



CRITICAL REVIEW OF LITERATURE

Families, nurses and organisations contributing factors to medication administration error in paediatrics: a literature review

Albara Alomari*, Val Wilson, Patricia M. Davidson and Joanne Lewis

*Corresponding author: University of Technology Sydney, Australia
Email: Albara.Alomari@student.uts.edu.au

Submitted for publication: 6th May 2014

Accepted for publication: 1st April 2015

Abstract

Background: Medication error is the most common adverse event for hospitalised children and can lead to significant harm. Despite decades of research and implementation of a number of initiatives, the error rates continue to rise, particularly those associated with administration.

Objectives: The objective of this literature review is to explore the factors involving nurses, families and healthcare systems that impact on medication administration errors in paediatric patients.

Design: A review was undertaken of studies that reported on factors that contribute to a rise or fall in medication administration errors, from family, nurse and organisational perspectives. The following databases were searched: Medline, Embase, CINAHL and the Cochrane library. The title, abstract and full article were reviewed for relevance. Articles were excluded if they were not research studies, they related to medications and not medication administration errors or they referred to medical errors rather than medication errors.

Results: A total of 15 studies met the inclusion criteria. The factors contributing to medication administration errors are communication failure between the parents and healthcare professionals, nurse workload, failure to adhere to policy and guidelines, interruptions, inexperience and insufficient nurse education from organisations. Strategies that were reported to reduce errors were double-checking by two nurses, implementing educational sessions, use of computerised prescribing and barcoding administration systems. Yet despite such interventions, errors persist. The review highlighted families that have a central role in caring for the child and therefore are key to the administration process, but have largely been ignored in research studies relating to medication administration.

Conclusions: While there is a consensus about the factors that contribute to errors, sustainable and effective solutions remain elusive. To date, families have not been included as key stakeholders in researching or developing effective interventions to reduce medication administration errors.

Implications for practice:

- Future solutions to reduce medication errors need to take into account staffing levels, skill-mix, stress and workload
- Organisations need to provide appropriate policies and guidelines as well as access to supportive technology and ongoing educational support aimed at reducing errors
- Engaging nurses, doctors, pharmacists and, most importantly, families in developing practice through person-centred approaches is vital in order to improve the culture of medication safety and reduce medication errors

Keywords: Medication administration, error, nurses, families, children, organisation

Introduction

Medication error is the most common adverse event during a child's stay in hospital and can lead to significant harm (Wong et al., 2009). Rates of all medication errors are reported at between 3.9%, as a conservative estimate, and around 40.4%, but may be even higher, with non-disclosure a factor (Özkan et al., 2011). A traditional method of ensuring medication safety has been to follow the five rights of medication administration to prevent errors and, more recently, the nine rights of medication administration (Elliott and Liu, 2010). These are:

- Right patient
- Right documentation
- Right drug
- Right action
- Right route
- Right form
- Right time
- Right response
- Right dose

However, achieving the right drug/dose for the right child at the right time continues to challenge paediatric services in hospitals and community healthcare settings (Walsh et al., 2011). Correct dosing, monitoring and treatment adherence are critical to achieving optimal outcomes (Miller et al., 2007). Medication errors occur across the spectrum of prescribing, dispensing, and administering processes. They are attributed to family, nurses and organisational factors (Fernández-Llamazares et al., 2012).

Medication errors have been defined as:

'Any preventable events that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient or family. Such events may be related to professional practice, healthcare products, procedures, and systems, including: prescribing; order communication; product labelling, packaging and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use' (National Coordinating Council for Medication Error Reporting and Prevention, online, 2015).

Given the multiple potential causes of medication errors, it is therefore vital to look at how they may be prevented from the perspective of the nurses, family and the patient, as well as in terms of the events that influence the medication process. While the medication process may appear simple and linear, there are at least 50 unique steps between prescription and the patient receiving the drug (Hughes and Edgerton, 2005). It is easy to see the potential for error given the complexity of the process and the human and system factors involved in the process.

The medication administration phase is the actual giving of the medication and may involve opening the container, removing (or reconstituting) the prescribed dosage and giving the medication to the patient following the prescriber's orders. This review will address this phase for the following reasons. First, medication administration is the phase that falls under the remit of nurses, who spend at least 16% of their time preparing or administering medication (Garrett and Craig, 2009), administering as many as 50 medications in this timeframe. Due to this high frequency of administration, alongside the other demands of their role, nurses are at increased risk of committing an administration error (Sears et al., 2013). Second, approaches to reduce prescribing errors (Walsh et al., 2008) and dispensing and labeling errors (Cochran et al., 2007) have been successful in improving medication safety for children. However, despite a number of initiatives aimed at improving the administration phase, error rates associated with administration continue to increase gradually (Sears et al., 2013).

Errors associated with the administration phase were reported in 26.9% of paediatric patients (Keers et al., 2013). This is likely to be an underestimate as errors may go unreported because they are not

detected, hidden, easily fixed (prescribing errors) or because there is fear of the consequences of reporting (Prot et al., 2005). The errors reported are thought to account for only 5-20% of the incidents that actually occur (Prot et al., 2005). Despite clear documentation of the medication administration problem and decades of medication safety research, researchers have failed to identify sustainable solutions to reduce errors (Keers et al., 2013). Until recently, the incidence of medication errors in paediatric patients has received relatively little scrutiny compared with those in the adult population, and even less has been done to assess prevention of these errors (Fortescue et al., 2003).

The aim of this literature review is to explore the nurse, family and healthcare system factors that impact on medication administration errors in paediatric patients and to identify gaps in the literature and opportunities for improvement.

Methods

A systematic literature review design was chosen in order to provide a comprehensive understanding of how nurse, family and healthcare system factors impact on paediatric administration errors. Systematic reviews inform practice by summarising evidence regarding a specific clinical problem and are the focus of evidence-based practice initiatives (Whittemore, 2005).

Databases

A search of electronic databases was conducted to answer the following question:

What are the nurse, family and healthcare system factors that impact on medication administration errors for paediatric patients?

The databases searched were the Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE, EMBASE and the Cochrane library.

Search terms

The keywords used in this search were medication administration, drug administration, error, error*, child*, children, Paediatrics and Paediatric and the combinations are provided in Figure 1. Family, organisation and nurse were not used as keywords to make the search broader and avoid excluding any related article. During the manual title/abstract and full text screening, the included articles will be classified according to these terms.

Figure 1: Search strategy

The following databases were searched:

CINAHL, MEDLINE, EMBASE and the Cochrane library (Time limited to 2000-2013)

Search terms:

(Child* OR

Paediatric* OR

Paediatrics)

AND

Medication administration

AND

Error*

The limits applied included those articles restricted to:

CINAHL and MEDLINE: Human, journal article, research studies

EMBASE: Human, research articles

The Cochrane Library: 2000-2013

Limitation

Limiting criteria specific to each database were applied accordingly (Figure 1).

Inclusion criteria

Only studies reporting the nurse, family and organisational factors contributing to medication administration errors, or reporting interventions aimed at reducing medication errors were selected. The study population included in this review are children (16 years of age and younger) who received medication either in hospital, at home, at school or in community care.

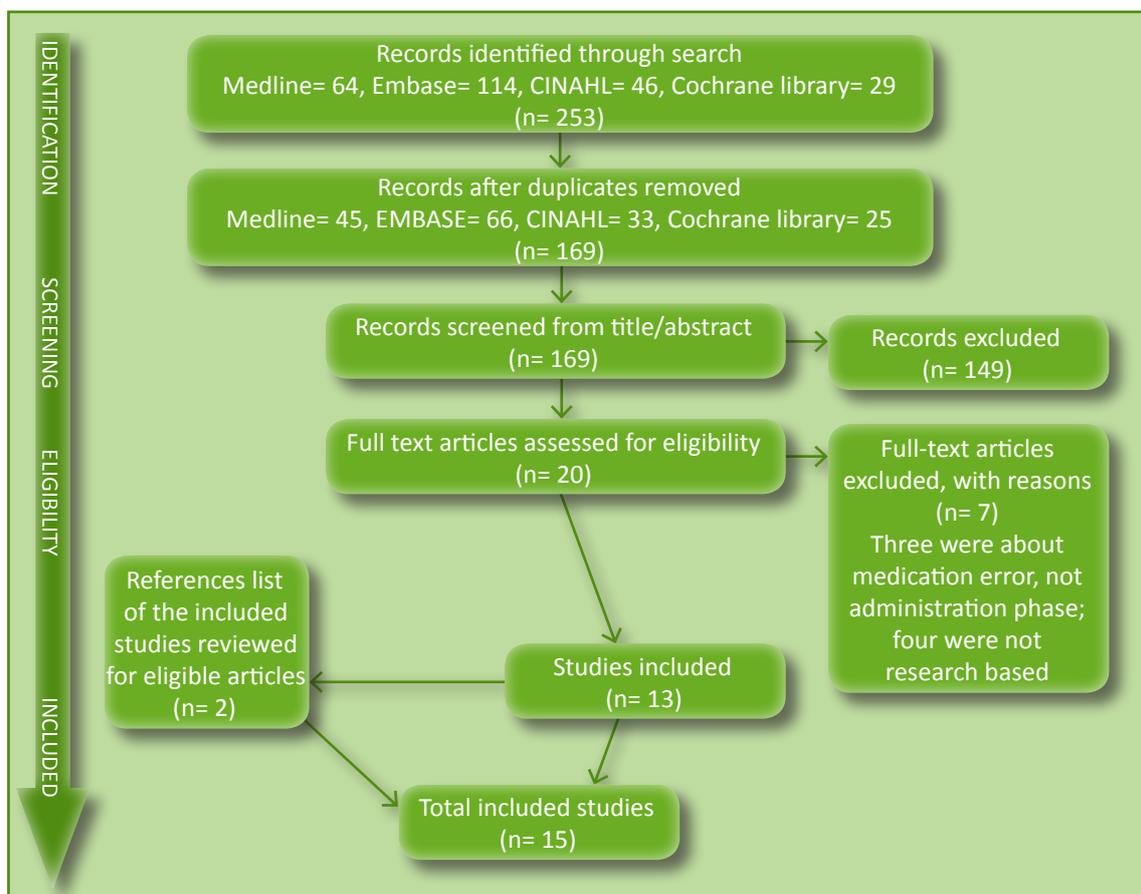
Exclusion criteria

Articles were excluded if they were not research studies, if they related to medications and not medication administration errors or if they referred to medical errors rather than medication errors.

Screening of search findings

The search of electronic databases retrieved a total of 253 published papers. The papers were imported to EndNote X601® (Figure 2). After removal of 84 duplicate articles, the abstracts and titles of the papers were assessed for eligibility against the inclusion criteria. The results of this preliminary screening process resulted in the identification of 20 articles for full review against the inclusion criteria. The full text of the 20 articles was reviewed and seven were excluded. The remaining 13 met the inclusion criteria and were included in the integrative review (Figure 2). A snowball method was used: the reference lists of the included studies were also searched for further relevant articles that might be eligible for inclusion (Whittemore, 2005). Two more studies that met the criteria were found in the reference lists and included (Fortescue et al., 2003; Morriss et al., 2009), giving a total of 15 included studies.

Figure 2: Screening of search findings



Results

The 15 studies included in this review reported the contributing factors (organisational, nursing and family) that increase the risk of medication administration errors, and strategies aimed at reducing these errors. The description of each study and the reported outcomes are summarised in Table 1. The results of the review will be described in relation to organisations, nursing staff and families.

Table 1: Included studies				
	Authors/ year	Design/method	Sample/setting	Results
1	Alsulami et al., 2012	Systematic literature review		One RCT reported that double-checking process reduced medication error rates in prescribing, dispensing and administration
2	Chedoe et al., 2012	Prospective study with pre- and post-intervention measurement using direct observation	Nurses at a neonatal ICU; 595 medication doses were observed	Educational sessions for nurses reduce the incidence of medication errors from 41% to 31%
3	Davis et al., 2009	Cross-sectional survey study	278 paediatric nurses from the emergency department, ICU, medical and surgical wards	Junior nurses reported that they do not strictly adhere to medication administration policies and guidelines (P= <0.001)
4	Ficca and Welk, 2006	Cross-sectional survey study	314 school nurses	Two-thirds of participants showed low adherence to medication policies due to workload
5	Fortescue et al., 2003	Prospective cohort study	1,020 paediatric patients in two academic medical centres	The potential preventability of medication errors with: computerised system is 27%; availability of pharmacy in the ward is 85.3%; and improved communication between nurses and doctors is 75%
6	Lemer et al., 2009	Prospective cohort study	1,685 paediatric patients in US	The majority of the families failed to receive written information from the doctors (74.3%) or pharmacists (68.7%): failure of communication
7	Morriss Jr et al., 2009	Prospective observational cohort study	92,398 medication doses were administered to 958 paediatric patients	The barcode medication administration system reduces medication administration errors from 39/1,000 doses to 20/1,000 doses (P=0.008)
8	Murphy and While, 2012	Non-experimental survey design	140 clinical staff working in a children's hospital	The participants reported insufficient training and knowledge (64%), interruption (86%), heavy workload (78%) and communication failure (71%)
9	Oshikoya et al., 2013	Non-experimental survey design	50 paediatric nurses in Nigerian public hospitals	52% of nurses identified workload as a major contributing factor to medication administration errors
10	Özkan et al., 2011	Qualitative and quantitative designs, using interviews and observational methods	25 nurses working in university hospitals in Turkey	Interruptions, lack of experience, workload and insufficient protocols increase the medication administration errors
11	Sears and Goodman, 2012	Retrospective, pan-Canadian study using a survey	372 paediatric nurses from three tertiary hospitals were surveyed	Insufficient nurse training (n=32), overtime (n=88) and workload (n=88) cited as major contributing factors for medication administration errors
12	Sears et al., 2013	Descriptive, prospective, pan-Canadian study	372 paediatric nurses in three tertiary paediatric hospitals in Canada	Workload, distraction and insufficient increase medication administration errors
13	Stratton et al., 2004	Descriptive survey study	57 paediatric and 227 adult hospital nurses	Nurses identified distractions (50%), workload (37%) and failure to double-check doses (28%) as contributing factors to medication administration errors
14	Taylor et al., 2008	Prospective observational study	526 medication administrations in a neonatal ICU	The computerised physician order entry system reduced medication variances from 19.8% to 11.6%
15	Walsh et al., 2011	Prospective observational quasi-experimental study design	52 home visits for children with chronic diseases	Physicians were not aware of 83% of the errors occurring at home with parents: failure of communication

Organisations

Four studies in the review reported on the organisational factors that contributed to the outcomes of medication administration error in children, or on strategies to reduce error rates (Fortescue et al., 2003; Taylor et al., 2008; Davis et al., 2009; Morriss et al., 2009). The key factor is a lack of support from organisational structures to ensure adherence to medication safety guidelines. Strategies to reduce medication administration errors included the use of technology such as barcoding and computerised entry systems, and improving communication between the healthcare professionals .

Organisational contributing factors

Only one paper reported on factors contributing to non-adherence to medication policy and guidelines (Davis et al., 2009). In their descriptive, exploratory, cross-sectional study, the authors used a survey of 278 paediatric nurses from an Australian tertiary paediatric hospital. Junior nurses responding to the survey said they did not necessarily follow the medication policy and believed that their medication administration practice could be influenced by the person with whom they checked the drugs ($P=0.001$). Senior nurses agreed with these findings, reporting that, as senior staff, they dictate acceptable levels of medication policy adherence through role modelling ($P=0.001$). Although the authors did not find that adherence to medication administration policies would either increase or decrease error, they believed that at an organisational level, health services needed to create multidisciplinary education programmes to promote universal understanding of, and adherence to, medication administration policies (Davis et al., 2009).

Organisational strategies to reduce medication administration errors

A prospective, observational cohort study was conducted by Morris et al. (2009) to assess the effectiveness of a barcode administration system to determine whether such a programme would decrease medication administration error. The nurse working with this system was required to scan the patient's wristband barcode to select the patient, scan the unit dose medication barcode and administer the medication item. Some 92,398 medication doses were administered to 958 paediatric patients during the study period. The barcode system reduced the preventable adverse drug events from 39/1,000 doses to 20/1,000 doses ($P=0.008$). The main limitations of this study were that the working culture of the clinical area was not described. Moreover, the authors failed to mention the staff ratio, the cost of implementing the barcode system or the severity of illness of the children. These omissions may affect the generalisability of the results to other settings. Additionally, although the medication errors post-implementation of barcoding were reduced, significant levels of error did remain and the authors failed to discuss the reason for this result.

Taylor et al. (2008) reported a similar result to Morris et al. (2009), finding that the use of technology support programmes was associated with a decrease in medication administration variances. They reported the outcomes of a computerised doctor order entry system with the variance defined as a discrepancy between the order and the medication administration. The authors conducted a prospective observational study of 526 medication administrations in a neonatal intensive care unit. Medication variances were detected for 19.8% of administrations during the pre-computerised doctor order entry period, compared with 11.6% with computerised doctor order entry. Although there was a significant reduction in the rate of medication administration variances, the authors suggested that additional methods may be needed to improve neonatal patient medication safety further.

In a larger study of 1,020 patients, Fortescue et al. (2003) conducted a prospective cohort study, over a six-week period, to classify the major types of medication errors in paediatric inpatients and to determine which strategies might be most effective in preventing them. The doctors evaluated pre-suggested error prevention strategies to identify the most effective, using a five-point Likert scale (Fortescue et al., 2003). The involvement of nurses and pharmacists in each morning round with doctors, with the aim of increasing communication, was found to reduce medication administration errors by 75.5% (from 616 to 151). Also, computerised doctor order entry with clinical decision support systems was found to reduce medication error by 27% (from 616 to 450) and the presence of a ward-based clinical pharmacist reduced errors by 81% (from 616 to 115). While these results reflect

the potential preventability of the errors and all achieved a significant reduction in the error rates, a significant number of errors persisted.

Nurses

Eight studies reported the contributing factors affecting medication administration from a nursing perspective (Stratton et al., 2004; Ficca and Welk, 2006; Alsulami et al., 2012; Chedoe et al., 2012; Murphy and While, 2012; Sears and Goodman, 2012; Oshikoya et al., 2013; Sears et al., 2013). The studies found similar factors that may increase medication administration errors but only two of the studies reported strategies aimed at reducing error (Alsulami et al., 2012; Chedoe et al., 2012).

Nurse contributing factors

A descriptive study by Stratton et al. (2004) surveyed, through a pilot-tested coded questionnaire, 57 paediatric nurses and 227 adult hospital nurses to determine nurses' perception of factors that contributed to medication errors. Paediatric nurses report a higher proportion of errors (67%) than adult nurses (56%). Paediatric nurses most frequently reported distraction (50%), workload (RN-to-patient ratio) (37%), volumes of medication administered (35%) and failure to double-check doses (28%) as contributing factors. The self-reporting tool used in this study was limited by the fact that participants reported on a range of specific distractors pre-identified by the researchers rather than identifying factors themselves, which may lead to underestimating the influence of other potential contributing factors (Davis et al., 2009).

In their study of 71 school nurses in Pennsylvania, US, Ficca and Welk (2006) found that a lack of understanding of policies and guidelines with regard to task delegation was a contributing factor to medication administration errors. In self-reported surveys, the nurses indicated that they had responsibility across several sites of their education facility; two-thirds of school nurses delegated some medication administration to unauthorised or untrained personal, such as principals or school secretaries. While they viewed a perceived lack of support and workload demands as justification for this delegation, it contributed to increasing medication administration errors (Ficca and Welk, 2006). As mentioned previously, the data from self-reported surveys may fail to reflect the full reality of the issue.

More recently, in a prospective quasi-experimental design study of 372 nurses, Sears and Goodman (2012) collected data from three Canadian university-affiliated tertiary paediatric centres through a confidential survey of paediatric nurses. Nurses identified that some factors correlated significantly with increased risk of more severe error outcomes. These included: insufficient training (n=32, P= 0.008); working overtime (n=88, P= 0.0016) and precepting a student (n=25, P= 0.0004). In a more recent publication from the same study, the author found that the involvement of one or more of these factors tended to increase the severity of the outcomes of the medication errors (Sears et al., 2013). The generalisability of the findings in the study was limited because the three hospitals included are similar in terms of culture and staffing level.

Similarly, Özkan et al. (2011) conducted a mixed method design study in a paediatric ward in a university hospital, Turkey (Özkan et al., 2011). The authors interviewed 25 paediatric nurses to explore the factors associated with medication administration errors. They also used an observation method to determine the frequency and the types of error. Errors were made in 36.5% of the 2,344 doses that were observed. Nurses identified workload, insufficient protocols, interruption, and lack of experience as contributing factors. The authors concluded that these factors were due to systems errors rather than individual errors.

Likewise, outcomes were reported in a non-experimental survey design study of 140 paediatric nurses conducted by Murphy and While (2012), who sought to describe the contributing factors to medication administration errors. Workload stress and communication failure were reported by 78% and 71% of

the staff respectively, as potential contributors. Interruptions were also cited by 86% of respondents. However, the small sample size in this study from just one hospital, as with the previous study, may limit the generalisability of the findings.

A confidential self-reporting questionnaire of 50 paediatric nurses in a Nigerian hospital asked nurses about their experience of medication administration mistakes during their career (Oshikoya et al., 2013). The authors found that 32 nurses (64%) admitted to having committed medication errors over the course of their career. Workload was reported by 26 nurses (52%) as the main reason for errors. However, as the questionnaire asked nurses about medication errors during their entire career, errors that occurred many years ago may have been forgotten and timeframe may introduce recall bias.

Nursing strategies to reduce medication administration errors

Two studies reported strategies to reduce medication administration errors from the nurse's perspectives (Alsulami et al. 2012; Chedoe et al., 2012). The first of these (the only systematic review included in this paper) was undertaken by Alsulami et al. (2012). Their aim was to evaluate the effectiveness of double-checking the administration of medicines. The authors identified 16 articles that met their inclusion criteria, with only one randomised controlled clinical trial (RCT), which showed a statistically significant reduction in the medication error rate. The other studies reported that there were some practical problems associated with the double-checking process. These involved staff shortage and emergency situations. The authors recommended that the process of double-checking medication prior to administration should be evaluated scientifically.

In the second study, the authors assessed the effectiveness of a multifaceted educational intervention on the incidence of medication preparation and administration errors in a neonatal intensive care unit (Chedoe et al., 2012). The intervention included teaching and self-study sessions on the preparation and administration of the drugs being commonly used in the unit. Using a prospective study design with pre- and post-intervention measurement using direct observation, the authors found the incidence of errors decreased from 49% (151 errors from 311 observations) to 31% (87 from 284). Although there was a clear reduction in numbers of error after implementation of the education intervention, alarmingly high numbers of errors continued to occur. The authors concluded that while an education session as an intervention reduces medication error rates, it is not sufficient on its own. Therefore further innovative strategies are required to supplement this.

Families

Only two studies reported on medication administration error contributing factors from the family's perspective (Lemer et al., 2009; Walsh et al., 2011). These two studies identified a number of factors that increased medication error but failed to provide strategies to reduce medication administration error. No studies were found where families were involved in developing strategies.

Family contributing factors

In one study (Lemer et al., 2009) a prospective design was used to explore the effect of advice from healthcare professionals on medication safety in children aged 12 years and younger. The authors reviewed the medication charts and surveyed the parents of 1,685 paediatric patients. The data were collected between July, 2002 and April, 2003. The results demonstrated that the advice from both doctors and pharmacists was poor in quality and limited in provision of information. It was reported that healthcare professionals usually failed to offer medication information, and the majority of the families did not receive written information from the doctors (74.3%) or pharmacists (68.7%). The authors also found that the provision of this advice was necessary for this group as they were involved in the majority of the medication administration for children at home. It is not possible from the results of this study to identify whether advice from healthcare workers has significant influence or not on medication errors because of a number of limitations. First, the study was reliant upon the participants' memories of advice provision so may not have been accurate and may have introduced

a recall bias. In addition, the authors collected neither copies of written advice given nor examples of conversations from either the doctor's office or the pharmacy; therefore, it is difficult to assess the circumstances of these communications.

More recently, Walsh et al. (2011) found similar results, with medication errors often occurring due to communication failures between the doctor and the family and at home between family members, with doctors largely unaware of the problem. In their observational, retrospective study, carried out between November 2007 and April 2009, the authors visited 52 homes, reviewed 280 medication charts and directly observed medication administration techniques. They found 61 medication errors (21.7%), of which the majority were at the administration stage (51%). They also found that 95% of parents were not using support tools such as alarms or reminders, which resulted in 44% more medication errors compared with those using supports ($P=0.0002$). However, the Hawthorne effect may have influenced the results of the study by underestimating the error rate: research participants have been shown to alter their behaviour or performance because of their awareness of being a part of a study (Campbell et al., 1995).

Finally, no studies reported on strategies to reduce medication errors that included the families.

Discussion

Factors that contribute to medication administration errors were reported in the majority of the included studies, but few studies reported strategies to counteract these factors (see Table 2 for details). While the studies that aimed to identify these factors were consistent in their findings, the intervention studies that did consider error management had variable results and, where positive, they only outlined short-term benefits and failed to evaluate whether practice changes were sustained (Fortescue et al., 2003; Taylor et al., 2008; Morriss et al., 2009; Alsulami et al., 2012; Chedoe et al., 2012). The contributing factors to medication administration errors were mainly attributed to system process errors, rather than those made by individuals (Evans, 2009).

Table 2: Studies that reported factors contributing to medication administration errors versus studies that reported strategies to reduce them

Contributing factors (increase errors)	Studies (see Table 1)	Strategies (reduce errors)	Studies (see Table 1)
Increased workload (n=7)	4, 8, 9, 10, 11, 12, 13	Computerised prescribing (n=1)	5
Insufficient training (n=4)	8, 10, 11, 12	Educational intervention (n=1)	2
Non-adherence to policy (n=5)	3, 4, 8, 10, 13	Double-checking (n=1)	1
Failure in communication (n=3)	6, 8, 15	Barcoding (n=1)	7

Educational interventions may be successful in reducing medication administration errors only when they are associated with other interventions, such as increasing staffing numbers and implementation of medication policies and guidelines. Future interventions to reduce errors should be comprehensive and include all personnel involved in the medication process (Otero et al., 2008). Similarly, the use of barcoding and computerised systems was found to decrease medication administration errors (Fortescue et al., 2003; Morriss et al., 2009). However, it was noted that a reliance on computer systems may lead to a reduction in human vigilance, resulting in nurses being less conscious of safety and unaware of medication administration errors (Evans, 2009).

Due to the limitations associated with strategies to reduce medication administration errors, specific attention to medication safety in the paediatric setting is necessary so that the risk is reduced. The process of double-checking the administration of medications is a recommended strategy for nurses.

However, this process fails to eliminate errors fully and there is a need for other medication safety procedures (Evans, 2009). Previous studies reported double-checking medications to be a labour-intensive procedure that requires two nurses and so increases workload – which itself has been shown to increase errors (Alsulami et al., 2012). Additionally, double-checking relies very much on human effort, thus the risk for errors remains high (Evans, 2009). Finally, having a ward-based pharmacist as a strategy to reduce medication errors was not found to be scientifically proven and its effectiveness has not been verified (Fortescue et al., 2003).

The consequences of a poor workplace culture, such as a lack of communication and teamwork, have serious implications for patient outcomes (Manley et al., 2011). Such consequences have a direct influence on medication administration; for example, double-checking as a safety initiative will only succeed with effective communication and a strong sense of teamwork. Interventions to date have tended to focus on isolated components of the administration chain, such as improving the numeracy skills of nurses, rather than looking at how the culture influences practice and what might be done to improve it. A missing strategy, as identified in this review, is the role that parents assume as advocates for their children in medication management processes. Family involvement in the process has not previously explored how family members are supported and encouraged to be proactive in the health system, or the potential for them to be viewed as part of the medication safety agenda. Therefore, to change the workplace culture and to develop practice, the approach should not only be evidence-based; it needs to be inclusive of staff and families (and patients) and be adaptive to changing healthcare needs such as the transition of complex care into the community (Manley et al., 2011).

An important element of practice development is the use of the knowledge and skills of the personnel involved to provide good quality patient care (Gregory, 2012). To make a positive impact on people's lives requires a change in perceptions – encouraging involvement, developing new understandings and enabling choice (Christie et al., 2012). Person-centred approaches to practice are aimed at improving both quality and satisfaction, as they focus on the person thereby increasing feelings of satisfaction and wellbeing (Gregory, 2012). In the paediatric setting, person-centred approaches to care have been closely associated with family-centred models of care, which espouse inclusion of families in the child's care (Williams, 2006). Patient and public involvement is crucial to the delivery of appropriate, meaningful and safe healthcare (National Advisory Group on the Safety of Patients in England, 2013). However, for such a family-professional partnership to succeed, communication must be open, and decisions must be made together, with a willingness to negotiate care approaches as needed (Garling, 2008; Arango, 2011).

The centrality of the patient and their family in supporting a safety agenda has been highlighted in recent national and international reports on improving the safety of care for patients. The Garling report (2008) highlighted the importance of improving communication between healthcare professionals and patients. In the UK, the Berwick report (National Advisory Group on the Safety of Patients in England, 2013) extends the previous notion of 'patient' engagement to 'patient and their carer' involvement as part of the care pathway. Developing family-centred approaches has the potential to decrease medication errors, reduce death and disability, improve medication adherence, and help families to cope with the illness (WHO Global Forum for Government Chief Nursing and Midwifery Officers, 2012). A person-centred approach has long been advocated as a critical strategy in developing practice and optimising healthcare, albeit one that has so far been implemented in a limited way.

Family-centred care presents the continuum of children's healthcare and covers concepts of:

- Parental participation in children's healthcare
- Partnership and collaboration between the healthcare team and parents in decision-making
- Family-friendly environments that normalise as much as possible family performance within the healthcare setting
- Care of children (Franck and Callery, 2004).

Family-centred care enhances the health and wellbeing of children and their families through a respectful family-professional partnership (Arango, 2011). It values the strengths, cultures, traditions and expertise that everyone brings to this relationship (Arango, 2011). It empowers families and fosters independence, which can increase the family's own activity and responsibility in relation to their child's illness and thereby contribute to better health and life satisfaction (Blomqvist et al., 2010). In the particular context of medication management, this suggests that providing substantial opportunities for parents to be involved in medication management while their child is in hospital is likely to influence their behaviours at home and result in more effective care in the community.

In this review, the role of the family in the medication administration process was unclear and while communication was identified as a factor contributing to errors, the exclusion of the family may be limiting the potential for improving medication administration practice. Previous literature (Yin et al., 2010; Basey et al., 2013) found that medication errors caused by family are preventable if the family is supported by the doctors, nurses and pharmacists prior to discharge (Yin et al., 2010). Basey et al. (2013), in another study of the medication process from family's perspective, found that although doctors knew the importance of obtaining an accurate medication history from the families and checking prescriptions with parents, they often failed to put this into practice, resulting in prescribing errors. However, the same study showed that the family was able to provide and discuss their child's medication in more detail than the doctors during admission to hospital.

Family involvement in delivering complex care has shown great success, with parents able to undertake roles such as tracheostomy care (Messineo et al., 1995), changing central line dressings (Rizzari et al., 1992), provide care to children on parenteral nutrition (Byrne et al., 1977) and providing stoma care (Gray et al., 2006). This suggests it is now time to move beyond an individual approach and consider the entire family as the client (Butcher, 1994). Why are families not being considered or included in the medication administration process or in developing future strategies to reduce medication administration errors? Indeed, if we are serious about reducing medication errors it is vital that we take a person-centred approach that values the contribution of staff (nurses, pharmacists and doctors) and families, includes their perspectives and ideas and enables them to participate in developing a culture of medication safety.

Limitations

Several limitations to this review need to be acknowledged. The literature search did not include grey literature and used only four computerised databases and the reference list of the included studies. This may have resulted in a smaller sample for the review with the potential for weakened conclusions. The small number of papers, using a wide range of methods, sample sizes and sites may limit the generalisability of the results (Pai et al., 2004).

It is recommended that the data evaluation stage should be conducted by two or more reviewers to code the individual studies for content and quality (Pai et al., 2004). However, the review of the literature was conducted by one individual (as part of his PhD candidacy). To minimise the effect of this, any uncertainty regarding a study was discussed with supervisors and consensus was achieved.

Implications for research

There is a need for well-designed studies to evaluate the ongoing effect of interventions to reduce medication administration errors. An additional consideration for the effectiveness of future interventions aimed at reducing medication administration errors must be the inclusion of families. The key focus of most studies included in this review is on a nursing perspective, with only two studies reported the parents' concerns and issues. Thus, there is a need for new studies to evaluate the involvement of families in the medication administration process as one possible solution for this complex problem.

Implications for practice

Many strategies were shown, in the short term, to be effective in reducing medication administration errors. However, errors continued to occur and remained significant in number. There is a need for multidimensional and innovative solutions to address this ongoing issue. Solutions need to take into account staffing levels, skill-mix, stress, workload, policies and guidelines, education support, the use of technologies and improved communication. The engagement of nurses, doctors, pharmacists and families in developing future strategies to reduce medication administration errors is vital.

Conclusion

This review highlighted agreement from a number of studies about the contributing factors to medication administration error rates. While there have been multiple attempts to improve medication administration safety reported in the studies in this review, sustainable solutions are not readily obvious. The strategies to reduce errors need to be more comprehensive and include all the key players including nurses, families and organisations. The family has been largely ignored as part of the solution, so the question remains; can the family be included in the medication administration process in order to reduce medication errors and associated harm?

References

- Alsulami, Z., Conroy, S. and Choonara, I. (2012) A systematic review of the effectiveness of double checking in preventing medication errors. *Archives of Disease in Childhood*. Vol. 97. No. 5. pp e2.
- Arango, P. (2011) Family-centered care. *Academic Pediatrics*. Vol. 11. No. 2. pp 97-99.
- Basey, A., Krska, J., Kennedy, T. and Mackridge, A. (2013) Prescribing errors on admission to hospital and their potential impact: a mixed-methods study. *BMJ Quality and Safety*. Vol. 23. No. 1. pp 17-25.
- Blomqvist, K., Theander, E., Mowide, I. and Larsson, V. (2010) What happens when you involve patients as experts? A participatory action research project at a renal failure unit. *Nursing Inquiry*. Vol. 17. No. 4. pp 317-323.
- Butcher, L. (1994) A family-focused perspective on chronic illness. *Rehabilitation Nursing*. Vol. 19. No. 2. pp 70-74.
- Byrne, W., Halpin, T., Asch, M., Fonkalsrud, E. and Ament, M. (1977) Home total parenteral nutrition: an alternative approach to the management of children with severe chronic small bowel disease. *Journal of Pediatric Surgery*. Vol. 12. No. 3. pp 359-366.
- Campbell, J., Maxey, V. and Watson, W. (1995) Hawthorne effect: implications for prehospital research. *Annals of Emergency Medicine*. Vol. 26. No. 5. pp 590-594.
- Chedoe, I., Molendijk, H., Hospes, W., Van den Heuvel, E. and Taxis, K. (2012) The effect of a multifaceted educational intervention on medication preparation and administration errors in neonatal intensive care. *Archives of Disease in Childhood: Fetal and Neonatal Edition*. Vol. 97. No. 6. pp 449-455.
- Christie, J., Camp, J., Cocozza, K., Cassidy, J. and Taylor, J. (2012) Finding the hidden heart of healthcare: the development of a framework to evidence person-centred practice. *International Practice Development Journal*. Vol. 2. No. 1. Article 4. Retrieved from: www.fons.org/library/journal/volume2-issue1/article4 (Last accessed 15th April 2015). pp 1-21.
- Cochran, G.L., Jones, K., Brockman, J., Skinner, A. and Hicks, R. (2007) Errors prevented by and associated with bar-code medication administration systems. *Joint Commission Journal on Quality and Patient Safety*. Vol. 33. No. 5. pp 293-301.
- Davis, L., Ware, R., McCann, D., Keogh, S. and Watson, K. (2009) Evaluation of contextual influences on the medication administration practice of paediatric nurses. *Journal of Advanced Nursing*. Vol. 65. No. 6. pp 1293-1299.
- Elliott, M. and Liu, Y. (2010) The nine rights of medication administration: an overview. *British Journal of Nursing*. Vol. 19. No. 5. pp 300-305.
- Evans, J. (2009) Prevalence, risk factors, consequences and strategies for reducing medication errors in Australian hospitals: a literature review. *Contemporary Nurse: A Journal for the Australian Nursing Profession*. Vol. 31. No. 2. pp 176-189.

- Fernández-Llamazares, C., Calleja-Hernandez, M., Manrique-Rodriguez, S., Pérez-Sanz, C., Duran-García, E. and Sanjurjo-Saez, M. (2012) Impact of clinical pharmacist interventions in reducing paediatric prescribing errors. *Archives of Disease in Childhood*. Vol. 97. No. 6. pp 564-568.
- Ficca, M. and Welk, D. (2006) Medication administration practices in Pennsylvania schools. *Journal of School Nursing*. Vol. 22. No. 3. pp 148-155.
- Fortescue, E., Landrigan, C., McKenna, K., Goldmann, D., Rainu Clapp, M. and Federico Frankbates, D. (2003) Prioritizing strategies for preventing medication errors and adverse drug events in pediatric inpatients. *Pediatrics*. Vol. 111. No. 4. pp 722-729.
- Franck, L. and Callery, P. (2004) Re-thinking family-centred care across the continuum of children's healthcare. *Child: Care, Health and Development*. Vol. 30. No. 3. pp 265-277.
- Garling, P. (2008) *Final Report of the Special Commission of Inquiry: Acute Care Services in NSW Public Hospitals, Overview*. Sydney, NSW: Department of Premier and Cabinet.
- Garrett, R. and Craig, J. (2009) *Medication Administration and the Complexity of Nursing Workflow*. Paper presented to the Proceedings of the Institute of Industrial Engineers Society of Health Systems Conference, Chicago.
- Gray, E., Blackinton, J. and White, G. (2006) Stoma care in the school setting. *Journal of School Nursing*. Vol. 22. No. 2. pp 74-80.
- Gregory, J. (2012) How can we assess pain in people who have difficulty communicating? A practice development project identifying a pain assessment tool for acute care. *International Practice Development Journal*. Vol. 2. No. 2. Article 6. Retrieved from: www.fons.org/library/journal/volume2-issue2/article6 (Last accessed 15th April 2015). pp 1-22.
- Hughes, R. and Edgerton, E. (2005) First, do no harm: reducing pediatric medication errors. *The American Journal of Nursing*. Vol. 105. No. 5. pp 79-84.
- Keers, R., Williams, S., Cooke, J. and Ashcroft, D. (2013) Prevalence and nature of medication administration errors in health care settings: a systematic review of direct observational evidence. *Annals of Pharmacotherapy*. Vol. 47. No. 2. pp 237-256.
- Lemer, C., Bates, D., Yoon, C., Keohane, C., Fitzmaurice, G. and Kaushal, R. (2009) The role of advice in medication administration errors in the pediatric ambulatory setting. *Journal of Patient Safety*. Vol. 5. No. 3. pp 168-175.
- Manley, K., Sanders, K., Cardiff, S. and Webster, J. (2011) Effective workplace culture: the attributes, enabling factors and consequences of a new concept. *International Practice Development Journal*. Vol. 1. No. 2. Article 1. Retrieved from: www.fons.org/library/journal/volume1-issue2/article1 (Last accessed 15th April 2015) pp 1-29.
- National Coordinating Council for Medication Error Reporting and Prevention (2015) *What is a Medication Error?* Retrieved from: www.nccmerp.org/about-medication-errors (Last accessed 16th April 2015).
- Messineo, A., Giusti, F., Narne, S., Mognato, G., Antonello, L. and Guglielmi, M. (1995) The safety of home tracheostomy care for children. *Journal of Pediatric Surgery*. Vol. 30. No. 8. pp 1246-1248.
- Miller, M., Robinson, K., Lubomski, L., Rinke, M. and Pronovost, P. (2007) Medication errors in paediatric care: a systematic review of epidemiology and an evaluation of evidence supporting reduction strategy recommendations. *Quality and Safety in Health Care*. Vol. 16. No. 2. pp 116-126.
- Morriss, F., Abramowitz, P., Nelson, S., Milavetz, G., Michael, S., Gordon, S., Pendergast, J. and Cook, E. (2009) Effectiveness of a barcode medication administration system in reducing preventable adverse drug events in a neonatal intensive care unit: a prospective Cohort Study. *The Journal of Pediatrics*. Vol. 154. No. 3. pp 363-368.
- Murphy, M. and While, A. (2012) Medication administration practices among children's nurses: a survey. *British Journal of Nursing*. Vol. 21. No. 15. pp 928-933.
- National Advisory Group on the Safety of Patients in England (2013) *A Promise to Learn – A Commitment to Act. Improving the Safety of Patients in England*. London: Department of Health.
- Oshikoya, K., Oreagba, I., Ogunleye, O., Senbanjo, I., MacEbong, G. and Olayemi, S. (2013) Medication administration errors among paediatric nurses in Lagos public hospitals: an opinion survey. *International Journal of Risk and Safety in Medicine*. Vol. 25. No. 2. pp 67-78.

- Otero, P., Leyton, A., Mariani, G. and Ceriani Cernadas, J. (2008) Medication errors in pediatric inpatients: prevalence and results of a prevention program. *Pediatrics*. Vol. 122. No. 3. pp e737-e743.
- Özkan, S., Kocaman, G., Öztürk, C. and Seren, S. (2011) Frequency of pediatric medication administration errors and contributing factors. *Journal of Nursing Care Quality*. Vol. 26. No. 2. pp 136-143.
- Pai, M., McCulloch, M., EnaNoria, W. and Colford, J. Jr. (2004) Systematic reviews of diagnostic test evaluations: What's behind the scenes? *ACP Journal Club*. Vol. 141. No. 1. pp a11-a13.
- Prot, S., Fontan, J., Alberti, C., Bourdon, O., Farnoux, C., Macher, M., Foureau, A., Faye, A., Beaufile, F., Gottot, S. and Brion, F. (2005) Drug administration errors and their determinants in pediatric inpatients. *International Journal for Quality in Health Care*. Vol. 17. No. 5. pp 381-389.
- Rizzari, C., Palamone, G., Corbetta, A., Uderzo, C., Vigano, E. and Codecasa, G. (1992) Central venous catheter-related infections in pediatric hematology-oncology patients: role of home and hospital management. *Pediatric Hematology and Oncology*. Vol. 9. No. 2. pp 115-123.
- Sears, K. and Goodman, W. (2012) Risk factors for increased severity of paediatric medication administration errors. *Healthcare Policy*. Vol. 8. No. 1. pp e109-e126.
- Sears, K., O'Brien-Pallas, L., Stevens, B. and Murphy, G. (2013) The relationship between the nursing work environment and the occurrence of reported paediatric medication administration errors: a pan Canadian Study. *Journal of Pediatric Nursing*. Vol. 28. No. 4. pp 351-356.
- Stratton, K., Blegen, M., Pepper, G. and Vaughn, T. (2004) Reporting of medication errors by pediatric nurses. *Journal of Pediatric Nursing*. Vol. 19. No. 6. pp 385-392.
- Taylor, J., Loan, L., Kamara, J., Blackburn, S. and Whitney, D. (2008) Medication administration variances before and after implementation of computerised physician order entry in a neonatal intensive care unit. *Pediatrics*. Vol. 121. pp 123-128.
- Walsh, K., Landrigan, C., Adams, W., Vinci, R., Chessare, J., Cooper, M., Hebert, P., Schainker, E., McLaughlin, T. and Bauchner, H. (2008) Effect of computer order entry on prevention of serious medication errors in hospitalized children. *Pediatrics*. Vol. 121. No. 3. pp e421-e427.
- Walsh, K., Mazor, K., Stille, C., Torres, I., Wagner, J., Moretti, J., Chysna, K., Stine, C., Usmani, G. and Gurwitz, J. (2011) Medication errors in the homes of children with chronic conditions. *Archives of Disease in Childhood*. Vol. 96. No. 6. pp 581-586.
- Whittemore, R. (2005) Combining evidence in nursing research: methods and implications. *Nursing Research*. Vol. 54. No. 1. pp 56-62.
- WHO Global Forum for Government Chief Nursing and Midwifery Officers (2012) *Strengthening the Role of Nursing and Midwifery in Noncommunicable Diseases: Forum Statement*. Retrieved from: www.who.int/hrh/nursing_midwifery/20MayForum_statement.pdf?ua=1 (Last accessed 16th April 2015).
- Williams, W. (2006) Family-centered care. *Journal for Specialists in Pediatric Nursing*. Vol. 11. No. 3. pp 203-206.
- Wong, I., Wong, L. and Cranswick, N. (2009) Minimising medication errors in children. *Archives of Disease in Childhood*. Vol. 94. pp 161-164.
- Yin, H., Mendelsohn, A., Wolf, M., Parker, R., Fierman, A., van Schaick, L., Bazan, I., Kline, M. and Dreyer, B. (2010) Parents' medication administration errors: role of dosing instruments and health literacy. *Archives of Pediatrics and Adolescent Medicine*. Vol. 164. No. 2. pp 181-186.

Albara Alomari (Master Hons, RN), PhD Candidate, University of Technology Sydney, Australia.

Val Wilson (PhD, RN), Professor of Nursing Research and Practice Development, University of Technology Sydney, and the Sydney Children's Hospitals Network, Australia.

Patricia M. Davidson (PhD, RN), Professor of Cardiovascular and Chronic Care, University of Technology Sydney, Australia.

Joanne Lewis (PhD, RN), Lecturer, Faculty of Health, University of Technology Sydney, Australia.