Switching Electronic Health Record Systems: Effects on Rounds and Perceived Impact on Communication and Workflow in a Paediatric Critical Care Unit

A. Bateman[1], J. Tomasi[2], A.M. Guerguerian[3], P. Laussen[3] and P. Trbovich[1,2]

[1] Institute of Biomaterials and Biomedical Engineering, University of Toronto, Toronto, Ontario, Canada
[2] HumanEra, Research and Innovation, North York General Hospital, Toronto, Ontario, Canada
[3] Department of Critical Care Medicine, The Hospital for Sick Children, Toronto, Ontario, Canada

Abstract— **The overall objective of this study was to explore the impact that switching electronic health record (EHR) systems has on daily bedside rounds in a paediatric critical care unit. Naturalistic observations were used to contextualize rounds and to characterize how EHRs are used during rounds. Semi-structured interviews occurred in two phases. In phase one, interviews were conducted with clinicians to elicit detailed perceptions of rounds, and to understand how EHRs were used during rounds. Six months after the implementation of a new EHR system, phase two interviews were conducted to understand perceptions on how the new EHR system had impacted communication and workflow during rounds. Thematic analysis was performed on the qualitative notes from observations and interviews to identify patterns based on the data collected. Results of thematic analysis indicate that switching EHRs has an impact on how clinicians prepare for rounds, access information during rounds and document patient care goals during rounds. The results from this study will inform the design of interventions to improve daily bedside rounds in future work.**

Keywords— **Rounds, electronic health records, critical care, communication, human factors engineering**

I. Introduction

Communication is integral to the delivery of safe patient care. Errors in communication are a major cause of adverse events in healthcare[1]. In critical care, patients are severely ill with limited physiological capacity for error, yet risk for adverse events is double that of general care units due to the complex nature of care[2]. The most significant opportunity for communication occurs during daily patient rounds, the regularly scheduled meetings attended by healthcare providers to review patient status and determine patient care plan. Rounds can positively affect clinical outcomes such as length of stay[3] and mortality rates[4] and are therefore, critical to patient safety.

Tools and technology, such as electronic health records (EHR), are rapidly being introduced into healthcare environments[5]. While EHRs can facilitate improved quality of care[6] and productivity[7], it can also cause a myriad of unintended consequences for patients and providers[8][9]. Considering the pervasiveness of EHRs within healthcare, and the need for effective communication to ensure patient safety, it is important to understand the impact that EHRs may have on communication. A human factors approach provides a systems perspective for studying how different components (e.g. persons, tools and technology, tasks, environment, and organisation) interact and affect the performance of the human-centered, sociotechnical healthcare system[10].

For this study, the impact of EHRs on communication and workflow during bedside rounds was explored in the Paediatric Critical Care Unit (CCU) at The Hospital for Sick Children (SickKids). The CCU at SickKids switched their EHR system from *KidCare*, to *Epic* in June 2018 which provided an opportunity for exploring the impact that switching EHRs has on communication and workflow. The literature suggests that EHRs can both positively and negatively impact healthcare, but little is known about how replacing EHRs affects communication and workflow during rounds. Given that switches in EHR systems are becoming increasingly common, we require systematic knowledge about their impact on communication and workflow during bedside rounds.

II. Data Collection

Data collection was conducted in the CCU at SickKids in Toronto, Ontario. The study was approved by The Hospital for Sick Children Research Ethics Board. Naturalistic observations and semi-structured interviews were used to characterize rounds and to assess the impact that switching EHRs has on communication and workflow during rounds.

A. Naturalistic observations

Two researchers observed 10 weeks of bedside rounds in the SickKids CCU. Observers captured free text field notes to contextualize rounds and to characterize the use of EHRs during rounds. Free text notes were recorded in written form and digitally recorded immediately following rounds.

B. Interviews

Semi-structured interviews were conducted in two phases. In phase one, researchers elicited stakeholders' detailed perceptions of rounds within SickKids CCU. Group interviews were conducted with medical trainees (fellows and residents), nurse practitioners (NPs), registered nurses (RNs), respiratory therapists (RTs), pharmacist and interdisciplinary healthcare providers (e.g. dietitians and physiotherapists). Individual interviews were conducted with all CCU staff physicians. Two researchers were present during interviews and all interviews lasted approximately one hour. Interviews were audio recorded and subsequently transcribed into digital text.

Six months after the initial interviews, the new EHR system, *Epic*, was implemented at SickKids. A second set of interviews were conducted six months post *Epic* implementation, to elicit stakeholder perceptions on how the new EHR impacted rounds within the CCU. Individual interviews were conducted with the primary EHR users (medical trainees, NPs, RNs and pharmacists). One researcher conducted interviews and interviews lasted approximately 15 minutes. Immediately following interviews, hand-written qualitative notes taken during the interview were digitally transcribed. Group interviews were also conducted with staff physicians, medical trainees, NPs, RNs, RTs, and pharmacists. Two researchers were present and interviews lasted 30 minutes to one hour. Interviews were audio recorded and qualitative notes were taken from audio-recordings.

Interviews were conducted until qualitative saturation was reached. Substantially more interviews were conducted in phase one (i.e. 88 clinicians) versus phase two (i.e. 37 clinicians) as phase one interviews explored clinician perspective of all aspects of rounds, while phase two interviews focused solely on EHR impact on rounds. As a result, qualitative saturation was reached with fewer interviews in phase two.

III. DATA ANALYSIS

Thematic analysis was performed to identify patterns that emerged from the interviews and field notes according to a modified framework method[11]. Codes were developed inductively and grouped together to form themes. Researchers independently assigned codes to qualitative notes. Inter-rater reliability (IRR) was performed on a subset of qualitative notes and an acceptable IRR (kappa > 0.7) was reached.

IV. RESULTS

Results from naturalistic observations and interviews are grouped by theme and summarized in Table 1.

A. Preparing for rounds

During rounds, a medical trainee or NP presents the patient case to the rounding team. Presenting clinicians typically provide a brief patient introduction, acute status update and determination of the care plan for the day. This process requires the presentation of large amounts of data for each patient. In preparation for rounds, presenting clinicians gather this data from the EHR.

Interviews and field notes indicated there was no standard way to prepare for rounds. Using *KidCare*, clinicians combed through the EHR in an unstructured manner to gather data. The data was then transferred onto a template that varied by clinician (e.g. printed patient census, blank piece of paper, custom made template). Using *Epic*, some clinicians created customized structured tools that pulled in patient data automatically and could be printed for rounds (a feature not available with *KidCare*). Other clinicians continued to prepare for rounds in an unstructured way due to increased flexibility. Some staff physicians prepared for rounds with the *Epic* mobile application (not available with *KidCare*), a feature that provided convenient and remote access.

B. Access to information

Throughout rounds, a workstation on wheels operated by medical trainees and NPs accompanies the rounding team enabling ongoing access to patient data. From observational data and interviews, the workstation enabled convenient access to patient data during rounds. With both *Epic* and *KidCare*, the clinician operating the workstation frequently referenced the EHR and recited relevant information to the group. In interviews, clinicians reported difficulties in quickly accessing EHR data when using *Epic* compared to *KidCare* citing difficulties in navigating the user interface.

C. Documentation of patient care plan

During rounds, the workstation on wheels also provides clinicians with the ability to document goals of care. Medical trainees and NPs take primary responsibility for documentation, in the form of entering orders (e.g. medication orders, procedures). Observational data and interviews indicated that the presence of the workstation at the bedside enabled quick and efficient order entry. With both EHRs, explicit instructions to enter orders were given and documentation of orders occurred immediately. The ability to document the care plan at the bedside also facilitated clarification and refinement of the plan with the team. With both EHRs, pharmacists helped to enter medication orders and nurses provided input on aspects of the plan that required updated documentation.

Table 1: Summary of results

Theme	Code	KidCare	Epic	Example(s)
Preparing for rounds	Clinician prepare for rounds in an unstructured format	X	X	Clinicians skims through EHR, handwriting data onto a custom template
	Preparing for rounds is a time consuming and cumbersome process		X	Pharmacists report that preparation time for rounds using Epic is almost double to that of KidCare
	Mobile application provides convenient and remote access to prepare for rounds		X	Staff physician prepares for rounds remotely by accessing patient data via the mobile application
	Configurable EHR allows for flexible tools that can be used for rounds preparation		X	In Epic, clinician creates custom patient census page to act as a structured template for rounds preparation
Access to information	EHR provides quick access to patient data during rounds	X	X	Clinician operating workstation immediately provides clinical value from EHR when prompted by team
	Accessing and displaying data from the EHR is time consuming and difficult to do		X	Clinician has difficulty finding requested clinical data in Epic and rounding discussion moves on without the data
Documentation of patient care plan	EHR facilitates clean and efficient order entry during rounds	X	X	An explicit instruction to input an order is given and the order gets entered immediately on the workstation
	Entering orders during rounds allows for clarification of patient care with care team	X	X	Pharmacist assists clinician on workstation in entering medication orders
	Orders are inconsistently entered and updated during rounds due to non-EHR causes	X	X	Clinician is unable to enter orders during rounds because 1) they cannot hear 2) rounds move at high pace 3) interruptions redirect their attention 4) care plan is unclear
	Orders are inconsistently entered and updated during rounds due to impact of EHR		X	Clinician is unable to enter orders during rounds because they have difficulty navigating the Epic user interface
	Errors in order entry are made during rounds		X	Error in medication orders occur during rounds due to incorrect suggested doses in Epic

Conversely, from observational data and interviews it emerged that there were also numerous barriers to entering orders effectively during rounds. With both EHRs, a number of non-technical related barriers such as inability to hear the rounding discussion, high pace of rounds, frequent interruptions and unclear care plan contributed to difficulties in entering orders consistently. In interviews, clinicians reported difficulties in navigating *Epic* compared to *KidCare* due to a cumbersome user interface (e.g. large number of clicks required to enter orders). Errors in order entry using *Epic* (e.g. incorrect medication dose or clinical procedure ordered) emerged as a theme from the interviews. Fellows and pharmacists cited inaccuracies in *Epic* as a potential cause (e.g. incorrect recommended doses listed in the EHR).

V. DISCUSSION

Results from this study demonstrate that switching EHRs can both positively and negatively impact how clinicians prepare for rounds, access information, and document patient care plans during rounds in a paediatric critical care unit.

A number of interventions could address the potential barriers identified. Clinicians prepared for rounds in an unstructured format that was tedious and allowed for high variability of content between presenting clinicians. A standardized rounding report that pulls data automatically from the EHR significantly reduced rounding preparation time for surgical residents[7] and could be considered as a potential intervention. The inability to conveniently access patient data at the bedside using *Epic* also emerged as an opportunity for improvement. Using iPad technology at the bedside reduced the time to look up medical information during rounds in a neurology unit[12], and a large interactive monitor allowed the entire rounding team to access patient data simultaneously in another paediatric critical care unit[13]. Last, there were numerous barriers to consistent order entry during rounds such as difficulties in navigating the EHR, inability to hear rounding discussion, interruptions and unclear patient care plans. The presence of physician assistants during rounds in another critical care unit reduced interruptions and is a potential in-

tervention to consider for improving order entry[14].

Other studies have demonstrated the impact that switching EHRs can have on workflow in different clinical settings. Two years after the implementation of a new EHR system in an orthopaedic clinic, providers spent more time documenting patient care and less time directly interacting with patients[15]. In an internal medicine clinic, the implementation of a new EHR system increased provider satisfaction by enabling remote access; however, reduced perceived efficiency when ordering medications due to EHR usability issues[16]. Our study contributes to the growing body of evidence that switching EHRs can have unintended consequences on the workflow of a variety of clinical activities.

During thematic analysis of the interviews and observations, the potential biases of the researchers may have influenced the coding and interpretation of qualitative notes; however, inter-rater reliability between two researchers was performed to mitigate this risk. Future work will focus on quantitatively comparing the impact that switching EHRs has on bedside rounds through a time-motion study.

VI. Conclusion

This study has demonstrated that switching EHRs can impact how clinicians prepare for rounds, access information during rounds and document patient care plan during rounds. The results showed that while *Epic* provided a mobile application and the flexibility to configure custom templates which helped clinicians prepare for rounds, usability issues increased the time required to prepare for some clinicians. Furthermore, clinicians expressed usability concerns with accessing data and documenting the patient care plan when using *Epic* that did not exist with *KidCare*. Results from this study will inform the development of future interventions to improve communication and workflow during interdisciplinary bedside rounds.

Conflict of Interest

The authors declare that they have no conflict of interest.

Acknowledgements

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