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The Impact and Usability of the eRIC System in the ICU - A Qualitative Study

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Abstract. The Intensive Care Unit (ICU) is an information-intense environment where more patient data points are recorded than in other wards. The electronic Record for Intensive Care (eRIC) is an ICU information system that integrates patient data every minute from multiple systems. Once implemented across New South Wales (NSW), eRIC will be one of the largest system-wide ICU clinical information systems in the world. This study explored experiences with the use of eRIC by ICU clinicians at an Australian metropolitan teaching hospital. Semi-structured, in-depth interviews relating to physician electronic test management processes were conducted with 11 ICU clinicians and one clinical information system manager was observed in their use of the system. The introduction of eRIC resulted in an additional patient record, which was perceived to hold implications for workflow and patient safety. Study findings are valuable for informing implementation as the rollout of eRIC continues.

Keywords. Intensive care unit, clinical information system, qualitative studies

1. Introduction

Clinicians in the Intensive Care Unit (ICU) are responsible for the care some of the most acutely ill patients in the hospital, utilising over 1300 items of clinical information each day in the decision-making process [1]. Digital health can greatly assist in managing and organising this information in the monitoring of critically ill patients to improve safety and support care delivery. Reported benefits to ICU clinician workflow include enhanced efficiency and decision-making, and improved overall quality of care [2,3]. However, misalignment between digital health interventions and clinical contexts can lead to system misuse and unintended adverse consequences, including patient mortality [4].

The electronic Record for Intensive Care (eRIC) is an ICU information system that integrates patient data every minute from multiple systems. Once implemented across NSW, eRIC will be one of the most comprehensive system-wide ICU clinical information systems in the world [5]. Following deployment of the system to select ICUs, this study aimed to explore experiences with the use of eRIC by ICU clinicians at an Australian metropolitan teaching hospital.

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2. Methods

2.1. Study Design

A cross-sectional qualitative study involving in-depth, interviews was conducted to explore clinician perceptions and use of digital health in their diagnostic test management work processes. Interviews were guided by semi-structured questions which allowed participants to raise any issues deemed pertinent to the impact of the digital health intervention on their patient management work practices.

2.2. Study Setting and Sample

The study was conducted in the ICU of a 450-bed Sydney metropolitan teaching hospital, which used the eRIC system. Participants were selected purposively based on their use of and familiarity with ICU patient information systems, and to ensure representation across clinical roles. Nine interviews (and one observation) were conducted three months following implementation in March 2018 and four follow-up interviews were conducted 18 months post implementation in early July 2019 to assess changes (Table 1).

2.3. Data Collection & Analysis

Semi-structured, in-depth interviews relating to clinician test processes were conducted by two researchers. One unstructured observation was conducted with a clinician super-user demonstrating their use of the eRIC system. Interviews (range: 21-52 minutes), and an observation (29 minutes) were audio-recorded and subsequently transcribed verbatim to allow for qualitative analysis using a thematic grounded theory approach [6]. One researcher analysed transcripts in the first phase of interviews, whilst two researchers analysed transcripts from the follow-up phase. Resultant themes were reviewed by two researchers and a key informant from the site to achieve triangulation of analyses and member checking, respectively.

Table 1. Participant demographics.

ID	Role	Gender	Age
IA4	Senior staff specialist	Female	45-54
IB4*	Resident	Female	25-34
IC4	Senior nurse	Female	25-34
ID4	Clinical information system manager	Female	25-34
IE4*	Registrar	Female	25-34
IF4	Senior nurse	Female	45-54
IG4	ICU Director	Male	45-54
IH4	Staff specialist	Male	45-54
II4	Staff specialist	Male	35-44
IJ4	Registrar	Male	25-34
IK4	Registrar	Female	25-34
IL4	Fellow	Male	35-44

*Participants interviewed in both phases

3. Results

The key themes of workflow and patient safety emerged from the interviews.

3.1. Workflow

Participants in the initial round of interviews expressed difficulties in adjusting to the use of an additional electronic patient record alongside an existing electronic record (Cerner PowerChart), and the substantial differences between systems. The ICU-specific eRIC system was designed to mimic the appearance and layout of traditional ICU flow sheets, resulting in a substantially different presentation of data from that of PowerChart. Respondents overwhelmingly favoured the existing PowerChart system, although some conceded that experience with using PowerChart had likely fostered familiarity.

Notable differences in eRIC were the lack of standardised data presentation features of the systems, such as the chronological presentation of returned laboratory test results in eRIC (as opposed to reverse-chronological in PowerChart), increased patient data presented per page (resulting in a "*busy*", or "*messy*" screen), and differences in the way pathology results were flagged (three levels of acuity in PowerChart versus two in eRIC). However, whilst issues with novelty were not raised in follow-up interviews, many of the problems identified immediately post-implementation remained over a year later.

> *"for the most part, we complained a lot about eRIC and then nothing seems to change."* Registrar, 2019

> *"I wrote a detailed list of all the things that I thought needed to be changed for [eRIC] to be improved. […] but I have largely given up on trying to make any meaningful improvements because to me it seems like they're not investing in improving eRIC, I would say"* Registrar, 2019

3.2. Safety

The inability to view multiple screens concurrently within the eRIC system and load times during screen switches were perceived to hold negative cognitive implications. Physicians described disruptions in the cognitive process when having to gather information from multiple locations of eRIC when forming a clinical decision.

> *"It's a significant problem […] there's a certain way that you think, and that's, right: check this, check this, look at that, bring all of these things together, make a decision, done, let's move on. When you get to that point and you're delayed then you have to go back and recheck that and recheck that because your working memory has kind of made up its mind, finished its job, disgorged all of its contents. So it's deliberately making someone stop and wait"* Senior staff specialist, 2018

The process of documentation (for progress notes, discharge summaries etc.) was also negatively affected by the inability to access patient information from different parts of the eRIC record simultaneously.

> *"it increases transcription errors, because you can't see the [observations] at the same time as you're typing. You memorise them, or sometimes you make up what you think is correct and then you might forget to go back and change it if that was wrong"* Registrar, 2018

One workaround physicians conceded to performing at three and at 18 months following implementation was the copy and pasting of all pertinent information into a temporary Microsoft Word file, and referring to that record when documenting.

Despite a substantially different format and layout of the eRIC system, however, presentation of certain test results that took markedly longer to return (most notably microbiology results) was perceived to be more "*intuitive*" in eRIC, appearing according to time of result availability. In the PowerChart system, returned results conversely appeared at the date when the test was ordered. Follow-up of results returning several days or, less often, weeks after the order date would have disappeared off the screen in the relevant location of the record, and would rely on the responsible physician (often from a different clinical team) being aware of and searching back to the date of test order.

> *"… what happens is it gets repeated, or a positive test gets missed. I've seen that happen many, many times when […] another doctor comes along and says, "Oh, we need a vasculitic screen," and no one trawls through to see it was done two weeks ago […] So, what I find I have to do is when I've got a really complicated patient who's had lots of tests I have to get [other doctors] to write a [Microsoft Word] spreadsheet to make sure we chase the right tests, because otherwise you're going to forget the serum rhubarb was done two weeks ago."* Staff specialist, 2018

Finally, despite the eRIC system serving as a complete ICU record, limitations of the system meant that reliance on PowerChart remained 18 months post implementation. Respondents reported the simultaneous use of both systems as a workaround to some tasks, but perceived the potential for an increased risk of error associated with continually adjusting to different systems.

> *"The quickest way on a round we found is to have both windows of an eRIC and an eMR open […] Sometimes when we're handing over in the morning […] a lot of the bosses do prefer to look at trends on eMR [PowerChart], but to look at the gross daily information on eRIC"* Registrar, 2019

> *"since the addition of two separate electronic ordering and reporting systems, the complexity and how fragmented and the possibility of error has just increased dramatically in my opinion […] it's just the simple human error of – instead of going and looking at a paper chart that's in front of a patient and where you're used to looking at checking the patient details – just having the wrong thing open in front of you or reading from left to right or right to left […] we're using different systems that work differently."* ICU Fellow, 2019

> *"It's not even a preference thing. If there was just one system, you'd adapt to that, if it was just paper based you'd adapt to that but it's the constant having to [shift]"* Registrar, 2019

A summary of the differences between systems is presented in Table 2 below.

Table 2. A comparison of system features between PowerChart and eRIC.

System feature	PowerChart	eRIC
Display of pathology results	Reverse-chronological	Chronological
Flagging of pathology results	3 levels of acuity	2 levels of acuity
Display of microbiology results	By date of test request	By date/time of result availability
Navigation	Simultaneous viewing of multiple pages/screens; Faster screen load times	Viewing of individual screens only; Slower screen load times

4. Discussion

Previous studies have demonstrated the propensity of digital health to affect work processes [2,3], with some systems being withdrawn as changes were so dramatic [7]. This study explored user perceptions of a comprehensive, ICU-specific patient record three months following implementation with follow-up interviews undertaken 18 months post-implementation with heavy users of the system. Whilst increased familiarity with a system is likely to affect perceptions [8], findings from this study identified significant patient safety issues which remained 18 months after the system was introduced. The use of workarounds to overcome the cognitive implications of slow load times between screens within a system which does not allow the simultaneous viewing of multiple pages, for example, will likely continue with future use.

A combination of information systems presents challenges in terms of safety, with patient information possibly being missed, and the duplication of information wasting resources and time [9]. The simultaneous use of an *ICU-specific* patient record with a substantially different, *hospital-wide* record system was perceived to potentially increase the risk of error. The eRIC system offers the capacity to deliver long-term patient safety benefits both within and beyond the ICU through the elimination of paper record complements and improved accessibility and communication of comprehensive ICU patient information [5]. Consideration of user feedback as part of a continuous monitoring and evaluation process will facilitate realisation of intended benefits.

5. Conclusions

This study explored user perceptions of a comprehensive, ICU-specific patient record three- and 18-months following implementation. Study findings are valuable for informing implementation as the rollout of eRIC continues across the state.

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