

BMJ Open Impacts on quality of care following electronic health record implementation within a large Canadian community hospital: a qualitative study

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ABSTRACT

Objective This study aimed to describe how healthcare providers perceived the impacts of implementing and using an electronic health record (EHR) on quality, safety and person-centredness of care.

Design A qualitative descriptive design using semistructured interviews.

Setting In October 2020, a large Canadian community hospital implemented a new EHR system (Epic) across three sites, transitioning from a previously fragmented (combination of paper-based and electronic) system.

Participants Sixty-two healthcare providers and clinical leaders.

Results Participants shared their experiences regarding the impact of EHR implementation on quality of care, which were analysed into common themes including task efficiency, information management, patient interactions and patient safety. While the system significantly altered their routines and introduced new responsibilities like additional documentation requirements, it also facilitated adherence to clinical guidelines, improved information visibility and enhanced documentation, benefiting overall quality of care and patient safety. Participants reported that EHR implementation led to increased efficiency, freeing up time for patient care and improving communication with patients and other providers.

Conclusion EHRs have the potential to improve quality of care and patient safety, but this depends on their perceived value and how well healthcare providers can integrate their various features into clinical routines.

INTRODUCTION

Electronic health records (EHRs) represent the technologies used to gather, organise, store and exchange healthcare information and are intended to improve ease of access to patient information, facilitate safer, higher quality care and streamline communication between healthcare providers.^{1 2} Care quality and safety indicators such as avoiding medical errors, accurately prescribing medications and following clinical guidelines have consistently improved with the introduction

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Our participant sample included a wide range of healthcare providers with different levels of experience, areas of practice and comfort levels with electronic health records (EHRs), allowing us to capture diverse perspectives.
- ⇒ The use of a single interviewer allowed for the interview guide to be reflexively adapted throughout data collection.
- ⇒ Impacts on quality, safety and patient-centred care were assessed through experiences and perspectives of healthcare providers, rather than a quantitative health system metric or patient and caregiver voices.
- ⇒ Implementation of the EHR occurred during the COVID-19 pandemic, introducing dynamics such as stress and irregular routines, teams and protocols, which may limit the transferability of our findings to non-pandemic contexts.

of EHRs,^{3 4} especially when measured using quantitative, standardised assessments.⁵ Likely mechanisms include real-time communication, clear documentation, medication dosage regulation, safety alerts and performance monitoring that often result from EHR implementation.⁶ These features also equip healthcare providers to provide care that is more patient-centred, meaning that it supports shared decision-making with patients and caregivers, engages a broad team of care providers and focuses on an individual's priorities, circumstances and resources rather than only their diagnosis.^{7–9} While EHRs are often intended to streamline tasks and offer efficiency, their implementation can sometimes lead to adverse experiences for healthcare providers.¹⁰ These systems may inadvertently contribute to healthcare provider burnout by introducing time-consuming administrative

tasks, which can negatively impact the quality, safety and person-centredness of care.¹⁰

Though EHRs often promise these benefits, their realisation is dependent on what extent healthcare providers are able to actualise them as the primary users of this technology. Implementing and adopting an EHR requires an already stretched healthcare workforce to shoulder extensive training on new systems, re-learn daily tasks and re-orient themselves to how complex health systems function.^{11 12} Technology-induced errors in the healthcare setting have also been described.¹³ Successful EHR implementation also requires a culture shift and healthcare provider buy-in to the proposed benefits, alongside comprehensive training and support, easy integration into care workflows and compatibility with users' organisational contexts.^{14 15} This culture shift may involve changes to dynamics around morale, teamwork, leadership and shared values within a healthcare workforce because EHRs can change the way people communicate, prioritise and delegate tasks and work together.^{2 16–18} Though there is some qualitative literature about the impact of EHRs on quality of care available, it is often focused either on specific clinical areas (eg, primary care^{19 20}) or healthcare providers' perspectives broadly with less emphasis on setting.^{21 22} Increasingly, however, the entire health systems are adopting EHRs in hopes of better care quality through information connectivity and communication across clinical settings and teams. In these settings where a single health workforce shares culture and interpersonal and professional norms, there has been little exploration into how EHRs are perceived to contribute to or limit healthcare quality.

As healthcare providers are the primary users of EHRs, their experience with the implementation of EHRs and impacts on care they deliver is key to understanding how far downstream (ie, from information systems, to providers and staff, to patients) the potential benefits can reach, particularly as they relate to care quality, safety and person-centred care.

Objectives

To describe the perceived impacts of the implementation and ongoing use of the Epic EHR on the quality, safety and person-centredness of care, through the lens of healthcare providers' experiences and perspectives.

METHODS

This study is a part of a broader multimethods evaluation to understand the impacts of implementing an EHR called Epic (Verona, WI) on health outcomes, provider experiences, and productivity and cost at a large community hospital. In the broader study, we engaged healthcare providers, health system leaders, and operational and administrative staff and clinical administrative data to measure organisation-wide outcomes and individual interviews in selected units to understand implementation. In this study, we used the Institute of Medicine's

Box 1 The Institute of Medicine's six domains of healthcare quality¹⁹

Safe: Avoiding harm to patients from the care that is intended to help them.

Effective: Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and misuse, respectively).

Patient-centred: Providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions.

Timely: Reducing waits and sometimes harmful delays for both those who receive and those who give care.

Efficient: Avoiding waste, including waste of equipment, supplies, ideas and energy.

Equitable: Providing care that does not vary in quality because of personal characteristics such as ethnicity, geographic location and socioeconomic status.

definition to conceptualise quality of care,²³ which includes six domains: safe, effective, patient-centred, timely, efficient and equitable care (see [box 1](#)). We focused on changes in communication and interactions with patients, time spent with patients and families, and patient outcomes to understand the impact of Epic on the quality of care.

Setting

Trillium Health Partners (THP), located in Mississauga, Ontario (the sixth largest city in Canada), is comprised of three hospital sites with 1457 inpatient beds, over 1.7 million annual patient visits (including 276 003 emergency and urgent care visits and 64 839 discharges), and more than 11 000 staff and physicians.²⁴ Previously, THP had used distinct information systems at the three different sites, which lacked complete electronic documentation, computerised physician order entry, closed loop medication administration or electronic clinical decision support. Recognising the importance of implementing one EHR for achieving a streamlined patient and staff experience across the organisation, THP implemented a single instance of Epic amidst the COVID-19 pandemic in October 2020 across all inpatient and outpatient programmes in three sites to replace their former systems. Prior to Epic's implementation, healthcare providers and administrative staff received basic training and had access to a demo environment to practice using the system. Some healthcare providers, administrative staff and leaders received extra training to become 'super users', who were responsible for supporting and mentoring others with technical challenges and workflow integration. Working groups comprised of select leaders and providers from various clinical programmes were established to make software configuration decisions prior to implementation that reflected unique workflow and operational realities in different care settings.

Approach

We employed a qualitative descriptive approach to describe and understand the ways that Epic impacted quality of care from healthcare providers' perspectives.^{25 26} To appreciate the broad context and mechanisms of the implementation, our analysis is informed by the Consolidated Framework for Implementation Research (CFIR).²⁷ To select factors and data elements related to the EHR intervention that are specific to technology (eg, system use), we draw from the Human, Organization and Technology (HOT)-fit framework¹⁵ which has been carefully developed from literature and tested in a number of EHR evaluations.²⁸ HOT-fit recognises that the net benefits from EHR implementation are dependent on factors related to technology (system, information and service quality), human (system use and user satisfaction) and the organisation (structure and environment).¹⁵ These overlap with CFIR domains of intervention, individual, and inner and outer context, respectively. We used these frameworks in the development of interview guides and the interpretation of our findings. We received ethics approval from the THP Research Ethics Board for this study (#1062).

Patient and public involvement

As healthcare providers and clinical leaders are the primary users of EHRs and were the sole participants in this study, we did not involve patients or members of the public in this work. In this study, we wanted to explore provider experiences and perceptions of how an EHR can impact the quality of care they deliver, so patient and public involvement did not seem appropriate. Members of the study team (TT, SV) are healthcare providers and contributed their perspectives to the study's design and data collection and analysis.

Data collection

We looked for aspects of context, mechanisms, processes and factors related to Epic in individual semistructured interviews with healthcare providers (including nursing, allied health and physicians) and clinical leaders between 12 May 2022 and 20 April 2023, using a combination of purposive random sampling, maximum variation and snowball sampling to capture specific roles within each of seven hospital programmes (medicine, rehabilitation, surgery, palliative, mental health, emergency, oncology).²⁹ Interview recruitment was conducted by email and posters in staff break rooms. Interested individuals were asked to contact a research associate, who provided them with a consent form and answered any questions they had. Verbal consent was obtained at the start of interviews, which were conducted and recorded on Zoom or by telephone. Audio recordings were transcribed verbatim by a professional transcriber. Transcripts were de-identified and reviewed for accuracy.

Interviews focused on the experience of early adoption, integrating Epic into workflows and hospital culture, and how the organisation reflexively adapted to such a change

over time. Interview guides (see online supplemental appendix) were informed by CFIR²⁷ and HOT-fit¹⁵ concepts, focusing on the perceived fit of humans, the organisation and technology, but with room to explore other topics arising. Interviews were customised to individual roles and users of Epic (eg, management or clinical staff) and probed participants' views on aspects of the technology itself; challenges they faced during the adoption phase; and perceived impacts of Epic on themselves, patients and the organisation.

Analysis

First, a few interview transcripts were coded by the study team (CH, JN) using thematic analysis. This involved becoming familiar with the data, generating initial codes from the data and creating a draft codebook. The codebook included codes informed by the CFIR²⁷ and HOT-fit¹⁵ frameworks and patterns across the initial coding of the dataset. This codebook was brought to the broader team for review and modification, with a handful of transcripts. After team feedback and revisions, the codebook was used by CH, JN, LS and SV to code the remaining transcripts. Any discrepancies were resolved through detailed discussion, ensuring a shared interpretation of the data. RG, ST, CH, JN, LS and SV ensured coding consistency through a review of the coded transcripts. After all transcripts were coded, codes were discussed and consolidated, and themes were developed through ongoing dialogue and consensus while considering the IOM components. NVivo 12 was used for qualitative data management.

RESULTS

Sixty-two individuals participated in an interview; of these, 37 were healthcare providers (15 nurses, nine interdisciplinary healthcare providers and 13 physicians), and 25 were clinical leaders who oversaw healthcare provider teams (seven programme chiefs, seven directors, two division heads and nine managers). From the analysis of interview transcripts, we identified four themes about providers' perceptions of how Epic impacted care quality: (1) balancing tasks for efficiency; (2) managing information; (3) introducing technology into patient-provider interactions; and (4) embedding features to improve patient safety.

Balancing tasks for efficiency

At the time of implementation, Epic impacted provider workload and experiences, which was reported to affect quality of care in turn. Learning and adjusting to Epic were challenging, especially amidst the height of the COVID-19 pandemic, and participants felt that more support could have been offered to a workforce already struggling with limited resources and low morale. Beyond the initial implementation phase, some physician participants felt that tasks such as charting continued to take longer than before Epic because of the 'unintuitive'

nature of the software or issues with transcription, regularly requiring an additional one to 2 hours of work after their shift. This learning curve led to difficulties and delays in completing routine tasks such as placing orders and creating patient lists, causing frustration.

That first week that Epic went live, it was—we kept apologising to patients because we were going at a snail's pace and I have a picture of 10 of the staff standing around a computer trying to figure out how to put an order in, while this patient is sitting on the stretcher looking at us. - Emergency Physician 13

Following the initial go-live period, some providers described a trade-off between efficiency and fulsome patient interactions, while some made efforts to maintain full attention and avoid typing notes during encounters. This also often resulted in more time charting afterwards, limiting their time to rest before the next shift or uphold work-life balance.

Managing information

Some participants had difficulty disconnecting from the constant stream of information that Epic brings, such as messaging between healthcare providers, which contributed to their cognitive load and time devoted to work tasks. Providers often struggled with generating the required documentation in Epic, ensuring patient records were complete and authorised, and the constant need to monitor and respond to messages, which were perceived as excessive and redundant.

Epic is my favourite and my worst tool. Actually, I had it on my phone and the download broke 1 day and I never fixed it because I found that the pinging—like any day of the week, on weekends it was just like I couldn't separate from work. So, I think that's one just to be mindful of; I think from a staff wellness perspective. It's great to have the convenience, but, you know, that ability to turn it off as well. - Palliative Care Leader 05

At the bedside, using Epic on mobile devices made it easier to document and track patient progress. For example, embedding pictures of wounds into patient charts allowed providers to rely on multiple types of information during assessments. Immediate access to comprehensive patient information such as images and trend charts also enabled healthcare providers to invite patients and caregivers into the conversation and facilitated shared decision-making. With the ability to share results and care plans with patients and caregivers, providers were better prepared to answer questions and demonstrate their thought processes for decision-making, which they perceived as improving the quality of care they delivered.

If somebody has a question about their medication, it's as simple as pulling out your [mobile device] and saying okay, this is what the medication you have access to, and this is what you're getting, or that sort of

thing. So, we're right there, able to answer questions, like a lot of questions immediately...I feel like it permits us to spend a lot more time with our patients, in terms of assessments and therapies and that sort of things. - Mental Health Registered Nurse 29

Participants reported that better accessibility of information in Epic also enabled patients to progress through treatment faster; for example, interdisciplinary health professionals could better prepare patients for encounters with physicians by ensuring tests or preparations were completed beforehand. Epic's abilities to provide a clear, organised and legible view of patient records' connect them with some external care providers and institutions; and offer features like messaging between providers to share timely patient data all contributed to less time tracking down information.

Introducing technology into patient-provider interactions

While Epic improved certain aspects of patient care delivery, its impact on patient-provider interactions was complex. On one hand, some participants reported that it enhanced patient-provider relationships because they had better tools to efficiently share updates with patients; create educational and follow-up materials; and easily access important information. Epic was reported to improve efficiency by allowing providers to type notes during encounters and therefore spend more time with patients, which they reported to improve the quality of their interactions. However, others reported that if they were viewing or updating information in Epic during encounters, some patients expressed dissatisfaction with lack of eye contact and perceived that providers' attention was diminished, negatively affecting their overall relationship.

But then when it actually comes back around to taking the history and stuff, most people really hate it. They find it very intrusive and, like, well, you're not listening to me and—which is true, to be honest. You can't listen and talk and type at the same time. - Emergency Physician 10

Embedded features to improve patient safety

Participants described several ways that Epic contributed to patient safety. With the transition away from handwritten notes, better chart legibility was a key factor in avoiding errors and gaining a full view of a patient's status.

So, the huge bonus is being able to read exactly what the physician or the clinician wants to say vs trying to guess because of the penmanship. That's a huge, huge problem that we had. Mind you, we do get used to it, but I honestly hate the fact that I'm guessing what a diagnosis is, and it can very be easily transcribed into a different one if I'm not careful. It's happened many, many times. - Emergency Nurse 06

Epic enhanced patient safety by centralising critical information in patient charts, such as the inclusion of Do

Not Resuscitate flags, Power of Attorney designations, and allergy and fall risk indicators on patient 'story boards', which provide quick access to the essential elements of a patient's 'story', and wristbands. Epic also introduced new workflows, such as those related to medication administration, requiring providers to scan barcodes on patient wristbands and medications before administering them. This feature enables providers to verify the accuracy of medication type and dosage and automatically documents administration in patient charts. Patient safety was also reported to improve through automated procedures and test reminders for specific patient populations and standardised treatment plans on Epic. This helped to prevent care gaps, ensured timely testing and interventions and reduced errors associated with treatment variations.

For example, when a patient gets admitted for in-patient chemo, in the past, we used to have to manually enter the entire order, and there are a lot of very complex regimens for patients who are admitted for chemo just because they're sicker and they need much more complicated regimens. And so that was a big safety issue, because then if you're manually entering, there's definitely more risk for chances of error. So one thing Epic has helped with is because all the orders are pre-set, have treatment plans that are built and in place. I think making sure that everything is correctly entered and given correctly and more standardised has been improved. – Pharmacist 19

Similar to the trade-offs participants described about patient interactions, while many recognised that the intention of Epic's safety features is to reduce the likelihood of errors and promote information visibility, some still had concerns about added steps to their workflow. Particularly when perceived as trivial or redundant, additional tasks can lead to poor adherence or work-arounds, reducing their potential positive impacts on patient safety.

In terms of patient safety, it's great to improve that, but in terms of workload, it does affect the workload. And, you know, some people are still overriding because of workload. Like it's not an option to pick that, like why are you overriding it, 'It's because I'm like so busy'. But people do that. – Medicine Registered Nurse 18

DISCUSSION

In this study, we identified several ways that implementing an EHR in a large community hospital impacted the quality and nature of healthcare delivered by physicians, nurses, and interdisciplinary staff. Notably, our findings offer a unique perspective on the effects of an EHR implementation on quality of care within a unified health system, a context often overlooked in existing literature. Our findings show that Epic changed the nature of many routine tasks such as charting, administering medications and

sharing information with colleagues and patients, which necessitated sometimes challenging trade-offs to balance providers' capacity to deliver high-quality care. Though some of Epic's features increased their workloads, many of them facilitated better adherence to clinical practice guidelines, higher visibility of critical information and clearer documentation, which were perceived to improve patient safety and quality of care. Despite some initial hurdles in learning the new system, providers reported that Epic made everyday tasks more efficient, freeing up time to spend on patient care, and made it simpler to share information with patients and caregivers and invite them into shared decision-making.

Our findings align with existing qualitative research exploring the impact of EHRs on healthcare providers' perceptions of care quality. These studies have identified similar benefits, including improved accessibility, legibility and organisation of information and safety features offered by EHRs.^{6 18 30} For instance, Upadhyay *et al* also noted these similarities in their study exploring clinicians lived experience with EHRs across multiple hospitals. They highlighted how EHRs improved communication and reduced the risk of medical errors, although they also observed an impact on patient interactions.²² Existing literature also describes the tensions we observed between improved efficiency, pre-occupation with screens during healthcare encounters and higher demand for documentation, leading to uncertainty regarding whether or not EHR actually free up time to spend with patients and improve quality of interactions.^{2 30–32} However, these findings are not consistent across all studies, as some literature suggests that providers' perceptions of the impact of EHRs on productivity, quality and safety can decrease with more complex EHR due to difficulty integrating them into clinical routines.¹ Some of our participants described more cognitive load and spending significant time each day, even beyond Epic's initial implementation phase, on the additional tasks and documentation requirements that Epic introduced, which can contribute to burnout and decreased job satisfaction over time. Though direct associations were not drawn in our findings between this burden and quality of care, other studies have demonstrated strong relationships between provider burnout, job strain and low career satisfaction and poorer quality and safety of healthcare.^{33 34}

We explored how Epic may have impacted the person-centredness of care delivered by participants in this study. Person-centred care ensures that patients and families have timely and comprehensive information needed to participate in shared decision-making, focuses on the whole person (their needs, priorities and life outside of their illness or the healthcare system) and brings multidisciplinary healthcare providers around patients in an informed and unified way.⁷ Healthcare providers in this study reported that Epic enables fulsome documentation of patient information that can easily be accessed by care teams and shared with patients and caregivers, but almost to a fault; some documentation requirements

seemed overbearing and redundant and could encroach into patient encounters if providers had limited time to complete charting tasks during or after work hours. Health systems can use EHR to support person-centred care by carefully developing a culture around how healthcare providers can concisely document, prioritise and share relevant information and co-designing EHR interfaces that make key information visible and shareable. Some EHRs include unique features to identify and monitor social determinants of health that could impact a patient's ability to become and stay well, but to be effective, it is important that this information is concise, visible and easy to document and track. For example, Epic has a Social Determinants of Health Wheel feature that prompts healthcare providers to screen for and embed indicators in patient records, which enables easier tracking over time and visibility across multidisciplinary teams.

Our study had several strengths. We included a range of healthcare providers from various areas of clinical practice, levels of professional experience and comfort levels with Epic, which enabled us to capture diverse perspectives and enhanced the transferability of our findings. Using a single interviewer (CH) allowed the interview guide to be reflexively adapted throughout the data collection process; the interviewer regularly liaised with the study team to discuss adding or revising questions to expand on new ideas and capture all relevant information. Interviews were conducted over a period of eight to 20 months following Epic's implementation, which allowed us to capture its initial impacts as well as patterns that unfolded over time as healthcare providers became more comfortable using it. However, this may have introduced variability to the way participants responded to interview questions depending on when they took part in the study.

This study also had limitations. Importantly, the quality, safety and person-centredness of care in this study were assessed through the experiences and perspectives of healthcare providers and clinical managers, rather than quantitative health system metrics or patient and caregiver voices. As the participants in this study were the primary users of Epic, we focused on their perspectives about the care they delivered, but perceptions about how care was received by patients or rates of errors or clinical guideline adherence, for example, may have differed from these. Additionally, while our study provides valuable insights into providers' and clinical leaders' experiences, it did not explore the perspectives of other stakeholders in the healthcare system, such as patients, caregivers, researchers, senior leaders, and policy-makers. These groups may have distinct experiences and challenges in relation to EHR implementation and quality of care. Health systems with different structures, jurisdictions, sizes or clinical specialties or that use a different EHR may not be able to directly adopt our findings. Considering that Epic was implemented in our setting and most interviews

were conducted during the COVID-19 pandemic, our participants' views, experiences and perspectives were likely impacted by situational factors of that time. In addition, some interviews were conducted over a year post-implementation of Epic, which may have introduced recall bias; however, we tried to mitigate this by building on earlier ideas shared by others to assess resonance.

Our findings offer several recommendations for increasing the potential for EHRs to positively impact the quality of patient care. Offering flexible and highly supportive training far in advance of implementation may mitigate initial challenges in delivering high quality care or user stress when the system 'goes live'. As EHRs become commonplace, patients and healthcare providers have an opportunity to share dialogue and perspectives around patient-centred communication styles and co-create shared expectations for acceptable use of EHRs during care encounters. Emerging technologies such as AI Scribes may ease documentation burden and enhance clinician-patient interactions.³⁵⁻³⁷ Similarly, iterative, human-centred customisation and co-design with a diverse group of healthcare providers before, during and after EHR implementation could ensure space for dialogue around shared goals for the impacts of EHRs, necessary versus optional EHR features to implement, and expectations for tasks (eg, charting, signoffs, responding to messages) and their timely completion.^{38 39} Providing this space could impact the balance between enabling high-quality care and overwhelming providers' workloads and may reduce the potential of beliefs that EHR safety features are trivial or redundant. Though customisation and co-design opportunities were made available in our health system prior to implementing Epic, these discussions focused on the software's features, functionalities and layout. Without real-world experience with Epic, it would have been difficult to navigate these conversations in advance, but continuous engagement and iterative optimisation can help identify emerging opportunities to leverage EHR tools and features to optimise care quality, address providers' needs and enhance work experiences, and collectively solve problems as they arise.

EHRs can support the quality and safety of patient care by introducing various features that streamline documentation, improve legibility and accessibility of records, highlight important patient care information and facilitate rapid communication between healthcare providers. EHRs can also make it easier for patients and caregivers to be invited into care teams as active participants and decision makers, which supports patient-centred care. However, the wealth of available features and the incremental responsibilities they can impose on healthcare providers, such as responding to instant messages, documenting care in multiple places or completing additional verification

tasks, can challenge their capacity to consistently deliver high-quality, patient-centred care. Engaging patients and healthcare providers in dialogue about shared expectations for how technology can best integrate into healthcare and to set priorities for EHR features should lead to better experiences and maximise impacts on patient quality and safety.

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Patient consent for publication Not applicable.

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