A LMIC-First Approach to Developing Electronic Medical Record Systems

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Letter to the Editor:

Having spent almost two decades developing electronic medical record (EMR) systems in low- and middle-income countries (LMIC), the inability to quickly design, develop systems and deploy new clinical guidelines remain bottlenecks to successful scale up and continued use. Significant gaps persist in EMR designs for LMIC settings. These gaps result from failure to understand how the environments, models and processes of delivering healthcare in LMICs are fundamentally different from high income countries [1], [2]. Additionally, EMRs are often planned in top-down fashion, driven by an implementers or external funder's vision. EMR systems for LMICs model those used in the global north, requiring heavy text data entry, complex data models, and heavyweight hardware to support. Here we outline a "LMIC-First" approach to designing EMR systems intended for LMICs. This approach considers the EMR system, its environment and how these interact when the system is implemented. The following six themes describe the proposed LMIC-First approach to EMR design:

Democratised EMR Development
EMR implementation in LMICs has mostly followed a project-based approach with independent contractors or implementing partners funded by donors working independently with little-to-no direct involvement from the Ministry of Health (MoH) staff in the host country [3]. While this was done to fasttrack EMR implementation, it has led to reduced country ownership, increased dependency on external organizations, and protracted development cycles, sometimes including transitions between implementing partners and often exceeding donor funding cycles [4]. This approach has led to a graveyard of failed digital health systems where software or hardware breaks lead to their abandonment. Furthermore, reliance on independent contractors increases the risk of 'over-engineered' systems with inherent complexity that requires highly-qualified and specifically-trained technical staff to support and maintain. To reverse this worrying trend, MoH staff must be empowered with EMRs that have easy-to-use, built-in tools for addressing continually changing clinical landscapes and guidelines.

Process- & guideline-centric
Many attempts to build EMR systems for LMIC settings focus on data collection with limited consideration of the care process. Healthcare is delivered through a sequence of physical and mental tasks performed by multiple people in one or more work environments i.e. workflows [5], [6]. The sequences of tasks form the basic building blocks of healthcare delivery and define

the data elements needed to complete and document the performance of an activity. These activities roll up into a care visit where ideally a clinician is presented with information to support best clinical decisions for a patient. Given the complexity of care, workflows further describe the different paths, through one or more branches, for completing an activity. Electronic systems are most beneficial when they help the healthcare provider successfully navigate the care delivery workflow [7]. To provide value for the healthcare provider and patients, EMR systems must prioritise displaying accurate and timely information through well-designed workflows rather than being designed for data collection, billing, and reporting.

Point-of-care

EMRs hold promise for improving the quality and delivery of care when used by frontline healthcare workers during care delivery. Point-of-care use has the dual benefit of supporting improved quality of care through clinical decision support in addition to not requiring additional staff/time to perform data entry required for reporting. Point-of-care EMRs must offer value to clinicians to be used consistently and be designed in a way that does not interfere with care provision.

Touchscreen-first

Touchscreen user interfaces greatly reduce the need for hand-to-eye coordination over traditional mouse and keyboard interfaces and offer an intuitive user experience that facilitates learning and reduces the time it takes to gain proficiency with electronic systems [8]. Software initially designed without a touchscreen user interface may have significant limitations when later adapted for touchscreen [9]. Developing a native user interface around a well-defined set of criteria improves the usability of systems and makes user adoption of the system easier.

Low cost

LMICs have limited healthcare resources. While electronic systems can improve the delivery and quality of care, this cannot be done at the expense of providing essential commodities such as medicine, diagnostic capabilities, or human resources. If the precious resources are to be spent on electronic systems, the total cost of buying and owning the system must be low and show positive return on investment. Furthermore, many EMR projects in LMIC start as pilot projects to assess the feasibility of different systems. Donors frequently pay for demonstration/pilot projects with the expectation that the host country governments will pay for nationwide scale-up and future maintenance of successful projects. However, little attention is paid during design-time to the overall cost of ownership of these solutions and what they entail for the limited resources available.

Low power

Continuous availability of electricity remains a problem in many LMICs and their health facilities [10]. EMRs require electricity, preferably uninterrupted, to function. As such, power backups are essential to ensure uninterrupted service. The cost of power backup can often exceed the cost of the computing hardware when power consumption is not considered. To make economical use of available power during prolonged power outages, low power devices (especially for workstations, servers, and network equipment) are preferable. Further consideration must be paid to the choice of power backups as traditional UPS systems are designed for infrequent and brief power outages unlike the frequent, prolonged outages that are common in LMICs.

We believe careful consideration of these themes will spark a rethink of choices and approaches when developing EMRs in LMICs. We acknowledge that the LMIC-first approach may result in different interpretations and implementations based on the context and the different problems that the implementations address. However, these themes support more careful exploration of creative, innovative, and sustainable EMR solutions that positively impact care delivery processes and ultimately, patient outcomes.

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