined as having power supply for at least 75% of the day with access to back-up power and voltage stabilizer. If downtime is >25% which means >2 hours a day OR >10 hours a week OR >40 hours a month, plans should be made for a power back-up, otherwise it is recommended that such a site should enter the data into the EMR retrospectively, i.e. after the patient visit. This explains the decision for retrospective entry at Nyamira as documented in the November 22 2012, I-TECH EMR Implementation Progress. The reasoning behind starting with retrospective entry at Butere is not clarified in the same report; retrospective entry was recommended at Lodwar while it waited for 8 additional computers. Currently, the strategy is to enter data retrospectively using facility staff and data clerks and then progress to POC based on stage of facility infrastructure upgrade. The first documentation of this strategy appears to be in a June 4 Technical Working Group (TWG) meeting. Family AIDS Care and Education Services (FACES) program has developed and implemented the MOH257 face page that is intended to support retrospective data entry.

In other cases, security concerns determined the decision to implement KenyaEMR for retrospective data capture. The quarterly report for October-December 2012 shows that a decision for retrospective data capture was consciously made for a site without adequate security to host the virtual machines needed for POC data capture. The facility made the enhancements needed, which were minimal, to ensure security of a room where the server was subsequently installed. The expectation was that the facility would continue to put in the security measures needed to allow the placement of virtual machines at all points of care to allow for POC data capture in the near future. Another instance of such a decision is found in the June 4, 2013 Central Province TWG meeting, where recognizing the lengthy approval processes for infrastructure upgrades, the decision was made to begin with retrospective implementation of KenyaEMR. Much earlier in March 2011, during a multi-stakeholder assessment to determine readiness for another software (C-PAD) implementation and interoperability between EMR systems in 26 facilities in Nyanza, staff, at the minimum data clerks, was recognized as a need for retrospective implementations.

The installation of a server allows for the migration of legacy, including demographic, data from paper to KenyaEMR. New and continuing patient data can be entered at POC once their demographic data is available on KenyaEMR. At patient visits, data can be entered on virtual machines placed at every point of care. For POC KenyaEMR implementations, often a hybrid of POC and retrospective entry occurs as described below.

KenyaEMR Retrospective entry only

In facilities not 'implementation ready' by the agreed time, particularly with regards to security, only the server may be installed making it possible to enter legacy data. Facilities may not be implementation ready due to an overestimation of the available infrastructure during site assessments; or an underestimation of the time and resources needed to procure the infrastructure necessary for POC implementation. In the absence of virtual machines, once demographic data has been entered, patient visits can only be documented after the fact as retrospective data.

Hybrid KenyaEMR POC and retrospective entry

In high volume facilities, data migration cannot keep pace with patient visits. For patients with available demographic data on KenyaEMR, POC entry can be practiced. For others, demographic and most recent visit data may be entered after the patient leaves. As acknowledged in a June 4, 2013 TWG meeting, in facilities with a long history of providing HIV care and treatment, patient charts may go back to a time preceding the MOH 257 health information card (blue card). Migrating all the vital data elements from patient charts to KenyaEMR to ensure better HIV care can be time consuming. Ensuring that demographic and essential data are available for these patients may require a combination of POC and retrospective entry both at patient and facility level.

Facilities experiencing power outage and fluctuations temporarily replace POC entry by retrospective entry. Of the 17 sites assessed between July-November 2012, only 1 did not have power supply for at least 75% of the day and almost 90% of the sites had back-up generators. An instance of lack of fuel to power generators was found in the December 2012 report. Only a third of the facilities had voltage stabilizers, with most facilities depending on their UPS to protect computers from power surges. However, one mentor report shows that some UPS may be of poor quality and not fit for purpose. In practice, even a short power outage or fluctuation may mean that health care providers (HCPs), particularly in high volume sites, enter information into patient charts, registers, notebooks during the patient visit and, later retrospectively enter this information into KenyaEMR.

Hybrid POC and paper entry

At the time of the visit, KenyaEMR only accepted demographic and antiretroviral therapy/tuberculosis (ART/TB) history, which in turn, did not include all the fields/options available on the patient card as discussed later. The system did not accept some data. In the absence of modules, data fields, and due to technical bugs, patient data may be entered into paper or other electronic databases. Also, staff was required to note demographic and ART/TB history, along with all other information gathered during a patient visit, on paper forms, registers, diaries, logs and notebooks. This included additional information required by other implementing partners for their own reporting purposes as observed in a site visit report of 6 February 2013. Hence, POC and paper notations occurred simultaneously or sequentially, so that sometimes paper notations were entered into KenyaEMR retrospectively.

- **Users' perceptions of the technical features of KenyaEMR**

Features of the latest KenyaEMR release can be found on page 15 of the October 2012-September 2013 report. Necessary actions include internal testing and field trial of software products to ensure minimum/no errors. Software patches and fixing bugs require both remote and physical access to the server.

Overall, users were pleased with the technical features of KenyaEMR. During observations, trainees said that they found KenyaEMR to be user-friendly, simple and believed that with practice, they will learn. They were confident that they knew where to go for help with KenyaEMR if they needed it. The system was perceived as time-saving because dropdown menus removed the need for note-taking and produced reports with figures appropriately rounded-up at the click of a button. However, the reports are not yet aligned to the DHIS. Users did not mind log-in and other problems because once resolved, the time loss is reduced.

The random generation of the unique number for HIV patients removes duplication of two records for the same patient. This random number is preceded by the Master Health Facility List number (MFL), to provide a unique number for each HIV patient. Also, every patient seen must be recorded allowing for the correct estimation of numbers enrolled and initiated on ART.

Some incorrect or inconsistent information is automatically rejected by the system. Also as it is known who entered the data, errors can be more easily addressed. One mentor reported that users get easily distracted by alerts/warning when they are navigating through the system.

Where other EMR or HMIS exist, interoperability and merging of datasets to reduce duplication is not yet discussed. However, as reported before, some hospitals are successfully migrating EMRs from their current systems to the KenyaEMR system. In such cases, other implementing partner information needs must be accommodated.

- **Technical support services critical to support KenyaEMR use**

The evaluator did not find evidence of clear instructions to facility-level staff on what to do when facing difficulty working with KenyaEMR. Facility staff said they first consult each other because the problem could lie with their practice or the computer rather than the software; then they go to the Champion and then the resident DHRIO; perhaps the PHRIO and finally call the software developer they are most familiar with. They do not use their occurrence book to record the problem. Staff is learning how to solve problems by watching others. Implementing partners also assist with technical problems and have been trained to assist with configuring and troubleshooting systems. The proposed helpdesk will be useful.

The development and implementation of maintenance training including the repair of broken cables is needed.

- **Helpful practices for KenyaEMR development, installation, and maintenance**

Linking with international consultants/communities assists with KenyaEMR development while linking with a clinician helps ensure its relevance to the user. Use of a roadmap/Pivotal Tracker to guide timely releases, testing of products before release and user feedback are useful for KenyaEMR development.

Installing KenyaEMR on the server at the I-TECH office has increased efficiency in deployment. KenyaEMR architecture has been improved to an automatic upgrade framework, a large e-health infrastructure element, which is more robust against power outages and fluctuations during downloads. During installation, anti-virus, internet and other software needs should be noted and addressed. The server administrator needs reference documentation.

During installation, gaps in procurements of essential items such as UPS, monitors and power extension cords have been observed. If the room where the server is to be installed or is to be reached is locked, wait time for the authorized person to open it can be long. This might also be the case when trying to reach the server to update the software. Sometimes the server room is dual purpose, for example as the Medical Officer's office, and cannot be accessed to address problems in the server.

Procurements may arrive at different times from the various vendors due to issues related to availability or delayed payments, which can affect installation.

Using open-source technologies, I-TECH has developed a Performance and Usage Monitoring (PUMP) system to collect, store, transmit, and display system performance and usage statistics from all sites using Kenya EMR. The PUMP system gathers system performance and usage statistics from the server, displays these statistics on a local dashboard and provides alerts for the on-site administrators, transmits those statistics to a central server, and displays these statistics centrally, on a multi-site dashboard. The statistics from the central server can be used to assess real-time system use at each KenyaEMR site. The PUMP will provide system metrics needed to identify additional improvements.

Maintenance was not explored. The only spontaneous mention came from a facility which had a pre-existing HMIS that incurred heavy servicing charges.

Behavioral Factors

The evaluation questions of interest here include those on KenyaEMR adoption and use; staffing roles and responsibilities; factors affecting KenyaEMR use; and the role of training in promoting KenyaEMR adoption and use.

- **KenyaEMR adoption**

In general, users have been able to apply knowledge and skill learned under training and mentorship. Initial reactions to KenyaEMR ranged from resistance to excitement. Immediate use increased fears and anxieties with system errors/problems. Common difficulties include using keyboard, mouse and navigation through the computer. In the first three months, the PHRIOs reported receiving many calls for help. The PHRIOs thought there should be a

help option to provide guidance when needed rather than having a phone call be the first option. With use, staff sees possibilities and are anticipating they will see the fruits of using an EMR system. Staff is very motivated to learn, with some coming in on Saturdays to practice as reported at Bungoma Clinic. They appreciate that they are learning to use the computer. Mentors' and ICs' reports bear out the enthusiasm and positive attitude of most new users of KenyaEMR. An IC report documented that facility staff was very determined, eager and interested to learn KenyaEMR, foregoing breaks and coming in early to practice on the system.

Mentor and IC reports bear out the confidence users have during practice even if they forget steps. Trainees ask questions and seek clarification on steps in KenyaEMR use. Observations also showed that senior personnel who had low computer literacy was determined to practice even when in full view of their junior staff in order to master KenyaEMR. During mentoring, mentors have to help mentees work through users' fatigue.

Users find KenyaEMR helpful for finding patients in the system by name even if they do not present with their patient card (it is not clear how they confirm whether the person is indeed the 'Njeri' who is in the system). HCPs report that patients also like that they are not card dependent. Users anticipate that KenyaEMR will reduce their work as they do not have to write and fewer files will be mislaid. However, staff worries about power/blackouts and its effect on data entry.

Clinic flow and related change management support KenyaEMR adoption. For example, in Bungoma and St. Matia Mulumba, the clinic flow was changed so that patients can be registered at any work station. In Bungoma, patients could go to just one room and get complete services. To make that possible, the files were moved from the reception to an inner room. This one provider-one room policy has shortened the waiting time for patients. In Kisumu District Hospital, the clinical reception was changed to the data room. In St. Matia Mulumba, they are creating a new building so that the inpatients can have more privacy. This will open up more room for the TB clinic held on Tuesdays and Thursdays (T/Th). Currently, the TB clinic is held at the HIV clinic which does not have a big well ventilated waiting area. The current waiting area will then become a consultation room provided it is equipped with a virtual machine.

- **Staffing roles and responsibilities needed to support KenyaEMR adoption and use**

As already elucidated, the role of the HRIOs at the provincial, county, district and facility level is crucial in facilitating the changes in infrastructure and practice at the facility and individual levels. Their role is in identifying needs, problem-solving, and supporting KenyaEMR adoption and use.

Management teams at the provincial, county, district and facility level have a role to play in resource mobilization, human resource development and strategic planning to support KenyaEMR implementation and use.

Extraordinary duties due to KenyaEMR include the formation of committees to anticipate and prepare for facility-level needs for infrastructure, quality data and useful information. The committee needs to liaise with the health management team to ensure that KenyaEMR implementation is integrated with other EMRs and planned activities in the facility.

Individual and public health system level roles and responsibilities need to be assigned for policy-making and development of SOPs around ICT and data handling, management and quality assurance; software development, installation and maintenance; hardware and other infrastructure procurement, placement and maintenance; training and mentoring on new/improvement functionalities as well as for new/temporary staff; data quality assurance; continuous quality improvement; data use for clinical and managerial decision-making; and for championing the use and improvement of KenyaEMR. Decision-making authority and access to resources need to be clarified at the various levels of the public health care system.

- **Factors affecting on-going KenyaEMR use**

Implementing partner and MOH support is crucial for resource mobilization, problem solving and providing the momentum needed for KenyaEMR adoption. End-user training creates awareness and familiarity with KenyaEMR; however, practice is necessary to use the system competently. A report on the KenyaEMR installation in three health

facilities in the Western Province showed end user eagerness, application of training received, and application of mentoring skills. Facility-level mentoring reports show that capacity gaps in navigating through KenyaEMR are systematically identified and addressed. There will need to be a system of ensuring that the mentors are themselves competent. P/C/D/HRIOs also provide support by aligning with leadership, bringing knowledge on M&E and reporting requirements, and sometimes coming with IT skills. The facility-in-charge is another source of support, particularly in ensuring the presence of necessary infrastructure, social support and wider facility engagement for successful KenyaEMR use.

Table 7 in **Appendix 1** offers a model for supporting end users based on the processes described above.

Understanding health needs/patient demands in the catchment area and a dynamic/learning work culture can make a site attractive for KenyaEMR implementation and increases the likelihood that the user will try new behaviors. The 26 August 2013 trainers FGD raises concern about the lack of appreciation for data and its application at the clinic, facility and public health levels. Patient load, workflow, availability of equipment and technology help determine how to set up a site for KenyaEMR and allow the user to try new behaviors. Having the necessary infrastructure, strategic plan, supportive policy and leadership provide the structures needed to support the practice of new behaviors. Selecting the right people for training, having prior experience with IT/EMR, incentives, intrinsic/professional interest, confidence that one has acquired the skill, problem identification and resolution, and critical self-reflection (mentee-state) can favorably predispose end-users to KenyaEMR. Continued learning, training, observations, and social interactions can create supportive grounds for increased access to relevant content, collaborations, consensus, changes in environment, team approaches and reward systems which reinforce and validate the new practice.

The ratio of mentors to mentee is quite high with three mentors mentoring six mentees at a time. Mentoring support is important in the beginning to help start up the system, troubleshoot and train others. With time, individuals need less mentoring; however, KenyaEMR naïve staff will continue to need introduction, familiarization, practice and mentoring support. Mentors note mentee progress and technical problems in mentoring reports. As mentioned before, the frequency and format of these reports seem to be variable. Also, mentors noted that MOH, implementing partners and I-TECH also check on end users during visits.

At the installation, the Medical Officer and hospital administration can be key in initiating the migration of demographic data and enrolment of new patients at POC onto KenyaEMR. As previously discussed, data migration can effect KenyaEMR use. On average, demographic data from 40 files and clinical data from 15-20 files can be entered in a day. Data migration is quicker with improved user-experience, identification of a champion, and fees provided for data entry including to staff who do not directly work in the CCC. The facility-in-charge has to determine the nature and amount of the fee to avoid misunderstandings between staff, particularly if data clerks were not given a fee while HCP were for performing over and above their duties. There are no standard fees set across provinces or facilities. Data clerks may need to be retained or temporarily hired in high volume facilities or those that have a long history of providing HIV care and treatment. Policies, procedures and strategies are needed to facilitate quick and quality data migration.

Low computer literacy, networking problems and slow performance of KenyaEMR can cause intermittent rather than consistent use of KenyaEMR. Mentors are able to spot bugs and system logical errors, but report that end-users are not always able to do so.

Facilities can communicate problems to the Champion Mentor. If the Champion Mentor cannot resolve the problem, they may involve PHRIOs or ICs, who can log issues into the *Redmine* issues tracking system to alert the software developers. The mentoring reports reviewed showed some documentation of the types of software and other problems encountered. However the structure of the report and the level of details varies; this probably means that the recipient needs to be vigilant, clarify notations and inform the software developers of the identified problems.

There may still be need for further training and facility-level attention on data validity and quality.

- **Revision of training model (content, format, mode of training)**

There have been changes in training content, format, model over time, to reach more and different types of users and to achieve greater efficiency in capacity-building. These include:

- i. Reducing length of training workshops from a curriculum for 5 days to one for 3 days, starting in early 2013;
- ii. Switching from off-site workshops to onsite workshops, starting around August 2013;
- iii. Change in the pool of trainers from full-time trainers from 3rd party institutions to local experts as part-time trainers, starting around August 2013;
- iv. Transition of Champion Mentor role to one or more on-site staff who demonstrate competency during initial user training, and who receive an additional 1-2 days of mentor training.

The new model addresses some of the problems related to newly trained end users who transfer or rotate out of HIV clinic, leaving the CCC devoid of KenyaEMR trained personnel. Training at the facility creates a larger pool of trained persons who can support each other.

Individuals are at various levels of motivation and skill when it comes to use of ICT. Having background information on the trainee mix can help trainers tailor the training to ensure that the different levels of need are met. The training comes with pre-set objectives that may not be met depending on the motivation and skill mix among participants. Trainees with high competency can help with training and be champions to support others during and after the training. In the trainers FGD held 26 August 2013, trainers stressed the need to convey the importance of data to end users to motivate KenyaEMR use for decision-making. The process should be facilitated through practical exercises on the KenyaEMR. Trainers need access to more examples or scenarios to bring the message home to trainees.

In general, the trainers believed that the reduction in days from 5 to 3 was not detrimental and refocused the training to practical experience with KenyaEMR giving users more contact time with the system. Nonetheless, all aspects of the previous training were important and had a logical sequence and flow, which now was being compressed into a 3-day agenda. All forms of training are important – lecture, handouts, demonstration, role-play and practical experience on the system; however, the sequencing is important to keep trainee attention and to ensure that different learning styles are stimulated. Trainees appear to enjoy role play the most. Trainers feel that more self-reflection and trainee feedback can improve their performance. Sharing stories about challenges in the field can help trainers prepare each other for the realities of facility-based training.

In-facility training consists of a day of didactic training where KenyaEMR is introduced: its technical features, data quality and classification, data use; days two to four are for practice (staff is rotated through the training so that patient care is uninterrupted); on day five, the trainees demonstrate learning either individually or as a group.

I-TECH is considering a blended learning approach to gain efficiencies during scale-up. Blended learning allows mature learners to self-pace their progress. Prior experience with e-learning shows that availability of the learning platform, IT support, connectivity, electricity and low computer literacy could be challenging. Similarly issues around infrastructure for the design, hosting and assessment of modules; learners' self and external assessment; and, HCP workload need consideration. Trainers thought podcasts or videos would be effective as it reaches those who learn better by listening than reading. Some form of assessment to progress to the next milestone and reward system such as a certificate are needed to keep HCP motivated to self-learn KenyaEMR.

Trainers perceived the new training strategy as difficult because it required them to work alone and have expertise in areas previously covered by a team member, for instance, on system maintenance when they do not come from an ICT background. The strength of diversity of the trainers is best captured by working in teams. Also, at facilities, trainers found themselves assembling computers and encountering problems, such as loss of connectivity, which detracted from their main purpose of being there, which was training. They would prefer to be paired with a technical person well versed in KenyaEMR. Some areas, for instance in the North Rift, are not easily accessible due to distance, climatic, and safety issues; communication, transport and accommodation may also be a problem. This makes facility-based training challenging in some cases.

Trainer reports and observations on the August visit bear out that sometimes, KenyaEMR is not yet installed or there is access only to the demonstration site or server because the virtual machines are not installed or networked. This creates a time lag between training and practice that may leave gaps in knowledge and skills. In such cases, where available, trainers use LCDs to project KenyaEMR to all trainees. Sometimes the system crashes during the training and there may not be IT support to address the matter quickly. In sites with a long history of HIV care and treatment,

demonstration and practice of retrospective data entry can be difficult due to the quantity of data. Conversely, these experiences prepare the end users for the reality of working with KenyaEMR.

4.2 KenyaEMR Process and Outputs

Processes in the PRISM Model refer to actions that end users perform on an EMR system (see **Figure 1 in Appendix 1**). For KenyaEMR, these processes are related to data collection, report generation, and data quality feedback.

The main output of interest in the PRISM Model is that related to the quality of the data including data completeness, consistency and accuracy.

Use and Performance of KenyaEMR to Support Clinical and Programmatic Decision-Making

This section examines how KenyaEMR performance and its use lend themselves to clinical and programmatic decision-making. The evaluation questions of interest include those on KenyaEMR features and use for data retrieval, collection, documentation and reporting; data quality in patient medical records and aggregate facility reports; and, use and impact of information collected on KenyaEMR.

- **KenyaEMR use for data retrieval, collection, program documentation and reporting**

KenyaEMR is very efficient for data retrieval as just the patient name is enough to help locate the patient's medical records.

Sometimes the KenyaEMR system is slow. Still users prefer using the electronic system; though some HCPs noted that they still have to enter data on paper and other electronic systems to meet MOH, facility and implementing partner needs. So in effect, their work is not reduced.

There is no apparent order of appearance of medication in dropdown menus such that time can be spent trying to find the correct response.

After registration, when the patient sees the HCP, vital signs are entered. For this, the HCP identifies the patient by name only. At least at the mock demonstration, there appeared to be no inbuilt prompts to verify if the patient is indeed the correct one (e.g., confirmation of birthdate, address). HCP appear to copy vital signs in the area for complaints and history taking rather than repeating measurements. Whether this is in fact reflective of practice should be examined; it may have been done expeditiously for the demonstration. In reality, it may be that the triage nurse takes the first measurements and then the consulting HCP repeats it on the page that captures complaints and history taking. This would be good practice. However, if in practice the second entry is simply a copy of the first, then both documentation and clinical practice need to be tested against national guidelines.

At the time of the visit, KenyaEMR was not able to generate reports needed by the DHIS. However, data in the system can be summed and aggregated. Kisumu District Hospital in particular looks out for missing data in order to understand why information is missed and identify where intervention is needed. Some reports may be incorrect, possibly due to a field error. One facility noted that when generating a report on those never on cotrimoxazole, it is the count of those who are on cotrimoxazole that is reported.

- **Features of KenyaEMR related to data retrieval, collection, program documentation and reporting**

KenyaEMR provides alerts and has internal validation that rejects incorrect information.

- **KenyaEMR data quality at patient and aggregate levels**

Facilities that have data quality assurance procedures, such as the Kisumu District Hospital, report that 60-70% of KenyaEMR data is of good quality. This data quality assurance system may be worth sharing across facilities.

Data may be inaccurate due to recording/HCP bias, transcription error and errors in selecting or collecting data from respondents. KenyaEMR provides alerts and has internal validation features that reject incorrect information. During retrospective data entry, a recording error may be found; for instance, a patient had been identified as a referral from the TB clinic (as per clinic ID#). However, instead of being recorded as being at Stage 3 or 4, the patient had been recorded as being at Stage 1 for HIV. Some Guidance and SOPs to address such recording errors during data migration is needed. How should the HCP or data determine whether the error was clinic ID# or the staging? How should any changes be documented (which source documents/legibility/ audit trail)? An example of processes and documentation to keep an audit trail of what was wrong in the data record and how it was corrected, by whom, and when can be found at the Kisumu District Hospital. Other facilities report checking information with the HCP, patient, daily register and hard copies including the patient book and appointment diary before changing records.

Also, during retrospective data entry, transcription error can occur; for instance, the number '4' can be read and entered as the number '11' for the month of enrollment for a patient enrolled in April. There are currently few inbuilt consistency checks for retrospective data. The rationale for having few inbuilt consistency checks is that data clerks should be entering the data as it appears in paper form. This would mean that data quality would be equivalent to pre-KenyaEMR period. However, in this case, the inaccuracy may have been introduced during data migration. Where data clerks or community health workers enter legacy data, they may not be able to identify inconsistencies in documented clinical information. For this reason, HCPs double-check the entered data. The implementing partner, APHIAplus is experimenting with complete data abstraction before data entry to ensure quality data while waiting for a decision to build validity checks for retrospective data entry. There is no guidance on data cleaning and validation during data migration. Data audit trails for reconstructed or corrected data as well as related procedures can standardize practice and ensure better quality data.

The data in KenyaEMR is not yet complete as data migration is still ongoing. Not all eligible persons or modules are entered into the data base. NASCOP guidance on what data to migrate is needed. Since migration is being done section by section, only a portion of the list is done. In high volume sites, the number of visits migrated into electronic records may be limited to the last two visits or critical indicators. Having a clear protocol or standard procedures can increase efficiencies and produce better quality data. Actions include those such as prioritizing active files, entering data just in time for next patient visit or at the visit itself, clarifying the essential data elements and the boundaries of migration of legacy data, using non-clinic days for data migration and retrospective data entry, and tracing patients. St. Matia Mulumba is an example of such good practice, where the facility set the target numbers of patient charts to be entered in consultation with the appointment diary to ensure POC entry at the patient visit. Currently, demographic data and every visit with a CD4 count over the six years of service provision is entered. The remaining visits (non-CD4) will be entered post-October 2013. This strategy is because the data goes back to October 2006.

Missing data entry fields (such as those to record client eligibility for ART) or having constrained options for responses (such as response options related to due dates for CD4 testing and samples taken) meant that the dataset was incomplete. The drug combinations and pediatric formulation options are not as per national guideline and do not have the option to 'specify other.' In other cases, some medications, such as hydrocortisone cream, do not appear in the dropdown list; or the female condom does not feature in the list of family planning options. In the TB section, non-TB medication cannot be added; so this history is lost when seen by someone else at the next visit. Also, Isoniazid Prevention Therapy (IPT) cannot be recorded in KenyaEMR. The pharmacy and laboratory modules are not yet available in KenyaEMR. Patient information on voluntary medical male circumcision, prevention of mother to child transmission of HIV, and in-patient care are not linked to KenyaEMR. For retrospective data entry, occupation and education level cannot be entered into the database. The DHRIO in the Kisumu District Hospital uses a retrospective entry form to check for completeness of data collected at POC. In consultation with HCPs, reasons for missing information are identified and addressed to reduce repeated failure to collect all the required data.

Missing information due to data migration or lack of data fields along with patient flow and electricity-related problems can mean that data are not current and reporting may be delayed. When patients visit several stations, particularly laboratory or pharmacy, the HCP may be too busy to update or close the encounter upon the patient's return. Similarly, when POC is not possible due to electricity, system errors or maintenance issues, then retrospective data entry may be delayed. Hence, the data may not be up-to-date.

Data in KenyaEMR may not be reliable as they are not collected in the same way across facilities. In the absence of indicator definitions on the screen, similar data elements can be confused, for instance the Patient Clinic Number (the number of the referring clinic) with the Unique HIV Patient Number (MFL code + randomly generated unique number). Some facilities have indicators that meet partner and not MOH definitions.

Some indicators lack precision – for example, marital status could be entered as 'single' or 'never married' or a partner cannot be listed as a family member for tracing purposes.

The integrity of KenyaEMR may be compromised in some facilities. Users have found ways to manipulate the system such that they can override system errors. For example, in facilities where KenyaEMR will not accept the 11-digit Unique HIV Patient Number, they may drop the first digit – a zero – and continue with data entry. The time stamp does not appear automatically and staff may be forced to exaggerate the time between module entries to gain entry to the next module. Administrators, when away from the facility, may share their administrative rights with staff so that they can resolve problems with logging into the system. Sometimes staff enter others' users accounts to access patient files.

The role and continuation of HIVQUAL or HealthQUAL in Kenya should be explored as this project measures quality of data and patient care. If HIVQUAL/HealthQUAL assessments are already conducted consistently or it is planned to collect this information periodically, they will offer measures of change in data quality and patient care for sites which use KenyaEMR.

- **KenyaEMR data use for clinical and managerial decision-making**

The system provides checks and balances by providing complete patient history which can make clinical decision-making better. This includes trends in weight, CD4 counts, Highly Active ART, and missed appointments. Prompts for CD4 tests are useful. Kisumu District Hospital uses patient history and trend analyses on alerts to identify patients who are possibly on failing regimens. They intend to enter all the legacy data to be able to analyze patient trends and do a two to three years review. Similarly, prompts should appear for drugs that must be administered within a specific period.

The data allows staff to make and track patient appointments in order to trace those who have missed scheduled appointments. Until all data are retrospectively entered, the true Loss to Follow Up cannot be known. Once entered, patients considered "lost", would be traced, and if found to be dead or transferred out, they are discontinued from the HIV care and treatment program at that facility.

Facilities use data for clinical but not managerial decision-making. Kisumu District Hospital said that they use the data to identify service gaps, but this was not further explored during the visit.

- **Changes in data quality and clinical performance**

Benefits already noted at the implementation level are that data are more accurate due to inbuilt validation checks, leading to a more appropriate representation of patient conditions, for example, their age and treatment regimens. Reports generated reduce the burden of calculations and measurements on HCPs. Patient can be seen even without their patient cards and the waiting times have reduced.

4.3 Transitioning KenyaEMR implementation

Eventually KenyaEMR implementation must be transitioned to the MOH. *The Health Sector ICT Standards and Guidelines* of June 2013 provide the policy structure needed for software development, installation, deployment, maintenance, end user training and data security.

I-TECH's presentation prior to the release of its semi-annual report for 2013 shows that the MOH and implementing partners are collaborating to build the national infrastructure needed for EMR implementations. Concurrent evaluations of EMRs in Kenya along with on the job training for an estimated 3000 health workers, health managers, DHRIO and other MOH staff on EMRs, as well as internship programs for software developers and EMR trainers are expected to sustain systems beyond USG funding.

- **Ongoing technical assistance needs to support MOH's KenyaEMR implementation**

All the processes for KenyaEMR implementation need to be supported by policy documents as well as SOPs. Both policy and procedure documents will need to be 'living' and responsive to the fast changing world of technology and HIV epidemiology, care and treatment.

KenyaEMR in particular could be supported by a national community of users emulating the 9-years old international OpenMRS community drawn from 40 countries to get forum based assistance. With the founders of both OpenMRS and KenyaEMR being Kenya-based, software development, modifications, and stepwise improvements to KenyaEMR functionality will be possible through these international and national communities. In particular, functionalities related to patient monitoring and clinical decision-making support need to be refined.

The MOH will need to contract with an organization or build a unit to provide the software needed to meet emerging needs for patient care and information as well as to improve KenyaEMR functionality. Necessary actions include internal testing and field trial of the product to ensure minimum/no errors. The PUMP system will provide system metrics needed to identify additional improvements. There is need for a mechanism that facilities can use to report problems and emerging needs to a central point (whether national, provincial, or county level will need to be determined). In turn, a mechanism is needed for deploying upgrades and new software from the center to the health care facilities.

Site selection processes will need to be formalized to ensure appropriate strategies and prioritization based on patient load and site readiness. Current area of focus are the HIV and TB clinics with a spread into maternal and child health clinics. Over time other modules will need to be built into KenyaEMR and corresponding departments/clinics prepared to implement and use the new modules. Site assessments forms may need to be modified to capture data essential for planning and procurements; for instance, information regarding presence of implementing partners.

Guidance on minimum and essential datasets will be needed to ensure that patient history is captured while being efficient during data migration and reconstruction. The datasets should be able to generate standard reports on the key indicators identified for the HIV, TB and maternal and child health programs in the near future; and, for other modules as they are developed and put into use.

- **Determining readiness to transition of KenyaEMR implementation**

There is no formal process for determining readiness to transition to different entities. Transitions that have occurred-- such as the transition of site assessments and of delivery of training sessions to the MOH and implementing partners--are in response to needs that require more material and human resources than are at I-TECH's disposal.

- **Elements of KenyaEMR implementation that have transitioned**

Site assessments have transitioned to the MOH/partners. This has been largely possible due to:

- i. Initial involvement of the PHRIO who has acquired familiarity with the process and built interviewing skills over time;
- ii. Sensitization process the day before the site assessment where the facility management typically gain a more favorable attitude toward KenyaEMR implementation;
- iii. Participation of a networking expert who can specify what networking infrastructure is needed;
- iv. Use of a simplified, electronic tool (unavailable on FormHub at the time of the visit);
- v. Immediate report-writing which is signed as a true record by the team and the facility; and
- vi. Inclusion of an action plan based on identified gaps.

Post-installation technical assistance is in process of being transitioned to implementing partners, perhaps with shared responsibility with I-TECH, who are being trained on OpenMRS and basic troubleshooting. Implementing partners are invaluable for IT support being more immediately on hand to address problems.

The location and responsibility for delivering training is in process of being transitioned to facilities to minimize the number of people who are pulled away from their sites for participation in multi-day training workshops and to increase the available pool of experts who can support new system users from within the facility or from another in close vicinity. On-site Champion Mentors will be trained and expected to conduct cascade-level on-site training to other EMR users at their facility. Champion Mentors can draw on provincial teams comprised of MOH, implementing partners, and I-TECH ICs for assistance.

- **Identifying and addressing problems arising post-transition in KenyaEMR implementation**

Problems appear to be identified and addressed through Provincial TWGs, facility-based EMR committees, and implementing partners' (including I-TECH's) management and implementation teams. Visits by the PHRIO and the presence of onsite DHRIO and HRIOs will also help identify problems in transitioned elements of KenyaEMR implementation. It is expected that the Champion Mentor and supportive supervision and mentoring teams will be able to identify problems with KenyaEMR performance, data quality and use.

- **Results of transition of each of the various elements to the MOH in the 4 provinces (pace, changes in internal operations, staffing, and resource allocation)**

Initially, the results of transitioning site assessments were mixed with some overstatements of facility-level infrastructure. The MOH, implementing partners and facilities have taken accountability for the information collected and have been assured that capacity gaps are not a deterring factor, rather their identification furthers capacity building and infrastructure upgrades at facilities. The I-TECH Oct-Dec 2012 progress report shows that two sites were identified for re-assessment in two months within which time, major security and electricity concerns should have been addressed. The pace of the transition of site assessments has varied by region due to differences in relationships and available resources. The lack of access to the electronic site assessment tool (since resolved) appears to have somewhat impeded the transitioning process. The transition of site assessments has not changed internal operations for the MOH because the PHRIO accompanied the site assessment team anyway. In some regions, the MOH vehicle is used by the team as transport for site assessments. The transition of site assessments has positively impacted I-TECH Kenya by freeing the ICs from participation in all site assessments. It has increased the burden on implementing partners who now send their own staff, possibly in their own vehicles to be part of the assessment team and of the action plan/solution to fill existing gaps. The transition of site assessments has increased involvement of facility staff, who have to be part of the assessment and action planning. However, the time and effort spent here, saves time during the infrastructure upgrade and deployment.

I-TECH's annual report covering the period between October 2012 and September 2013 highlights the leading role of the MOH and implementing in the EMR readiness assessments following identification of the sites. Reportedly, the EMR readiness assessments have improved over time with assessors gaining experience and competencies. MOH and implementing partner involvement has greatly increased the number of sites assessed and allowed a swift pace for KenyaEMR implementation. For instance, from October 2012 to September 2013, 200 sites were assessed in the four provinces.

Site selection processes have also greatly improved with greater adherence to the guiding criteria including the (i) availability of HIV care and treatment services in a facility, (ii) high volume of patients (≥ 500 patients actively receiving care), and (iii) absence of any of the EMR systems recommended for implementation in Kenya. These assessments resulted in the decision to implement in all but 17 health care facilities (one in Western, two in Central, and 14 in Nyanza Province) based on the availability of electricity and adequate security measures. The findings are used to prioritize sites needing the least amount of interventions for implementation. KenyaEMR is not implemented at sites with existing plans to adopt an EMR system with another partner.

Dissemination meetings immediately following the assessment lead to mutual agreements on the validity of the findings as well as on the upgrade plans. These discussions lead to the buy-in from the management and leadership structures to support EMR implementation work. A little more than half of the sites identified as implementation ready are using KenyaEMR.

Post-installation technical assistance is in process of being transitioned to implementing partners with mixed results because:

1. Partners are variably engaged depending on their own priorities, mandate and available resources.
2. The curriculum to train MOH staff on OpenMRS and the KenyaEMR software is not yet ready.
3. Though open-source, I-TECH will still need to be involved to resolve some technical issues.

We will need to learn from implementing partners how assuming responsibility for post-installation technical assistance impacts on their internal operations, staffing, and resource allocation. For I-TECH, ICs had to learn basic configuration and about KenyaEMR to be able to address basic problems. Having support from implementing partners is expected to release their time to continue with the implementation process (which was expected to be between 100-150 facilities by 20 September 2013). It also removes the need to visit sites where there are already implementing partners – this is a bonus because sometimes, it is not a software problem at all – it has to do with the user not being computer literate.

The effectiveness of the new model for **training** that combines facility based and blended learning techniques needs to be monitored and evaluated. We will need to learn from facilities how assuming this responsibility impacts on their internal operations, staffing, and resource allocation. For I-TECH, this strategy will remove the logistical duties of the training team and leave them free to do monitoring visits and coordinate with the trainers to provide on-site training/training for Champions and Mentors. If the identification of additionally needed training and its coordination occurs through implementing partners, they may not be able to meet the costs of trainers and accompanying/visiting PHRIOs.

- **Best practices and lessons learned related to transition of KenyaEMR implementation**

This was not explored because different aspects that are transitioned/are in process of transitioning are not uniformly recognized at the country office. It would appear that the **promise of sustainability** lies with the healthcare workers who are motivated to use KenyaEMR. The system may be demand driven. Simultaneously, the software industry in Kenya is growing and vibrant, with many moving into the health records arena. So access to technical capacity will improve. Similarly, the move to build training capacity will help the continuation of capacity building in EMR use.

5.0 DISCUSSION

The *Kenya EMR Standards and Guidelines* document contains the guidance on best practices for KenyaEMR implementation. This section compares I-TECH's KenyaEMR implementation against these best practice guidelines. It draws on the document reviews as well as on the analysis of interview and field notes to identify challenges in implementing best practices and lessons learned through the life cycle of the project for each of the requisite steps (See **Table 8** in **Appendix 1**).

Implementation Planning

1. A comprehensive implementation and management plan covering all phases of EMR implementation shall be developed in conjunction with all relevant stakeholders.
2. EMR implementers shall identify a team at the facility-level, representing all EMR stakeholders, to guide the implementation process.
3. A phased approach to EMR rollout will be adopted to minimize service interruptions.
4. The implementation team should plan for a post-implementation review within two weeks of EMR rollout.

The biggest strength of I-TECH's implementation is its partnerships that make for effective implementation. I-TECH Kenya fosters partnerships and prides itself on being completely open and transparent including on budgets and allowable costs. Structures are in place at the international, national, provincial, facility, and implementing partners' level. These are also used to identify and resolve problems. However, a full implementation plan that outlines the whole process has not been possible to develop due to time and resource constraints as well as changing partnerships. Staff attrition, rotation, and transfers within MOH, implementing partner organizations and I-TECH necessitates continuous coordination and relationship building.

The PHRIOs are invaluable in conveying the MOH directive to switch to EMRs at facilities, in leading site assessments, arranging for storage and transport of procured goods and services, monitoring end-user skills, and troubleshooting technical and user problems. There is no EMR specific transportation for the PHRIO, which may impact their availability. The PHRIO access the Province's vehicle when available and I-TECH reimburses the cost of fuel and the drivers' per diem. The devolution of MOH structures has made collaboration more complex. Each province has several counties, which are charged with performing duties previously performed at the provincial level. This increases the level of coordination and number of meetings needed between the MOH structures and other implementing partners. While counties may be more responsive and attuned to local needs, their funding structure and budgets are unclear. Provinces also share resources, for example transport; counties' access to such resources and the geographical boundaries for their use are unclear. This may impact transport arrangements and related costs for I-TECH.

As far as is practicable, working with teams rather than individuals in MOH and within implementing partner organizations will help maintain continuity. Partnership processes can be slow or stall if the right persons with decision-making authority are not identified early.

Some facilities have EMR Committees and the rest are being encouraged to form one. Provisions have been made to support such committees and related administrative costs, which will eventually have to be borne by facilities. Where there were EMR committees, members were also part of the Multi-Disciplinary team (MDT) which allowed facility-level decision-making around KenyaEMR implementation and use. The Kisumu District Hospital has a

complete file for the EMR Committee and its members, has a workplan, and has meeting minutes. The Committee discusses challenges and as three members are KenyaEMR mentors, they can usually address these.

The EMR rollout has been phased in modules which match service delivery areas. At the time of this process evaluation, only HIV and TB modules were in use. Maternal and Child Health was intended to be introduced soon, and other modules will be defined and introduced over time. Specific change planning and management processes, including training, are needed with penetration of the EMR into each new service area.

Through this phased approach of module development, the needs for specialists in OpenMRS generally, in the KenyaEMR specific customizations, and in clinical and business processes have been identified. This identification has led to the idea of emulating the international online OpenMRS community specific to KenyaEMR for technical and other support. Simultaneously, partnerships have been built with universities to provide students with intensive exposure to and use of OpenMRS/ KenyaEMR and software development. Internships may be offered with promising interns absorbed into further software development and KenyaEMR implementation. As new modules are released, the cost of data migration may be an impediment to full integration of new and historical patient data.

Reviews, extending into the post-implementation period, are conducted at facility, provincial, TWG and I-TECH levels every quarter. Minutes show that the meeting members are transparent and discussions center on the identification and follow-up of action items to keep the pace of implementation.

- **Preparatory Phase**

Though budgetary and specification issues are addressed early in order to negotiate vendor agreements, the context and needs of each facility is unique making forecasting and planning difficult. Also prices fluctuate or specifications are modified based on experience (for instance, types of servers and switches) which can require reallocation of funds and further resource mobilization. Nonetheless, planning and coordination can ensure timely disbursement of funds, adequate administrative support and the presence of key persons at planned activities. Holidays, campaigns, grants negotiations are examples of delays that can be foreseen and built into the work plan. Implementation can be slow due to scheduling conflicts, lack of transportation, inclement climate, inaccessible/remote areas, and security issues. A shared activities calendar and working closely with the MOH in insecure areas as well as having contingency plans including for transport can keep the pace of implementation.

Governance structures, i.e. EMR committees have to be introduced and supported at facility level. The PHRIO in all four provinces has been invaluable in furthering KenyaEMR implementation. However, with the devolution of responsibilities to the County level, lines of communication, accountability and partnerships need clarification. Also, County staff new to KenyaEMR will need to learn and emulate the role played by PHRIO thus far. Strategies to increase facility-level ownership include engaging with leadership, working with Champions, and supporting EMR committees. Feedback and dissemination occurs at quarterly meetings.

- **Implementation Phase**

During this phase processes for hardware and software installation, usability/user acceptance and competency testing should be specified in SOPs. The processes for hardware and software installation have evolved over time and any existing SOPs will need to be updated. User acceptance is currently being tested. Competency tests occur pre and post-training and periodically by mentors.

Currently partnerships are being built to develop a functional and accessible local concept dictionary management structure as well as to meet technical assistance needs at installation and during use.

Champion mentors will be trained on technical issues, but will need links to technical support. A help desk should meet some of the technical support needs of users. Implementing partners are willing to learn and provide technical support for KenyaEMR implementations. Kisumu District Hospital has a system of recording, reporting and addressing bugs in KenyaEMR that can be emulated across facilities. Implementing a help desk model suitable for the large scale of implementation and for eventual transition to MOH leadership will be challenging, and this model has not yet been defined.

- **Transition**

The transition to KenyaEMR at the facility level has been ad hoc and organic to facilities in the absence of guidance for data migration, reconstruction and management.

- **Post-implementation Review**

Regular TWG meetings representing all stakeholders continuously review progress and areas for improvement. Quarterly meetings at the provincial, facility and at I-TECH Kenya offices also lead to improvements in future implementations. These are captured as lessons learned and best practices in **Table 8** in **Appendix 1**.

Implementation Guidance

EMR system developers must provide guidance on the minimum hardware requirements for the optimal operation of their systems.

Minimum specifications for hardware have been provided. However, the hardware requirements have changed with changing needs and new technologies. Improvements include a checklist of accessories and supporting infrastructure that must be assessed. Process analysis to remove unnecessary steps increases efficiencies – for instance, removing the step of packing from I-TECH to the vendor reduces the time between receipt of goods and delivery. Similarly, choosing reputed vendors from Nairobi for technical infrastructure reduces time otherwise lost in delayed procurements, delivery of low quality goods or those that do not meet specifications, and in procuring related technical services (for e.g., in estimating networking needs and the material specifications to meet them per facility). Use of SOPs for procurements and buying in anticipation of need can reduce inefficiencies and delays. Involving the site assessment teams and TWGs/EMR committees can be key to identify and address resource constraints.

1. Servers and workstations must be powered by an Uninterruptable Power Supply (UPS) sufficient to power the system for long enough to ensure safe shutdown, and to prevent corruption of databases.
2. Testing and maintenance of power backup units must be done to ensure their reliability.

As illustrated throughout this report, lack of consistent power supply is one of the most important persistent constraints facing KenyaEMR implementations. Policies, SOPs, and resources are needed to ensure procurement, testing and maintenance of alternate sources of electricity. In the interim, facilities begin data migration on the server and retrospective data entry until conditions to begin POC entry are met. Paper forms remain on the ready so that work can continue during power outages and other downtimes.

The need for surge protection and voltage stabilization is assessed during site assessment as well as during hardware installation. There is no evidence that batteries are tested with sufficient frequency and products regularly serviced/maintained to ensure they are at operational capacity.

Every health facility intending to use an EMR system will first be assessed to determine its level of readiness for implementation.

Site assessments inform level of readiness and remedial actions needed. The selection of sites to be assessed has improved with increased understanding within the MOH of the minimum criteria set by NASCOP (presence of HIV clinic with a patient load ≤ 500 without access to a MOH recommended EMR). Continuous communication, relationship building, and involvement of MOH and implementing partner teams has resulted in several assessment teams that can move independent of I-TECH. This has increased the pace of implementation.

Efficiencies have been achieved in site assessments by working through teams of stakeholders including implementing partners. Understanding location and distances between facilities can reduce travel costs and time. Frontend time in identifying the appropriate respondents at facilities can yield good information. Facilities and assessment teams need to be accountable for the information to ensure a true representation of infrastructure needs to allow for timely remedial actions. Currently, it appears that the presence of supporting policies and procedures and reporting requirements are not assessed at site visits. Networking related information and procurements were initially problematic; this has been resolved by working directly with the supplier. Similarly, delays in procurement have been reduced by using the vendor to pack deliveries per facility.

Facilities and implementers of EMR systems shall ensure that staff are well-trained and possess the competencies relating to their areas of responsibility.

Since both POC and retrospective data entry may be practiced at a site either sequentially or simultaneously, estimating the number of staff to be trained, their role and function, and the corresponding skillsets required of them is challenging. At present, the strategy is to use facility staff irrespective of type of entry so that they can practice on KenyaEMR and bring their clinical knowledge to bear when migrating data. In facilities with one-stop workstations, staff will have to be trained on registration, data entry and data management. Both managers and end-users are trained on KenyaEMR. Implementing partners have also received training in order to better support facilities. They will also be trained on technical issues so as to provide backstopping support. The IT and administrative support training modules are yet to be developed. Experience shows that multi-disciplinary teams – those that understand content, curricula development and adult learning theory are needed to create appropriate trainings. Time should be invested to ensure standardized understanding and clarity on the expected outcomes of joint work. With multi-disciplinary teams, allocating lead roles and key responsibilities to partner organizations can foster ownership. Tertiary institutions providing training in OpenMRS have facilitated intensive training on DHIS and KenyaEMR; they will also be sources of interns who can be absorbed into software development and EMR implementation.

Recognizing the insufficiency of didactic training (even if supplemented by practicals), mentors have been trained to provide user support at the facilities. As the numbers and needs grow, an alternate strategy of facility-based training and blended learning is proposed. Mentors and Champions, chosen for enthusiasm and ease with computer use, can provide facility-level training. They will have access to master trainers at training institutions. Clarity of role and function of the Champion, Mentor, CHRIO and other partners involved in capacity building will help remove duplication and cover gaps. The advantage of in-facility training is the opportunity for practice and ‘teaching moments. Job aids and on the job training by more computer literate peers can increase user skills and confidence. Staff should be encouraged to take computer classes and KenyaEMR naïve staff should receive more attention in the first weeks of use. Access to both the local copy of the system and the remote server can make it easier to demonstrate on KenyaEMR during system user trainings. Clarity of role and function of the Champion, Mentor, CHRIO and other partners involved in capacity building will help remove duplication and cover gaps.

1. Facility management must take a leading role in defining a policy to clarify their direction of, and support for, information security.
2. Health care facilities should have a written information security policy document approved by management and communicated to all relevant personnel.
3. Health facilities shall manage the security of information assets used in the handling of patient related data and information.
4. A secure physical environment shall be provided for computer equipment.
5. Health facilities shall screen personnel to ensure security.

Facility level measures were not verified during this visit. However, the ICT guidelines of June 2013 should guide information security measures. During implementation, I-TECH pays attention to a secure physical environment for implementation. The facility maintains an inventory of assets and is responsible for its security. Data appears to be uniformly backed into an external hard drive; the security measures for it and the data it carries appears to vary between facilities. Ideally, this should be in a building away from the server. Back-up plans and procedures were not verified. Anti-virus systems are in place; however, whether and how frequently they are used and updated was not verified.

1. Every facility or institution using an EMR system will identify its source of support, which may be sourced either internally or externally through a service level agreement.
2. The source of support and how to access it shall be known to the management and to all users within the facility.

In the one facility with a vendor agreement for servicing their computers, the costs shocked management. User manuals, EMR Champions, D/C/PHRIOs and implementing partners provide technical and user support.

1. There shall be a defined process for managing requests for changes and implementation of those changes to the EMR system. This process should be controlled by the health facility management or a group to which the responsibility has been designated.
2. Major changes to EMR systems should be accepted by all stakeholders.

In the software design and development process, there are feedback processes from national to facility level to inform changes needed to the system. It would appear that this feedback is received and prioritized by I-TECH without TWG or other input. A workplan is developed to ensure that requested specifications are met in a timely manner. The repair of bugs and other small fixes do not go through acceptance testing. However, new releases and

fixes needing changes in work flow or additional training have to be tested and accepted by all stakeholders before deployment. Early involvement of partners can assure their informational needs are met and that KenyaEMR pre-implementation, implementation and post-implementation responsibilities are shared.

The upgrade system needs to be automatic for efficiency at large scale and be robust against power fluctuations, reducing the disruption to work. Staff has access to paper forms in the event of downtimes, scheduled or unscheduled.

Supervision shall be integrated across all phases of EMR implementation and use, and included in the implementation and management plan.

The facility management and PHRIOs have provided supervisory support throughout the pre-implementation and post-implementation phases. Involvement in the pre-implementation phase has increased oversight, ownership and the identification and resolution of problems in meeting commitments to prepare the site for KenyaEMR implementation. Supervisors in some instances have also overseen the installation of hardware and software as well as of repairs. This has increased the pace of implementation. D/PHRIOs report high number of requests for support immediately after implementation for a period of three months.

1. All EMR implementations shall have a monitoring and evaluation plan to guide implementation and evaluate successes and failures.
2. The implementation team should identify and document key process milestones that will be used to monitor the EMR installations.
3. Additionally, the team should define key questions and outcome indicators for periodic evaluation of the EMR systems based on the overall objectives and expectations.

M&E plans and their implementation exist for the development of software and for implementation. Post implementation data migration status is monitored. Evaluations have stalled due to conflicting messages on allowable activities to evaluate and improve processes. Outcomes of interest are use of data for clinical and managerial decision-making. While anecdotal evidence exists, facility level document review and observations are needed to verify these accounts. Data monitoring and evaluation tools within the KenyaEMR functionalities and as part of facility level data quality assurance can improve KenyaEMR performance and use.

6.0 CONCLUSIONS AND RECOMMENDATIONS

This visit led to the revised tools captured in **Appendix 2** and provided insights into the implementation of future evaluations (See **Appendix 3**).

After a slow start in 2012, I-TECH Kenya's KenyaEMR implementation has grown exponentially. Early implementations were slow because I-TECH Kenya had to hire staff and build partnerships in order to systematically deliver to the MOH request. Competing priorities for the MOH and training institutions as well as difficulty in finding the right skill mix among I-TECH staff delayed early implementations. Also, delays in completing KenyaEMR development delayed implementation from September 2012 to Dec 2012. The slow start-up allowed the identification of problems in KenyaEMR software product and development process; site assessment processes and tools; procurement and delivery; and inefficiencies in KenyaEMR installation. These problems have been addressed in part through close partnerships and consultation with provincial level players within the MOH and implementing partners. At the national level, partnership with the University of Nairobi (UON) is addressing some of the capacity gaps in software development, technical backstopping, and end user training. In 2013, I-TECH sponsored and trained 20 UON students on KenyaEMR. As these processes have stabilized, transition to MOH, implementing partners and facilities has been possible. These gains should be consolidated in formal agreements and manuals of operation that lay the blueprint for KenyaEMR implementation.

As the number of implementations grew, preparing health managers and end-users through central trainings was impractical. A temporary solution was to have site-based training through master trainers. This strategy is being finessed such that a blended training approach will allow Champions to master KenyaEMR and support end users. Master trainers will be called upon for sites that are struggling or to address particularly problematic areas of KenyaEMR use.

As the processes up to implementation are being established, the need to support KenyaEMR performance and use has become evident. KenyaEMR needs additional functionalities to meet Kenya's health information needs. Facilities need certain entry fields and support, as well as a bug-free environment. Use is dependent on data migration and assurance of quality data. I-TECH proposes working closely with NASCOP to clarify guidance on essential data elements and through implementing partners to assure data quality. KenyaEMR performance will need continued input from I-TECH, which also plans to train MOH and implementing partners to provide technical support.

Specific recommendations follow below.

Organizational support for implementation: While the partnership model has been a great strength of the KenyaEMR project, this is also an area of great vulnerability as scale-up progresses. I-TECH does not have resources to "do it all", partners have other priorities, and long-term sustainability must be considered.

Recommendations:

- Find sustainable approaches for MOH involvement within capacity building and oversight teams, with standardized I-TECH policy for covering MOH incidental and transport costs related to assessments, supervision and committee meetings.
- Integrate EMR committees with existing site-level Multi-Disciplinary Teams, and develop standard I-TECH policy for provision of sitting fees for EMR Committees.
- Consider providing travel per diems and EMR Committee sitting fees during a time-limited number of months, such as two months before installation and six months after.
- Provide standard binders and support materials for EMR committees.
- Establish clear roles and functions for I-TECH and partners, and establish regular meetings with partners.

Software development: While there is much strength to the KenyaEMR, it is still missing important functionality, especially to facilitate data migration and reporting.

Recommendations:

- Ensure there is a data entry interface for both front and back of the MOH 257 health information card (blue card)
- Ensure all MOH standard reports can be generated
- Definitions for data fields (especially from the blue card) are not available on KenyaEM screen and should be added
- Need to ensure procedures for bug and issue reporting are disseminated and partners are engaged in using these procedures to express their on-going needs with respect to the software functionality

Infrastructure assessment and set-up: Some sites implementing KenyaEMR are still struggling with power supply issues despite the assessment and infrastructure set-up process. This hampers their potential to successfully move to POC KenyaEMR use.

Recommendations:

- Need to better understand power supply issues to identify solutions.
- Regularize procurement and inventory management, including documentation. Establish SOPs and reinforce consistent application of the procedures.
- MOH guidance on minimum patient load and other criteria to justify EMR implementation exists but is evolving in its application. I-TECH needs to “lead from behind” on the evolution of the site selection criteria based on successes and challenges in implementations to date.

Implementation procedures: Implementation of KenyaEMR following installation is a highly complex endeavor and can leave sites struggling with data migration, entry, management and use. I-TECH needs to assure responsive technical assistance as well as disseminate and support practices most likely to lead to successful implementation.

Recommendations:

- SOPs are needed for areas of implementation other than software development and deployment, such as for data migration, data cleaning and validation during migration, data cleaning and document change, data back-up, reporting and data collection. These will help ICs and standardize I-TECH’s approaches during scale up.

Data management and data use: There can be a large gap between simply having functional hardware and software, and having a functional system populated with high quality data which are regularly used for decision-making. I-TECH’s technical assistance is critical to bridge this gap.

Recommendations:

- Guidance on data migration (standards, best practices) is needed. In particular, sites need guidance on what data should be migrated for high-volume patient records and on best practices in handling data migration. I-TECH should work with MOH and “lead from behind” on this.
- Adapt and share the data quality assurance protocol from Kisumu District Hospital or MOH and advocate for allocation of staff to permit this type of protocol to be applied in all areas. Include content on the data quality assurance protocol in the Champion Mentor training.
- Establish SOPs for system maintenance and clarify partner roles in applying the procedures.
- Create a performance checklist for measuring and monitoring success in POC EMR use, and integrate this within I-TECH’s “implementation dashboard” (see *On-going monitoring and evaluation* section below) .

Staff capacity and training: With the shift in I-TECH’s training strategy, there are new opportunities and threats.

Recommendations:

- Champions need a way to train users at sites on a demonstration version of the system, rather than on the production version. The existing solution needs to be fully disseminated and made reliable for all Champions.
- Clarification of partner roles in fulfilling the new training strategy is needed. There is a need for SOPs that clearly express purpose, role definition, materials needed, procedures, and deliverables in applying the training strategy.
- Existing M&E tools, especially for mentoring and tracking mentee progress, have been inconsistently used. We need to modify existing tools for efficient yet illuminating M&E of capacity building efforts.

On-going monitoring and evaluation: As I-TECH proceeds with scale-up and adapts implementation approaches, processes and progress must be continually monitored and documented for constant learning and program improvement. Staff turnover can lead to loss of important knowledge of project history, context, and lessons learned.

Recommendations:

- Routine M&E tools and processes by I-TECH need to be revisited to retain “implementation history”.
- Need to ensure that an impartial observer goes to sites where the new training strategy is being applied, even if nothing being done at the site by any trainer/mentor, to identify problems.
- Need to establish indicators for transition-readiness (when KenyaEMR use is considered stable), but also have systems for rapidly identifying and responding to sites that are experiencing new or on-going struggles.
- Need to feed information on patterns, best practices, and lessons learned back to partners and stakeholders to motivate further M&E related data collection and documentation.

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Appendix 1: Figures and Tables

Table 1: I-TECH Kenya and MOH collaboration on Digitalization of Medical Records in Kenya

Deliverables	Apr 2010-Sept 2011	Oct 2011-Sept 2012	Oct 2012-Sept 2013
EMR standards and guidelines	<p>Developed and launched standards and guidelines document</p> <p>Reviewed EMR systems against standards</p>	<p>Disseminated EMR systems review report</p> <p>LIS Transitioned the LIS standards development meetings structure to MoH Task force developed into the initial draft of the LIS standards</p> <p>PHC Preliminary meeting with HIS on PHC standards development</p>	<p>LIS, PHC & PIS Finalized PHC & PIS launch pending</p> <p>Standards website Ready to host all standards documents</p> <p>OpenLIS/BLIS Processes for customization initiated</p>
Capacity building	<p>Developed high level manager's capacity building curriculum with the MOH (NASCOP & HIS)</p> <p>Piloted the curriculum</p>	<p>Curriculum: Completed EMR user including system specific content Supported Health Informatics Curriculum for undergraduates students</p> <p>Training institutions: Orientation for institution and master trainer Developed the training standards guide</p> <p>Workshops: Content experts' to review IT/Software Administrator curricula and training materials on current software features</p>	<p>Partners: Trained on KenyaEMR configuration and technical support</p> <p>Workshops: Health manager orientation Mentorship including visits along with MOH Discussion to integrate these in training institutions</p> <p>Trainings: End users in 4 Provinces Revised model, materials and job aides</p>
Interoperability	<p>Developed and tested first phase of the Open EMR connect (OEC)</p>	<p>OEC Deployed to two sites</p> <p>Fansoft interoperability Consultative meetings</p> <p>Data availability Select patient clinical and demographic data available</p>	<p>EMR-DHIS Working on pre-defined template for easy transmission of DHIS to any EMR system</p> <p>CPAD Upgrade</p>

Deliverables	Apr 2010-Sept 2011	Oct 2011-Sept 2012	Oct 2012-Sept 2013
		including in a centralized database	<p>Improvements System, deployment, administration modules</p> <p>Documentation On OEC website EMR-DHIS postponed to Oct-Dec 2013 ADT-OpenMRS concept note developed KenyaEMR concept note developed</p> <p>Transition To KEMRI/CDC in-process</p>
Model site set-up & EMR rollout		Development of software P/DHMT sensitization SOPs for EMR implementation Site assessments (8)	<p>CHMT Lead EMR implementation</p> <p>OpenMRS Community Foster OpenMRS education</p> <p>Pre-Implementations 200 assessments in 4 Provinces EMR committees fostered Encouraged EMR Champions Partnerships to address capacity gaps</p> <p>Implementation 103 deployments Partnership to migrate data and provide technical support Progress dissemination meetings Acceptance testing Concept dictionary management</p>

Table 2: KenyaEMR Model Sites (as of 15 Sept 2013)

Name of the site	Volume (# active HIV patients)	Level	Data Migration Status	Province / Location	Implementation Mode
Kisumu DH	4754	DH	100%	Nyanza	POC
Nyamira DH	6000	DH	20%	Nyanza	POC
Rachuonyo	11,456	DH	20%	Nyanza	POC
Ruambwa	3180	Health Centre	26%	Nyanza	Retrospective
Awendo	8161	SDH	<1%	Nyanza	Retrospective
Alupe SDH	2062	SDH	100%	Western	POC
Bungoma DH	6000	DH	100%	Western	POC
Butere DH	3800	DH	10%	Western	POC
St. Marys MH	4500	Other – MH	100%	Western	POC
Mbale	506	RHC	66%	Western	
Kabarnet	2409	DH	100%	North-Rift	POC
Kapenguria	3564	DH	83%	North-Rift	POC
Kapsabet DH	5389	DH	72%	North-Rift	POC
Nandi Hills	3637	DH	40%	North-Rift	POC
Lodwar	3600	DH	3%	North Rift	TBD

**Proposed sites for in-depth evaluation via site visits are indicated in grey.

Table 3: Evaluation Objectives

Table 3: Evaluation Objectives and Questions

Evaluation Objective 1: Identify best practices and lessons learned with respect to organizational, behavioral and technical factors influencing KenyaEMR implementation (“Inputs” component of the PRISM model)	
Organizational factors	<ul style="list-style-type: none"> • How is the type of KenyaEMR implementation (point-of-care/retrospective) determined? • What actions and structures are needed for sustainable implementation of KenyaEMR at the institutional level? • What are the mechanisms to identify and resolve problems and how well have these mechanisms worked?
Technical product & service factors	<ul style="list-style-type: none"> • What are the processes used to develop and deliver software, and what process steps are needed to maximize efficiency in software development? • What are the availability, stability, and security of the health information system infrastructure and how can they be improved? • What processes are needed to deliver and maintain hardware and health information system infrastructure at the required quality in a timely manner? • How do users perceive the technical features of KenyaEMR (e.g. patient registration/look-up, patient summary, screens for health care visit data capture, reports, interoperability, etc.) • What technical support services are critical to support KenyaEMR use? • What are practices commonly identified by stakeholders as helpful for KenyaEMR development, installation, and maintenance? • How should complementary technologies, such as national unique patient identifier (NUPI), and smartcard technology, be organized and delivered as part of facility-level health information systems?
Behavioral factors	<ul style="list-style-type: none"> • What practices are commonly identified by stakeholders as helpful for KenyaEMR adoption and use? • What staffing roles and responsibilities are needed to support these practices? • How do individual skills and motivation, peer influence, social support and leadership skills and motivation affect KenyaEMR adoption? • How can the training model and content be modified to support optimal development of skills and motivation in using KenyaEMR?

	<ul style="list-style-type: none"> • How effectively has the training model been revised and delivered to reach increased number and types of users? (content, format, mode of training)
Evaluation Objective 2: Assess use and performance of Kenya EMR in actual practice to support clinical and programmatic decision-making (addressing “Process” and “Outputs” components of the PRISM model)	
<ul style="list-style-type: none"> • How is KenyaEMR used for data retrieval, data collection, and program documentation and reporting? • What features of KenyaEMR support or impede data retrieval, data collection, and program documentation and reporting? • What is the level of completeness, timeliness, and accuracy of KenyaEMR data? • What affects the quality of data in: a) patient medical records; and b) aggregate facility reports? • What facilitates or impedes use of data for clinical and managerial decision-making? • What changes are observed in data quality and clinical performance over time? 	
Evaluation Objective 3: Identify requirements and strategies for transition of systems to MOH leadership for long-term sustainability	
<ul style="list-style-type: none"> • What are the ongoing technical assistance needs to support MOH’s KenyaEMR implementation? • How has readiness to transition been determined for various elements (steps, processes or procedures) of KenyaEMR implementation? • For which process has transition of various elements of KenyaEMR implementation occurred? • How have problems been identified and addressed while implementing transitioned elements of KenyaEMR implementation? • What are the results of transition of each of the various elements to the MOH in the 4 provinces? (pace, changes in internal operations, staffing, and resource allocation) • What are best practices and lessons learned related to transition of KenyaEMR implementation? 	
Evaluation Objective 4: Evaluate the effectiveness of KenyaEMR implementation	
<ul style="list-style-type: none"> • How do facility-level aggregated quality of care metrics change over time before vs. after KenyaEMR implementation? • How do facility-level aggregated patient health outcomes change over time before vs. after KenyaEMR implementation? 	
Evaluation Objective 5: Evaluate the cost and cost- effectiveness of KenyaEMR implementation (addressing cost as well as the “Outcomes” and “Impact” components of the PRISM model)	
<ul style="list-style-type: none"> • What is the total cost of KenyaEMR implementation in the 15 model sites, from the health system perspective? 	

- What is the total cost of KenyaEMR implementation at each stage (pre-implementation, implementation, post-implementation) by type (labor, recurrent, equipment, infrastructure and donated or on-hand resources) and level (national, provincial, country, facility) of cost?
- What is the cost per facility and HIV-infected patient of KenyaEMR implementation?
- How do costs vary by type of EMR implementation, by type of facility (level 3-6), and by patient load?
- What is the anticipated cost of additional (future) EMR implementation by type of facility (level 3-6), and by patient load?
- What are the expected costs of additional implementations of the KenyaEMR?
- What are the expected costs of implementation of the KenyaEMR if implemented by the MOH?
- What are the incremental costs per Quality Adjusted Life Year (QALY) for KenyaEMR use?

Table 4: Information Gathering Methods

#	Method	Source	N
Interviews			
1	Formal interviews	I-TECH Kenya leadership, management and implementers	8
2	Dyad interview	I-TECH Kenya software developers (n=2)	1
3	Group interview	I-TECH Kenya implementation coordinators (n=5)	1
4	Informal group discussions	MOH staff including KenyaEMR Champions, mentors, users and Health Records and Information Officers in health care facilities in the Central, Nyanza, and Western Provinces of Kenya (n=18)	3
5	Informal group discussions	Two persons from a partner organization in Nyanza Province	1
Observations			
6	Health care facility tour	Work flow, patient flow and data capture/use	3
7	Facility-based user training	The last day of a 4-days training of end-users (n=11)	1
8	Partner meeting	Central Province Technical Working Group (n=4)	1
9	Management meeting	I-TECH project management meeting (n=8)	1
10	Packaging of materials	By vendors at I-TECH offices	1
Document reviews			
11	Reports	Reports to CDC and attachments; EMR readiness reports, networking reports, mentorship reports, progress reports, EMR implementation status reports, and select presentations	32

Table 5: Documents Reviewed

#	File name
1	Qtr Oct to Dec 2011
2	SAPR2011
3	AnnualPartnerReport2011 including embedded documents
4	EMR Readiness Assessment Report_10Jan2012
5	Bungoma DH EMR Assessment Summary Oct 2012
6	I-TECH EMR Implementation Progress - 22Nov2012 Final
7	North Rift October progress report North Rift
8	Nyanza Octobers Progress Report PC
9	Western Octobers Progress Report EC
10	Network observation Mumias
11	Network observation Rwambwa
12	Network observation
13	Summary for Kimanga Nov 2012
14	Monitoring_EMR_Implementations_Western_19Dec2012
15	Mbale RTHC and Butere DH revisit for readiness assessment report
16	EMR system installation
17	I-TECH_Quarterly_Progress_Report-OctDec2012
18	Facility_Visits_Observations_06Feb2013
19	TheKenyaEHRProtocalDevelopment_28Feb2013
20	I-TECH_Supporting_Health_Information_System_24Apr2013
16	I-TECH_QTR_Narrative_Apr-June2013_Final including embedded documents
17	Pre SAPR 2013 Presentation to Partners 2013 NK.ppt
18	Facility_EMR_Implementation_Status_22Jul2013
19	I-TECH Presentation Oct 12 to Jun 13
20	I-TECH_APR_Narrative_Oct2012-Sept2013
21	MENTOERSHIP REORT RWAMBWA HC
22	MENTORSHIP REPORT - bdh- bungoma
23	NYANZA MENTORSHIP REPORT
24	EMR readiness Nyanza Folder
25	OLMIS APHIAplus Nuru Ya Bonde 5th Apr2013.ppt
26	Call with Lisa 26 July with SK
27	I-TECHPMTMeetingMinutes21-8-13
28	FGD_Trainers_Notes_26August2013
29	Health sector ICT standards and guidelines (from document titled “Health sector ict standards and guidelines_FG Final Copy-2”)
30	Kenya_EMR_Standards_and_Guidelines document

Table 6: Implementing Partners

Region	Key Partners	Key Contributions
Central	<ul style="list-style-type: none"> - APHIAplus* Kamili - Centre for Health Solutions (CHS) - CRISSP, University of Nairobi 	Physical security upgrades (eg. Grills on doors/windows)
Nyanza	<ul style="list-style-type: none"> - APHIAplus* - Chagua Maisha - The International Center for AIDS Care and Treatment Programs (ICAP) - Family AIDS Care and Education Services (FACES) - Médecins Sans Frontières (MSF) 	Supporting migration of legacy data
Western	<ul style="list-style-type: none"> - APHIAplus* - Kenya Episcopal Conference (KEC) - The Academic Model Providing Access to Healthcare (AMPATH) 	Joint technical support post-implementation
North-Rift	<ul style="list-style-type: none"> - APHIAplus* - APHIAplus* Imarisha - The Academic Model Providing Access to Healthcare (AMPATH) - Elizabeth Glaser Pediatric AIDS Foundation (EGPAF) - Walter Reed 	

* AIDS, Population and Health Integrated Assistance Plus

Table 7: A Theoretical Framework for Supporting KenyaEMR End-users

Pre-implementation	Steps	Post-implementation
1. Community diagnosis	<ul style="list-style-type: none"> - Health needs - Patient demands - Communities of learning - Adaptability to changing knowledge and practice - Ability to adapt/change present environment - Dynamic work culture and practice 	12. Possibility of seeing positive/desired outcomes Adoption of new skill
2. Facility diagnosis	<ul style="list-style-type: none"> - Patient load (number, time available and physical demand) - Ergonomics - Organizational structure - Equipment - Technologies 	11. Opportunity for practicing new skills
3. Administrative and Policy factors	<ul style="list-style-type: none"> - Infrastructure - Strategy - Policy - Supervision and leadership climate that positively reinforces good work and learning through mistakes 	10. Support for practicing new skills
4. Predisposing factors	<ul style="list-style-type: none"> - Right person in right job - Monies - Previous training - Family support, expectations, values - Intrinsic/professional interest - Self-efficacy - Ability to identify and discuss problems - Critical self-reflection 	9. Likelihood of wanting to try new skills
5. Enabling factors	<ul style="list-style-type: none"> - Guidelines - Learner intelligence - Learner motivation - Learner learning style - Trainer responsive to different learning styles - Trainer capacity to communicate complex materials - Access to other sources of information - Opportunity to observe skills - Response efficacy - Everyday experiences - Story telling/causal modeling - Finding solutions 	8. Social interaction
6. Reinforcing factors	<ul style="list-style-type: none"> - Support - Relevant content - Overlap in content - Trainee involvement - Trainer knowledge, skills, efficacy, role modeling - Collaboration - Authority/consensus - Perceived advantages in new system/knowledge/skill - Perceived ability to change environment - Team approach - Reward systems 	7. Training/ mentoring/ coaching

This framework was conceptualized by the author using the PRECEDE/PROCEED Model (Green, L).

Table 8: Challenges, lessons learned and best practices by each year of implementation

Year	Challenge	Lesson Learned	Best Practice	
Operations and Finance				
2010-2011	Start-up activities delayed implementation	Cash flow can impede implementation plans	Work should be planned in accordance to field realities; Planning can ensure timely disbursement of funds and adequate administrative support.	
2011-2012	Hiring key management position took time	Staffing plans and their execution take time		
	Staff attrition	Finding the right skill mix is difficult		Liaise with tertiary institutions and polytechnics to build skill pool
	Staffing shortages can delay subcontracting with partner institutions	Partner institutions have their own mandate and resource limitations		Identify the key contact person to facilitate partnerships with other institutions
Partners have scheduling conflicts	Schedule activities in advance with dates offered within set periods			
2012-2013	Restructuring of the public health administration	Working in teams of MOH staff can reduce dependence on individuals	Work with the MOH administration to ensure continuity in tasks even in times of change; work with County level staff to assure ownership and sustainability	
	Dependence on MOH transportation	There are conflicting needs for transport related resources	Greater coordination and alternative forms of transportation can ensure that activities continue as planned	
	Inaccessible areas	Weather, transport and security issues can impede implementation	Foresee and plan for local vagaries in order to ensure timely and secure implementations	
	I-TECH in conjunction with NASCOP and MOH/HIS conducted back to back workshops due to time limitations.	Back to back workshops can very challenging especially with regard to budgetary requirements, reconciliation procedures, reports write ups and travelling schedules.	Work should be planned in accordance to field realities	
	KenyaEMR implementation schedules have conflicted with other	Advance planning is needed to ensure key persons are present at key	Shared activities calendars within the organization and with the MOH can reduce time conflicts	

Year	Challenge	Lesson Learned	Best Practice
	I-TECH and MOH program activities	activities that are completed in a timely fashion	
	Rollout has necessitated changes in KenyaEMR strategies particularly for training	Change communication and management strategies are needed	Lines of communication and accountability for I-TECH should be clear to ensure smooth change management and transition of processes
	System ownership is unclear	Facilities that own the system perform better on KenyaEMR	Strategies to increase facility-level ownership include engaging with leadership, working with Champions, and supporting EMR committees. Feedback and dissemination occurs at quarterly meetings
Software Development, installation			
2011-2012	The lead developer's FTE was significantly reduced	Decisions may be beyond the implementing office	Partnerships can fill gaps in staffing
	Software development was delayed due to the absence of a local concept dictionary	Software developers need management support to manager consultant/ contractor agreements	Having a functional and accessible local concept dictionary management structure assists in software development
	Bugs in the software system	A system to identify and address bugs in KenyaEMR are needed	Kisumu District Hospital has a system of recording, reporting and addressing bugs in KenyaEMR that can be emulated across facilities
2012-2013	Software installation at facilities was inefficient	Software can be installed and tested in Nairobi reducing ICs' time commitment during installation at the facilities	Process analysis to remove unnecessary steps increases efficiencies
	Partners reporting needs are not met	MOH facilities do not work in isolation; partner organizations fill important gaps and have their own deliverables	Early involvement of partners can assure their informational needs are met and that KenyaEMR implementation responsibilities are shared
	Viruses remain a threat	Anti-virus systems should be assessed	ICT policy and procedures should be followed to assure data security

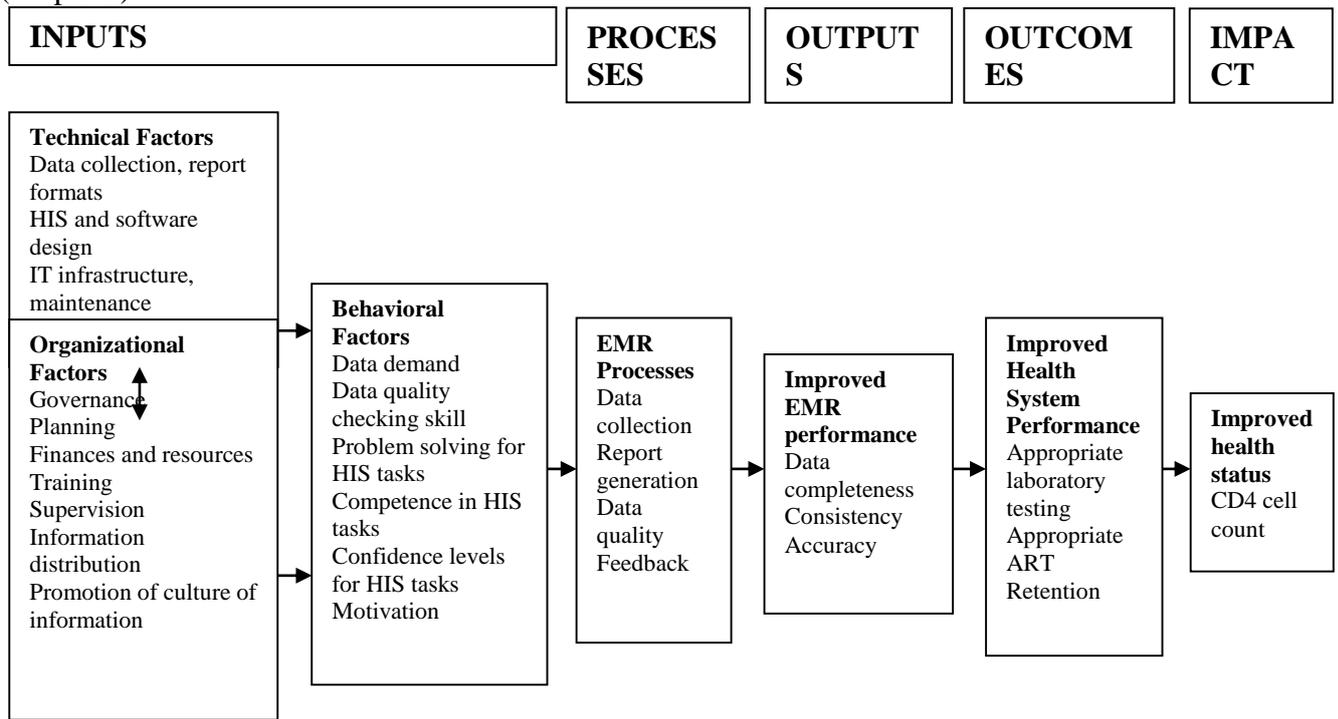
Year	Challenge	Lesson Learned	Best Practice
	Champion Mentors are frequently expected to handle user account issues, backups, and other, more technical issues.	Champion mentors need support to meet users' technical demands	Champion mentors can be trained on technical issues and should be linked to technical support; Implementing partners are willing to learn and provide technical support for KenyaEMR implementations; Operationalize and implement help desk support structures
	Insufficient expertise in OpenMRS in the country	Developers and implementers are needed to meet growing demands	Build a KenyaEMR community; provide internships to ICT students/graduates
Site Selection			
2011-2012	Regions were not identified until the last quarter	Delays in one area can delay the entire project	Continuous communication and relationship building can produce timely results; do not overstep own role and responsibility
2011-2012	Selected sites had preexisting EMRs	Agreements at the national level are not fully understood at lower levels	Identify areas where further national level guidance/ involvement is needed and facilitate collaborations.
Site Assessment			
2012-2013	Distances between facilities is poorly understood	Inefficiencies arise when facilities are not approached as a cluster	Liaise with the facilities to understand distances and reduce travel times to various facilities
	Finding the right respondents	People with the most information and most conversant with EMRs provide better information	Spend time identifying the right respondent; Ambiguities in tools should be addressed
	Reports on power availability were inaccurate	Inconsistent power supply creates a hybrid of POC and retrospective data entry	Hold facilities and assessment teams accountable for the information, emphasizing that accurate reports allow for timely remedial action to ensure POC KenyaEMR implementation
Training			
2010-2011	Content area experts do not necessarily know about	Expertise in one area does not imply experience or expertise in other areas of implementation	Ensure enough time to standardize understanding and clarify expected outcomes of joint work; With multi-disciplinary teams,

Year	Challenge	Lesson Learned	Best Practice
	learning theory and curriculum development		allocating lead roles and key responsibilities to partner organizations can foster ownership
	Unforeseen difficulties can arise in the field	Practice sessions clarify deficiencies in training materials, content and delivery	Have clear roles and functions as well as contingency plans in case of changes in the field
2012-2013	There was an increase in demand for the Health Managers workshops	Meeting user demands has budgetary and work planning implications	Flexibility in cost and time allocation is needed to meet user demands
	Trainees had low computer literacy	Lack of previous experience can limit the absorption of theory	Training should provide opportunities for practice and draw on 'teaching moments' ; Job aids and on the job training by more computer literate peers can increase user skills and confidence. Staff should be encouraged to take computer classes.
	Some mentors had not received end-user training	Persons identified as mentors do not necessarily have the requisite skills on EMRs and ICT.	Identify trainees for mentorship training from among those who demonstrate the most knowledge and enthusiasm for EMRs.
	Staff workload, attrition and transfers	Workload, resistance to change and individual anxiety can delay use	Ensure mentoring and supportive supervision particularly for new users
	With KenyaEMR rollout, meeting trainee needs is resource intensive	In-facility and e-learning options are needed to meet the growing numbers that need training	New models of training should be tested for efficiency and effectiveness
	Not all Champions are trained in mentoring	Mentoring support can ensure mentor and mentee needs are met	Facilities and training institutions can fill gap in mentor training
	Poor internet connectivity can prevent trainees login to the system during demonstrations.	Training time is lost due to technical issues	Have both the local copy of the system and access to the remote server for the system user trainings.
Infrastructure procurement and delivery			
2012-2013	Delays in procurement	Have checklists to ensure all key items are assessed; ensure vendor	Have standard operating procedures for procurements; buy in anticipation of need;

Year	Challenge	Lesson Learned	Best Practice
		agreements are in place; ensure cash flow	
	High infrastructure investment	Partner mandate and allowable costs may not allow them to meet commitments	Technical Working Groups and steering committees are key to identify and address resource constraints
	Hardware and other requirements vary across sites	Monitoring systems are needed to ensure correct orders are placed, specifications are met and delivery is as planned	Standard procedures and monitoring tools can increase efficiencies in procurement
	Material needs for networking was poorly understood	Inadequate estimates lead to delays in procurement and infrastructure upgrades	A checklist on networking and use of a networking vendor/contractor assures the correct placement and delivery of orders
	Data back-up systems are absent in some facilities	Data back-up systems should be assessed at site visits, during upgrades and supervision should support its timely and correct use	Data back-up systems in the form of external hard drives may be needed; these should be kept separate from the server, preferably in a separate building
	Sites are not implementation ready	Power and security measures are needed for POC KenyaEMR implementation	Retrospective data entry while waiting for facility upgrades can shorten the time to POC entry
Data migration			
2012-2013	Huge volume of legacy data	Policy is needed on what data needs to be migrated, by whom, how and by when.	Management and Champions are key to setting and achieving targets for data migration
	Data migration is resource intensive	Facility plans are needed to reallocate resources to meet fluctuating needs for data entry and management	Kisumu District Hospital and St. Matias Mulumba can demonstrate best practices
KenyaEMR adoption and use			
2012-2013	KenyaEMR adoption and use can be slow	Management, mentors and Champions are key to support end user trial and habitual use of KenyaEMR.	Involve management from pre-site assessment to data use; identify EMR Champions early; provide structure for championing KenyaEMR; create steering/implementation committees for KenyaEMR

Year	Challenge	Lesson Learned	Best Practice
	Unreliable power supply can disrupt POC KenyaEMR implementation	Provision for retrospective entry into KenyaEMR is needed due to unreliable electricity; however, this can increase patient waiting time	Ensure alternatives to electricity supply are in place and there are measures to ensure they are functional (Supplies, fuel, service, maintenance)
	User competency is varied	Concerted efforts are needed at all levels to assess and support user competency	Stakeholders visiting/partnering with sites can liaise to address varying levels of individual user training/support needs
	Data quality is variable	Standard operating procedures for data quality assurance are needed	Data monitoring and evaluation tools within the KenyaEMR functionalities and as part of facility level data quality assurance can improve KenyaEMR performance and use

Figure 1. Performance of Routine Information System Management (PRISM) Framework (adaption)



Appendix 2: Revised Tools (21 August 2013)

Participant Information Sheet

KenyaEMR Program Evaluation

You are invited to participate in an evaluation of the experiences with implementation of the electronic medical record system, called “KenyaEMR”, with health care facilities in Kenya. The overall goal of this I-TECH’s program evaluation is to identify best practices and lessons learned during the course of providing technical assistance to the Kenya Ministry of Health (MoH) in development, deployment, training, and support for use of the KenyaEMR system. The findings will guide adjustments to I-TECH’s strategies and activities as we support KenyaEMR scale-up in more than 300 health care facilities.

Purpose

The purpose of the KenyaEMR program evaluation is not to judge any individual person, facility or organization, county or province within Kenya’s health system. Rather, the purpose is to strengthen I-TECH’s contributions to Kenya’s national health information system. Having timely, complete, and accurate individual and population health information within the hands of health care workers is important for delivering health care services of strong quality.

Specifically, the results from the evaluation will help I-TECH to identify:

- Improvements in procedures and workflow for KenyaEMR software development;
- Evidence-based strategies for successful integration of national unique patient identifier (NUPI) and smartcard technology within facility-level health information systems;
- Efficient procedures for procurement, deployment, storage and maintenance of IT hardware and infrastructure;
- Refinements of the site readiness assessment framework, based on a comparison of assessment results with the planned and actual activities undertaken to prepare sites for KenyaEMR implementation;
- Refinements of the training content for optimal skills development for various types of stakeholders and users of the KenyaEMR;
- Refinements of the mode of training delivery, with increased integration of “eLearning” tools, for greater efficiency of training delivery at large scale;
- Advice on cost-efficient KenyaEMR implementation, with explicit and detailed requirements on the human and material resources required to fulfill local needs;
- Information needed for MoHs’ increasing role in the efficient and effective implementation, rollout, and maintenance of KenyaEMR;
- Tools and methods which the MoH could apply in further evaluation of health informatics implementation work carried out directly by the MoH or by other partners.

Method

- The program evaluation will use a combination of evaluation methods.
- I-TECH will use routinely collected program monitoring data including assessments of site preparation for KenyaEMR implementation, routine updates on KenyaEMR implementation status, pre- and post-test scores for participants of KenyaEMR

trainings, observation checklists for KenyaEMR user skills, and I-TECH's program procurement and financial records.

- The evaluation will also use key informant interviews, focus group discussions, and surveys of facility personnel, in order to gain in-depth perspectives on questions of interest. These non-routine evaluation activities will help fill in information gaps and by provide objective assessments of program capacity, achievements, and needed improvements.

Voluntary participation

- Your participation in the evaluation is completely voluntary. You may discontinue participation at any time.
- If you do not wish to participate, you may indicate this at any point to an I-TECH representative. Once you notify I-TECH that you do not wish to participate, we will cease to contact you about the KenyaEMR program evaluation.

Use of Your Responses

- Any written and verbal responses you provide as a participant are confidential. Where there are more than one interviewee during an interview, we request all interviewees to maintain confidentiality. However, we cannot guarantee this confidentiality. When we summarize the findings from this evaluation, your opinions and perspectives will be presented in a manner that protects your confidentiality and the confidentiality of all participants.
- One or more reports summarizing the opinions and perspectives of health care workers, other health care facility staff members, and other KenyaEMR stakeholders on KenyaEMR implementation and use will be prepared as a result of this evaluation. No individual responses will be identified within the report. *Quotes may be used but will be used in a manner that does not allow identification of the individual.*
- Findings from this evaluation may be published in a public manner, such as through reports available on public websites, conference presentations, or journal articles. Findings will be presented in a way that protects your confidentiality and the confidentiality of all participants, and you will not be identified in any way.

Questions For any questions about the KenyaEMR program evaluation or to indicate that you do not wish to participate further, please contact:

- Veronica Muthee, I-TECH Kenya Monitoring and Evaluation Officer, tel: 0705699277; email: vmuthee@itech-kenya.org
- Nancy Puttkammer, I-TECH Research and Evaluation Advisor, tel: +1-206-616-5139; email: nputt@uw.edu

Observation Tools

Facility Questionnaire

Facility Code: _____

Dates of Site Visit: _____

Evaluation Team Members: _____

1. Level of Facility (pre-fill)

- Referral Hospital
- Provincial Hospital
- District Hospital
- sub-district Hospital
- Health Center with beds
- Health Center without beds
- Dispensary
- Other: _____

2. Other partners at the site (pre-fill)

- Other: _____

3. Current Patient Volume in HIV Clinic

Month: _____ Number of patients: _____

Month: _____ Number with data migrated: _____

Month: _____ Number being entered POC: _____

4. For every staff person you meet, ask:

Sr #	Position/title	Main location of work within facility	Uses KenyaEMR
			Daily Weekly Monthly Less than monthly, or never
			Daily Weekly Monthly Less than monthly, or never
			Daily Weekly

			Monthly Less than monthly, or never
			Daily Weekly Monthly Less than monthly, or never
			Daily Weekly Monthly Less than monthly, or never
			Daily Weekly Monthly Less than monthly, or never
			Daily Weekly Monthly Less than monthly, or never
			Daily Weekly Monthly Less than monthly, or never

Confirm with the the sister-in-charge, you have captured all the staff in the CCC and have identified those who use the KenyaEMR. If any missed, then ask to meet them so you can fill the amount of time question.

Ask the sister-in-charge, if you have missed any management/health care provider at the facility level who works with KenyaEMR (TB, ANC, OPD other)

Ask the sister-in-charge, if you have missed any data-related staff at the facility level who works with KenyaEMR . Ask to meet them.

(IT, DHRIO, HRIO, data clerk, volunteer). Complete this information

Records Management for HIV Program:

1. What are all the paper-based sources of patient data in the HIV care and treatment program?
[Observer lists sources] **This needs to be asked, cannot be seen**
2. Where are each of these sources stored? Is the storage set-up at the site typical of the norm?
[Observer describes via field notes] **This needs to be asked, cannot be seen**
3. How is privacy of patient records assured in the storage set-up? Is the privacy set-up at the site typical of the norm? [Observer describes via field notes] **This can be observed in passing but maybe atypical. Difficult to establish without asking and not to sound judgmental when asking**
4. How are the records organized and filed in the storage area? What is the logic for retrieval of records? Is there any temporary or permanent storage of records outside of the designated area? Is the organization and filing of records at the site typical of the norm? [Observer describes via field notes] **These need to be asked**
5. How are inactive records handled? Is archiving, long-term storage, or disposal of records at the site typical of the norm? [Observer describes via field notes] **these need to be asked**
6. Describe the overall impression of records management in the facility. [Observer describes via field notes]

IT Infrastructure: Again these all need to be asked. So may be it's not an observation but a walk about? This is certainly a better to collect the information than just sitting and asking.

1. **What are the different software used to collect patient level data (eg. PIS, LIS, other)**
2. How does the IT infrastructure function in supporting the facility's HIS? What works well? What are the gaps?
3. What is the bandwidth of the internet connection?
4. What is the speed of the internet connection and how does this vary?
5. How many days during the past week was internet available?
6. How many days per week is it typically available?
7. Is antivirus software used? If so, describe type and use?

Item	# Available on site	# Functional on site	# Used as part of K-EMR
Equipment			
Desktop computer (total)			
Desktop computer with internet access			
Server			
Monitors			
UPS for power back up			
Alternative power source (generator, solar panels, etc.)			
alternate ways to connect to internet			
LAN			
Printer			
Scanner			
External hard drive			
Supplies			
Toner			
Paper for printer			
Patient visit forms (HIV outpatient)			
Register (HIV outpatient)			
Report forms: monthly facility			
Report forms: daily surveillance			
Report forms: HIV case report			

Interview Guides

Central MOH (management/decision-making level)

Contextual Information:

What is the role of the Central MOH in EMR implementation in Kenya?

What has been your role in KenyaEMR implementation?

Overall: (IF involve with KenyaEMR)

In your opinion, what have been the strengths of KenyaEMR implementation?

How are problems with KenyaEMR implementation identified and resolved?

What can be done to improve KenyaEMR implementation?

Organizational Factors:

What can be done to make EMRS a sustainable program in Kenya?

What concerns do you have for the use of EMR in Kenya in the longer term? What issues do you anticipate arising in the coming 12 months that could impact success of EMR use? How about the 2-5 year time frame?

Province

What systems need to be in place for successful EMR implementation in Kenya?

(HR, supervision and quality improvement, partnerships, policies and procedures, infrastructure, supply, transport)

Transition: (Requirements, strategies, sustainability)

Which of these structures and systems already exist within the MOH?

How can these structures and systems within the MOH be improved?

What other structures and systems must be put in place within the MOH so that the MOH can successfully implement EMRs?

What plans are in place within the MOH to create these systems and structures to support EMR implementation?

What is the role of other stakeholders in executing these plans to create the necessary systems and structures for successful EMR implementation?

What processes should be followed to support the transition of EMR implementation from I-TECH to MOH?

PHRIO (Responsible for supervision/EMR/qual at facilities in their province)

Contextual Information:

How did you first learn about the decision to implement EMRs in facilities in your province/?

What was your reaction when you learned about this decision?

What has been your role in KenyaEMR implementation?

How has the introduction of KenyaEMR changed your role and function?

How prepared did you feel for assuming your revised role and functions?

Overall:

How do you use the information from KenyaEMR to do your work? Make decisions?

How has KenyaEMR been helpful in your work?

How has KenyaEMR been unhelpful in your work?
What challenges do you face in meeting your work requirements?
In your opinion, what have been the strengths of KenyaEMR implementation?
What can be done to improve KenyaEMR implementation?

What concerns do you have for the use of EMR in Kenya in the longer term?

Organizational Factors: (type of implementation; CQI mechanisms)

What preliminary steps did you have to take before the EMR could be implemented?

What changes did you anticipate at the provincial level prior to KenyaEMR installation?
(Infrastructure management, HR needs, Information flow, reports, oversight functions?)

What were some of the best practices you observed on change management, at the

- 1) provincial level and
- 2) facility level?

Technical Products and Service Factors: (Hardware/infrastructure delivery/maintenance; technical support services)

How do **site assessments** today differ from the first few site assessments?

Team composition, role and function

Process

Documentation and reporting

Outcome

What led to these changes?

How useful is the information collected during site assessments?

How is the information collected used for deciding:

- Type of implementation
- Next steps

How well has the **KenyaEMR deployment** process worked?

(hardware/infrastructure procurement, training, installation)

How can the KenyaEMR deployment process be improved?

What do you think about the **KenyaEMR as a software** for entering point of care patient data, generating reports?

How can the software be improved?

What policies and procedures are in place for the **security** of:
the hardware? Infrastructure? Software? Data?

What difficulties have you observed in following these procedures?

What policies and procedures are in place for the **maintenance** of:
the hardware? Infrastructure? Software?

What difficulties have you observed in following these procedures?

What are common problems with KenyaEMR at the facilities? (hardware, infrastructure, software, data retrieval, report generation)

How you are these addressed?

What technical support is available to you to solve ongoing or new problems with KenyaEMR?

Use and performance

What common problems have you observed with data quality?
What are the underlying causes of compromised data quality?
How can these causes be addressed to improve data quality?
How are problems with **data quality** identified and resolved?
 What procedures are in place for ensuring data quality?
 What difficulties have you encountered in following these procedures?

Facility-in-charge (Responsible for clinic performance and health systems management in the CCC)

Contextual Information:

How did you first learn about the decision to implement EMRs in your facility?

What was your reaction when you learned about this decision?

What has been your role in KenyaEMR implementation?

How has the introduction of KenyaEMR changed role and function in your facility?

How prepared do you feel staff were for assuming their revised role and functions?

Overall:

How do you use the information from KenyaEMR to do your work? Make decisions?

How has KenyaEMR been helpful in your work?

How has KenyaEMR been unhelpful in your work?

What challenges do you face in meeting your work requirements?

In your opinion, what have been the strengths of KenyaEMR implementation?

What can be done to improve KenyaEMR implementation?

What concerns do you have for the use of EMR in Kenya in the longer term?

Organizational Factors: (type of implementation; CQI mechanisms)

What changes have occurred due to KenyaEMR installation in:

Infrastructure management

HR needs

Workflow

How data is entered, retrieved, stored

How data is analyzed, presented

Health care provision

Quality of services

Technical Products and Service Factors: (Hardware/infrastructure delivery/maintenance; technical support services)

How useful is the information collected during site assessments?

How is the information collected used for deciding:

- Type of implementation

- Next steps

How well has the **KenyaEMR deployment** process worked?

(hardware/infrastructure procurement, training, installation)

How can the KenyaEMR deployment process be improved?

Use and performance

What are the common problems reported by staff?

How are these problems resolved?

What common problems have you observed with data quality?

What are the underlying causes of compromised data quality?

How can these causes be addressed to improve data quality?

HRIO (Responsible for EMR at their facility including at the CCC)

Contextual Information:

How did you first learn about the decision to implement EMRs in your facility?

What was your reaction when you learned about this decision?

What has been your role in KenyaEMR implementation?

How has the introduction of KenyaEMR changed your role and function?

How prepared did you feel for assuming your revised role and functions?

Overall:

How has KenyaEMR been helpful in your work?

How has KenyaEMR been unhelpful in your work?

What challenges do you face in meeting your work requirements?

In your opinion, what have been the strengths of KenyaEMR implementation?

What can be done to improve KenyaEMR implementation?

What concerns do you have for the use of EMR in Kenya in the longer term?

Organizational Factors: (type of implementation; CQI mechanisms)

What preliminary steps did you have to take before the EMR could be implemented?

What changes have occurred in KenyaEMR installation in:

Infrastructure management

HR needs

Workflow

How data is entered, retrieved, stored

How data is analyzed, presented

Health care provision

Quality of services

How are problems with KenyaEMR implementation identified and resolved?

Technical Products and Service Factors: (Hardware/infrastructure delivery/maintenance; technical support services)

How useful is the information collected during site assessments?

How is the information collected used for deciding:

- Type of implementation
- Next steps

How well has the **KenyaEMR deployment** process worked?

(hardware/infrastructure procurement, training, installation)

How can the KenyaEMR deployment process be improved?

What has been done, if anything, to move data from patient charts/paper records/other EMR to KenyaEMR, for complete historical records for your patients?

How well did data reconstruction/migration work?

How can the process of making historical information available on KenyaEMR be improved?

What do you think about the **KenyaEMR as a software** for entering point of care patient data, generating reports?

How can the software be improved?
What policies and procedures are in place for the **security** of:
the hardware? Infrastructure? Software? Data?
What difficulties have you observed in following these procedures?
What policies and procedures are in place for the **maintenance** of:
the hardware? Infrastructure? Software?
What difficulties have you observed in following these procedures?
How well has KenyaEMR worked in the last month?
What is the typical pattern of availability of KenyaEMR?
What happens when KenyaEMR is unavailable?

What other problems do you commonly encounter with KenyaEMR in your facility?
(hardware, infrastructure, software, data retrieval, report generation)
How do you address these problems?
What sorts of IT support can you access when needed?
What technical support is available to you to solve ongoing or new problems with
KenyaEMR?

What procedures are in place for data management?
What difficulties have you encountered in following these procedures?

Use and performance

How are problems with **data quality** identified and resolved?
What procedures are in place for ensuring data quality?
What difficulties have you encountered in following these procedures?

What patient information has not been available or easy to access in KenyaEMR?
What concerns do you have about the quality of the information (accuracy, completeness, and
timeliness) in patient records?
What suggestions do you have for improving the quality of data in your patient records?

What challenges do you face in meeting reporting requirements?
How do you use the information from KenyaEMR to do your work? Make decisions?
What suggestions do you have for improving the quality of information in your routine
reports?
How do you meet requests for non-routine reports?

**Focus group discussion guide:
End users who did not participate in formal off-site training sessions**

[This guide can be adjusted depending on whether this is a FGD or individual interview guide. FGD would focus more on group experiences, norms, and attitudes. Individual interviews would focus more on personal experiences].

Hello, my name is ____ and I'll be leading this focus group discussion today. Thank you all for coming. As we mentioned earlier, we are interested in your thoughts and opinions on KenyaEMR and on the training of health care workers to use the KenyaEMR system. We are interested in your perspectives on how to improve training.

Please do not be shy about telling us your thoughts and opinions. All points of view are valid and we want to hear about all different types of ideas and thoughts. *[Make a list of ground rules with the participants here].*

We will be audio recording this discussion [show participants the recorder]. The reason we are recording this is to make sure we do not miss anything that is said. No one's name will be recorded. The main reason we are recording is because it will be difficult to write down everything that is spoken in the group. Once the FGD is over the tape will be transcribed verbatim and this text will be used for analysis. Does anyone have any objections to the tape recording? *[if anyone objects, recording will not be done].*

[If there is a note-taker then the note taker must be introduced.] X will also be taking notes – as we know technology can fail, and we want to be sure to capture your main messages to us. This will ensure that we consider your opinions as we revise the training materials and methods.

[NOTE TO FACILITATOR: Questions do not have to be asked sequentially, but all topics should be covered.]

First, we would like to ask you a little bit about KenyaEMR itself.

1. What do you like about KenyaEMR?
2. What do you not like about KenyaEMR?
3. For what purpose do you use KenyaEMR?
4. What do you do when you encounter a problem while using KenyaEMR?
5. How has using KenyaEMR affected:
 - a. Your productivity?
 - b. Your clinical decision-making?
 - c. Patients' experience in seeking care?
 - d. Collaboration between personnel involved in patients' care?
 - e. Quality of care ("doing the right thing right")?
6. What concerns do you have about the quality of the information (accuracy, completeness, and timeliness) in patient records?
7. What suggestions do you have for improving the quality of data in your patient records?
8. What concerns do you have with regards to KenyaEMR use for the future?

The remaining questions are related to the training and its consequences

1. Overall, what are your and your colleagues' experiences in using the KenyaEMR?
Probes:
 - a. For what tasks have you and your colleagues had an easy time using KenyaEMR?

- b. For what tasks have you and your colleagues had a difficult time using KenyaEMR?
 - c. Are there some tasks where personnel at the site are still using other tools (like paper forms, paper registers, electronic spreadsheets, etc.), rather than using the KenyaEMR? Can you explain why?
2. Overall, how well or poorly prepared do you feel health workers at your site have been to use KenyaEMR based on the training provided?
3. Please describe the types of training or support health care workers at your site received in order to prepare you to use the KenyaEMR? This can include both formal and informal training.
 - Probes:
 - a. Formal training? Informal training?
 - b. Who provided the training?
4. What are your opinions about the training or support for health care workers within your site on using the KenyaEMR?
 - Probes:
 - a. What content of training or support was most valuable in helping health care workers at your site actually use the KenyaEMR?
 - b. What content of training or support was least valuable in helping health care workers at your site actually use the KenyaEMR?
 - c. What were gaps in training or support?
 - d. What happened for health workers who lacked knowledge or skills to use the system? How did they resolve this?
5. What are your opinions about the *ability* of your on-site mentor to support health care workers at your site in on-going use of the KenyaEMR?
 - Probes:
 - a. What activities done by mentor(s) have been most helpful?
 - b. Least helpful?
 - c. What do you recommend for strengthening the preparation of mentors?
6. What are your opinions about the *availability* of your on-site mentor to support health care workers at your site in on-going use of the KenyaEMR?
 - Probes:
 - a. How frequently were you or your colleagues able to get the help you needed to use the KenyaEMR?
 - b. What do you recommend for strengthening the availability of on-site support?

There is an interest in moving towards providing “eLearning” materials (guided self-study using electronic learning resources) for health care workers to gain knowledge and skills for using the KenyaEMR. We would like to ask you about “eLearning” and KenyaEMR training.

7. When thinking about “blended learning” in relation to learning how to use KenyaEMR, what topics do you think are critical to cover via in-person training?
8. What topics would be appropriate for self-directed learning through eLearning resources?

9. What are your recommendations for making eLearning resources successful in the Kenyan context?

Probes:

- a. Are you aware of other examples of eLearning being used in other health training in Kenya? If so, what is your impression of the strengths and weaknesses of these programs?
- b. What would motivate participants to complete eLearning?
- c. How should eLearning materials be delivered?
- d. When and how do you think health care workers should complete guided self-study using eLearning?

Thank you for sharing your opinions!

Partners (supporting/interfacing with EMR at their facility)

In your opinion, what have been the strengths of KenyaEMR implementation?

In your opinion, what have been the shortcomings of KenyaEMR implementation?

What can be done to improve KenyaEMR implementation?

How did you first learn about the decision to implement EMRs in the facilities you support?

What was your reaction when you learned about this decision?

How has KenyaEMR implementation affected your work?

(competing tasks, data needs, reporting needs)

How has KenyaEMR been helpful to your work?

How has it not helped your work?

What has been your role in KenyaEMR implementation?

How well did that work?

What are the common challenges you see in facilities you support with regards to:

Hardware/infrastructure delivery and maintenance

Data migration/reconstruction

EMR use (data retrieval to reporting) and

performance (data quality and decision-making)

How can these challenges be addressed?

What concerns do you have for the use of EMR in Kenya in the longer term?

Types of questions posed to the Country Director (22/8/2013)

Organizational Factors: (actions/structures to sustain; CQI mechanisms)

What systems need to be in place for successful EMR implementation in Kenya?
(partnerships, policies and procedures, HR, infrastructure, supply, CQI, transport)

Transition: (Requirements, strategies, sustainability)

Which of these structures and systems already exist within the MOH?

How can these structures and systems within the MOH be improved?

What other structures and systems must be put in place within the MOH so that the MOH can successfully implement EMRs?

What plans are in place within the MOH to create these systems and structures to support EMR implementation?

What is the role of other stakeholders in executing these plans to create the necessary systems and structures for successful EMR implementation?

What processes should be followed to support the transition of EMR implementation from I-TECH to MOH?

How has the process of transition worked (for example of site assessments?)

How have problems been identified and addressed while implementing transitioned elements of KenyaEMR implementation?

What are the results of transition of each of the various elements to the MOH in the 4 provinces? (pace, changes in internal operations, staffing, and resource allocation)

What are best practices and lessons learned related to transition of KenyaEMR implementation?

Overall:

In your opinion, what have been the strengths of KenyaEMR implementation?

In your opinion, what have been the shortcomings of KenyaEMR implementation?

What can be done to improve KenyaEMR implementation?

What can be done to make KenyaEMR a sustainable program?

What concerns do you have for the use of EMR in Kenya in the longer term?

#	Types of questions posed to I-TECH Staff (22/8/2013)	I-TECH		
		George	Steve	ICs
Stakeholder involvement				
1	How did you prepare for KenyaEMR implementation?	√	√	√
2	How was I-TECH staff prepared for assuming their role and functions?	√	√	√
3	How are problems with KenyaEMR implementation (site readiness to use) identified and resolved?	√	√	√
4	In your opinion, what have been the strengths of KenyaEMR implementation?	√	√	√
5	In your opinion, what have been the shortcomings of KenyaEMR implementation?	√	√	√
6	What can be done to improve KenyaEMR implementation?	√	√	√
Site Assessment				
1	How are site assessments different today compared to your first site assessment?	√	√	√
2	What led to these changes?	√	√	√
3	What can be done to improve site assessments?			
Procurement				
1	How is the procurement process different today compared to initial model site KenyaEMR implementations?	√	√	
2	What led to these changes?	√	√	
3	How can the procurement process be improved?	√	√	
Installation				
1	How is the process for KenyaEMR installation different today compared to your initial installations?		√	√
2	What led to these changes??		√	√
3	How can the KenyaEMR installation process be improved?		√	√
4	How has data been moved from patient charts/paper records/other EMR to KenyaEMR?		√	√
5	How well did data reconstruction/migration work?		√	√
6	How can the process of making historical information available on KenyaEMR be improved?		√	√
Post-Implementation				
1	What policies and procedures are in place to ensure: Security of the hardware? Software? Data? What is the difficulty in following these procedures?			√
2	What policies and procedures are in place to ensure: Maintenance of the hardware? Software? What is the difficulty in following these procedures?			√
3	What policies and procedures are there in place for data management? What is the difficulty in following these procedures?			√
4	What policies and procedures are there in place to ensure data quality? What is the difficulty in following these procedures?			√
5	What can end-users do when they encounter a problem while using KenyaEMR?			√
6	What additional support do end-users need to be able to use KenyaEMR?	√	√	√

#	Types of questions posed to I-TECH Staff (22/8/2013)	I-TECH		
		George	Steve	ICs
7	How can the technical features of KenyaEMR be improved?	√	√	√
8	How can KenyaEMR use and performance be improved?	√	√	√
9	What challenges do you face in performing your duties?	√	√	√
10	What additional support do you need to meet performance expectations	√	√	√

Appendix 3 Suggestions for Future Evaluations

1. Going to the sites has to be well thought through. Preferably evaluators should fit into existing plans rather than have plans fit around them so that KenyaEMR implementation can be observed.
2. Both well performing and poorly performing sites should be visited to understand the underlying reasons for the difference in performance.
3. The day of the visit should coincide with a clinic day otherwise work flow and KenyaEMR use cannot be observed.
4. It is important to ask for clarifications on observations as things may be atypical on that day.
5. Distances and accommodation facilities permitting, an advance afternoon introductory meeting with facility staff may allow for early arrival (around 10a.m) for observation purposes only.
6. Drop patient observations – space does not allow for discretion and without knowing the blue card or other forms, it is difficult to know what is being observed.
7. Due to workload staff interviews occur after noon. If specific persons/types of respondents must be seen, then the country office needs to know in advance and ensure they are available at the time of the visit (or that the visit is well timed in that respect).
8. Assure interview tools match up with roles. Consider dropping Champions interview because though they may or may not have functionally different roles from Mentors. Champions serve as advocates/trouble shooters and may be super-users with administrative rights. They may also serve as mentors to end-users.
9. Information on model site implementations can only be gleaned retrospectively from the implementers from the various MOH, implementing partner and I-TECH offices. Staff attrition and redeployment across all organizations has resulted in a loss of institutional memory. In the absence of work diaries or documentation of steps in implementation, the reported changes in implementation will be difficult to verify.
10. Evaluations should be targeted rather than exploratory. The main question may be determined by programmatic need for information or by the need for an external objective review to improve KenyaEMR implementation. The I-TECH Kenya executive team proposed we address the following programmatic information needs:
 - a. Mentorship structure – does the new strategy work?
The suggestion is to look at process early in its implementation – November for how is working and then in the mid-term (TBD) to compare it to the previous training model
 - b. Usability – Through the PUMP and use of checklist such as that used the CDC and partners during monitoring visits. The CDC currently focuses primarily on retrospective data entry. We need a checklist to check for POC entry.Other evaluation questions of interest include:

c. Patient satisfaction with KenyaEMR