African Journal of Emergency Medicine 9 (2019) 165–171

Contents lists available at ScienceDirect

African Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/afjem

COMMENTARY

Implementation of electronic medical records at an Emergency Medicine Department in Tanzania: The information technology perspective

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ARTICLE INFO

Keywords:
Emergency Department Information System (EDIS)
EMD: Emergency Medicine Department
Emergency Medical Record (EMR)
Hospital Management System (HMS)

ABSTRACT

In 2015, the Emergency Medicine Department at Muhimbili National Hospital (MNH) installed and implemented the first Electronic Medical Record (EMR) tailored to the emergency centre (EC). The EMR deployed was designed for emergency centre use only (Emergency Department Information System (EDIS)) and linked with the existing EMR that focused on registration and billing. This very collaborative experience can be used as a reference to share the many lessons learnt by all, including hospital management, EC staff, private funders and EMR vendors. The IT Project Plan was developed to make sure steps were followed for EDIS implementation. This included the IT plan documents, specific user requirements, development of a Memorandum of Understanding and user manuals. Super key users were identified among the staff during the training and they helped to empower staff, consolidate knowledge and share the workload. Several challenges have been overcome, including when the power was not regulated so an automatic generator and uninterruptible power supply (UPS) devices installed to protect all computers. Providers were primarily a very novice group of computer users and many had little to no computer experience so were taught both basic computing skills and EDIS specific tasks. Trained staff were moved around the hospital and a lot of time was taken up training new staff, so discussion with hospital management led to retention of staff in the EC. Specific templates have been introduced to ensure adequate minimum documentation. However, even with these, clinical notes are often very brief and we are searching for further mechanisms to improve this. Hospitals in low-resource settings considering the implementation of an EMR should ensure that a comprehensive plan is in place that involves significant staff training, improvement of existing, or installation of new information technology systems, ongoing ICT support and funds for unforeseen issues and ongoing maintenance.

African relevance

- This paper provides an example of an introduction of electronic medical record in a resource limited setting.
- The paper describes the various challenges during implementation common to most African countries.
- The paper describes the variables that enabled electronic medical records within this resource limited setting.

Introduction

Muhimbili National Hospital (MNH) in Tanzania commenced the implementation of a computer system in 2004. Prior to this, all departments in the hospital were running manually with their own daily routines. Various modules of the computer system were designed to suit all departmental operations. The successfully implemented parts during this early stage were the modules of registration and billing.

The Emergency Medicine Department in Muhimbili National Hospital (MNH) started in 2010 and the computer system used at the time covered registration, billing and stock inventory. All these sections

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https://doi.org/10.1016/j.afjem.2019.07.002
Received 31 October 2018; Received in revised form 14 June 2019; Accepted 21 July 2019
Available online 22 October 2019
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were running in the rest of the hospital's departments as well. Clinical documentation, point of care services, prescriptions and the flow of patients were all manually documented. This led to difficulties in retrieving various patient information and creating reports for different departmental metrics.

In 2015, the emergency centre (EC) at MNH installed and implemented the first Electronic Medical Record (EMR) tailored to the EC. The EMR deployed was designed for emergency centre use only and this type of EMR is called an Emergency Department Information System (EDIS).

This article intends to describe the importance of using EMR, the process employed at MNH to deploy EMR in the EC and the challenges and lessons learnt before and after implementing.

This experience can be used in any other health care facility as a reference during the implementation of the hospital EMR.

The importance for African healthcare professionals

An EMR accelerates the improvement of patient care provision [1]. Many African countries have already introduced the use of EMR into their operations, however emergency centres are still being developed and EMRs specifically for this patient group are vital.

Sub-Saharan African countries with EMR

Many African countries have already started to introduce the use of EMR in their operations. Very few facilities have managed to be fully paperless, though a good number of facilities have some services managed electronically while the rest of the services are handled manually.

Health facilities with EMR in Sub-Saharan African countries include South Africa, Kenya, Tanzania, Uganda, Ghana, Mozambique, Rwanda, Nigeria, Malawi, Guinea Bissau, Cameroon, Congo, Angola, Botswana and Mali [3].

Benefits of EMR in healthcare facilities

EMR greatly improve hospital and clinic efficiency and provide more timely service for patients [2]. Furthermore, the EMR system gives the health-care provider instant access to other clinicians' evaluations, as well as all diagnostic tests. From an academic point of view, the EMR is an excellent tool for big data research through the huge amount of clinical information that is stored in the database [3]. Overall, the EMR is efficient, secure, and readily accessible to staff and to patients.

The state of electronic and computerised medical records in Tanzania

Tanzania is a developing country that is trying to provide basic health care to its citizens. The country has private and government health facilities from the level of Dispensaries, Health Centres, District Hospitals, Regional Hospitals and Referral Hospitals.

The Tanzania National eHealth Strategy, which was released in 2012 by the Ministry of Health, described various plans which were being implemented regarding electronic and computerised medical records. The Ministry of Health also developed the Tanzanian Health Enterprise Architecture (THEA) to guide the development of the national integrated Health Information System (HIS) [4].

The Tanzanian Government under the Ministry of Health used the THEA to design a hospital system called Electronic Facility Management System (eFMS), which is going to be implemented in all government hospitals in Tanzania, except the hospitals which currently have stable computer systems. eFMS has already been deployed in some hospitals like the University of Dar es Salaam Health Centre, Kigamboni Health Center and Mirembe Hospital. Deployment to the rest of the hospitals throughout the country is in the planning phase.

The goal of the eFMS is to centralise the information from all government hospitals to the Ministry. That means if they need to know the number of patients suffering from malaria this month, they can access that information easily and respond according to the results. Effectiveness and efficiency are targeted to be improved through eFMS in providing patient care by improving communication between care providers [4].

MNH was not identified as a target of this plan as an electronic hospital management system (HMS) had previously been implemented and is meeting the requirements set by the Ministry of Health. The MNH electronic system continues to be a success as it was planned and implemented very well and it continues to receive support from users.

The MNH Systems Administrators shared ideas with the developers of eFMS to modify the emergency-specific content. This collaborative approach ensured the foundations of EMR were able to be applied nationwide.

Developing an Emergency Department Information System (EDIS) implementation plan for Muhimbili National Hospital's emergency centre

Origin of the idea

Externships and emergency conferences attended by EC staff accelerated the awareness of having an EMR, as they could understand how it would simplify patient care provision and aid in data collection for various references. During these externships, some of the hospitals in the USA had a similar flow of patients as the Emergency Medicine Department of Muhimbili National Hospital (MNH), Tanzania. This included Emory University Hospital, which had similar flows of patients involved in Trauma, Psychiatry and Paediatric specialties.

The idea of deploying an EDIS for the EC was initiated by Abbott Fund Tanzania in 2012. It was very difficult to get an EMR which suited the EC patient flow due to the fact that there are more than five areas that patients could move through in the emergency centre. Various EMR vendors were contacted to review the flow and other user requirements, in order to design a system which fitted the EC.

The Wellsoft Corporation from the USA was given the contract and dedicated themselves to implementing their EDIS.

Participants

Many people were involved in all the stages of the EDIS implementation. The ICT Directorate from Muhimbili National Hospital provided human resources, Abbott Fund Tanzania provided project funds, the Wellsoft Corporation were the EDIS owners, while Napier were the developers of the HMS that was being used already and EC stakeholders were engaged in defining the scope of the EDIS. Administrative and technical scope were defined and were clearly understood by all parties.

Description of the implementation process

Preparation

The IT Project Plan was developed to make sure steps were followed for EDIS implementation to take place (Figure 1). The project plan included IT plan documents, specific user requirements, development of a Memorandum of Understanding document and user manual documents. All these documents laid out a clear picture of what should be done during the EDIS implementation. This preparation was a collaboration between the Systems Administrator based in the EC, the Wellsoft Corporation team in America and the Napier team from India.

The MNH team started by evaluating the existing devices to understand if they suited the EDIS needs. A good number of computers

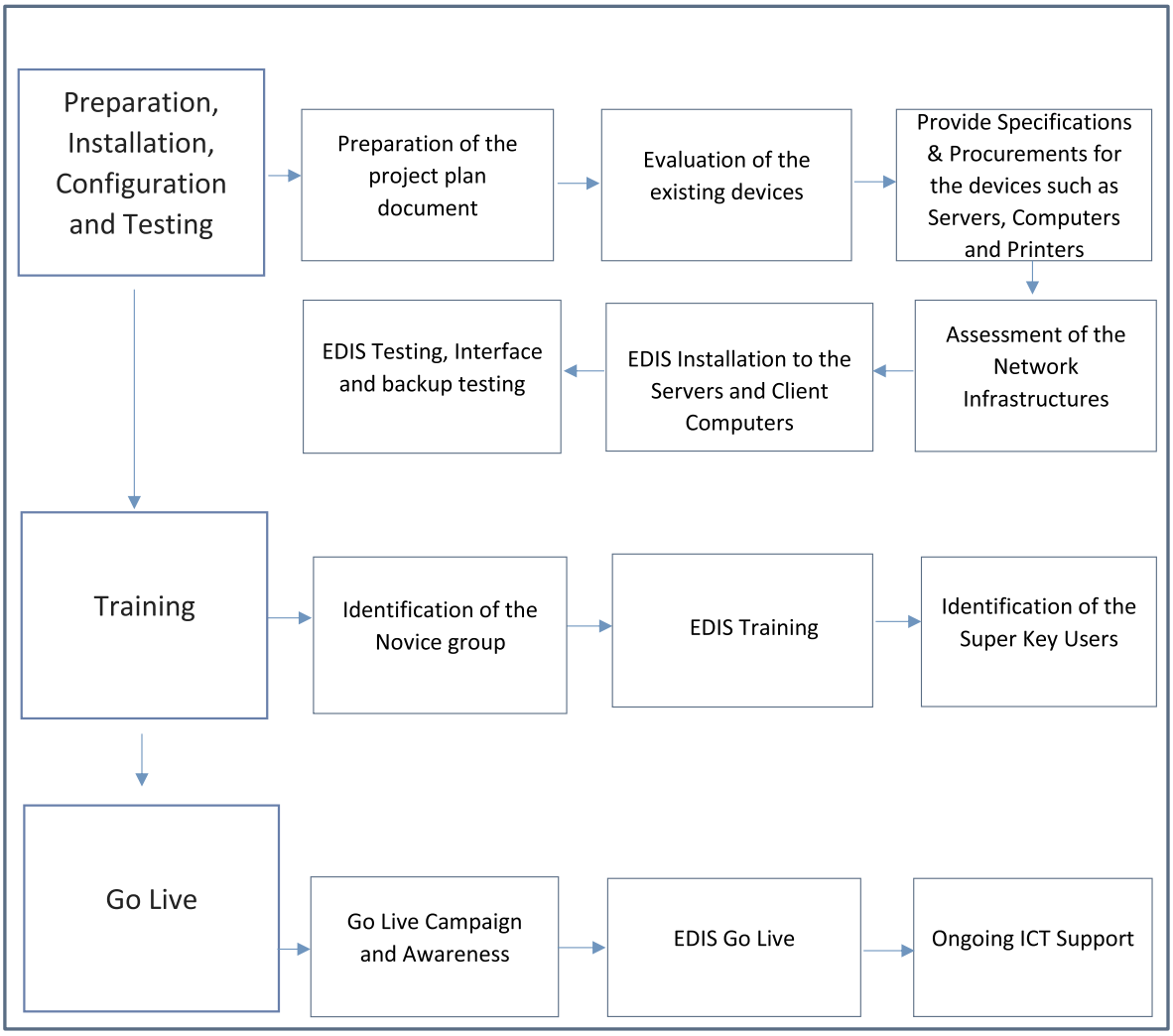

Fig. 1. Process map for EDIS implementation.

supported old versions of software and could not work properly with the new system. Abbott Fund Tanzania procured more than 60 new computers and phased out all old ones.

The Wellsoft Corporation stated the kind of server machines needed for EDIS to run through. They provided specifications for the database server, interface server, storage server and heavy duty printers.

The EMD Systems Administrator assessed all the IT infrastructure, such as Local Area Network (LAN) connections and identified that they were not well structured. Corrective maintenance was performed to correct all errors on the LAN infrastructure. This corrective maintenance gave the opportunity to connect more computers to use for the EDIS.

EDIS installation and configurations

The EC ICT team started the server's Windows installation and configuration. Various network policies were configured to the procured servers. For example, the servers were connected to the hospital firewall to ensure a high level of security. Next, the remote access connection was established so the Wellsoft team could start installing EDIS remotely. The computers placed in the respective areas of the emergency centre were configured specifically according to the needs of that area. For example, the default display in the resuscitation rooms was different to the default display in the treatment rooms.

At the same time, the Napier team were developing the interface to allow system communication between EDIS, HMS (Hospital Management System) and biomedical machines. The interface between EDIS and HMS specifically needed to share information regarding registration, billing and patient test results.

All members of the team had weekly Skype call meetings to provide updates on the progressing tasks. These meetings involved the EC ICT staff, the Wellsoft team and Napier team. Issues, progress and rising matters were discussed at these meetings and other tasks were assigned according to the nature of problem.

Testing

Before deploying any system software, all system requirements should be tested thoroughly in a designated testing environment which should be the same as the production environment [5].

EDIS testing was based on making sure that the application could run in the prepared environment as targeted. They tested the workability of the database as well as the modules which were going to be used by the providers. All these were tested remotely by the Wellsoft team.

The Napier team did the general interface testing. It included the testing of laboratory and radiology orders and it was performed in two sections: first, there was testing to making sure that orders can cross through the interface from EDIS to HMS for billing processes. Secondly, there were tests performed to make sure results could come to EDIS

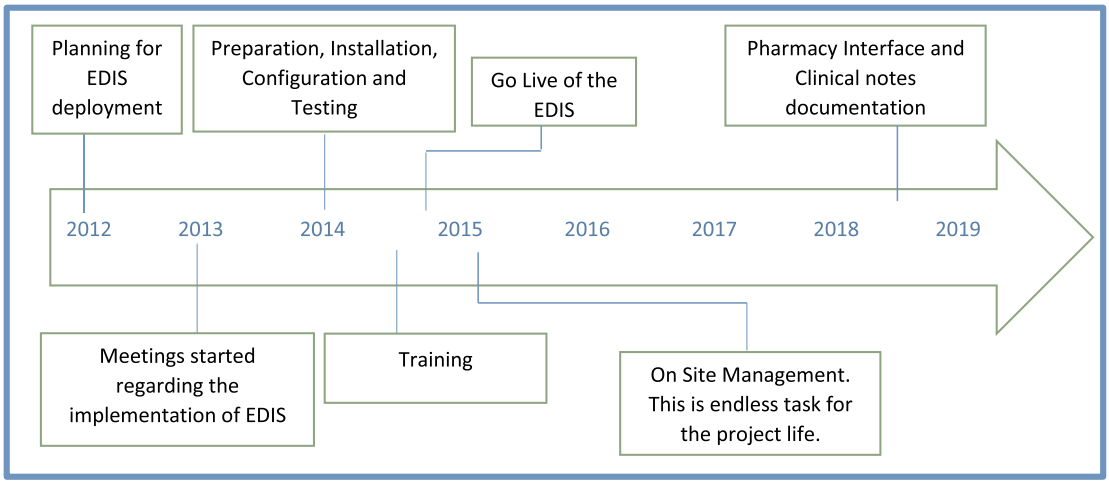

Fig. 2. Timeline of emergency centre EDIS implementation.

from HMS.

Backup system testing was another interesting part of testing, as the EDIS database and its interface needed to be backed up. Technically there were difficulties in attaining the needs of backup as intended. This led to investigation of various kinds of backup systems in order to have a wide selection to choose from and to be able to select the one which was going to suit our needs.

Symantec Exec Backup Company spent a good number of days with us to make sure that the backup needs were managed. In the beginning, we installed a backup product released in 2010, but by the time of Go Live there was another version which had been released in 2015. So this had to be updated.

Apart from those big parts of testing, we had another good amount of testing on minor parts of the system. For example, we tested workstations to check if they could connect to the EDIS application with the expected speed.

Training

Before Go Live of any software system, training is the critical part which should be performed to support the software activities [6].

There were a good number of providers who were not even aware of the normal use of a computer. Training was scheduled to train providers about basic computer skills, before training them in the use of the EDIS. Training was scheduled according to the carders and from each carder we identified the number of people who needed training on basic computers.

We prepared the computer classroom, which handles 20 students per session. We trained basic computer skills during the morning sessions while afternoon training was on the use of EDIS. We had three facilitators who passed by each student and helped them accordingly. There were very few slides prepared for presentation, as practical application covered the skills required for the training.

We had live scenarios for practicing how the system would behave. In the class, we designated different staff members to be patients, recorders, doctors, nurses, health attendants, social workers, cashiers and specialists. Everyone in the class participated in each position to give them an understanding of the way we were going to computerise our normal patient flows.

We decided to install EDIS test environment in all computers in the emergency centre for people to practice on, after they had classroom training and before Go Live. Sometimes facilitators were passing through the rooms to see the way people were practicing and provide support for those who requested it.

Super key users were identified among the staff during the training and were used to help others become trained on the use of the system. The aim of having super key users was to handle all small matters the users may have had during the go live phase. Fifteen super key users were obtained for nurses, five for Health Attendants and five for Physicians. EM Specialists had no super keys because it was very easy for them to manage the process, as their tasks were less complex.

Go Live

All emergency centre administrators (Head of Department, Business Manager, Social Work Head, Quality Officer, EM Specialists & Chief of Nursing) were good candidates to champion the process of Go Live. They were already predicting that the EDIS would make a positive impact.

We got two vendor representatives from the Wellsoft EDIS Corporation. They came one week before the Go Live date. One among those two was dealing with refresher training for the ICT administrators and super key users. Another one was dealing with system checking, to see if it was running smoothly, as intended. Both of them had a checklist which guided them to manage the Go Live process, according to their previous experiences.

Go Live awareness was championed during every morning meeting, for doctors and nurses. They reminded themselves the EDIS was going to be launched soon and that everyone should be ready for that. This encouraged some of the staff to go to the EDIS test environment to refresh their minds on how to use the EDIS.

We created one-page flyers for each cadre, which showed the steps of what should be done. The flyers were placed in each room and all staff passed through them once they were free.

The Go Live was originally planned for March 2015 but the infrastructure for the EDIS to run through could not support the plan and interface testing had not been completed in some parts (Fig. 2). The Go Live date was changed three times to ensure the EDIS was functioning as expected and then finally the date was set at November 19th, 2015.

The EDIS Go Live managed to happen on November 19th, 2015. All emergency centre staff demonstrated maximum collaboration during the Go Live week. There were no technical issues which arose during the week and all ICT leads required full-time (24/7) presence. Providers needed help and reminders on how to use the system, and this was given by the super key users.

Challenges and successes

The challenges before and after implementing the EDIS, together with the lessons learnt, are explained in Table 1.

Table 1
Challenges and successes.

Before EDIS implementation	
Challenge	Lesson
Power issues - despite having one of the most reliable electricity supplies in the country, the hospital power went off too often for a functional EDIS.	Constant, regulated power supply is needed. This necessitated the installation of an automatic generator and uninterruptible power supply devices for all computers.
It was very hard to convince aged staff to use computers in providing patient care. Some of them requested to shift to another department due to EDIS introduction.	We assured them it was very simple to use EDIS to provide services and that we would support them step by step until they understood it well.
Providers were primarily a very novice group of computer users. Many providers in our emergency centre had little to no computer experience.	Many staff needed to be taught both basic computing skills and EDIS specific tasks in the trainings.
Computers were being damaged.	People were not aware of correct use of the computers. We trained them and emphasised the importance of caring for the equipment. For example, no liquids near the computers.
Improper re-allocation of computers and equipment.	Introduction of computer cabinets, naming the computer according to the room and using cable ties to connect keyboard and mouse secured the devices in their locations.

After EDIS implementation	
Challenge	Lesson
Limited human resources for IT support.	A plan for 24-hour IT support is necessary when the emergency centre depends on an EDIS. This needs to be in place full time, not only during the initial roll out.
Quality of clinical note documentation. Some users do not provide enough documentation.	Specific templates or 'hard-stops' are necessary to ensure adequate minimum documentation. However, even with these, clinical notes are often brief and we are searching for mechanisms to improve this.
Trained staff shifting to other hospital departments.	Discuss with hospital management the importance of retaining trained staff.
New staff frequently arriving at the EMD requiring EDIS training	A lot of time is required to teach new staff entering the department. An efficient method of teaching must be established.

EDIS, Emergency Department Information System; IT, information technology.

Successes

- The EDIS Go Live did not affect the emergency centre's normal routine because what staff did on papers was simply shifted to the computers. Extra staff were added to make sure patients were attended to timeously and they received the same level of care.
- Having super key users helps to empower staff, consolidates their knowledge and shares the workload.
- We trained more than 300 staff who are currently using the EDIS system to provide the best quality of health services.
- EDIS improves the financial status of the emergency centre. The system has the ability to record all orders, medications and supplies used for a specific patient and ensure they are billed correctly before moving from the emergency centre.
- Number of research increases due to availability of information.
- EDIS improves the efficiency of clinical practice in many ways. For example, during triage, patients who need emergency care are identified easily according to the triage template designed by the EDIS. And now all patients have medical and nursing clinical notes in their files.

Current state of EDIS in the emergency centre at MNH

Staff are using the EDIS every day in their practice and are constantly sharing ideas for improvement and how to make it more user friendly. Refresher trainings have commenced to ensure staff are using the EDIS to its full potential and assess their level of understanding of the system. The EDIS is meant to be a live tracking list of patients in the emergency centre however, there are still some issues with delay in disposition of patients from the system.

Ongoing ICT support is available in the emergency centre to troubleshoot daily user issues, further customise the system, watch and update the servers, clear viruses and to make sure back-up systems are working. Technical calls with the EDIS vendors are still going on to support the Systems Administrator to advance the system.

Future plans

These are the phases which are planned for implementation, to continue making the EDIS simple to use. The current phases are as follows:

- *Documentation Templates*
  Currently all clinical notes templates are free text which means all documentation is written by doctors and nurses on a free pane.
  We have already placed more than 148 templates on the testing environment for providers to review. The templates are for both medical and nursing clinical documentation. Our teams are reviewing these to see if the templates will suit our needs and patient flow.
- *Pharmacy Interface*
  We have already started to discuss the way forward in implementation of the pharmacy interface.
- *Teaching for interns and new staff*
  There is a plan to create video tutorials for new staff to read themselves before starting work in the emergency centre.

Recommendations

Hospitals in low-resource settings considering the implementation of an EMR should ensure that a comprehensive plan for the implementation is in place that involves significant staff training, the improvement of existing, or installation of new information technology systems, and a plan to fund unforeseen issues and ongoing maintenance.

Discussion

The most important things to consider during the EMR implementation in countries with a low level of resources are as follows:

- *Establish needs*
  The hospital HMS did not keep the patients' clinical notes, point of care services, prescriptions or track the flow of patients. Any EMR deployed should answer the user questions in order to meet their needs.
- *Training*
  This is a continuous process. It must be conducted before the go live of the system and can be conducted if any changes are made to the system. On our site, we had super key users who were used as the champions to assist others before contacting the ICT team.
- *Go Live*
  This should be campaigned in order to create awareness among the users. In our experience, all staff were aware of the way the EDIS was going to work which helped to solve most of the problems, as they had already been addressed. Even the staff who had completed their shift remained to see and assist with what was happening during the Go Live.
- *ICT expertise*
  These staff are the backbone before, during and after implementation. Though we had a limited number of ICT staff, we managed all ICT issues that needed to be covered. We trained all staff and ran the Go Live processes. Currently we are looking at the issues arising and providing solutions accordingly.

Conclusion

Despite challenges in both human resources and technical computing systems, the emergency centre successfully initiated the use of a comprehensive EDIS. Success was due to thorough planning, dedicated team members and support from facility management, funders and computer systems developers. Engagement of the staff was crucial as this was a huge change and by involving them throughout the planning and implementation phases, they accepted the change easily.

Training was received in a very positive way by the staff and this motivated the implementation team. It encouraged them to push forward and ensure the Go Live happened.

Having an EDIS has greatly improved access to data and many reports are generated to understand the demands within the emergency centre. This data access has also allowed many research projects to be undertaken, as data collection is simple, fast and accurate.

The EDIS has now been in the emergency centre for more than three years and continues to be an area of development. Staff can see how the EDIS is beneficial and are now developing the way it is used, to streamline their workflow. Continuous ICT support allows for EDIS customisation according to the changing needs of the emergency centre.

Lessons learned from our implementation at MNH can be instructive to hospitals in low-resource settings considering implementing EMRs or EDISs.

Dissemination of results

This article has been shared to with all levels of administrations from MNH, Abbott Fund Tanzania and Wellsoft prior to publishing.

Authors' contributions

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: SV, SS and TFB contributed 20% each; LW contributed 19%; HS contributed 6%, JM contributed 3%; NL contributed 5%; BM

contributed 8%; UG contributed 4%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Conflicts of interest

Dr Hendry Sawe is an editor of the African Journal of Emergency Medicine. Dr Sawe was not involved in the editorial workflow for this manuscript. The African Journal of Emergency Medicine applies a double blinded process for all manuscript peer reviews. The authors declared no further conflict of interest.

Acknowledgements

The contributors would like to acknowledge Abbott Fund Tanzania, Muhimbili National Hospital, the Emergency Medicine Association of Tanzania, the Benjamin Mkapa Foundation and the Emory University Team for their contributions in this study.

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