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RESEARCH ARTICLE

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Intensive care nurses' experiences with the new electronic medication administration record

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Abstract

Aim: To explore the experiences of Registered Nurses who administered medications to patients using the electronic medication administration record (eMAR) in Electronic Record for Intensive Care (eRIC) at one adult intensive care unit (ICU) in NSW, Australia.

Design: The study research design used a qualitative descriptive exploratory approach that took place in two stages.

Methods: Five participants attended one focus group followed by the observation of each participant as medications were administered to their assigned patient using the eMAR in eRIC.

Results: From the data, three themes and one subtheme were identified. Themes included forcing nurses to work outside legal boundaries; patient safety; with a subtheme titled experiencing computer fatigue; and taking time away from the patient. To practise safely, nurses were required to implement workaround practices when using the new eMAR in ICU. Nurses also were concerned that the eMAR in eRIC took time away from the patient at the bedside and 'added more screen time' to their day.

KEYWORDS

focus groups, intensive Care, medication administration, nursing information systems, nurse observations, qualitative study, registered nurses experiences

1 | INTRODUCTION

Electronic medication administration record (eMAR) systems can overcome many issues associated with paper-based systems, yet they can also give rise to new risks and challenges. While goals of such systems are to reduce medication errors, and thus improve patient safety, concerns are still being reported. Examples include data entry errors, technical problems, insufficient clinical alerts, inadequate decision support, usability problems, workflow issues, poor integration with other hospital systems and poor correspondence between system functionality and hospital policies (Culler et al., 2011; Savage et al., 2010). Remarkably, medication errors still occur even after eMAR systems have been well established (Cho et al., 2014; Savage et al., 2010). With nurses being key users of eMAR systems, their experiences offer important insights into the challenges associated with eMAR system use and offer potential improvements.

2 | BACKGROUND

Medication errors pose risks to patient safety, staff well-being and hospital efficiency. The impact of medication errors on patient safety can be particularly serious in intensive care units (ICUs) due to high patient morbidity, use of restricted medications and the necessity for complex medication regimens in this environment. Medication errors can also have devastating impacts on nurses' emotional well-being (Athanasakis, 2019). In attempts to reduce some risks, electronic systems have been introduced to replace paper-based medication charts. Major issues with paper-based systems included poor legibility of prescriptions, delays with medication orders, prescribing errors by doctors, medication interactions, misplaced medication charts and the potential for multiple medication charts for the same patient in cases of complex illness (Franklin, 2012; McLeod et al., 2015). Responsibility often fell to nurses to pick up doctors' prescribing mistakes and resolve any other issues to ensure the correct medication was administered at the appropriate time. This could involve time-consuming and stressful interactions between nurses, doctors and hospital pharmacists.

Nurses hold primary responsibility for checking patient prescriptions and administering medications to patients using electronic systems. Understanding nurses' experiences with eMAR systems is key to further reducing medication errors. As such, nurses are crucial informants regarding these practices. Multiple factors related to nurse's experiences are known to influence medication errors, including workload, interruptions, time, physical environment characteristics, interdisciplinary communication and patient communication (Alomari et al., 2018; Harkanen et al., 2018; Manias et al., 2016). Nurses have also been found to employ various strategies to overcome such challenges to ensure patient safety. These include workarounds such as 'stashing' medications to ensure patient continuity of care (Martyn & Paliadelis, 2019; Mula et al., 2019; Smith et al., 2009), and communication strategies such as using communication logs and other communication tools (Manias, 2018). Further exploration of nurses' experiences with eMAR systems is warranted, especially in the ICU context, to optimize systems and processes to facilitate greater patient safety.

3 | METHODS

3.1 | Study design

This paper seeks to report ICU nurses' experiences with the new electronic medication administration record that is incorporated within the 'Electronic Record for Intensive Care' (eRIC), a clinical information system for the ICU. The research was part of a larger study about nurses' experiences and practices with the new eMAR introduced gradually across acute care hospitals in New South Wales, Australia, during 2016. In 2017, eRIC with the new eMAR was launched at the ICU research site in this study. Given that different eMAR systems are used for ICU, in contrast to the eMAR system used in the ward areas, we decided to report the ICU data separately.

The research methodology for this study used a qualitative descriptive exploratory approach that took place in two stages. A focus group was conducted followed by the observation of individual nurse participants as they administered medications to their allocated patient. The reason for the observations was to obtain data about aspects concerned with administering medications that supported what the nurses had discussed in the focus group and to see whether there were any other practices which nurses may not be aware of regarding their use of the electronic medication chart. The study was guided by the following question: What are the experiences and potential workaround practices that nurses make use of to resolve challenges that may arise during the administration of medications to patients in the ICU?

3.2 | Study setting

The research reported in this paper was conducted in one tertiary acute care public hospital adult intensive care unit (ICU) in New South Wales. The ICU has 12 beds for general intensive care patients and is located adjacent to the 10-bed high-dependency unit (HDU).

3.3 | The Electronic Record for Intensive Care (eRIC)

Electronic Record for Intensive Care is a clinical information system specifically designed for the intensive care environment. The system can automatically integrate data from multiple bedside devices and hospital information systems to generate a comprehensive health record and clinical data repository, including observational clinical parameters, nursing and medical clinical documentations, pathology results, microbiology reports and interface to the external radiology information system.

The Electronic Record for Intensive Care also incorporates the eMAR, which has a pre-defined drug library with some degree of clinical decision support system (CDSS) for prescribers, and includes standardized drug-specific prescribing template, drug-allergy alerts and alerts when the prescription exceeds the maximum dosage. These alerts prompt the prescriber to modify the prescriptions before being signed off; however, the prescribers may choose to override them. Similar alerts also exist when administering the medications.

All prescribed medications are listed within the 'Dose & Task List' function. Nurses may access the list to identify and validate the medications due for administration. When a medication is selected for validation, a pop-up screen appears, which contains patient's details, allergy status, medication name, dose, route of administration, frequency, time of administration and comment sections. All intravenous, subcutaneous and Schedule 8 (restricted) medications require another clinician to check and sign within eRIC before the medication can be validated.

3.4 | Participants

A convenience sampling technique was used to recruit Registered Nurses (RNs) to the study. The initial request was sent from the Director of Nursing (DON) to Nurse Unit Managers of wards and units inviting them to participate in the study. While several ward areas from three Sydney metropolitan hospitals were included in the wider study, only one critical care area (ICU) agreed to participate in response to the initial invitation from the hospital DON. Flyers were distributed to the ICU informing nurses about the study with an invitation to participate in a focus group and later to be observed in the natural ICU setting giving medications to their patients. Five (5) RNs who worked in ICU agreed to participate in the study.

3.5 | Ethical considerations

The Research Ethics Committee approval to conduct the study was granted from the hospital and university human research ethics committees prior to the recruitment of participants (Approval No. 18/244 HREC/18/POWH/484 and H13144). A separate site-specific approval was granted for this hospital to be included in the larger study (2019/ETH09277) after the study began. Written informed consent was provided by all participants, and confidentiality was assured. The researcher who collected the data was an outsider to the hospital, having no prior relationships with the participants in the study.

3.6 | Data collection

One focus group was conducted with ICU nurses in September 2019, followed by observation of nurses during a medication round in October 2019. At the commencement of the focus group, participants were informed about the study and were provided with an information sheet and consent form to complete. The focus group was held in the ICU conference room and took approximately 60 minutes. Participants were asked eight questions by the researcher (LG) during the focus group (see Table 1). Data from the focus group were digitally audio-recorded and then transcribed verbatim. At the end of the focus group, participants were asked to inform the researcher of a suitable time in which the observations of medication rounds could be undertaken (convenient to their rotating roster). Data collected during the observations were recorded on a field note tool. After each observation, the researcher reflected on the field notes made, self-monitoring for possible bias.

3.7 | Data analysis

Data were collected between September–October 2019. Content analysis using an inductive approach was used to analyse focus group data (Graneheim et al., 2017; Hsieh & Shannon, 2005). As described by Kondracki et al. (2002), this form of analysis is considered useful for analysing textual data from focus groups. Two researchers (LG and KP) immersed themselves in the data, reading focus group transcripts several times to search for similarities and patterns in the data. This was followed by discussing and making notes about first impressions. Codes and categories were constructed and highlighted from the analysis. From this, emerging themes were identified. In terms of rigour, other members of the research team independently reviewed the data to reach agreement about the themes that had identified.

TABLE 1 Focus group questions

1. What are your experiences with using the eMAR technology?
2. How does the eMAR compare to the former paper-based version?
3. Tell me about the support you received when using the eMAR system with the current infrastructure? Can you explain what happens if the system goes down or becomes unavailable?
4. Could you describe whether the eMAR system has changed the efficiency with which medication administration occurs? Could you explain whether the eMAR has impacted medication error rates? If so, which errors and why?
5. How does the doctor's use of the eMAR impact on your work?
6. Have you noticed any problems with the eMAR system? What do you like about the eMAR system? What don't you like about the eMAR system? What could be improved? (Please explain).
7. How has the eMAR technology enhanced (or constrained) your ability to educate patients about their medications?
8. Please tell me about what happens during interruptions of the medication administration round with the eMAR system.

3.8 | Findings

Five Registered Nurses participated in the focus group held in ICU. Each nurse was later observed completing a medication administration round with their patient. Observational data will be woven throughout the following three themes and one subtheme that identified from the data: *forcing nurses to work outside legal boundaries*, *patient safety*, with the subtheme *computer fatigue* and *taking time away from the patient*.

3.9 | Forcing nurses to work outside legal boundaries

This theme illuminates how ICU nurses were forced to work outside legal boundaries when using eRIC to administer patient medications. Nurses described their frustration with the system when they had accidentally cancelled a prescription. Part of this frustration was due to nurses who may not have witnessed the administration of the drug often being required to sign for it. Another concern was that if intravenous (IV) fluid orders were cancelled in error, then there were substantial difficulties associated with accurate documentation of fluid balance. Once deleted, there was no record of the existence or cancellation of the infusion prescription.

RN 2: That's another frustrating thing when you cancel a drug by mistake, you must get it re-prescribed. You could be near end of that bag [IV fluids] and you've made an error, so you mark it as error. From whenever you have hung the bag, it could have been 8 hours ago, there's 8 hours of that infusion gone and you can't get it back unless you get it re-prescribed.

RN 1: Then someone else must then re-sign it with you, who didn't probably see that medication get made up.

RN 2: That's my biggest pet peeve with the electronic system, when the medical team haven't prescribed it and then you come on to another shift and that person from the previous shift is asking you to sign for drugs that were administered at one o'clock in the morning. Because they've just been prescribed right at handover time. I happen to feel really anxious about doing that, I don't like to. So, I actually say, no and I ask them to find a night person. Because I wasn't there at 1:00 a.m., I was fast asleep. I don't like to have to do that.

Due to the time-consuming nature of prescribing in eRIC, doctors delayed charting medications for patients. Nurses reported that medications were frequently given on a verbal order. They recount how they could work an entire shift administering medications to a new patient without a documented prescription on eRIC.

RN 3: Sometimes it gets so busy that we must start medications on verbal orders. Doctors finish at half seven, they don't want to chart it and the night nurse has to come on and you've got to get the night doctors to come and chart for us – this happens a lot. That causes so much risk to the nurse, to the patient, to the doctors.

RN 1: I'm sure there's a lot of meds have been given that have never been signed for. Especially in an emergency.

RN 2: I hung an infusion of Precedex for a patient, it hadn't been charted and I had to go home. So, the next shift had to sign for it.

RN 3: .....if she [RN2] had to wait there, it's 2 hours that she'd be waiting to get somebody to write it up.

Nurses described the type of medications they administered without a medication prescription in place. The nurses expressed trepidation regarding adverse events and questioned their accountability should this occur.

RN 2: You could get an admission at 8:00 a.m. and it's 4:00 p.m. and they still haven't charted your meds. So, for that long period, you've had noradrenaline running, vasopressin, all your IV fluids. You've given multiple stat doses of drugs; nothing has been charted. There's not even an admission summary into the ward. I've basically given these drugs off a verbal order.

Administering medications on a verbal order was also evident during researcher observations. RN 5 told the researcher that 'nurses use different practices based on their experiences'.

While caring for ICU patients, the nurses' work took place in a variety of spaces in the critical care area. Nurses were observed to move across spaces to obtain medications and frequently had to obtain schedule 8 (restricted) medications that were kept in the HDU drug cupboard on the other side of the unit. Afterwards, the nurse would walk back to the patient in ICU to administer the medication to the patient. One participant in the focus group explained the challenges associated with preparing and administering schedule 8 medications using eRIC.

RN 2: So, you've got to log into eRIC, but the S8 cupboard [is located on the other side of the unit], you've got to fill out the S8 book, while you're in eRIC you've got to go to the PRN dose, you've got to select the dose you want to give. Someone has to validate the dose. Then you walk away to your bed space with no one else, no one checks it, you just check it off to yourself, because the person who carries the keys might be on the other side of the unit to you. So, I just feel like they're checking it [at the cupboard], but they're not actually checking the patient. Whereas if you had it on paper, someone would come back [to the bedside] with you.

RN 2 elaborated on how she managed these challenges to enhance patient safety in minimizing medication errors.

RN 2: For the way that I worked around that is I get my fentanyl out of the cupboard, I get whoever is close to check the S8. I illegally walk around with that vial, not make it up. Take it to the bed space and the person who I'm working next to, they check it on eRIC. They see me make it up and then I feel like for me, personally, I feel that's a safer way to do things.

3.10 | Patient safety

Participants explained the difficulties they had trying to correct or update changes to titrated medications.

The nurses explained that eRIC does not allow retrospective documentation of bolus doses administered to the patient when the documentation is not done in a chronological manner (on the paper chart this could be documented). Since the nurse validates syringe changes in eRIC, any bolus doses given prior to the syringe change are not able to be documented in eRIC. The nurse must document all the bolus doses first and then validate the syringe change.

RN 1: If you do an action, say a titrate medication, where you give him his bolus, then you change the syringe. You can't go back and go, oh, actually, I've given the extra four doses there, because you've changed the syringe now. It's like the action can't be done, you've already changed it - sort of like, right, so how can I document that they've had 10 milligrams, more of propofol than what's actually prescribed.

RN 4: That's why if the infusion runs out on the electronic program, you can't backdate anything. It goes, no, the syringe has ended, you can't do anything.

In the following account, one participant expressed concerns about different patient weights being programmed into the infusion pump and eRIC. The discrepancy caused a mismatch between the dose being documented in eRIC and what was displayed on the pump. The infusion doses are calculated based on weight, rate of the infusion and concentration of the drug. So, entering different weights resulted in a different dose being administered to the patient.

RN 1: Somebody's put the wrong weight into the fluid chart and the doctor has entered a different weight, it looks as if the patient is getting two millilitres less of the infusion on eRIC and the patient's getting two millilitres more. If you try to correct that, it is even a worse mess.

Participants also reported that verbal orders for medication were only being given to one nurse. They identified this was problematic and

were concerned that inexperienced nurses may not pick up any discrepancies in the order and potentially administer an inappropriate dose. Further, they were concerned that if an adverse event occurred, doctors providing the verbal order may not remember prescribing that dose.

RN 3: I think the range of verbal orders is the trigger - I think they have increased 100 per cent, the verbal orders from doctors who just say to one nurse and the nurse is happy enough with that. I am never happy enough with that. I want two people to listen to that.

RN 3: Then it can easily go (and I know it has happened in the past), oh, a verbal order, give this drug and three people get it, or whatever and then they came back and prescribed it. And then they say I don't remember saying that to you.

Further limitations of the technology included the lack of a maximum dose alarm or parameter function.

RN 2: With the S8, Endone, just say it was five milligrams, three-hourly, if you don't check the previous dose, it will let you give multiple doses, even though that that's not what's charted.

RN 3: But there's no max dose in eRIC. It's the same with Heparin and Clexane, they can both be charted on eRIC, while in eMAR, there's the high error pop up alarm. So, without any warning, there are two anticoagulants charted that could be administered.

Participants described how they employed workarounds to give IV medications. Workarounds for administering IV medications were also noted by the researcher during observations. RN 5 showed the researcher how nurses 'trick the system' in eRIC to enable appropriate doses to be given. The RN would document in eRIC that a medication such as thiamine 100 mg was given over 50 minutes in a certain volume, but instead the nurse was observed to give the thiamine via a push/bolus dose.

RN 5 stated that this was 'particularly important when the patient was on a fluid restriction as eRIC is not tailored to fit individual parameters'. As medications are usually administered much faster via a central line than the usual prescribed intravenous route, this is appropriate when a patient has renal impairment and is on a fluid restriction with a central line in situ. The nurse justified these actions stating that ICU nurses have advanced practice skills and are accustomed to administering medications this way and so they make decisions according to patient requirements. However, eRIC could not accommodate this.

Some participants complained that the IV infusion finished prior to it being registered on eRIC as completed. Alternatively, the infusion would sometimes register on eRIC as completed while still in progress and would require the RN to validate the next order for continuity of the infusion while the infusion was still in progress.

RN 3: What is documented in eRIC is not an accurate representation of what the patient's actually been given.

RN 4: With all the lines of medication running at the same time, they could be an hour out. If the infusion is commenced at 8 a.m. but in eRIC it is prescribed to commence at 6 a.m., it can be validated as commencing at 6 a.m. instead of 8 a.m. (when it was administered). The infusion runs out on the electronic program 2 hours early, you can't backdate anything. It goes, no, the syringe has ended, then you can't do anything.

One nurse described the problems they experienced when ICU patients were discharged to the wards. eRIC was not being linked to the ward eMAR system; therefore, there was potential for double dosing.

RN 2: We use a completely different medication system to the rest of the hospital. So, you discharge a patient, you've got to pull out your medication summary from ICU, then the doctors must then re-prescribe the meds that are going to go on eMAR. You've got to get both screens up on a computer at the ward and go through each individual medication. You could discharge the patient at midday and you've given the 12 o'clock cefazolin, but on eMAR it's still due. So, if you don't go through that, there's a chance that nurse will give that med again. So, it's dangerous.

3.11 | Computer fatigue

Participants complained that eRIC was not user-friendly. As a result, they spent lengthy periods of time navigating the system and highlighted the negative effects of prolonged engagement with a computer screen. They indicated frustrations with having to constantly go to different tabs or to repeat steps to give medication.

RN 4: You've also got computer fatigue, you're not able to pay attention, it may take multiple attempts to give the medication, by which time you're not paying attention. Always the errors that eRIC points out - you know that you have done it correctly so RNs become frustrated with the system and tired – little things that may need to be ticked or unticked but eRIC does not allow the RN to do this.

RN 3: It's impossible to find what you want to find. It's just getting bigger and bigger, there's more things to sign. With paper documentation, at least you could tick, tick, but with eRIC you must go this tab, then you have to click on multiple things and then it doesn't let you move on.

RN 1: Yeah, you're more focussed on doing the eRIC thing, than what you're giving them [patients].

The quotes above also highlight the time-consuming nature of administering medication via eRIC. This is illuminated further in the following theme.

3.12 | Taking time away from the patient

Nurses reported that a great deal of time was required to log into the system and to validate a medication, and complained that this took time away from the patient.

RN 1: It can sometimes just not work, it takes you about three times to get something validated, it won't go through straight away.

RN 2: It freezes and you must press control-alt-delete, end task, get out of eRIC and then log yourself back in to the whole system again.

RN 1: It's quite slow, as well, when you're logging in. You only know that the system is working when it takes forever to validate a medication. For Endone, I just think it's probably doubled the length of time it takes to give a 2.5 milligram dose of Endone.

RN 3: If you're with a sick patient and you're doing antibiotics, literally you could be going every hour with something. Medications, yes, it's very important, but I mean, where do we sacrifice our time? Where do we put our time? Do we take it from the patient to sit at the computer, or do we look after the patient?

Nurses complained that it took a lot of time to administer and record blood products into eRIC as there was duplication in checking. First nurses were required to check the product on the blood issue report and then repeat the process and enter it into eRIC.

RN 4: When you log it in, then you must manually enter all the product numbers (for blood products), which is 15, 20 characters.

RN 3: So, we had a gentleman on ECMO [extra corporeal membrane oxygenation]. There were two nurses looking after him. We gave 65 blood products that night. I was there for 2 hours and 45 minutes at the computer putting all the codes in, putting all the fluids in. It was one of the sickest patients and two nurses were there to look after the patient, with the ECMO and the dialysis, but I spent nearly 3 hours on eRIC.

RN 5: With blood products, you're signing the paper, logging on eRIC and doing it there. So, we are duplicating.

RN 3: It takes time from the patient at the bed side. You're behind the screen more.

4 | DISCUSSION

The electronic medication administration technology was developed with the intention of reducing medication administration errors, saving nurses time and enhancing patient outcomes (Nagle & Catford, 2008). While some research has found that medication errors were significantly reduced by the introduction of such technology, this current study supports previous research that found medication errors are not necessarily reduced with the introduction of this technology into clinical settings and that eMAR systems may introduce new types of errors and impact negatively on work practices (Booth et al., 2017; Redley & Botti, 2012).

This current research found that rather than reducing medication errors, the eMAR in eRIC introduced new risks for errors and encouraged poor legal practices in the administration of medications. Physicians and nurses alike were reported to be practising outside their legal boundaries due to the inflexible and cumbersome nature of the technology to ensure their patients received life-preserving medications. This is similar to findings from previous research that identified that medication administration technology was not intuitive or flexible to nurses' work particularly in a specialized high-risk setting (Lichtner et al., 2019).

The rigid nature of the eMAR system forced nurses who participated in this study to implement multiple workarounds to administer medications to their patients. This is concerning as despite being considered as necessary in urgent circumstances, workarounds have generally been found to increase medication errors and compromise patient safety (Koppel et al., 2008). While workarounds are common, and well-reported (Koppel et al., 2008), some of those highlighted in this study have implications not just for patient safety but nurses' professional accountability. In particular, workarounds that require nurses signing for medications they had not administered and administering medications without a valid order expose them to professional and legal consequences.

Additionally, the senior nurses who participated in this study were able to continually observe their patients and think critically about what their patients required. This was often in contradiction to what eMAR technology told them was required. Such contradictions indicate there may be substantial risk to patients if less experienced nurses rely purely on the technology for decision-making. Therefore, it is imperative that eMAR technology systems are continuously evaluated and improved to encourage best practice and protect patient safety (Koppel et al., 2008).

Nursing has a long and complex history with technology, with nursing reported to be both with and against technology (Sandelowski, 2000). This ambiguous relationship in part stems from the tension between technology enhancing nursing care but at the same time acting as a barrier to care (Sandelowski, 2000). Although findings from previous research showed the use of medication administration technology significantly improved nurses' satisfaction (Tubaishat, 2017), and did not take nurses' time away from direct patient care (Westbrook et al., 2013), findings from this current study highlighted nurses were unhappy with the additional workload involved with navigating the technology. Further, this study illuminated how the complex medication management system acted as a barrier to the nurse/patient relationship as it took nurses away from their patients in terms of both time and physical proximity.

There were some limitations in this study. Only one intensive care unit at one metropolitan tertiary referral hospital was recruited to the study. In addition, the small sample size (five participants) required only one focus group to be conducted together with the subsequent observations of the focus group participants.

5 | CONCLUSION

This study aimed to investigate ICU nurses' experiences with the electronic medication record in eRIC. It is clear from the study findings that there are substantial issues with this technology that threaten patient safety and undermine best practice for medication administration. However, ICU nurses recognized the risks and implemented workaround practices in order to administer medications safely. Nurses were also concerned about excessive screen time, which meant less time focussed on patient care. It is imperative to take into consideration these experiences of nurses working with this technology. These findings can inform and enhance further development of the system to optimize patient safety and ensure nurses are supported to work within professional and legal frameworks.

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CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTIONS

LG, TR and KP were responsible for the study conception and design. LG, RM, TR, KT, JH and KP organized the data collection. LG and KP performed the data analysis. LG, RL, LM and KP were responsible for drafting the manuscript. LG, RL, LM and KP made critical revisions to the paper for important intellectual content.

DATA AVAILABILITY STATEMENT

This study followed the COREQ (COnsolidated criteria for REporting Qualitative research) Checklist for qualitative research.

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