



Original Research Article

Impact of Emergency Department Information System on Patient Tracking and Clinical Documentation

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ABSTRACT

Background: Emergency Department Information Systems (EDIS) – an extension of Electronic Medical Records (EMR) – have the potential to completely transform emergency departments (ED). This article evaluates the impact of EDIS on operational and clinical workflows.

Objectives: The primary objective of this study was to evaluate the operational improvements from EDIS adoption, specifically the automated capture of time-efficiency metrics and electronic clinical documentation. The secondary objective was to analyze the level of satisfaction in the adopters of EDIS.

Methods: This was a comparative study conducted in a Level V ED in India. Primary data was captured through an open-source EDIS stack. Parallel paper-based legacy processes were compared in a time-motion study. Time-efficiency indicators of quality of care were extracted and analyzed. This was followed by an analysis of structured feedback provided by the focus group of emergency physicians and nurses.

Results: 510 patients were tracked in the system during the study period. Immediate benefits were realized from the electronic white board and automated patient tracking. Quality reporting was instantaneously automated and time-efficiency metrics became available in real-time. Clinical documentation, including medico-legal case reporting, was faster on EDIS when compared to paper-based processes. The satisfaction with EDIS in the emergency care providers was considerably high.

Conclusion: EDIS improves ED operations, especially in the case of patient tracking and clinical documentation. It is evident that the ED can be at the forefront of every EMR implementation with its unique settings, and we are bound to witness several EDIS implementations in the near future.

Keywords: Emergency Department Information Systems; Electronic Health Records; Quality Indicators; Workflow

INTRODUCTION

Health Information Technology (IT) has the power to transform healthcare. The Institute of Medicine (IOM) considers health IT to have significantly improved some aspects of quality and safety. Under the American Recovery and Reinvestment Act (ARRA) and Health Information

Technology for Economic and Clinical Health (HITECH) Act in the U.S.A., significant economic incentives and penalties have been provided for the implementation and “meaningful use” of EMRs. ⁽¹⁾ Health IT could result not only in time and cost savings for patients and

physicians, but could also significantly improve outcomes. ⁽²⁾

Outside of emergency medicine, the term Electronic Medical Record (EMR) System has been used to describe computer systems or applications used to support patient care. The term Emergency Department Information System (EDIS) was first used in 1975 to describe a computer system for emergency patients tracking and support for other aspects of ED workflow. Since that time, the definition of an EDIS has expanded significantly. The American College of Emergency Physicians (ACEP) states, "Health IT presents ongoing opportunities to improve the quality of emergency care, promote patient safety, reduce medical errors, and enhance the efficiency of emergency departments." ⁽³⁾

EDISs are electronic health record systems designed to manage data and workflow in support ED patient care and operations. According to ACEP, EDIS consists of several core functions to support the clinical care in the ED, such as patient entry, triage, clinical documentation, results reporting, document management, order entry, decision support and risk management, patient and resource tracking, and discharge management (prescriptions and discharge instructions). Core administrative EDIS functions include hospital and departmental statistical metrics management; coding and billing (including interaction with insurance carriers and provision of information to third parties); integration with public health and other registries; disaster management; disease surveillance; and integration of patient satisfaction data. ⁽³⁾

Emergency departments (ED) can be at the forefront in quality improvements, because of their unique characteristics: a simplified environment which is "essentially a self-contained miniature health care delivery system in terms of the processes of

care and categories of information that exist within its departmental walls." ⁽⁴⁾ Scaling from and EDIS implementation to an organization-wide EMR implementation can be viewed as an effective strategy towards EMR adoption. A more controlled environment with and anticipated time-lines in treatment and disposition can essentially test the healthcare organization's inclination towards effective use of EMR, which when further scaled up will not bring forth too many surprises.

According to the Emergency Care Special Interest Group – HL7, "Emergency Department Information System (EDIS) is an extended EMR system used to manage data in support of Emergency Department patient care and operations. The functions of an EMR may be provided by a single application or multiple applications." ⁽⁵⁾

EDIS has been associated with various quality and safety improvements. These include reduction in length of stay, accurate and complete patient history, patient flow automation, computerized physician order entry, automated quality-safety monitoring, alerts-reminders and sophisticated clinical decision support systems. ⁽⁶⁻¹⁰⁾

EMR adoption world-wide has seen a steep incline in the past six years, especially in the United States of America (USA), where Federal mandates and incentives have resulted in more than a five-fold increase in Hospital adoption of EMR systems. 59% hospitals in the USA have adopted at least a Basic EMR system. ⁽¹¹⁾ At least 46% of the EDs in the USA have adopted an EDIS. ⁽¹²⁾ In India, the story of EMR adoption is quite dismal. There are no published studies on the actual number of hospitals that have adopted any form of EMR systems, let alone EDIS. From the authors' knowledge of the Industry, only a handful of Private and Public hospitals have implemented and adopted systems that can

be deemed to be an EMR. In the case of EDIS there is probably only one fully functional deployment in India at the Apex Trauma Centre in the All India Institute of Medical Sciences. ⁽¹³⁾

Objectives

The primary objective of the study was to assess the operational improvements in emergency workflows due to EDIS adoption, specifically through the automated capture of time-efficiency metrics and electronic clinical documentation. The workflows included triage, initial assessment, medico-legal case reporting, clinical order entry and quality reporting. The secondary objective of the study was to evaluate the feedback received from early EDIS adopters.

MATERIALS & METHODS

A comparative study between EDIS and traditional ED processes was conducted at a Level V Emergency Department in India. ⁽¹⁴⁾ The open-source applications available from Veterans Health Affairs ⁽¹⁵⁾ were deployed and adopted during the study period. The EMR solution stack deployed included the following applications;

1. Electronic patient tracking system
2. Electronic Medical Record with evidence-based order sets for chest pain, head injury and poisonings
3. Reporting and intelligence system

The emergency providers – physicians, nurses and assistants – were given focused training and printed “ready-reckoners for using EDIS.

Primary data was captured through the EDIS-EMR solution stack and manual data for tracked patients, from traditionally maintained registers, was reconciled. The Veterans Health Information Systems and Technology Architecture - Computerized Patient Record System (VistA-CPRS) was

used for Computerized Physician Order Entry (CPOE) and clinical documentation. Clinical documentation was done both on paper as well as EDIS-EMR during the study period. This allowed for a comparison between the two modes of documentation in a time-motion study that was conducted using process-step ‘start-stop’ time-charts filled up using stop watches during physician’s activities on paper and on the computer. Nine time-efficiency quality indicators, including door-to-physician time, door-to-diagnosis time, door-to-ECG time and six others, were extracted and analyzed from the database. The study intended to uncover improvements in the monitoring process of these indicators due to EDIS. Performance on the indicators, as well as any direct quality improvement, and the analysis thereof, were out of the scope of this study. At the end of the study period structured feedback received from the focus group of emergency care providers, including physicians, nurses and assistants, was analyzed.

Statistical Methods

Data generated from the study was analyzed using the t-test at 95% level of significance.

RESULTS

A total of 510 patients were tracked in the system during the study period. Although the integration of the electronically generated data with the existing quality programs was not attempted, workflow improvements due to automation of the data extraction and monitoring processes were evident.

Immediate Benefits: The display board enabled continuous and real-time display of patient tracking information with a color code based on the standard Canadian Triage and Acuity Scale (CTAS). ⁽¹⁶⁾ Diagnoses with ICD codes, vitals, allergies and assessment notes were captured with quick electronic templates. Computerized Provider

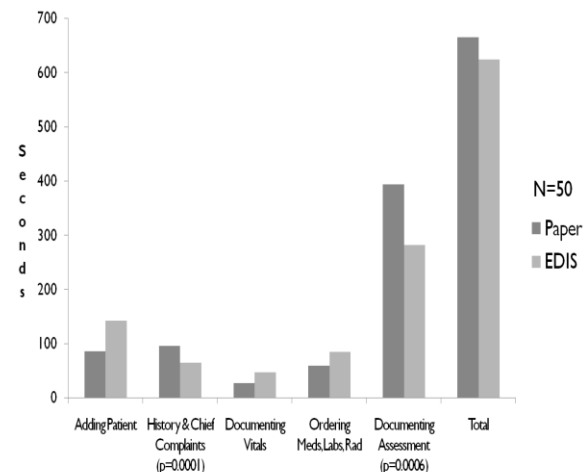
Order Entry (CPOE) was instituted with the use of quick orders and evidence-based order sets. Medico-legal case reports were also generated electronically.

ICD Groups: The ICD-9 classification of cases was possible because of point-of-care coding while adding presenting complaints in the automated emergency initial assessment workflow for emergency physicians based on the auto-populating ED assessment template. These were extracted from the reporting and intelligence tool and the commonest complaints could be analyzed. Diseases of the circulatory system were most frequent, amounting to 20% of the entire case load during the study period. ICD-9 - the de-facto coding version in Vista currently - was converted to ICD-10 at the output level in operational and quality reports.

Time-efficiency Quality Indicators: Nine quality indicators monitored as part of the Acute Coronary Syndrome, Stroke and Sepsis quality programs could be analyzed electronically from the information captured in EMR. Mean door-to-physician and door-to-aspirin times were both within 10 minutes, whereas mean door-to-diagnosis, door-to-ECG, door-to-GRBS and door-to-CT time were between 10-20 minutes. Mean door-to-statin, door-to-ScvO₂ (central venous oxygen) and door-to-antibiotic were 30-45 minutes. The study intended to only demonstrate the automation of the quality data capture process, which in terms of the monitoring effort had zero manual input required; otherwise this required a 15 person-day effort from various functionaries.

Time-Motion Analysis: The time-motion study (Figure 1), revealed a statistically significant reduction in documenting history and chief complaints, from an average 97 seconds on paper to 65 seconds in EMR (t-test, $p < 0.01$). The overall assessment documentation too had a significant

reduction from 11.06 minutes on paper to 10.38 minutes in CPRS (t-test, $p < 0.01$).

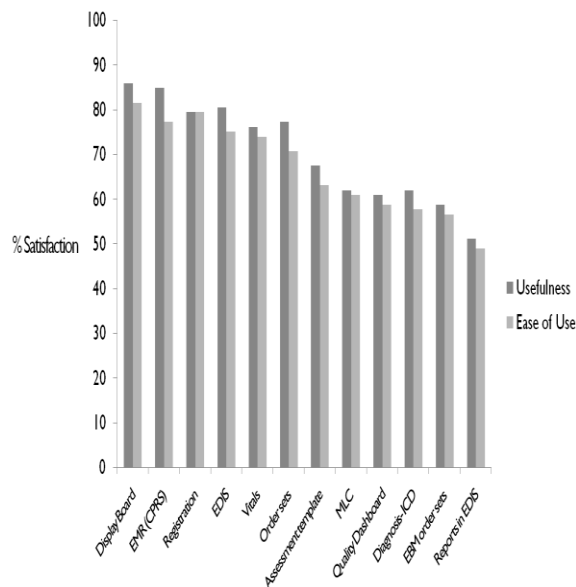


(Figure 1): Time-motion study comparing paper-based and EDIS activities

This was possible, in part, because of the auto-populating ED assessment template that had linked order sets and created the assessment notes and medico-legal case (MLC) reports simultaneously. In the paper-based process the assessment form required demographics and many other details to be re-entered. Free text entries for many of the assessment fields in the paper form were transformed into a template design that included point-and-click preferred complaints / diagnoses, assessment findings and orders on the same screen. This radically changed physician's inclination towards electronic templates.

Provider Feedback Analysis: A statistically significant proportion of emergency care providers ($p < 0.01$) were satisfied with the adoption of EDIS. They perceived the following features of EDIS to be useful and easy to use – Display Board, CPRS, Registration, Vitals, Evidence-based Order Sets, Assessment Template, MLC, Quality Dashboard, ICD-coded Diagnosis, Reports. Overall, 80% of the respondents

found EMR useful and 75% of the respondents perceived it to be easy to use (Figure 2).



(Figure 2) Provider feedback on EMR functionality

DISCUSSION

This is probably the first empirical study in India on the impact of EMR in the unique settings of the ED. Earlier studies on EMR published from India, either dealt with the challenges of EMR adoption in a single speciality Hospital (17) or in rural areas (18) and a few other select cases. The EDs in India have made significant progress in process improvement, adoption of clinical pathways, standardization and accreditation but the case for implementing EDIS had hitherto been untouched. From this study, it is evident that EDIS has the potential to transform critical ED operations, especially in resource-limited settings, achieving better outcomes through automation of workflows. A recent study (19) concluded that he integrated EDIS created new ways of working for ED clinicians. Such changes could hold positive implications for: time taken to reach a diagnosis and deliver treatments; length of stay; patient outcomes

and experiences. This was partially revalidated in this study where the three significant improvements in ED due to EMR implementation - the data capture process, clinical documentation and provider satisfaction – were quite evident.

The EDIS display board with real-time patient information, triage code and provider assignments can improve information exchange, thereby reducing care-coordination errors. The display that was used in the study was put up at a prominent location in the ED and since the triage codes and complaints were readily visible, all providers were able to view critical patient information in real-time with additional valuable inputs like the red colour code for all triage level 1 patients. With the display board, providers were always aware of changing triage levels, pending investigations status, patient location and patient notifications.

Order sets based on internationally accepted clinical practice guidelines (CPG) can improve CPOE and ensure evidence-based interventions. In this study, the chest pain and head injury order sets were most frequently used and allowed even junior emergency room physicians to ensure compliance to CPGs with a point-and-click user interface to well-organized order sets along with the relevant evidence basis and additional clinical information. The clinical documentation process is radically improved with the use of EDIS-EMR. Automated templates with a point-and-click interface allowed emergency room physicians to complete documentation in significantly lesser time than with the paper-based process. Automated emergency assessment and medico-legal reporting procedures can significantly reduce the time taken by ED physicians for documentation, consequently improving the effective time spent on direct patient-care activities. There is ample evidence emanating from the study for wide-

scale implementation of EMR-based clinical documentation in the ED.

Patient tracking in EDIS generates real-time quality and safety information, which can be used to institute corrective and preventive actions. This is true especially in the case of time-efficiency indicators like Door-to-ECG time, Door-to-Physician time, and Door-to-Aspirin time. In a paper-based system all these metrics have to be painstakingly extrapolated from the ED register and from other locations, compiled into spread-sheets and then calculated, with the obvious risk of errors and more importantly, with the additional manual effort. This can be completely eliminated with the implementation of EDIS.

CONCLUSION

There seem to be many reasons to pursue a wide-scale implementation of EMR, especially to improve efficiency, quality and safety of Emergency Departments. Hospitals in the pursuit of implementing EMR could very well consider the ED as the starting point in their EMR journey, where quick successes can catalyze an effective Hospital-wide EMR implementation. Although the study is indicative of the immediate benefits of EMR implementation, especially in the ED, a study involving a longer duration of clinical system adoption and the aggregate benefits accrued from it is definitely required to validate this further. A larger multi-centric study would uncover other unknown variables and would provide more insights to the benefits of using an EMR.

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