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Nurses' decision-making, practices and perceptions of patient involvement in medication administration in an acute hospital setting

- **Short running title**

  Medication decision-making by nurses

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Criteria	**Author Initials**
Made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data;	TB, MF, AH, MB, JC,TD, LH, JW-P, EM, RD
Involved in drafting the manuscript or revising it critically for important intellectual content;	TB, MF, AH, MB, JC, TD, LH, JW-P, EM, RD

Given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content;	TB, MF, AH, MB, JC, TD, LH, JW-P, EM, RD
Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.	TB, MF, AH, MB, JC, TD, LH, JW-P, EM, RD

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Conflict of Interest

No conflict of interest has been declared by the authors.

Abstract

Aims. To describe nurses' decision-making, practices and perceptions of patient involvement in medication administration in acute hospital settings.

Background. Medication errors cause unintended harm to patients. Nurses have a major role in ensuring patient safety in medication administration practices in hospital settings. Investigating nurses' medication administration decision-making and practices and their perceptions of patient involvement, may assist in developing interventions by revealing how and when to involve patients during medication administration in hospital.

Design. A descriptive exploratory study design.

Methods. Twenty nurses were recruited from two surgical and two medical wards of a major metropolitan hospital in Australia. Each nurse was observed for four hours then interviewed after the observation. Data were collected over six months in 2015. Observations were captured on an electronic case report form; interviews were audio-recorded and transcribed verbatim. Data were analysed using descriptive statistics and content and thematic analysis.

Results. Ninety-five medication administration episodes, of between two and eight episodes

per nurse, were observed. A total of fifty-six interruptions occurred with twenty-six of the interruptions being medication related. Four major themes emerged from the interviews: dealing with uncertainty; facilitating, framing and filtering information; managing interruptions and knowing and involving patients.

Conclusion. Nurses work in complex adaptive systems that change moment by moment. Acknowledging and understanding the cognitive workload and complex interactions are necessary to improve patient safety and reduce errors during medication administration. Knowing and involving the patient is an important part of a nurses' medication administration safety strategies.

Keywords: clinical decision-making, hospitals, medication errors, medication systems, medication administration, nurse-patient relations, nurses, patient participation

Impact Statement

- Nurses practise in a complex, dynamic environment with a high cognitive burden that must be recognised and appreciated to improve medication safety.
- Nurses perceive interruptions and distractions as major threats to medication administration in hospitals, therefore interruptions and distractions should be a critical focus when designing interventions to prevent medication errors in hospital settings.
- Having knowledge about patients' medical history and current status and engaging with them is an important part of safer medication administration.
- Training programs and information technology systems to improve and support nurses' decision-making and workflow in medication administration should address the complex workflows caused by interruptions and distractions during medication administration.

Why is this research needed?

- It is essential to understand why medication errors occur and how to prevent these errors in hospital settings, given the number of preventable medication administration errors occurring in hospital settings.

- Interruptions to workflow during medication administration practices increase medication errors. Thus, understanding how nurses make practice decisions and perceive medication administration practices may assist in intervention design to reduce interruptions and medication errors.
- To increase patient safety, research is needed to fill a knowledge gap about how and when to involve patients in medication administration in acute care hospital settings.

What are the key findings?

- Nurses' practices and perceptions of their role in medication administration in hospital settings were complex, with interruptions reported as a frequent and disruptive occurrence.
- Knowing and involving patients was an important part of nurses' medication administration practices and key to the patient safety strategy.
- Nurses collaborated closely with other experienced healthcare professionals in the multidisciplinary team to safeguard medication administration practices.

How should the findings be used to influence policy/practice/research/education?

- Understanding nurses' cognitive workload during medication administration in the real world is necessary prior to informing interventional research.
- When developing policies for administration of medications in hospital settings, managers should work to understand nurses' complex workflow factors during medication administration.
- Future research should focus on developing and testing interventions to reduce the cognitive workload and minimise interruptions and distractions during medication administration.

INTRODUCTION

Medication errors cause unintended harm to patients, negatively affect patient outcomes and increase healthcare costs (Australian Commission on Safety and Quality in Health Care,

2013). Studies that have focused on understanding how, when and why medication errors occur and how to prevent medication errors in healthcare settings, have identified multiple causes including administration errors, inadequate written communication, problems with medicines supply and storage, high perceived workload, problems with ward-based equipment, patient factors, staff health status and interruptions/distractions during medication administration (Richard N Keers, Steven D Williams, Jonathan Cooke, & Darren M Ashcroft, 2013; Raban & Westbrook, 2014; Roughead, Semple, & Rosenfeld, 2013). Several different interventions including training and education of nurses and barcodes and other automated delivery systems, have been tested to prevent medication administration errors. However, a patient-centred care approach has not been the focus of medication safety initiatives to date.

Medication administration errors account for between 5-10% of all errors in hospital settings (Kale, Keohane, Maviglia, Gandhi, & Poon, 2012; Roughead et al., 2013). Nurses are typically the last person in the chain of events from medication prescription to administration, therefore they have a major role in ensuring patient safety during the medication administration process and in involving patients in medication safety. However, two recent systematic reviews highlighted a lack of evidence for the effectiveness of interventions to reduce medication administration errors (Berdot et al., 2016; Raban & Westbrook, 2014). Given nurses' key role in the medication administration process, eliciting nurses' views and experiences of medication administration practices is required to better inform novel intervention strategies designed to minimise medication administration errors in hospital settings, particularly as a transition to technology occurs. Important in this process, are nurses' perceptions of patient involvement in administering medications.

Background

Medication errors most frequently occur when nurses are preparing and administering medications and may be influenced by the local working culture in hospital settings (Richard N. Keers, Steven D. Williams, Jonathan Cooke, & Darren M. Ashcroft, 2013). Interventions tested to date include automated drug dispensing computerized physician order entry, barcode-assisted medication administration with electronic administration records, nursing education and training using simulation and clinical pharmacist-led training (Berdot et al., 2016; Fanning, Jones, & Manias, 2016; Keers, Williams, Cooke, Walsh, & Ashcroft, 2014).

Interruptions to workflow during medication administration are shown to increase medication errors (Meyer-Massetti et al., 2011). To mitigate the risks of medication error related to

interruptions, the healthcare industry has turned to aviation and the principles underpinning the 'sterile cockpit' to reduce distractions during critical tasks. Application of the sterile cockpit approach decreases interruptions by using a focused medication protocol, staff education and visual reminders (vests and signs) to other staff and patients to avoid causing distractions during medication administration (Fore, Sculli, Albee, & Neily, 2013; Theresa M Pape, 2003; Tess M Pape et al., 2005). Fore et al. (2013) reported a reduction in medication errors from 3.95 per 100 bed days of care to 2.26 after introducing the sterile cockpit approach in an acute care setting. Similarly, Durham (2016) reported decreased medication administration error rates after implementing a pilot program that aimed to increase nurses' sensitivity to potential risk of medication administration errors. Nurses reported using mindfulness strategies to gain situational awareness before medication administration, which in turn reduced the risk of errors (Durham et al. 2016).

Double checking medications with two clinicians, most commonly nurses, is another approach recommended to help reduce medication errors (Hodgkinson, Koch, Nay, & Nichols, 2006). A briefing summary of literature prepared for the Australian Commission on Safety and Quality in Health Care concluded that "double-checking, when performed independently by two people and carried out selectively (in high-risk situations or patient populations and with high-alert medications) has been shown to reduce medication administration errors" (Ramasamy, Baysari, Lehnbom, & Westbrook, 2013 p.4). However, a systematic review of the evidence for double checking during medication administration in 2012 found insufficient scientific evidence to justify double checking and the authors recommended rigorous clinical trials to evaluate whether double checking reduces medication errors (Alsulami, Conroy, & Choonara, 2012), a view subsequently endorsed by Athanasakis (2015).

Patient participation is one potential strategy to address the high prevalence of medication administration errors. National and international organisations such as the Australian Commission on Safety and Quality in Health Care (2012), US Joint Commission on Accreditation in Healthcare Organizations (2005) and the World Health Organization (2007) advocate for consumer participation in health care. While active involvement of patients in their care may improve patient outcomes (Carman et al., 2013); there is a discrepancy between what nurses perceive as a person-centred approach during medication administration and their actual medication administration practices (Bolster & Manias, 2010). Bolster & Manias (2010) observed nurses in an acute care environment during medication activities and

found that although some of the medication administration activities comprised patient-centred care, the activities were based on what nurses thought was important for patients.

Recommended activities to improve patient involvement in medication administration include taking a medication history, educating patients about their medications such as monitoring side effects, developing medication administration plans in consultation with patients and involving patients and families during medication prescribing, administration, clinical handover and hospital discharge (Eassey, McLachlan, Brien, Krass, & Smith, 2017; Garfield et al., 2016; Manias, Rixon, Williams, Liew, & Braaf, 2015). A better understanding of nurses' practices and their perceptions of medication administration in the acute care context can contribute to developing interventions tailored to increase patient involvement and potentially reduce errors in medication administration.

THE STUDY

Aim

The aim of this study was to describe nurses' decision-making, practices and perceptions of patient involvement in medication administration in acute hospital settings. The intent of the study was to understand how nurses manage medications and factors that influence their decision-making and their interactions and communication with patients and others during medication administration.

Design

A descriptive exploratory study design was undertaken to address the study aim. Naturalistic observations and interviews were undertaken. Observation data were used to inform subsequent interview questions, in a sequential approach.

Setting and sample

Twenty nurses were purposively recruited with varying age, work experience and appointment levels from two medical and two surgical wards of a 600+ bed acute care tertiary teaching hospital in Melbourne, Australia. Nurse Managers approached eligible nurses who worked at least five shifts per fortnight providing direct patient care in the selected wards to ascertain their interest in participation. The Nurse Managers referred nurses who were interested in participating to the researchers. A researcher explained study aims, requirements of participation, answered questions and consented participants.

Nurse participants were selected from various educational backgrounds including medication endorsed enrolled nurses (ENs) and registered nurses (RNs). None of the selected nurses declined to participate. In Australia, RNs complete a three-year university nursing degree. ENs traditionally completed a one-year certificate qualification followed by a six-month course focused on medication administration. More recently, however, ENs complete an 18-month diploma qualification that includes medication administration as part of the curricula. ENs work under the supervision of RNs (Nursing and Midwifery Board of Australia (NMBA), 2016a, 2016b). Nurses are allocated to patients by a shift nurse manager at commencement of the working shift, using a ratio of 1 nurse to 4 patients. Medications were administered by the nurse caring directly for the patient, who was either a RN or an EN with medication endorsement. At the study site, the medication administration policy mandated double checking narcotics, high risk and injectable medications before administration. Specific cohorts of RNs could undertake a process whereby they were credentialed to single check, that is, to administer some medications without double checking.

Data collection

Data were collected from June 2015 - November 2015, consisting of two strategies: naturalistic observations and individual interviews. A trained research assistant (RA) who was a female RN (LH) with extensive experience in qualitative interviewing, observed the nurses during weekdays and weekends over different morning and afternoon shifts (8am, 2pm and 4pm) for 4-hour periods. Morning and afternoon shifts were purposefully chosen because they were periods of high medication administration activity. Nurses were instructed to undertake medication administration as usual. Observation data consisted of: total time to complete activity; type of episode; frequency and nature of interruptions; ward noise; other health care professionals involved; other tasks conducted; and information sources used. The RA was a non-participant observer. Patients were not the subject of observation; however, prior to observation of the nurse administering medication, the patients were asked if they objected. It was explained to the patients that the focus of the study was the nurses' actions only. None of the patients expressed an objection to the observation. Observation data were collected by a single RA, using a standardised observation tool. Data were collected and managed using a secure, web-based, electronic data capture application, Research Electronic Data Capture (REDCap), hosted at the study site (Harris et al., 2009), displayed in Appendix A.

Participant demographic characteristics were collected before each interview. Participants were asked some pre-formulated questions and specifically about the observed medication administration episodes (Appendix B), one episode represented one medication administration task for the observed nurse. Interviews with the participating nurses were conducted on the day of or a day close to the observation, in a private place of mutual convenience, by a single investigator (LH). The duration of interviews ranged from 20-50 minutes. All interviews were digitally recorded and transcribed. A semi-structured interview guide included: use of single checking versus double checking of medications; checking procedures for specific medication groups such as opioids and anticoagulants; nurses' perceptions and confidence to involve patients in the medication administration processes; knowledge about medications; and barriers and facilitators to introducing new education strategies, teach-back processes and technology used in medication administration in the hospital. The interview guide enabled consistency; additional questions were focused on individual observations and follow up questions.

Ethical considerations

The Human Research Ethics Committees at the study hospital and the University approved the study. All the nurses received oral and written information about the study, the aim and the nature of voluntary participation. Informed consent was obtained before the observations and interviews were conducted. Data transcriptions were de-identified to protect confidentiality. The recordings were deleted once the transcriptions were checked for accuracy.

Data analysis

Quantitative data were analysed using descriptive statistics. The median, mean, standard deviation and ranges are presented in Tables 2 and 3. Content analysis was used to analyse the qualitative data (Elo et al., 2014) and Nvivo 11 software used for data management (QSR International Pty Ltd, 2016). The transcribed interviews were read as a whole to gain an overall sense of the data. All the authors independently analysed at least two interviews. Coding was compared and contrasted in a meeting and preliminary themes and subthemes were developed and critiqued. Two authors synthesised the analysis, refined and justified the preliminary themes and subthemes. Disagreement about the coding process was resolved by discussions until consensus was reached.

Validity and reliability/Rigour

Discussion occurred between LH and TB during data collection to ensure methodological coherence, adequate sampling, responsiveness and saturation (Morse et al, 2002). Researchers (MF, LH and TB) independently analysed and coded data. Consensus was reached on the themes and sub-themes to ensure dependability and verification amongst the research team. Study results were reported and discussed with nursing executive and at a nursing forum to seek feedback on the credibility of the findings.

RESULTS

Participant characteristics

The participants were from two medical wards and two surgical wards. Most were female; 17 (85%). Nineteen (95%) were RNs and one was a Medication Endorsed EN. Among the RNs, 14 (70%) had Bachelors degrees as their highest qualification. They worked, on average, 34.3 (SD=4.1) hours per week (Table 1). Nine of the 20 nurses had completed a process to be credentialed to single check medication.

Nurses' medication administration activities

Twenty nurses were observed during 95 medication administration episodes, a range of 2-8 episodes (mean 4.8 episodes, SD) per nurse during a 4-hour period of observation. Duration of the medication administration episodes ranged from 1-71 minutes (mean: 11.9 minutes; SD: 14). The 71 minutes episode included a medical emergency during the observation period. Most of the activities involved preparing medications in 82 (86%) episodes and checking procedures (80-92%). Patient education occurred in 59 (62%) episodes. The different tasks performed during the medication administration are shown in Table 2.

Table 3 provides an overview of the types of interruptions (n=56) recorded during the 95 observation episodes; 26 of the 56 interruptions were medication related (for example, when nurses were missing information about the prescribed medication and the physician was unavailable) and 27 episodes involved another nurse. The information recorded about interruptions revealed that attending patient call bells, doctors reviewing patients thereby interrupting medication administration, nurses interrupting to discuss another patient, handover, or if the nurse needed to respond to a call, were the most common interruptions observed. When comparing the observations from surgical and medical wards, there were no obvious differences in interruptions related to type of ward.

Nurses' decision-making, practices and perceptions of medication administration

Four main themes were identified from the observations and interviews. Two themes related to the individual nurses' cognitive processing: dealing with uncertainty; and facilitating, framing and filtering information. Two themes were related to the environmental context: managing interruptions; and involving patients and improving patient knowledge. The four main themes and subthemes are presented in Table 4.

Dealing with uncertainty

Dealing with uncertainty involved seeking other experienced health professionals' (HPs) advice i.e. other nurses, doctors, pharmacists. Nurses sought out doctors for information when a patient status changed, and medications needed adjustment, uncertainty about doses, drug and time. Pharmacists were involved when medications needed adjustment or supplies of medication were needed. Other HPs and nurses were approached when nurses were unsure about administration processes, questioning urgent orders, or clarifying discharge scripts. Nurses generally sought information to clarify their knowledge and reduce their levels of uncertainty.

Participants described their uncertainty in several different ways. Some uncertainty related to the processes of medication administration when nurses needed to check doses, medication name and administration time. Nurses depended on the doctors' answers and saw themselves as an advocate for their patients. Participants explained how they often passed on patients' questions about their medications to the doctors. Some participants described uncertainty related to their lack of knowledge about the medications. All the participants reported that they asked other experienced nurses, doctors, pharmacists and sometimes patients to gain a second opinion or advice. When they sought information from patients, it was usually in relation to treatment for diabetes. When uncertain, the most frequently mentioned knowledge source was another nurse. However, half of the nurses also mentioned that they used online resources. One nurse said: 'Anything that I'm not sure how to give. If it's something I haven't given before, I'm checking it with someone. If neither of us feels confident to determine how it should be given or if we're concerned that there are extra precautions, we contact the pharmacist to clarify' (Participant 3).

The main reasons that participants contacted doctors were when the participants were unsure about the dose, the medication and administration time and when the patient's status had changed.

Facilitating, framing and filtering information

Nurses demonstrated and reported many examples of facilitating, framing and filtering information. Subthemes included: advocating for the patients to doctors; optimizing medication safety through co-ordination and communication across the multidisciplinary team; providing feedback; reorganizing time to explain and inform patients about their medications; and sharing decision-making with the multi-disciplinary team.

Advocating for the patients to doctors was mentioned by several of the participants. One participant said: 'We advocate for the patient, actually. So we'll go back to the doctors and rationalise why the patient will say that they might like to have [their routine medication in] at morning or night, or delayed by two hours, because it's about habits' (Participants 16). Framing and filtering to enable communication.

An important role was co-ordinating and communicating between HPs and patients, usually across multidisciplinary teams. Other nurses, pharmacists and doctors were consulted when there was a lack of knowledge about, for example, pharmacological information about medications and when a patient required a medication review, or a clinical situation arose that could have an impact on medication administration. Knowledge about patients' medical histories and current medical conditions was required for co-ordination. For example, understanding how and when a patient usually took their medications, allergies they had or side effects they experienced. 'What I've noticed is that pharmacists or doctors will change the time of day they [medicines] might be administered, so the dosage is always the same…it might just not quite match up to the patient's preference' (Participant 2). Nurses would provide feedback to medical staff and get changes to prescriptions.

Informing patients about charted medications was recognised as an important nursing role. Nurses framed and filtered information for patient understanding. The time needed to involve patients in medication activities was seen as a barrier. 'If we're really busy and just don't have that time, obviously the quality of what we deliver to them in the way of education…it's less effective.' (Participant 2). Some nurses felt there were numerous challenges that reduced their ability to involve patients. 'Time, other call bells, patients - other patients in pain… there's so many barriers.' (Participant 10).

Managing the environment and interruptions

Major concerns for nurses were the interruptions and distractions that occurred during medication administration; these often lead to delays and sometimes errors. The nurses talked about 'ideal conditions' where they could focus solely on the task of medication

administration but were resigned to a reality where the ideal was impossible to achieve for several reasons. Preventing interruptions from other staff during medication administration was sometimes managed by ignoring the other person or head shaking to indicate they would not interrupt their activity. While discussing the management of distractions one nurse said, 'I've completely ignored someone standing on the other side of the glass (outside the medication room) right in front of me, knocking on the door … or I've looked up and just shook my head' (Participant 17).

However, other process issues that could not be rectified included finding a nurse to double check medication with, managing competing demands during medication administration and reliance on other members of the multidisciplinary team to complete medication activities. The double-checking process required participants to find another person to double check the medications, 'so you can administer them in a timely and effective manner and be really productive about the way you do it, there are huge amounts of challenges' (Participant 2). Nurses acknowledged that distractions can lead to error if not effectively managed when they checked through the 'rights of medication administration'. One nurse said 'As I go through… six/seven rights… I have my own routine as to how I do that and also distractions is a big thing during medication administration. I can kind of steer away from the distractions as much as I can...'. (Participant 6).

Distractions included patient call bells or falls alarms or people entering or speaking in the medication preparation room. One participant said: e.g. 'We would start medications often, at least two or three times for each person, have multiple interactions…it seems like we waste an awful lot of time.' (Participant 1). Nurses reported loosing track of where they were up to; sometimes needing to start over or try to recall where they were up to in the checking process. Another nurse commented: 'it would be awesome in an ideal world if we could just turn everything off and just focus on medications at that time.' (Participant 19)

Peak medication administration times coupled with competing demands were also highlighted. One participant commented: 'you've got four people who are prescribed medications at 8am. They usually will all require observations, monitoring… or the recording of obs [observations] immediately before you administer meds. There's a massive conflict there when you discover that someone's in Clinical Review Criteria or Medical Emergency Team (MET) call criteria, it's very challenging to deliver an uninterrupted process with the demand of the ward at that time when staff is called away' (Participant 11).

The need to rely on other members of the multidisciplinary team to facilitate timely and appropriate medication administration was another challenge. One participant said: 'So they [doctors] have to prioritise, so sometimes, again we can have huge delays between when a need for a medication is identified, or a problem with a medication is identified and to get it rectified' (Participant 6).

Patient knowledge and involvement

Several issues arose when nurses involved patients in the administration of medications and discussed patient involvement. These were: the capability of the patient to be educated and involved; the accountability of nurses in involving patients; and the environmental pressures that prevented or limited patient involvement. Firstly, nurses talked about involving patients as a part of creating a safe medical environment.

Patient involvement was seen as a continuum from passive to active involvement. Nurses highlighted that while many patients need and want to be involved in medication administration there are others who cannot be or are just not interested. 'And sometimes there are patients that sort of, will just take the medication and…some patients that really want to know' (Participant 4). One nurse stated, 'Well I always go through what medications they've got, how many – what the dosage is, as well and checking to make sure that they've got no allergies, but I think it's also really important that they take responsibility for knowing what they're taking' (Participant 1).

Another nurse noted, 'I'm legally responsible for what they take, but I think information and knowledge is really powerful for a person' (Participant 4). 'So, I always involve the patient in everything and I always make sure for them this is the correct medication for why they're here and their diagnosis and their past history as well' (Participant 19).

Some patients often know a lot about their medications, for example people with type 1 diabetes. Another nurse commented that 'if patients say I'm definitely not taking that, I always triple check that we've got the right information. I trust my patients when they say they don't take that medication at all' (Participant 13).

Involving patients in supporting their home routines was also seen as a good strategy for increasing adherence around medication administration. A nurse noted that 'you're going to …promote compliance if you're working in conjunction with your patients when administering medication… and that's by explaining why it's going to benefit them. Acknowledging their usual regimens…if someone normally takes something at 8 o'clock and

you're trying to give them at 4 o'clock, they're going to say no (Participant 17). Involving patients in medicine management in hospital was seen as likely to enhance their ability to manage safely at home. One nurse commented that there is a need to 'educate the patient about the medications and why they're on it and to help them be more proactive at home as well as in hospital' (Participant 4).

An awareness that patients needed to feel comfortable and empowered to participate in medication administration was also considered to be vital: 'I think patient-centred care in relation to medication administration is completely upholding respect for your patient, being open with your patient and listening to them and educating them on exactly what they're taking. (Participant 8). Another nurse commented: 'I think it promotes a relationship between two strangers, one who's a patient and one is a health care provider whose job is to advocate for that stranger's best interest. And I think the more cooperation you can seek, the better outcome you're going to get.' (Participant 20)

Some nurses felt it was appropriate and at times safer to involve patients in the medication checking process. A nurse endorsed as a 'single checker' commented 'I do check meds with patients, especially if they've got what I refer to as a bit of a 'lolly bag'. So quite a big number of medications. I do normally quickly go through each one with the patient' (Participant 18).

Other nurses felt it was inappropriate to check medications with some patients such as those with cognitive impairment, while others thought 'certain groups' of patients, for example those with chronic conditions, may be more suited. One nurse stated: 'keeping it [medication checking] with doctors and nurses I think it's a whole lot safer, takes that responsibility away, or confusion away from the patient.' (Participant 5). Another nurse noted: 'I think that if you were going to do that [check medications with patients] …. because we've got a legal responsibility for how they're prescribed, they've got to meet criteria', especially cognitive impaired patients' (Participant 1).

However, other nurses noted that, involving patients in their own care could be more time efficient for nurses during medication administration. 'If you have a quick conversation with a patient before going and starting their meds [medication administration], you're not going to draw up meds they don't want or need or you're going to get the extra meds that they want and need' (Participant 18).

Discussion

This study aimed to describe nurses' medication administration decision-making and practices and their perceptions of patient involvement in medication administration in acute hospital settings. Observations and interviews with participants highlighted the cognitive burden experienced by nurses in administering medications in a dynamic and demanding context. Two themes identified related to nurses' cognitive processing of information, dealing with uncertainty and facilitating, framing and filtering information. Two themes related to the influence of other people on nurses' decision-making that had an impact on the medication administration process and outcomes: managing interruptions; and patient knowledge and involvement.

Clinical decision making is a cognitive activity where individuals seek information and assign meaning to that information to determine the best option (Bucknall, Kent, & Manley, 2009). The Hogarth (1980) model of decision making deduces that individual characteristics, such as personal attributes, values and capabilities; the complexity of the decision task; and the context or external environment all shape the behaviour of the individual decision maker. To manage uncertainty during medication administration and determine the best option or outcome, nurses in this study frequently sought clarification from other health professionals (HPs) whom they respected. At times, they would defer to alternative viewpoints to confirm or clarify their knowledge (Cranley, Doran, Tourangeau, Kushniruk, & Nagle, 2009). As the key personnel involved in medication administration nurses spent considerable time facilitating the collection of information, framing options for patients and other HPs and filtering information prior to deciding on the appropriate action as others have found (Johnson et al., 2017b; Liu, Gerdtz, & Manias, 2016; Manias, Aitken, & Dunning, 2004).

In addition, Sá, Kelley, Ho and Stanovich (2005) argue that individual differences in decision making are the result of both cognitive capacity (intelligence) and cognitive processing (thinking styles and dispositions). Critical thinking in informal reasoning situations has been shown to be related to cognitive processing rather than cognitive capacity (Sá et al., 2005). This research reiterated the issues that are known to commonly to cause medication errors, including interruptions, distractions and high workloads (Meyer-Massetti et al., 2011). The impact of the environmental context, which in most cases was out of nurses' control, on individual nurses during medication administration was an important finding. Managing interruptions is a major cause of medication errors. Nurses deal with numerous external

influences involving complex interactions between multiple stakeholders and in varying contexts, with an exponential number of potential outcomes depending on nurses' response. The impact on nurses' cognitive processing and the competence of their decision making can extend across a continuum of patient safety outcomes ranging from no error to a sentinel event and patient deaths (Bucknall, 2003; Bucknall et al., 2009). Interruptions have been associated with a doubling of the error rate and an increased severity of the error (Westbrook, Woods, Rob, Dunsmuir, & Day, 2010).

Most notable in the observations was that over half the medication administration episodes were interrupted. The study wards had either designated Medication Preparation Rooms or locked cabinets next to patients' beds with a separate medication room. Medication preparation either required nurses to walk across the ward or to prepare medications in an area shared with other members of the multidisciplinary team. Greater distances between medication rooms and patients increased the opportunity for nurses to be interrupted while preparing and administering medications. This was found in another study where repetitive traveling across different ward spaces by health professionals resulted in multiple interruptions, time wasting and delayed medication administration (Lui, Manias & Gerdtz, 2014). Other research has shown the frequency of interruptions during medication preparation and administration, where nurses are the main source of interruptions and the interruptions are largely unrelated to patient care (Johnson et al., 2017a; Westbrook et al., 2010).

Another factor that affected nurses' ability to provide uninterrupted and seamless medication delivery was the requirement to double check medications. Nurses highlighted the difficulty of finding another nurse and the interruption this caused to medication delivery. Although double checking may reduce medication administration errors (Ramasamy, 2013), the recommendations of a systematic review were that there was insufficient evidence to warrant double checking and further research is needed to test effectiveness using randomised controlled trials (Alusulami, 2012). The time delays encountered when double checking medications and the frequent lack of independence in the checking procedure, needs to be weighed against perceived benefits.

Clearly more effort is needed to reduce the prevalence of interruptions during medication preparation and administration. Research shows that a supportive practice environment

including improved teamwork between doctors and nurses and pharmacists and fostering the continuity of patient care enhances nurses' capacity to intercept errors, which reduces medication errors (Ashcraft et al., 2017; Flynn, Liang, Dickson, Xie, & Suh, 2012; Wilson, Palmer, Levett-Jones, Gilligan, & Outram, 2016).

An important finding related to the notion of patient involvement in an activity that offers potential harm to the individual receiving the medication. Nurses highlighted the need to involve patients in medication activities as part of a safety check. The nurses also discussed how they worked as a facilitator between patients and other members of the multidisciplinary team, particularly doctors, in ensuring that each party had the information required to improve medication administration. Similar to previous findings (Bolster & Manias, 2010), nurses initiated a considerable amount of communication with the medical team to ensure the correct prescription of medications for individual patients.

By contrast some nurses noted that time pressures had an impact on their ability to involve patients in medication activities. The concept of time pressures inhibiting patient-centred care in relation to medication administration, has been highlighted previously (Bolster & Manias, 2010). Nurses also acknowledged that not all patients wanted or were able to participate in medication administration. Some nurses embraced the practice of checking medications with patients; others felt it was inappropriate and safer to leave patients out of the checking procedure.

Much has been written about patient involvement in patient safety (Bishop & Macdonald, 2017; Lawton et al., 2017; Vaismoradi, Jordan, & Kangasniemi, 2015). Involving patients may improve therapeutic medication administration, create time efficiencies and improve discharge planning. Creating an environment where patients feel empowered and comfortable is vital in supporting them to be involved in their own medication administration in hospital and there is emerging evidence that participation can improve medication-related outcomes. One hospital introduced a Practice Partnership Model of Care and reported reduced medication errors (Cann & Gardner, 2012). Overall however, there are few studies exploring the culture of patient involvement in medication administration (Australian Commission on Safety and Quality in Health Care, 2013; de Jong, Ros, van Leeuwen, & Schrijvers, 2016)

Limitations

A convenience sample of 20 nurses from four wards in one acute hospital may limit the transferability of these findings to other settings and populations. However, study results

were reported back at a large hospital nursing forum to assess the credibility of the findings and promote discussion of the issues arising. To establish dependability, the data analysis process was conducted independently then collaboratively with the research team.

CONCLUSION

The cognitive burden associated with administering medications in complex systems is frequently overlooked when reviewing medication errors. Decision-making occurs in a clinical context that may optimise or adversely affect decision outcomes. Testing nurses' competency to administer medications safely in the absence of real world influences does not guarantee a reduction in errors. Research that takes account of the complex interactions and tests the effectiveness of interventions to reduce errors is long overdue.

Knowing and involving the patient is an important part of a nurses' medication administration safety strategies. The findings of this study highlight the importance of educating nurses on how the perspectives of patients and families can be included during medication administration and their potential to participate to prevent medication errors as well as skills in assessing the capability of patients in determining their suitability to participate and to maximise their potential.

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Table 1. Demographic characteristics of the nurses observed and interviewed (N=20)

Characteristics		N (%)
Gender	Female	17 (85%)
	Male	3 (15%)
Age	20-25 years	9 (45%)
	26-30 years	4 (20%)
	31-35 years	4 (20%)
	36-40 years	1 (5%)
	41-45 years	2 (10%)
Primary role in Hospital	Registered Nurse	19 (95%)
	Medication Endorsed Enrolled Nurse	1 (5%)
Hospital ward	Medicine-General	5 (25%)
	Medicine-Neurology, Stroke and Infectious Diseases	5 (25%)
	Surgical-Gastroenterology, General & Urology	5 (25%)
	Surgical-Plastics, Burns & Vascular	5 (25%)
Highest qualification completed	Bachelor degree	14 (70%)
	Bachelor degree (honours)	2 (10%)
	Graduate certificate	2 (10%)
	Endorsed Enrolled Nurse	1 (5%)
		Mean (SD)
Number of hours	Hours	34.3 (4.1)

worked each week

Table 2. Tasks performed during medication administration (N=95)

Tasks performed during medication administration	n (%)
Preparing medications	82 (86)
Checking patient identification	81 (85)
Checking the medication name	81 (85)
Checking the dose	81 (85)
Checking the route	80 (84)
Checking the time	92 (97)
Administration of medications to patient(s) at bedside	88 (93)
Patient education about medications	59 (62)
Performing dose calculation	57 (60)
Observing the patient consume the medications	44 (46)
Checking medication name for another nurse	12 (13)
Checking medication dose for another nurse	11 (12)
Checking medication route for another nurse	11 (12)
Clinical handover	1 (1)
Others	11 (12)

Multiple tasks were undertaken during each observation episode; 95 observations

Table 3. Medication administration episodes by nurse (n=95)

Nurse ID	Ward Type	Episodes	Interruptions*	Medication related interruptions	Other nurses involved
1	Surgical	6	0	0	3
2	Surgical	6	1	0	4
3	Medical	6	6	1	0
4	Medical	3	6	6	1
5	Medical	3	1	1	0
6	Surgical	8	5	1	1
7	Surgical	2	7	1	0
8	Medical	7	8	8	1
9	Surgical	2	0	0	0
10	Surgical	3	4	2	3
11	Medical	4	3	1	2
12	Medical	3	1	0	0
13	Medical	7	0	0	2
14	Medical	3	1	1	0
15	Medical	5	3	0	2
16	Surgical	4	1	0	0
17	Surgical	7	0	0	2
18	Surgical	7	5	0	3

19	**Surgical**	**3**	**1**	**1**	**2**
20	**Medical**	**6**	**3**	**3**	**1**

Number of interruptions was counted across all episodes observed for each nurse

Table 4. Perceptions of medication administration practices (N=20)

Themes	Subthemes
Dealing with uncertainty	• Seeking other experienced users for advice i.e. other nurses, doctors, pharmacists • Doctors involved when patient status changes and medication needs adjustment • Pharmacists involved when medication needs adjustment, supply of medication needed, unsure about administration, filling urgent orders, reviewing discharge scripts and for additional education • Passing on patient questions about medications
Facilitating, framing and filtering information	• Advocating for the patients to doctors • Optimizing medication safety through communication in the multidisciplinary team • Providing feedback • Reorganizing time to explain and inform patients • Shared understanding and decision-making between HPs
Managing the environment and interruptions	• Delays because of interruptions • High workload • Single versus double checkers • Contextual distractions
Patient knowledge and involvement	• Variability and capability of patients • Accountability of nurses involving patients • Workload pressures preventing patient interaction and

	patient-centred care