User Perceptions of the Implementation of an Electronic Medication Management System in a Paediatric Setting

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Abstract. The roll-out of a hospital-wide electronic medication management system (eMMS) is a challenging task, requiring planning, coordination, communication and change management. This research aimed to explore the views of doctors and nurses about the strategy used to implement an eMM system in a paediatric hospital. Semi-structured interviews were performed during the first week of the implementation on each ward, and were then followed up three and six weeks post implementation. In total, 90 users (60 nurses and 30 doctors) were asked about their impressions of the implementation, as well as their perceptions of training and IT support. Qualitative thematic analysis was performed by three researchers. Most users perceived the implementation of the eMM to be positive overall. Although perceptions of the implementation process remained largely consistent across the six weeks, users identified several areas where improvements were needed, especially early in implementation, including resources, planning, roll-out strategy and training. These findings are useful for future implementations of eMM systems in paediatric hospitals.

Keywords. Electronic medication management, electronic health records, implementation, training, resources

Introduction

Although previous research has explored factors associated with successful implementation of clinical information systems in adult hospitals, limited research has focused on the implementation of electronic medication management systems (eMMS) in paediatric settings. These settings may present unique challenges to those reported in adult hospitals. Previous studies in adult hospitals have shown that successful implementation, as perceived by system users, is dependent on [1-4]:

- The availability of super users (doctors/nurses) to act as peer support.
- Training, including multiple training methods to suit staff needs, quality of training.
- Ongoing user support.

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- Strong leadership, including commitment and adequate budget. This also includes sufficient resources, funding and staff.
- An interdisciplinary planning and implementation group, incorporating developers, IT staff and importantly, end users.
- A comprehensive implementation strategy, including flexibility for change and a plan to deal with down time.
- A system that is fast, reliable and user friendly.
- Anticipation of workflow changes well before implementation, and proactively adapting the system and work practices to complement each other.

Failure to consider all aspects of a system implementation may lead to poor acceptance of the system by users [1, 5].

This study aimed to explore the views of nurses and doctors about the strategy used to implement an eMM system in a paediatric hospital. User interviews were followed up over the course of six weeks, to identify if views changed over this implementation time-frame.

1. Method

1.1. Setting and Implementation

This study was conducted across eight wards in a children's hospital in Sydney, Australia. The study ran from May to December 2016. Following roll-out on two pilot wards, one new ward introduced the system each week for eight consecutive weeks. The eMM system comprised the clinical module of the hospital's existing commercial electronic clinical information system (Cerner Corporation) [6].

1.2. Participants

Participants from eight wards were recruited to participate in the study via direct approach. Nursing unit managers (NUMs) were notified of interviews one week in advance and two interviewers visited the ward each week for approximately 1-2 hours. Participants included nurses and doctors present on that ward on the day of interview, and included registered nurses, NUMs, clinical nurse educators (CNEs), enrolled nurses (ENs), registrars, residents, specialist consultants and surgeons.

An opportunistic sampling approach was used- recruitment continued until all available users on the ward at the time of the visit had been invited to participate. Ethics approval was obtained by the Human Research Ethics Committees of the hospital and Macquarie University.

1.3. Interviews

Short semi-structured interviews (Figure 1) were held three days post implementation on the first week that wards introduced the system, and then on the third and sixth week after implementation. In total, 90 users were interviewed, including 60 nurses and 30 doctors. Interviews were audio recorded, lasting on average approximately ten minutes.

1.	What is your overall impression of how the eMMS is going?
2.	How has the eMMS changed your prescribing (or administration) of medications?
3.	Do you think the eMMS is safer or less safe than the paper system? Why?
4.	How is the eMMS helping and/or hindering your work?
5.	Have any new problems or issues emerged?
6.	Can you think of any ways the eMMS can be improved?
7.	Overall, do you think implementation of the eMMS has been positive or negative for you as a health professional? For patients? For the organisation as a whole?

Figure 1. Questions asked in the semi-structured interviews.

1.4. Data Processing and Analysis

Audio-recorded interviews were transcribed verbatim and de-identified. Three team members independently reviewed the interview transcripts to identify user attitudes towards the implementation process. Attitudes and perceptions were classed into themes and the researchers came together after each week to discuss themes and ensure consistency in coding. Disagreements were resolved via a consensus approach.

2. Results

A large number of themes emerged from the interviews, however, here we present only the themes that directly related to the implementation process. The main themes included training, support during implementation, resources, after-hours help, roll-out strategy, planning and overall impression of the implementation. Table 1 describes these themes and includes an illustrative quote for each finding.

Table 1. Factors that were identified by doctors and nurses to influence the implementation process (w1=week 1, w3=week 3, etc).

Theme	Implementation factor (week identified)	Example quote
Training	**Positive factors:** Training was available and provided as needed (w1, 3, 6), super users available on every shift (w3, 6)	"It's been positive in that we've had lots of backup and there's lots of help in that first few days when we were all still very new to the system." Nurse, w3
	Negative factors: Limited practice on a real patient (w1, 6), training too early before implementation (w6), no super-user doctors, only nurses (w1, 3, 6), insufficient training for senior doctors (w3, 6), lack of training in some work process changes (e.g. location medication is checked) (w3)	"…we have paged them [IT] and then they've come down straightaway." Nurse, w3

Theme	Implementation factor (week identified)	Example quote
Support during implementation	**Positive factors:** Hospital asked for feedback on the system (w1, 6), support staff available (w1, 6), technical problems fixed quickly (w3), IT support (w3)	"Simple stuff is fine and that's resolved quickly. " Nurse, w1
	Negative factors: Insufficient staffing on wards during implementation (w1), staff working overtime to complete tasks (w3), slow responses to problems (w1), support people on first day unavailable when needed due to covering multiple wards (w3), lack of long term and weekend help on wards (w3), support staff not listening to concerns problems with system (w3), difficulty getting access/training for agency and casual staff (w6)	"I find my boss now has to get more staff in the morning to get through the admissions…" Nurse, W6 "We can't do what we used to do if it's going to take that much time, and we've had issues along the way, and getting answers to them have been a little bit difficult…" Nurse, w1
Resources	**Negative factors:** Insufficient power points to charge computers (w3, w6), need computers at bedside (w3), would prefer tablets or mobile devices (w3, 6), laptops are heavy (w3, 6), computers and network very slow (w3, 6), logging on/off system slow and plagued with errors (w3, 6), laptop computers take up too much space (w3, 6), desktop computers preferred to small screen, slow laptops (w6), lack of computers at peak times, e.g. rounds (w6)	"I think it's vital that we have a device at every bedside, but then the issue with that is logging in just takes so long and a lot of our prescribing is done on ward rounds…there are some wards that have individual computers and just the logging in process takes, almost the whole time that we spend with the patient…." Doctor, w6 "Tapping on and off this morning…it took me about 15 minutes to get a computer working. The first one didn't work. And then the second one I had issues with, so I had to restart it. So it was like 15 minutes before I could actually do anything." Nurse, w6 "It is difficult to get close to the patient with the portable COW{computer on wheels}." Nurse, w6
After hours help	**Positive factor:** After hours help has been good (w3) **Negative factor:** Trouble finding help quickly on weekends/night (w3)	"So the only thing we've found a bit difficult is on weekends and part of that is just training." Doctor, w3 "When I've had issues…calling the generic IT number they often don't know the answer and have to refer me to someone else who may or may not be available at the time and then that's not very practical when you're trying to prescribe on the spot." Doctor, w6

Theme	Implementation factor (week identified)	Example quote
Roll-out strategy	**Negative factor:** Difficulty caused by hybrid system as whole system didn't go online at once (w1, 3, 6), potential for errors due to patients moving between wards where system was or was not yet implemented (w1, 6), fast roll out with lack of infrastructure to support it (w1), issues not fixed before rolling out to other wards (w1), some wards (e.g. respiratory) rolled out in their busiest month, better planning required for this (w3)	"We've had to call ICU, contact the nurses, get them to print off records if they haven't beforehand. So yeah, it's certainly taking more time for the nursing staff and medical." Doctor, w1 "…it would be better if the whole system was electronic because at the moment handover takes a while to do because you've got paper and you've got forms and it would be a lot easier if everything was electronic." Nurse, w3 "In theory, it works well, however I think the roll out was perhaps too fast, the infrastructure is not quite there" Doctor, w1
Planning	**Negative factors:** Lack of input in designing the system from junior doctors, sub-specialty teams and nurses (w1, 3), lack of backup for system downtime or crashes, no way to administer medications (w1), system is not user friendly (w3), some IT solutions do not fit with common ward procedures (w3, 6)	"…many wards took up the system without a lot of input from junior doctors, and we're the ones who use it a lot, and particularly a lot of the sub-speciality teams." Doctor, w1 "I think it's been a reasonably difficult transition. I think the system is not particularly intuitive." Doctor, w1 "Interface and the format is confusing." Nurse, w3 "It's not user friendly at all…" Doctor, w3
Overall impression with implementation	Implementation positive for users, hospital and patients (w1, 3, 6), users see potential for implementation to be positive over time (w1, 3, 6)	"Yeah, positive. I mean, it was always going to happen and it's good that - it's worked - it's been a lot more smooth than I thought it would be, definitely." Nurse, w3 "I don't know. I can see where it's going to be - in the end where it's all kind of nutted out and smooth and it's all whatever, that will be great." Nurse, w3

3. Discussion and Conclusions

The majority of nurses and doctors in our study perceived the implementation to be positive overall. However, users also identified areas they perceived as needing improvement. Although perceptions of the system implementation remained largely consistent across the 6-week time frame, the areas where improvements were needed appeared to vary depending on time elapsed since roll-out.

During the first week of the system implementation, users focused on the training they had received. Overall training was reported to have gone well, but some participants said their training had not been recent enough, a factor which was associated with poor system acceptance in a mental health hospital [7] nor had it been application-specific. Many users also felt they had not been given adequate practice on the system before roll-out, which has previously been identified as a potential barrier to successful system uptake in a study of perioperative nurses [8]. In weeks one and three, users mentioned that while support from IT staff had been good, they were required to work overtime due to the increased time it was taking to complete their tasks for the

day and they identified a clear need for additional staff during the first few weeks following implementation. However by week six this need was rarely mentioned.

During week 6, users were more experienced and familiar with the system. They focused on a number of improvements that had been made to the system and on limitations of the computers, network and infrastructure. From a planning perspective, concerns were mentioned uniformly across the six weeks, with users feeling they had not been consulted for their input during the planning of the implementation. This resulted in some users feeling that the system was not designed with the hospital or ward's routine work practices in mind, and that anticipation of workflow changes could have resulted in more tailored training.

The factors we identified - resources, planning, roll-out strategy and training - have been shown to influence acceptance of a system [7-10], especially immediately following implementation. Some of these factors are comparable to those identified in adult hospital implementations [1], however we found that participants were particularly adamant about receiving practice scenarios during training and were especially focused on changes in work practices being considered in the design and planning of the system. These may reflect the unique needs of staff working in a children's hospital.

Some views were expressed more frequently by doctor or nurse users. For example, nurses perceived that doctors and specialists had not received adequate training, there were no doctor super users, and so doctors regularly relied on nurses for assistance in navigating the system. While previous work in adult hospitals has identified super users as an important factor in successful system implementation [10], this study highlights the importance of super users for each type of user.

Limitations of the study include that it was conducted at only one hospital, however the system and implementation may be similar to other paediatric settings within Australia and internationally. Also, some bias may be present as only views of those that volunteered are presented. Finally, due to limited resources, we were unable to interview staff only working night shifts, who may have had different experiences.

Many of the implementation factors identified in this study echo those described elsewhere in adult hospitals, and reflect the time, budget and resource restrictions associated with a large-scale implementation. However, this is the first study to interview users several times over the weeks following eMMS implementation, which has revealed differences in user perceptions over the course of system implementation. Lessons learnt from user perceptions in this study may be valuable to users and implementers at other paediatric or adult hospital sites, as they embark upon system implementation. As eMM systems become more commonplace in paedictrics, future implementation work should also focus on ensuring interoperability between hospitals (e.g. adult hospitals), and between hospitals and other settings (e.g. general practice).

Acknowledgements

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