ORIGINAL RESEARCH

Implementing Electronic Surgical Registries in Lower-Middle Income Countries: Experiences in Latin America

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BACKGROUND: THE NEED FOR DATA

Trauma is a leading cause of morbidity and mortality worldwide, with more than 90% of deaths caused by trauma occurring in low- and middle-income countries (LMICs).[1] Trauma quality improvement programs, based on data and evidence, have the potential to decrease injury-related deaths in LMICs by more than 30%, according to 1 global analysis.[2] The current limitation to this evidence-based approach to trauma care improvement is that many LMICs do not have programs for injury surveillance, and consequently these hospitals lack the ability to design quality improvement initiatives based on clinical data from their hospitals. Although there have been several successful examples of trauma registry implementation in LMICs, there is still great disparity in the number of trauma registries in LMICs compared with high-income countries.[3] To this end, a recent consensus statement from 3 world trauma organizations called for the need for injury surveillance programs that are directly linked with data-driven quality improvement initiatives.[4]

We describe our on-the-ground experience with implementing a hospital-based electronic trauma and emergency surgery registry in 2 urban Latin American hospitals in Guatemala and Paraguay. The tablet-based application, the electronic Trauma Health Record (eTHR), has been previously implemented in a large South African hospital in Cape Town, with more than 15,000 individual trauma patient health records recorded in this hospital-based registry since its implementation.[5] The eTHR was implemented by installing tablets with wireless Internet throughout the areas of the hospital where trauma patients are received and cared for, and training surgical providers, including surgeons and surgical trainees (residents, medical students), in data entry using the application. The implementation of the eTHR in South Africa has resulted in several important deliverables in terms of public health and injury surveillance. Nearly 10,000 consecutive admissions were analyzed to define demographic and injury risk profiles of trauma patients presenting to the hospital in order to guide future trauma prevention efforts.[6] Injury scoring in the high-volume trauma center in South Africa has also been found to be reliable and sustainable with the support of the mobile health tool, eTHR.[7] Finally, the eTHR has also enabled study and assessment of surgical trainees in the hospital, demonstrating the potential of registries to not only better understand burden of disease and clinical outcomes but also the impact of training and education on deliverables.[8]

The eTHR was intended to be a hospital-based, clinician-operated electronic health record tool, designed based on the paper patient health record, to capture the essential elements of the trauma

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patient admit note, operative note, and discharge summary. The ultimate goal was the creation of a user-friendly tool that diminishes the time and effort required to generate medical records, while at the same time capturing in real-time the clinical data required for a registry. User-friendliness was assessed through testing iterations of the electronic application with trauma care physicians before implementation in South Africa.[1] The registry was deemed user friendly because of its superiority in terms of time required to fill (compared with paper charting), as well as the ease of using the tablet-based technology, which is familiar to most practicing young physicians in LMICs.

Since the implementation of the eTHR in South Africa, a new section was added to the application. This section is called ACS, for acute care surgery, which has not been previously implemented in other settings. ACS is designed to encompass patients requiring emergency surgery, which represents a major portion of the global burden of surgical disease.[9] Thus the eTHR now contains both a trauma and an ACS component, in order to conduct injury and disease surveillance for patients who comprise a large burden of surgical disease in LMICs. The registry tool has the capacity to collect up to 200 demographic and clinical variables per patient, such as prehospital information (vital signs, interventions administered in the field, mechanism of transport, geospatial location of trauma), vital signs on arrival to the hospital, types of injuries or disease diagnosis, laboratory values, resuscitation measures, operative interventions and operative complications, intensive care unit stay, and discharge status (Figure 1). For ease of data entry, most questions are either yes/no,

a selection from a dropdown menu (eg, diagnoses or types of operations), or a manual numerical value entry (eg, for laboratory values).

Our experience described here focuses on the logistics, planning, and lessons learned from the implementation of this hospital-based electronic registry tool in 2 hospitals in Guatemala and Paraguay.

IMPLEMENTATION SITES

Two busy, urban Latin American hospitals were chosen as sites of implementation of the eTHR, as part of a grant funded by the Fogarty International Center of the National Institute of Health (NIH). Hospital de Clínicas (HC) is one of the largest hospitals in Paraguay, located in the capital, Asunción, and is affiliated with the National University of Asunción. This hospital caters to a public population and does not receive the trauma patients in the city of Asunción, and thus was chosen to be the pilot site of implementation of the ACS component of the eTHR application. Hospital General San Juan de Dios (HGSJDD) is 1 of the 2 largest hospitals in Guatemala, located in the capital, Guatemala City. This public teaching hospital receives a large volume of patients, including both trauma and emergency surgery, and was chosen to be the site of implementation for both the trauma and ACS portions of eTHR.

LOGISTICS AND PLANNING

Our implementation team conducted 2 preimplementation needs assessment visits to both hospitals in Paraguay and Guatemala before implementation of the eTHR. Logistics included assessing the
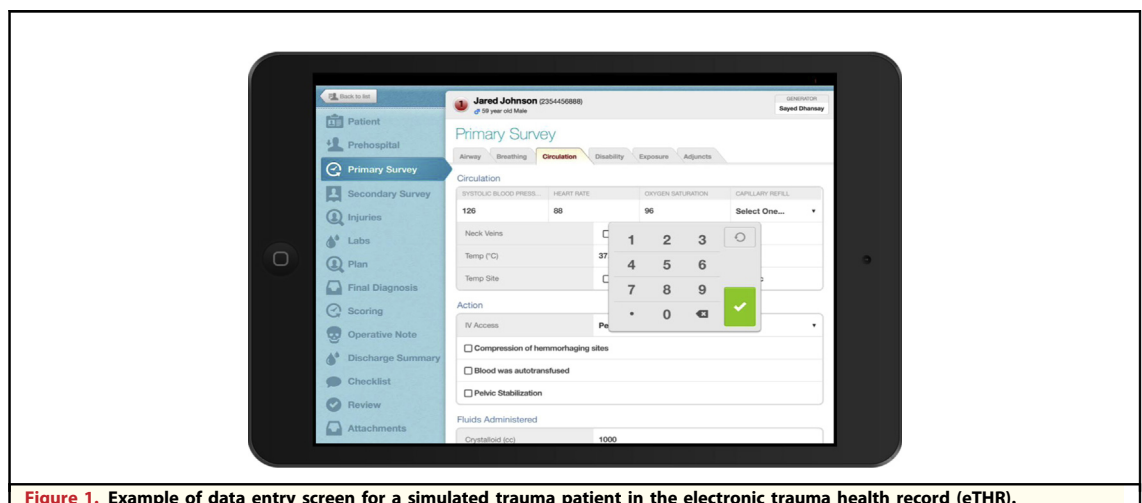
Figure 1. Example of data entry screen for a simulated trauma patient in the electronic trauma health record (eTHR).

locations in the clinical flow of the trauma and emergency surgery patient's hospital course where paper clinical charting takes place, in order to evaluate where the tablets needed to be installed to facilitate workflow. Internet needs were also assessed. In Paraguay, modems for wireless Internet were installed in locations where the tablets were installed, including the emergency department, operating suite, and surgical patient floors. Based on Internet connectivity problems that we experienced in Paraguay, the decision was made to opt for individual SIM cards with Internet plans for the tablets in Guatemala.

Because the eTHR implementation was designed to eventually replace the paper charting system for the admission, operative, and discharge notes, so as not to burden clinicians with double work of filling out both paper and electronic patient charts, we discussed with local administrators the methods in which the electronic chart would be accepted as a substitute for the paper charts. It was decided that a physical hardcopy of each admission, operative, and discharge note would still need to be physically present in the paper chart, along with all the other nursing and laboratory papers, which would remain in written paper form. To meet this institutional requirement, we installed wireless printers in strategic locations in the hospitals in order for the clinicians to be able to print hardcopies of the admission, operative, and discharge notes to place in the physical patient charts.

Training sessions were held before implementation start dates in both Paraguay and Guatemala in order to train all clinical providers involved in aspects of trauma and emergency surgery patient documentation in how to use both trauma and ACS portions of the eTHR. This included surgeons, residents, interns, and medical students. In Guatemala, prehospital emergency providers who perform a bulk of the prehospital documentation for trauma patients, were also trained. In Paraguay, triage nurses were trained in documentation of the first 2 pages of the ACS patient chart, because they are the ones who begin the patient chart that is later picked up by the surgical resident who sees the patient in the emergency department.

TRANSITION FROM PAPER TO ELECTRONIC CHARTING

One of the largest issues that emerged related to the implementation of this hospital tablet-based registry

application was the consideration that, in order for clinician-driven participation in filling the registry to occur, the need to fill both the paper and electronic charts would have to be eliminated. That is, "double work" was very difficult for residents and care providers to do, given the already pressing time demands in these busy clinical environments. Meetings with hospital administrators and leaders of the trauma, emergency, and surgery services at these hospitals, as well as residents, resulted in several realizations. First, that residents would not realistically be able to fill out both paper and electronic versions of the clinical chart, given the additional time this would take. Hospital administrators at both HC and HGSJDD mandated that a paper version of the form would still need to be present in the chart. Additionally, in both locations, the major concern that emerged was that, if Internet connectivity were to fail, what would happen to the use of the electronic charting? In South Africa, it was decided that cases of Internet failure were the only circumstance in which reverting to paper charting would be necessary. This was agreed on as a reasonable condition at both HC and HGSJDD as well.

In HC, given persistent difficulties with Internet connectivity as a result of the modems, the surgical department eventually decided to hire a registrar to fill the patient charts, because the residents were unable to do so given nonfunctioning Internet throughout the hospital as a result of Internet provider problems that were beyond our control. The registrar has entered more than 300 emergency surgery patients into the registry to date. At HGSJDD, the Internet has not posed an issue because the SIM cards are embedded in each of the tablets. Moving forward with implementation of electronic health record registries that employ tablets, we have learned that the technical method using SIM cards ensures better Internet connectivity than modems when Internet connectivity is an anticipated issue.

LESSONS LEARNED

Our experience with implementing these registries in these 2 hospitals identified several important considerations for introducing hospital-based electronic trauma and emergency surgical registries in LMIC environments. The largest issue that emerged was how unique and hospital dependent the requirements are for the transition from paper to electronic charting to take place. In the case of HC in Paraguay, the surgical department within the hospital recognized the utility and importance of maintaining the registry, such that

the department decided to hire a registrar to enter the patient data. This realization may have not occurred if we did not implement ACS here. One obvious limitation of this approach is that the cost of maintaining a registrar is not a feasible option in many LMIC hospitals. However, at the same time, the cost of maintaining any electronic trauma or emergency surgery registry in an LMIC, moving forward, will require some deliberation regarding long-term cost-benefit considerations, because such initial investment costs can eventually be reduced through data-based quality improvement initiatives that save time and money and improve patient care and outcomes.

This particular initiative was supported through a grant from the National Institutes of Health, with a planned budget of $100,000 per implementation site, including materials (tablets, internet, security devices for tablets), training personnel, and software support. The highest cost in his project was software support, specifically for troubleshooting and customization needed in each country. Based on our experiences, the solution for mitigating this cost in future efforts is to build technical capacity locally, such that there is someone within-country who can provide software and technical support. This would decrease the cost associated with software support coming from out-of-country and allow for more efficient customization as needed per each country and hospital.

We also learned that the implementation of such electronic hospital-based registry tools is a major cultural and workflow shift in the clinical structure of these hospitals. Both of these hospitals, as is common to many LMIC hospitals, had very little to none of their patient medical charts digitized before the introduction of the eTHR, with the exception of laboratory tests uploaded onto an internal server. Hospital administrators and clinical providers alike were both excited and skeptical of various aspects of the application, which required extensive preimplementation meetings, focus groups, and discussions to address the feasibility and acceptance of implementing this tool into the hospital, including potential customized changes that were envisioned to aspects of the electronic chart within each hospital setting.

CURRENT IMPACT AND FUTURE DIRECTIONS

Thus far, the implementation efforts of the eTHR in 2 of the largest hospitals in Paraguay and Guatemala has resulted in several important changes. Both hospital administrations have met with key stakeholders in order to evaluate the societal and clinical need for data surveillance. This also resulted in a presentation to the government of Guatemala, and key political and medical stakeholders in both nations to support such efforts. Several hundred patients have been entered into the data registries, enabling initial surveillance of prevalent trauma and surgical disease presentations in both countries.

Preliminary data analyses reveal that prevalent acute surgical disease presenting in one of Paraguay's largest hospitals is primarily composed of gallbladder disease. In Guatemala, partnership with prehospital emergency providers (ie, paramedic equivalents) has led to the robust collection of vital prehospital statistics that have hitherto not been obtained (Figure 2). Data analysis is currently being

Figure 2. Prehospital emergency care provider in Guatemala entering prehospital data on a trauma patient after arrival to the hospital.

conducted to examine the prehospital presentations of violent injuries in Guatemala, including geospatial mapping of the most common scenes of injury, as well as prehospital interventions. This can guide future resource allocation in resource-limited settings. As further data entry gets underway in both countries, we anticipate that meaningful, large-scale statistical analyses will be possible in order to conduct similar injury and disease surveillance, and ultimately improve clinical outcomes, as has been found in South Africa, where the eTHR was piloted.[6-8]

Our implementation experience showed that in some environments, the use of a registrar, similar to what occurs in many HIC hospitals, may be more acceptable and feasible in terms of introducing an electronic health record into an already time- and resource-limited clinical environment. Furthermore, we found that the individual requirements of both hospitals differed with regard to customized changes that were needed in electronic charts in order to officially replace the paper admission, operative, and discharge notes. Based on our experiences in these 2 hospitals, future consideration may have to be given to whether electronic systems that replace paper charting are more feasible, or whether a shortened electronic form that is populated by a registrar is preferable, which has been done in 2 other Latin American hospitals.[10] These decisions are necessarily dependent on the economic, clinical, and technical resources of each hospital and are important factors to take into consideration in the effort to further develop electronic surveillance for trauma and emergency surgery in LMICs.

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