


## A NOTE ON END-USER REQUIREMENTS ELICITATION FOR ELECTRONIC MEDICAL RECORDS IMPLEMENTATIONS

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**Abstract:** *This paper summarises the arguments and counterarguments within the scientific discussion on the issue of the implementation of Electronic Medical Records (EMR). The primary purpose of the research is to present a framework for gathering end-user requirements in EMR system implementation. The cross-geographical literature review demonstrates EMR system implementation to be a complicated task to manage. A systematic review of literature sources and approaches for solving the problem indicates that a lack of end-user participation often results in technology rollbacks. The failures to implement electronic medical records are considered to be the reasons for financial losses, followed by the rearrangements of key personnel. The author of the article investigates the role of the main actors involved in the healthcare process. Consequently, as the market adoption of EMRs grows and its impact as a workflow management tool in care facilities increases, focusing on end-user requirements during the implementation phase becomes essential. Investigation of the topic reveals that the opposing points of view, learning investments, and the embedded nature of older technologies deter users from accepting new technology. Methodological research tools involved studying the workflows in a regular outpatient journey. Taking the case of a standard outpatient facility, the paper attempts to present its results through a framework for requirement gathering in the pre-implementation stages. A plan of action for eliciting end-user requirements for the users in a three-stage framework is being proposed. Considering the diverse number of actors in the standard outpatient journey, the three-stage framework breaks down requirements by roles and educational backgrounds and gathers into 1) antecedent or existing conditions; 2) formal and informal communication channels; 3) user and system-generated requirements. This framework relies on synthesising existing frameworks and arranging them in sequential order for real-world implementations based on existing research papers.*

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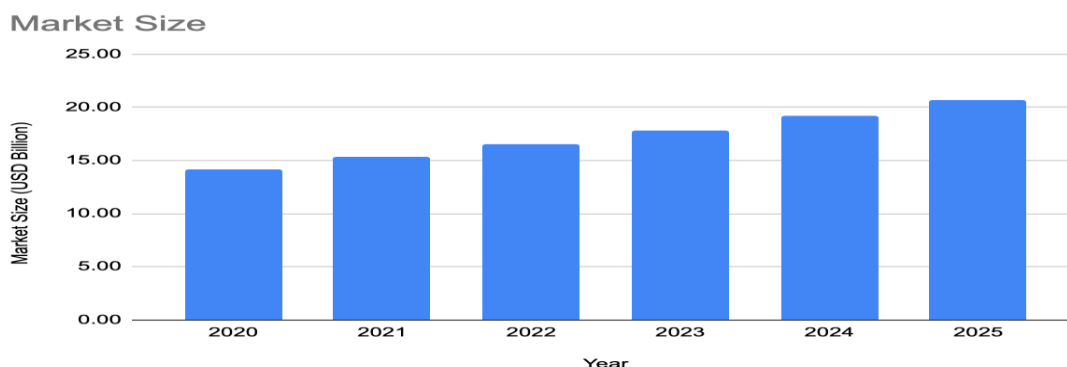
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**Introduction.** In 2011, a large non-profit eye hospital in the Indian city of Chennai decided to implement an Electronic Medical Record system. The management believed that investing in the EMR was imperative for providing evidence-based medicine and improving its customer service. Yet, despite the management’s push, the stakeholders rejected the new technology twice stating a lack of involvement in the project (Scholl et al., 2011; Pharmabiz.com., n.d.).

Three years later, and almost nine thousand miles away, similar issues were observed in the American Province of Georgia. The Chief Executive Officer of its regional Health System was forced to resign over the poor implementation of a large-scale EMR project. After “going live”, complaints about the software were reported to the management of the health system and the implementation was rescinded. Lack of end-user involvement was again the primary reason for the following research papers (McCan, 2014; Perna, 2014; Fetter, 2014; Person, 2014).

In both cases, the implementation failures led to financial losses – followed by technology rollbacks and rearrangements of key personnel. However, these are not isolated incidents. Estimates suggest that up to half of such technology projects are unsuccessful (Keshavjee et al., 2006; Kumar, 2018; Zieger et al., 2012). In particular, these failures are traced to the lack of interaction between the “sociological and technological” dimensions of the organisation. In this context, this paper highlights a framework for eliciting end-user requirements in EMR implementations.

**Literature Review.** Electronic Medical Records. According to the National Cancer Institute, an electronic medical record refers to “an electronic (digital) collection of medical information about a person that is stored on a computer” (NCI, 2022). In a standard care journey, the patient generates several important pivotal data points. Within this journey, EMRs improve the quality of care delivery with the storage and passage of information (Manca, 2015; Kaye et al., 2013). Positive trends in EMR adoption are reflected in the industry too; global adoption of EMR is growing at a compounded annual growth rate of 7.8% to reach an estimated 20.7 billion US dollars by 2025 (Markets and Markets, 2020).



**Figure 1. Trends in EMR adoption**

Sources: developed by the author on the basis of (Markets and Markets, 2020).

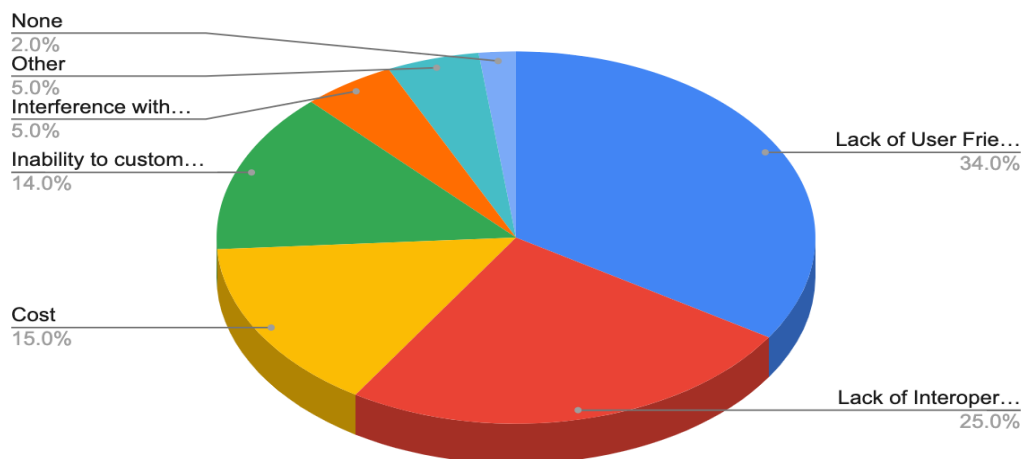
However, as demonstrated by the above-mentioned cross-geographical incidents, EMR implementations are difficult to manage. Actors involved in the healthcare delivery process belong to different backgrounds and perform various critical activities within the organisation – consequently developing different expectations from the rollout of the new technology (Joukes, 2015; SEadmin, 2019).

**Table 1. Healthcare actors and data points in an Out-Patient Journey**

Patient Journey Touchpoint	Example Actor	Example Data
<i>Appointment Scheduling</i>	Front-Desk Operator	Appointment Receipt
<i>Billing</i>	Billing Operator	Bill Receipt
<i>Nursing Assessment</i>	Nurse	Patient Vitals
<i>Consultation</i>	Consultant	Prescription
<i>Pharmacy</i>	Pharmacist	Pharmacy Bill Receipt
<i>Lab</i>	Phlebotomist, Lab Technician, Pathologist	Lab Report/Lab Receipt

Sources: developed by the author on the basis of (Gualandi et al., 2019).

Accounting for these factors, a lack of end-user friendliness is inevitably the major reason for implementation failures. As EMRs are increasingly being used for administrative and operational facilities, there is increased involvement of cross-functional teams in such implementations as well (Schulte, 2019; Cucciniello, 2015). Consequently, comprehensively understanding the end-user requirements in such teams becomes an essential part of implementations.



**Figure 2. Reasons for Crashing of EMR Projects**

Sources: developed by the author on the basis of (Prasad, n.d.)

Conventional Approaches and Sociological Approaches to Implementations. Aarts et al. (2022) note that conventional approaches categorise implementations as purely technology-based play. In such approaches, pre-defined deliverables are set up for implementation early on in the life cycle – periodically being audited through documented evidence. In several instances, these deliverables are decided by the management and are independent of the organisational setting. Within this context, change management in the organisation is enforced through training and conversion strategies (Hanken et al., n.d.).

However, such conventional approaches are criticised for ignoring the perspectives of the end-user and for not accounting for organisational differences. Within the context of healthcare organisations, different actors can share divergent beliefs on a topic (Nielson et al., 2014). For the actors, subjective, cultural and interest-based understandings of “abstract categories” and “patterned causal relationships” lead to competing visions for the use of the particular technology (Cresswell et al., 2010).

**Table 2. Approaches towards Implementation**

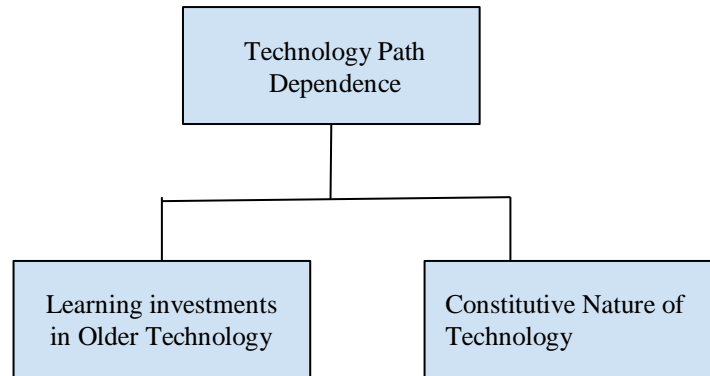
Approach	Explanation
Technology-Based Approach	<i>Conventional Approach</i>
	Top-down implementation based on management goals. Goals informed (Hanken et al., n.d.)
Cultural View	<i>Sociological Approaches</i>
	Implementations informed by pre-existing, interconnected, networks of people, processes and tools.
	Implementation prioritizing subjective priorities of the end user. Priorities informed by cultural factors and technological artifacts critical to the workflows. (Cresswell et al., 2010)
Social Constructionist View	Implementation informed on the previously adopted technological path. (Bernstein et al., 2005; Mehrizi, 2019)
Institutionalist View	

Sources: developed by the author.

The implementation process is also influenced by existing technological artefacts. Work sites present a complex interwoven relationship between “people, tools, organisational routines, documents” (Pentland and Fredman, 2005). Berg (1999) notes that if these artefacts are removed, work practices lose their smoothness.

Since these tools are so critical to the functioning of the actors' day-to-day life, end-users accept the sunk costs of the failed implementation to revert to the older technology.

The success of new implementations also depends on the efforts made by the user in adapting to an older technology. Arthur (1994) states that Complex technologies result in significant reorganisation for the workers. Learning investments made in previously used technologies impact the implementation of new technology. As a result, the processes get locked in and become difficult to reverse.



**Figure 3. Predominance of older technology**

Sources: developed by the author.

**Methodology and research methods.** Based on the literature review, this paper proposes an actor-centred framework for setting up EMR implementations. It identifies all the actors involved in the patient journey, and lists their preferences according to the different phases of EMR implementations.

Although EMRs primarily perform clinical functions, they allow for the passage of critical information across multiple domains. Moreover, EMRs increasingly include administrative and operational tasks. As a result, including multiple perspectives at the implementation stage is essential for ensuring EMR's success (Greenhalgh et al., 2009; Takian et al., 2012).

EMR implementations can be further analysed using pre-implementation and post-implementation frameworks. Pre-implementation tools include needs assessment, assessment of current workflows, assessment of the readiness of EMR, and assessment of the impact of change (Ghazisaeidi et al., 2014). Needs assessment refers to the evaluation of project goals. Assessment of current workflows refers to the study of existing processes. Assessment of the impact of change measures the difference between the current and future scenarios.

On the other hand, the post-evaluation framework focuses on system qualities, information quality, service quality, system usage, user satisfaction, assessment of quality and usage (Lau et al., 2007). System qualities gauge the usability of the EMR. Information qualities evaluate the quality of data movement. Service quality assesses the vendor's responsiveness after implementation. System usage monitors the usage characteristics of the users and user satisfaction refers to the fulfilment of the goals of the users.

Pre-Implementation	Post Implementation
<ul style="list-style-type: none"> <li>• Needs Assessment</li> <li>• Readiness Assessment</li> <li>• Assessment of Current workflows</li> <li>• Change Implementation</li> </ul>	<ul style="list-style-type: none"> <li>• System Qualities</li> <li>• Information Quality</li> <li>• Service Quality</li> <li>• System usage</li> <li>• User satisfaction</li> <li>• Assessment of quality and usage</li> </ul>

**Table 3. Pre- and Post-Implementation Tools**

Sources: developed by the author.

This paper focuses on the pre-implementation phase. It proposes a unique three-stage framework for mapping and eliciting end-user requirements. The ordering of the stages is based on a deductive philosophical approach of moving from general to specific concerns.

**Results.** Considering the diverse number of actors in the standard out-patient journey, this section outlines the end-user perspectives by breaking them down into their expected requirements by roles and educational backgrounds. Then, it proposes a plan of action for eliciting end-user requirements for the users in a three-stage framework inspired by existing literature.

**Table 4. Pre-Implementation Stage for Eliciting End-User Requirements for the Users**

<b>Actors</b>	<b>Job Requirements</b>	<b>Educational Backgrounds</b>	<b>Expectations from Software</b>	<b>Facility Specific Expectations</b>
<i>Front Office Staff</i>	Computer usage, scheduling workflow, technology usage, work environment,	Mixed education backgrounds; Healthcare Management, Accounts.	Data movement from registration to billing, appointment booking, scheduling, results viewing, decision support, reporting	To be understood and mapped.
<i>Billing Staff</i>	Computer usage, billing workflow	Secondary Schooling; Diploma in healthcare Billing	Data movement from registration results viewing, decision support, reporting	To be understood and mapped.
<i>Nurse</i>	Computer Usage, workflow for clinical assessments	Diploma, Bachelor or Master's in Nursing; Professional certifications.	Data Movement from registration to assessment; quality of information; clinical ease of use; results viewing, decision support, reporting	To be understood and mapped.
<i>Doctor</i>	<p>Keep up-to-date patient medical records that include all assessments, prescriptions, treatments, allergies, test results, and other information.</p> <p>Assess the patient's symptoms to decide the best course of action for treating them.</p> <p>Inform patients of all potential dangers, problems, and interactions with any other medications they may be taking while prescribing pharmaceuticals in accordance with local, state, and federal laws.</p> <p>To guarantee complete compliance with laws and that the existing care programme is as efficient as possible, supervise and evaluate medical assistants.</p> <p>To help patients make informed decisions and take appropriate care of their health, consult with them on matters like healthy nutrition, exercise, and hygiene.</p>	Medical school, Residency, License, board certifications	Issuing of Medication orders, lab orders, prescriptions; results viewing, decision support, reporting	To be understood and mapped.

**Continued Table 4**

<b>Actors</b>	<b>Job Requirements</b>	<b>Educational Backgrounds</b>	<b>Expectations from Software</b>	<b>Facility Specific Expectations</b>
<i>Office Manager</i>	Hiring and monitoring staff performance; liaising with insurance providers, taking payments, and addressing client issues	Mostly management or business degrees; on the job training for most graduates.	Viewing practice analytics, Managing Users, managing customer relationships; results viewing, decision support, reporting	To be understood and mapped.
<i>Lab Technician / Phlebotomist</i>	executing experiments, collecting data, and carrying out fundamental studies guaranteeing the appropriate operation of laboratory instruments and equipment by adjusting, calibrating, and testing it washing and sanitising the workspace and the tools identifying and preparing biological material for preservation or analysis keeping thorough records of study findings buying and storing up on lab supplies	Minimum requirements: Lab technicians high school diploma  Industry standard: Associate's Degree in Laboratory Science or Lab Sciences Bachelor's Degree	Receiving Lab order workflows, Bill Receipts, inventory management; results viewing, decision support, reporting	To be understood and mapped.
<i>Pharmacist</i>	Receiving and taking medications and completing them discussing patients' health and drugs with medical professionals receiving symptom reports from patients and recommending over-the-counter drugs Making sure that the right medications are precisely measured, prepared, and given to the patients who require them Managing the inventories	Professional Certifications: Pharmacists: Pharmacy degree before they are allowed to practice;  Requirement of professional certifications in some cases.	Receiving Medical order workflows, Bill Receipts, inventory management; results viewing, decision support, reporting	To be understood and mapped.

Sources: developed by the author on the basis of (Choat, 2005; *Careers and occupations*, n.d.; Perrotta et al., 2016).

Framework for Mapping Facility-Specific Requirements. Based on Green (2020), this paper suggests the following framework for requirement gathering for a set of diverse users at the first stage. This first stage focuses on antecedent conditions and on the philosophical basis of EMR implementations. Appropriate methods of collecting data at this level could involve surveys and focus-group interviews.

**Table 5. The First Stage for Eliciting End-User Requirements for the Users**

- |  |
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| <ul style="list-style-type: none"> <li>● Purpose of EMR: The underlying intention of adopting the new technology.</li> <li>● Users of EMR: Understanding who will be the primary users of the EHR.</li> <li>● How Can EMR Improve workflows: How can the adoption of EHR improve workflows?</li> <li>● Background and conditions of Patients: Comprehending the demographic and clinical background of patients.</li> <li>● Research Existing Hardware: What are the hardware tools being used in the facility?</li> <li>● Compliance Documentation: What documentation tools would be required for adopting the EMR?</li> </ul> |
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Sources: developed by the author on the basis of (Green, 2020; *EHR*, n.d).



The second stage focuses on the implementation of the informal workflow and communication channels within the practice. Informal channels typically involve actions that are not a part of the software.

The idea of focusing on informal channels at the second stage is to understand whether formal and informal channels align in theory and in practice. Data collection at this level can be carried out through ethnography-based methods.

**Table 6. The Second Stage for Eliciting End-User Requirements for the Users**

- Communication channels: Understanding how users communicate with each other within the practice, and how that can be integrated into the technology.
- workflows that are not necessarily standardised: Seeking information on how some users are able to perform their tasks more efficiently

Sources: developed by the author.

Once the philosophical goals and the existing informal work channels are understood, the framework suggests the mapping of the User requirements and the system requirements (APA Committee on EHRs, 2012). User requirements refer to the software modules used by users in daily activities, whereas system requirements refer to the backend logic of the software. Data collection in this stage can be through an in-depth study of existing tools in relation to the actors' activities. The idea of proposing a final mapping of user requirements and system requirements is to synthesise the data collection from stage I and II and map it in actionable form.

**Table 7. The Third Stage for Eliciting End-User Requirements for the Users**

- Field Mapping: Unit Level data fields for maintaining data quality through the transition.
- Function Mapping: Mapping the specific steps involved in each workflow.
- Workflows with different settings: Counting workflows with different configurations.
- Sequential Ordering of Requirements: Arranging requirements in an order of what needs to be completed first.

Sources: developed by the author on the basis of (APA Committee on EHRs, 2012)

**Conclusions.** In conclusion, this paper recommends an actor-oriented framework for eliciting and mapping end-user requirements. This framework relies on synthesising existing frameworks and arranging them in sequential order for real-world implementations based on existing literature.

**Conflicts of Interest:** Authors declare no conflict of interest.

**Data Availability Statement:** Not applicable.

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#### **Коментар щодо виявлення вимог кінцевих користувачів до впровадження електронних медичних записів**

У статті узагальнено аргументи та контраргументи у межах наукової дискусії з питання впровадження електронних медичних записів (ЕМЗ). Основна мета дослідження полягає у представленні системи для збору вимог кінцевих користувачів при впровадженні системи ЕМЗ. Результати міжкраїнового аналізу джерел літератури свідчать, що впровадження системи ЕМЗ є складним завданням в контексті управління. Систематичний огляд літературних джерел та підходів до вирішення проблеми вказує на те, що відсутність участі кінцевих користувачів часто призводить до технологічного регресу, а невдачі у впровадженні електронних медичних записів вважаються причинами фінансових втрат, що супроводжуються змінами у кадровому складі основного персоналу. Автор статті досліджує роль основних осіб, залучених до процесу надання медичних послуг. Отже, зі зростанням впровадження ЕМЗ на ринку та збільшенням їх впливу як інструменту управління робочими процесами в медичних установах, необхідним стає зосередження уваги на вимогах кінцевих користувачів на етапі впровадження. Дослідження зазначеної теми показало, що наявність протилежних точок зору, інвестиції в навчання та вкоріненість старих технологій стримують користувачів від прийняття нових технологій. Методологічний апарат дослідження передбачає вивчення робочих процесів, пов'язаних зі звичайним амбулаторним візитом. На прикладі стандартного амбулаторно-поліклінічного закладу в роботі зроблена спроба представити результати дослідження за допомогою системи збору вимог на етапах, що передують впровадженню. Пропонується план дій для з'ясування вимог кінцевих споживачів до користувачів в межах триетапної моделі її реалізації. Враховуючи наявність кількості учасників стандартного амбулаторного процесу, триетапна модель розподіляє вимоги за ролями та рівнем освіти і об'єднує у такі групи: 1) попередні або існуючі умови; 2) формальні та неформальні канали комунікації; 3) вимоги, що генеруються користувачами та системою. Модель розроблено на основі синтезу існуючих моделей та упорядкуванні їх у послідовному порядку для її реалізації за реальних умов, заснованих на існуючих дослідженнях.

**Ключові слова:** електронні медичні записи, цифровізація, інформаційні технології в галузі охорони здоров'я, кінцевий користувач.