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Nurses' Perceived Causes of Medication Administration Errors: A Qualitative Systematic Review

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Background: Medication administration errors (MAEs) are a critical patient safety issue. Nurses are often responsible for administering medication to patients, thus their perceptions of causes of errors can provide valuable guidance for the development of interventions aimed to mitigate errors. Quantitative research can overlook less overt causes; therefore, a qualitative systematic review was conducted to present a synthesis of qualitative evidence of nurses' perceived causes of MAEs.

Methods: Publications from 2000 to February 2019 were searched using four electronic databases. Inclusion criteria were articles that (1) presented results from studies that used a qualitative or mixed methods design, (2) reported qualitative data on nurses' perceived causes of MAEs in health care settings, and (3) were published in the English language. Sixteen individual articles satisfied the inclusion criteria. Methodological quality of each article was assessed using the Critical Appraisal Skills Programme (CASP) tool. Thematic analysis of the data was performed. Perceived causes of errors were labeled as knowledge-based, personal, and contextual factors.

Results: The primary knowledge-based factor was lack of medication knowledge. Personal factors included fatigue and complacency. Contextual factors included heavy workloads and interruptions. Contextual factors were reported in all the studies reviewed and were often interconnected with personal and knowledge-based factors.

Conclusion: Causes of MAEs are perceived by nurses to be multifactorial and interconnected and often stem from systems issues. Multifactorial interventions aimed at mitigating medication errors are required with an emphasis on systems changes. Findings in this review can be used to guide efforts aimed at identifying and modifying factors contributing to MAEs.

Medication errors (MEs) result in at least one death each day and injure approximately 1.3 million people annually in the United States.[1] MEs are a global problem, with low-, middle-, and high-income countries estimated to have similar ME rates.[1] Errors can occur during any stage in the medication process, from prescribing, transcribing, dispensing, and administration; however, the majority of MEs occur during administration.[2] Nurses are the primary team members responsible for medication administration (MA) to patients. Although it is difficult to estimate the prevalence of medication administration errors (MAEs) due to underreporting of errors and differences in methods used to collect and analyze data on MAEs, a recent systematic review of eight studies conducted in the United Kingdom determined that approximately 10% of intravenous MAs are in error.[3]

MAE is defined as "a deviation from the prescriber's medication order as written on the patient's chart, manufacturers' preparation/administration instructions, or relevant institutional polices."[4(p. 1)] MA involves both preparing and giving medication and includes safety checks referred to as the "6 Rights." These rights are taught and practiced throughout nursing education programs and encompass the right patient, medication, dosage, route, time, and documentation.[5] An error among any of the "6 Rights" is considered an MAE.

Understanding what factors lead to MAEs is required to guide efforts aimed to mitigate the occurrence of these errors. The World Health Organization (WHO)[2] and researchers in the MAE field assert that systems factors are often the main contributors of MAEs, although a detailed understanding of how these factors arise and interconnect is not fully understood.[6] Systems factors and other factors that lead to MAEs are often interconnected, making it difficult to delineate and understand their root origins. However, given that nurses spend up to 40% of their workday in the MA process,[7] they may be able to provide valuable insight into factors that contribute to MAEs. Qualitative research of nurses' perceptions of MAE causes can provide a deeper understanding of the contributing factors and the necessary guidance for interventions and policies.

Researchers have used both quantitative and qualitative research designs to investigate factors contributing to MAEs. The use of direct observation and self-report surveys have been the predominant methods of quantitative data collection.[8–10] These quantitative findings are highly valuable; however, qualitative findings can provide rich descriptions of perceived MAE causes, identifying details that can create a better understanding of this complex issue. For example, qualitative research could explore if multiple

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factors were involved in an error, or if an error might be linked to a less overt reason. This depth of understanding cannot be gained through quantitative research methods alone.

Prior reviews have focused primarily on studies using quantitative methods[10,11] or a combination of quantitative and qualitative methods.[6,12] The more recent quantitative review by Parry et al. reported on studies published between 1999 and 2012 that explored registered nurse MAE causes.[11] Keers et al.'s review presented an aggregate of quantitative and qualitative studies published between 1985 and 2013 that explored MAE causes among various health care workers who had direct involvement in an MAE.[6] Although the present review reports on some of the same studies examined by Keers et al.[6] (due to an overlap of qualitative studies searched between 2000 and May 2013), the current review is unique because it focuses only on nurses' perceived causes of MAEs, does not have an inclusion criterion of direct involvement with an MAE, and presents only qualitative evidence. Moreover, 10 newly published qualitative studies on causes of MAEs have emerged since 2013, warranting an updated review. To the authors' knowledge, this is the first review of purely qualitative findings of nurses' perceived MAE causes published to date.

METHODS

The aim of this review was to critique and synthesize the qualitative evidence on perceived causes of MAEs as reported by nurses in health care settings. Definitions or descriptions of the term *nurse* were provided in seven studies in this review and included "qualified/licensed" nurses[4] and "registered" nurses.[13–18] The term *nurse* was not defined or described in nine studies; however, it was clear in all studies that the participants held the title of nurse in their respective health care setting. Some studies included in this review reported perceptions from other health care providers or nursing students in addition to nurses' perceptions of MAE causes. Only studies in which nurses' perceptions were able to be clearly identified and extracted (such as when perceptions of causes were prefaced with "nurses reported . . ."; "as stated by a nurse . . .") were included, and only nurses' perceptions were presented and discussed in this review.

Design

Using the Enhancing transparency in reporting the synthesis of qualitative research (ENTREQ) statement[19] for guidance, a qualitative systematic review was performed. Qualitative reviews aim to present a comprehensive understanding of participant perceptions or experiences to provide quality recommendations for patient care.[20] Thematic synthesis[21] of the qualitative data gathered across the studies was conducted.

Search Strategy

Four electronic databases—Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, Scopus, and Google Scholar—were searched for articles written in English and published between 2000 and February 2019. A Boolean search using "nurse or nurses or nursing" AND "perceptions or attitudes or opinion or experience or view or reflection or beliefs" AND "causes or factors or determinants or contributing factors or determining factors" AND "medication errors" was conducted in CINAHL, PubMed, and Scopus. The search strategy required adaptation in Google Scholar due to the limitations of the database to search combined terms. Reference lists of included studies were hand searched for additional articles. Inclusion criteria were articles that (1) presented results from studies that used a qualitative or mixed methods design, (2) reported qualitative data on nurses' perceived causes of MAEs in health care settings, and (3) were published in the English language. Only the qualitative results from the mixed methods studies were reported in this review.

Search Outcomes

The searches resulted in 1,183 articles. At the first stage, a title review was performed on all articles. A titles-first strategy (compared to a simultaneous titles and abstract screening) has been found to be an efficient and accurate method to use for systematic reviews.[22] All titles were screened for relevance to the main interests of the review, broadly being nurses' perceived causes of MAEs collected via a qualitative method. Based on the title review, selected abstracts were screened, and, subsequently, full-text articles were obtained. A detailed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram[23] of the search strategy is depicted in Figure 1.

Quality Appraisal

All studies were appraised using the Critical Appraisal Skills Programme (CASP) tool for qualitative research.[24] This tool is widely used in appraisal of qualitative research[25] in qualitative systematic reviews[20] and is recommended by Nadelson and Nadelson[26] to critically appraise evidence due to its effectiveness and efficiency. The CASP tool guides the reviewer in examining the key areas to assess in qualitative studies, with a focus on the validity of the results, what the results are, and the value of the research.

Data Extraction

The first author carefully and iteratively read all included articles, highlighted qualitative data on perceived MAE causes, and wrote line-by-line notes regarding emerging themes in the margins. Data consisted of quotes from participants (first-order constructs) and researchers' interpretations of the data (second-order constructs). Extraction of

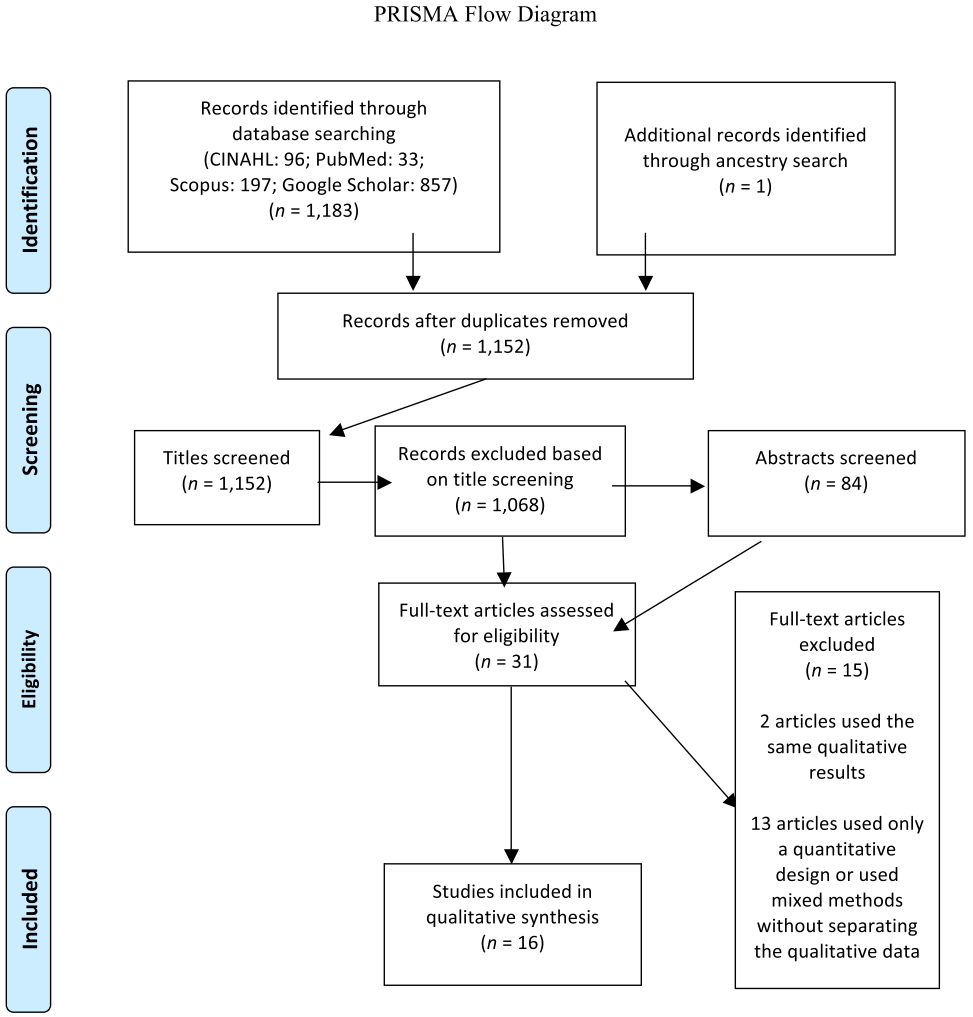


Figure 1: This diagram illustrates the processes used to identify, screen, and determine eligibility of studies for inclusion in the review. CINAHL, Cumulative Index to Nursing and Allied Health Literature.

both types of data helped to ensure that the findings presented in this review were thorough and founded on the original experiences of the participants.[20]

After repeated readings of the articles and review of the highlighted data and notes, the first author performed a thematic analysis[27] for each study's data. This process began with coding each line of text that included study data on nurses' perceived MAE causes. Many sentences had more than one code applied (for example, "inexperience" and "lack of guidance"). This process resulted in a total of 61 initial codes. Thematic synthesis then began.[21]

Thematic Synthesis

Thematic synthesis of the qualitative data gathered from studies involves three stages: (1) line-by-line coding of findings of primary studies, (2) organization of codes into descriptive themes, and (3) development of analytical themes.[21] The analytical themes in this review were not newly developed. Instead, existing themes originally developed by Hand and Barber were used.[28] In accordance with the ENTREQ statement, investigators can conduct a thematic synthesis in a deductive manner and assign data to predefined concepts.[19]

The use of line-by-line coding enabled translation of concepts from one study to another.[21] The similarities and differences among the initial codes were examined and grouped into 20 descriptive themes. Then, using a template organizing analytical approach,[29] data were placed into the Hand and Barber a priori constructed analytic themes of factors that lead to MAEs: knowledge-based, personal, and contextual factors.[28] The Hand and Barber themes used in this review were chosen due to their clarity, parsimony, and broadness, which were fitting for a synthesis of findings across studies. The three authors reviewed the findings and themes together on multiple occasions, and any disagreements were discussed until a consensus was made. The full list of factors can be found in Table 1.

RESULTS

A total of 16 studies met all inclusion criteria. Studies were conducted in nine different countries, with most

Table 1. Nurses' Perceived Causes of Medication Administration Errors (MAEs)*

Authors Year Country	Setting Sample	Aim Route of administration studied	Method/Design Established error framework used	Findings of nurses' perceived MAE causes:		
				Knowledge-based	Personal	Contextual
Keers et al.[4] 2015 United Kingdom	2 teaching hospitals—unspecified wards/theatres 20 qualified/licensed nurses directly involved with IV MAE	Investigate underlying causes of IV MAEs Route of administration: IV	Descriptive qualitative/semistructured interviews with nurses directly involved with MAE Framework: Reason's model of accident causation	Lack of knowledge of medications	Complacency Lack of confidence Fear of looking lincompetent Overconfidence	Environmental noise Equipment design Distractions/Interruptions Heavy workloads Lack of staff Inadequate staff skill mix Challenging professional relationships Insufficient access to support during evenings/weekends Lack of availability of guidelines Illegible prescriptions Lack of prior documentation of MA Pressure from other staff/lack of time Risky practice norms Work-related pressure/rushing
Björstén et al.[13] 2016 Sweden	Multiple health care settings 585 registered nurses directly involved with MAE	Increase understanding of potentially hazardous medication errors by nurses with regard to type of error and contributory factors Route of administration: All	Descriptive qualitative/content analysis of narratives in case files of reported medication errors in which a nurse was held responsible for malpractice Framework: Reason's model of accident causation	Lack of knowledge of medications	Negligence Forgetfulness Lack of attentiveness Not following protocol Practice beyond scope of practice (nurse changed a medication order without authorization from provider)	Communication breakdown between staff Role overload Look-alike medication Inappropriate location of medications Unclear communication Unclear orders Lack of access to guidelines Interruptions Distractions Wrong drug delivered from pharmacy Work pressure
Hemingway et al.[14] 2015 United Kingdom	Various mental health settings 111 total participants: 70 registered mental health nurses; 41 student nurses	Investigate registered and student nurses' perceptions of barriers to safe MA in mental health settings and to examine their understanding of why MAEs occur Route of administration: All	Mixed methods/descriptive Self-administered survey with open-response questions Framework: Reason's model of accident causation	Lack of knowledge of medications Inability to correctly calculate medication dosages	None identified	Distractions Interruptions (from other staff and phone) Noise Lack of space to administer medication Poor lighting Lack of qualified staff Heavy workloads Illegible/unclear prescriptions Work-related pressure Cultural/linguistic barriers between nurse and patient (difficulties in correct identification of the patient)

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Table 1. (*continued*)

Authors Year Country	Setting Sample	Aim Route of administration studied	Method/Design Established error framework used	Findings of nurses' perceived MAE causes:		
				Knowledge-based	Personal	Contextual
Jones & Trieber[15] 2010 United States	Multiple settings 158 registered nurses directly involved with MAE	Explore nurses' perceptions of how and why MAEs occur Route of administration: All	Mixed methods/ descriptive Self-administered questionnaire—open-ended questions regarding direct involvement with MAE Framework: none identified	None identified	Fatigue/physical exhaustion	Distractions Interruptions Lack of staff Heavy workloads Inexperience Lack of training
Keers et al.[16] 2018 United Kingdom	Mental health hospital 20 participants: registered mental health nurses and student nurses directly involved with MAE	Investigate causes of MAEs affecting inpatients in a mental health hospital Route of administration: All	Descriptive qualitative/semistructured interviews with participants directly involved with MAE Framework: Reason's model of accident causation	Lack of knowledge of medications	Tendency to make assumptions Stress Nervousness Lack of confidence	High workloads Low staffing Noisy environment Distractions/interruptions Unclear prescriptions Communication breakdown between staff Lack of supervision Lack of support Lone working Inadequate staff skill mix Patient's mental status (led to misidentification of patient) Sound-alike medications Look-alike medications Competing demands (for example, ward rounds, patient meetings) Work-related pressure/rushing Inexperience
Treiber & Jones[17] 2018 United States	Multiple settings 71 registered nurses with less than 5 years of experience directly involved in an MAE	Understand recent nursing school graduates' perceptions of adequacy of nursing education, their experiences after making medication errors, and subsequent organizational responses Route of administration: All	Mixed methods/ descriptive Self-administered questionnaire—open-ended questions regarding direct involvement with MAE Framework: none identified	None identified	Fatigue	Low staffing Time pressures Malfunctioning equipment/technology (computers, IV pumps, etc.) Changes in medication packaging Changes in procedures Inexperience

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Table 1. (*continued*)

Authors Year Country	Setting Sample	Aim Route of administration studied	Method/Design Established error framework used	Findings of nurses' perceived MAE causes:		
				Knowledge-based	Personal	Contextual
Wei et al.[18] 2015 Malaysia	General hospital with various wards 8 total participants: 4 registered nurses; 4 pharmacists	Explore registered nurses' and pharmacists' experiences and perspectives on medication safety Route of administration: All	Descriptive qualitative/ semistructured individual interviews Framework: none identified	Lack of knowledge of medications	None identified	Inexperience Work pressure Hectic environment Lack of staff
Hand & Barber[28] 2000 United Kingdom	London teaching hospital—various wards 17 nurses—not specified if all participants had direct involvement with MAE	Investigate nurses' attitudes and beliefs about MA and medication system errors and the impact errors have on the nurse and the ward Route of administration: All	Descriptive qualitative/ semistructured interviews Framework: none identified	Lack knowledge of medications	Fatigue Stress Lack of confidence Lapses Lack of concentration Lack of care Complacency	Lack of staff Heavy workloads Long drug rounds Long work day Distractions/interruptions
Dias[30] 2014 Brazil	Basic health unit and teaching hospital 20 nurses	Assess the understanding of nurses in basic and hospital units about aspects of interrelated care: patient safety and medication errors Route of administration: All	Descriptive qualitative/ semistructured interviews Framework: none identified	None identified	Lack of attention Unpreparedness	Workload Lack of training Illegible prescriptions Lack of staff Inadequate physical environment Rushing Chaotic environment
Farzie et al.[31] 2017 Iran	16 various ICUs from 7 teaching hospitals 19 total participants: 13 nurses; 5 physicians; 1 pharmacist	Explore and describe perceived causes of medication errors from ICU team Route of administration: All	Descriptive qualitative/ semistructured interviews Framework: none identified	Lack of pharmaceutical knowledge—proper dilutions, storage of medication, drug interactions	Drowsiness Fatigue Talking Stress	Interruptions Lack of professional communication/collaboration Heavy workloads Insufficient lighting Disorderly drug shelves Understaffed

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Table 1. (*continued*)

Authors Year Country	Setting Sample	Aim Route of administration studied	Method/Design Established error framework used	Findings of nurses' perceived MAE causes:		
				Knowledge-based	Personal	Contextual
Nichols et. al.[32] 2008 Australia	Teaching hospital—various units 26 total participants directly involved with MAE: 7 nurses; 15 physicians; 4 pharmacy staff	Study the clinical contexts contributing to harmful medication errors Route of administration: All	Descriptive qualitative/ semistructured interviews with prescribers and staff directly involved in MAE Framework: Reason's model of accident causation	Lack of knowledge of medications Lack of knowledge of protocol	Stressed Tired Multitasking Distracted Personal or family health issues	Poor communication within team/with others Lack of guidance Emergency situation Difficulty accessing drug information, protocols, or guidelines Understaffed Wrong drugs in medication drawer Similar medication bottle to another Rushed
Pazokian et al.[33] 2014 Iran	Various units of a teaching hospital 20 nurses	Explore and obtain deep insight into factors affecting medication errors based on nurses' perspectives Route of administration: All	Descriptive qualitative/ semistructured interviews Framework: Reason's model of accident causation	Lack of knowledge of medications Lack of skills required for drug administration Dose miscalculations	Personal or family health issues	Heavy workloads Look-alike medications Sound-alike medications
Sanghera et al.[34] 2007 United Kingdom	Hospital ICU 13 total participants directly involved with MAE: 7 nurses; 6 physicians	Explore attitudes and beliefs of health care professionals regarding causes and reporting of medication errors Route of administration: All	Descriptive qualitative/ semistructured interviews with participants directly involved in MAE Framework: Reason's model of accident causation	Lack of knowledge of medications	Complacency Tendency to make assumptions Inattention Memory failure	Risky practice norms Lack of clarity of responsibility of second checker Lone working (isolation rooms) Poor communication among staff

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Table 1. (*continued*)

Authors Year Country	Setting Sample	Aim Route of administration studied	Method/Design Established error framework used	Findings of nurses' perceived MAE causes:		
				Knowledge-based	Personal	Contextual
Alharbi et al.[35] 2019 Saudi Arabia	Adult oncology unit of a public hospital 38 total participants: 24 nurses; 7 physicians; 7 pharmacists	Identify and explore factors related to medication error in adult medical oncology department as the basis for developing an intervention to reduce medication errors in this context Route of administration: All	Descriptive qualitative/ semistructured individual interviews followed by focus groups Framework: none identified	None identified	Fatigue Fear of looking incompetent	Poor interprofessional communication due to gender discrimination Poor interprofessional communication due to underestimation of other professionals' roles Heavy workload Inexperience Work-related pressure/rushed Illegible handwriting of medications/prescriptions Look-alike medications Sound-alike medications
Ozkan et. al.[36] 2011 Turkey	Pediatric ward of hospital 25 nurses directly involved in MAE	Examine the frequency of pediatric MAEs and contributing factors of the errors Route of administration: All	Mixed methods/ descriptive DO and semistructured interviews with nurses directly involved in MAE Framework: Reason's model of accident causation	Misinterpretation of medication preparation protocols	Fatigue	Heavy workloads Lack of time Emergencies Insufficient protocols Late arrival of medication Distractions/interruptions Suitable equipment not available Inexperience
Taxis & Barber[37] 2003 United Kingdom	2 hospitals—10 various wards 113 nurses directly involved with MAE	Investigate the causes of IV drug administration errors Route of administration: IV	Ethnography/DO and informal conversations with participants directly involved in MAE Framework: Reason's model of accident causation	Lack of knowledge of medications Lack of knowledge of technology (electronic infusion pump)	Deliberate deviations from guidelines (IV bolus administered faster than guidelines state)	Lack of staff Heavy workloads Distractions/interruptions Poor communication among staff Poor design of equipment (for example, too complicated) Small and/or ambiguous medication vial labels (difficult to read) Lack of supervision of inexperienced nurses Lack of training of staff on IV MA

IV, intravenous; MA, medication administration; DO, direct observation.

* References can be found at the end of this article.

($n = 6$) in the United Kingdom. The majority of studies ($n = 9$) used a descriptive qualitative design with semistructured interviews to collect data.[4,16,18,28,30–34] One study used semistructured interviews followed by focus groups.[35] Other studies used either mixed methods with data collected via a self-administered questionnaire ($n = 3$),[14,15,17] mixed methods with direct observation of MAEs followed by semistructured interviews with participants ($n = 1$),[36] review of narratives of case reports of medication errors ($n = 1$),[13] or ethnography with direct observation of MAEs followed by informal conversations with participants ($n = 1$).[37]

Approximately one third ($n = 6$) of study settings were in specialized areas: pediatrics,[36] adult oncology,[35] ICUs,[31,34] and mental health settings.[14,16] The majority ($n = 10$) of studies took place across various general health care settings. Two studies focused only on the intravenous route of MA,[4,37] whereas other studies explored all routes. Many studies ($n = 9$) used Reason's model of accident causation[38] to guide their study,[4,13,14,16,32–34,36,37] whereas other studies did not identify use of an error framework. Further details of each study can be found in Table 1.

Validity/Methodological Rigor

Methodological rigor of the studies was assessed. Methodological rigor in qualitative studies refers to the demonstration of legitimacy of the research process.[39] Legitimacy was demonstrated in all 16 reviewed studies with a clear statement of the aim(s) of the study and use of an appropriate qualitative method and research design. Evidence of confirmability, which is concerned with establishing that the interpretations of findings are clearly derived from the data,[39] was also provided in all the studies. However, evidence for credibility and dependability of findings varied.

Credibility can be supported through the use of peer debriefing and member checks.[39] Peer debriefing was reported in most ($n = 11$) of the studies reviewed, yet a detailed explanation of how peer debriefing was performed with review of data, codes, and categories was described in only one quarter ($n = 4$) of the studies.[18,31,33,35] Member checks were used to validate the congruency of codes with the participants' experiences in only two studies.[31,33]

Dependability can be achieved through auditing,[39] a process through which others can follow the progression of events in a study and understand the researchers' logic through the provision of detailed descriptions of methods used.[40] Studies in this review varied greatly in their descriptions of the methods used to achieve dependability. For example, a deductive content analysis was used in one study, yet the study provided only a brief explanation of how the themes were derived.[14] In contrast, another study provided many examples of how dependability was achieved, with detailed information at different stages of data gathering, analysis, and inference.[31]

Value of the Studies

All studies provided qualitative findings of nurses' perceived causes of MAEs. However, the level of detail of causes of MAEs varied across studies. Most studies ($n = 12$) had a clear aim of exploring underlying causes of MAEs and provided thorough descriptions from nurses of their perceptions of causes. Four studies had a broader focus on medication errors, such as to explore nurses' understanding (not specifically their perceptions of causes) about medication errors,[30] and thus provided less in-depth findings and fewer exemplars on nurse perspectives of MAE causes.[17,18,30,36] Findings are described and categorized below.

Qualitative Findings

Knowledge-Based Factors. Knowledge-based factors of perceived MAE causes were noted in most of the studies ($n = 12$). Lack of medication knowledge was commonly cited, which included lack of knowledge of safe dosages of medications, proper dilutions, and drug interactions. Inability to properly calculate medication doses and infusion rates, misinterpretation of protocols, and how to use technology were also perceived as contributing to MAEs. Researchers described an occurrence of a nurse in a neonatal ICU who administered an infusion over 3 hours instead of over 20 minutes, which the nurse later explained was due to lack of knowledge of how to set up the syringe driver.[37]

A different nurse with less than one year of experience shared: "I think because I was newly qualified and it [how to dose 'when required' medications over 24 hours] hadn't really been explained very well, so I thought that they could have two [doses] in a day. . . . But, you have to do it from the time, don't you. . . ."[16(p. 7)] This lack of knowledge resulted in a wrong-time MAE. Inexperience and lack of training, which could be considered either personal or contextual factors, contribute to lack of knowledge. This error could have also been influenced by other contextual factors, such as lack of supervision of inexperienced nurses, which is a perceived contributor to MAEs[16,37] (Figure 2).

Personal Factors. Identification of personal factors was recurrent throughout nearly all ($n = 14$) of the studies. These factors included negligence, complacency, stress, lack of confidence in approaching the prescriber to clarify an order, inattention, tendency to make assumptions, and deliberate deviations from guidelines. Complacency was interconnected with a tendency to make assumptions specifically related to the nurse second check of medication.

In two studies, responses indicated that nurses were complacent or made assumptions about medication checks.[16,34] A nurse stated: ". . . it's probably umm having a relaxed attitude to it, being complacent with drug checking . . . it does happen quite often. . . ."[34(p. 59)] This specific factor of a relaxed attitude with the second check of medication was further explained by the same nurse: "I think that the staff are very trusting of one another, when checking drugs, instead

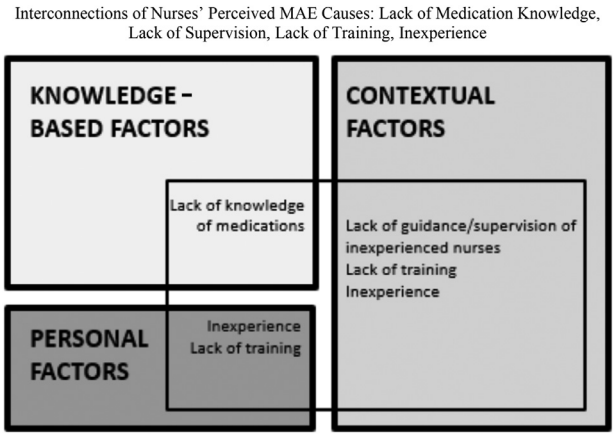


Figure 2: Shown here is an exemplar provided of a nurse with less than one year of experience who made a medication administration error (MAE), as described in one qualitative study.[16(p. 7)] All of the factors could have contributed to the other factors and ultimately to the MAE.

of looking carefully at the prescription as they should do. Umm, because they take it for granted that you wouldn't make a mistake I suppose."[34(p. 59)] Other personal factors reported were fatigue and physical exhaustion. These factors could be due to individual circumstances; however, the exemplars provided in the studies often gave insight into contextual factors, such as understaffing and heavy workloads.

Contextual Factors. Contextual factors were the most frequently reported perceived MAE causes across the studies. Recurring contextual factors included interruptions and distractions, communication problems, challenging professional relationships, understaffing, heavy workloads, lack of supervision/support, inexperience, lack of training, improper physical working conditions, work-related pressure, lack of time, and unsafe practice norms.

Interruptions and Distractions. Interruptions and distractions were reported in most studies ($n = 9$) as contributing to MAEs: "While I was administering medication, the in-charge nurse interrupted my task and simply made me do another thing. . . . I got distracted . . . and so, I gave the patient a shot of clindamycin instead of pantoprazole. . . ."[31(p. 161)] Noise,[4,14,16] chaotic environments,[4,16] and heavy workloads create the grounds for distractions and interruptions to occur, and were also cited by respondents as perceived MAE causes.

Poor Communication/Challenging Relationships. Problems with verbal communication, such as linguistic barriers between nurses and patients, and refusal to communicate with team members due to challenging relationships were frequently described. As expressed by one nurse, "Over and over, again the physician's handwriting has been illegible, and we have had doubts about the exact medicine, but we have refused to call the physician and ask them because they usually get angry and think we are careless. Thus, we just transcript the same drug as we guess[,] which has proved to be wrong many times."[31(p. 161)] (Figure 3). Difficulties in identifying the correct patient due to linguistic barriers[14] and failure to communicate MA information between nurses during patient transfers[37] were also perceived as contributors to MAEs.

Heavy Workloads/Lack of Staff. In the majority of studies ($n = 14$), participants communicated that understaffing and/or heavy workloads lead to MAEs. Pressure, lack of time, and feeling rushed were also often cited. As a nurse in one study explained: "if you are under pressure, it leaves more room for mistakes. . . ."[14(p. 736)]

In addition to pressure, understaffing and heavy workloads were associated with nurse fatigue and physical exhaustion. Respondents in one study indicated that they were physically exhausted, often due to working multiple shifts, working long hours, or not taking adequate breaks or lunch.[15] When discussing physical exhaustion, a participant shared a personal experience of making an error: "[I] increased the rate of lidocaine infusion to 230 cc/hr. instead of 23 cc/hr. I was hypoglycemic, no break in 5 hours, no food, and had blurred vision"[15(p. 245)] (Figure 4).

Lack of Supervision/Support/Lone Work. Participants voiced concern over lack of supervision of inexperienced nurses, working as the only nurse on the unit, or working in isolation rooms. Nurses stated that when they worked as the only nurse on the unit, this increased their feelings of pressure, caused mental distraction, and led to poor decision making. When discussing making a medication error, a nurse conveyed: ". . . I was naturally more anxious for that shift anyway because I was the only nurse on [the ward]. . . . I'm looking after 20 patients on my own. . . . So I think there was an underlying anxiety as well that maybe I was also distracted by that when I was dispensing the medication which did probably have an effect as well."[16(pp .9–10)]

Inexperience/Lack of Training. Inexperience or lack of training was reported in six articles as a perceived cause of MAEs.[15–18,35,36] Although it could be argued that these factors can be personal or contextual, both are listed in this review as contextual factors. Ozkan et al., authors of one study included in this review, assert that gaining knowledge and experience is not only a personal responsibility but also an organizational (contextual) responsibility that is accomplished through organization-provided training.[36]

Poor Physical Working Conditions. In three studies,[14,30,31] the physical working conditions were believed to lead to MAEs. A nurse in an ICU described lack of lighting as a contributor to errors: ". . . the environment plays a major role in the occurrence of errors. Lack of light in the ICUs

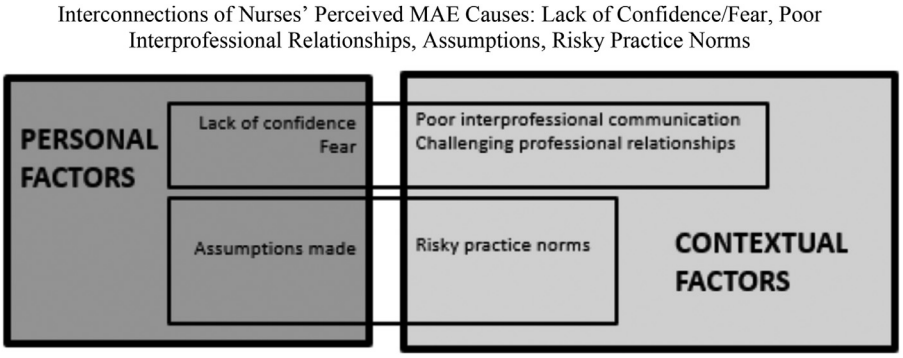


Figure 3: This figure illustrates a nurse report of physicians' illegible handwriting, the difficulty nurses had communicating with physicians about the problem, and the resulting medication administration errors (MAEs).[31(p. 161)] All of the factors could have contributed to the other factors and ultimately to the MAEs.

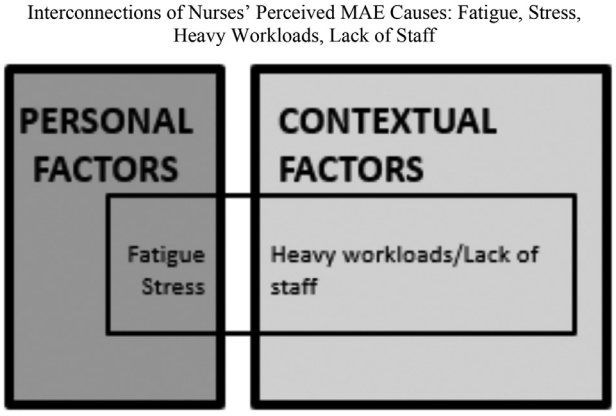


Figure 4: Shown here are exemplars provided by respondents in one study who indicated that they were physically exhausted due to working multiple shifts, working long hours, or not taking adequate breaks, with one nurse describing a medication administration error (MAE).[15(p. 245)]

can cause errors. There is not enough light at the site of patients' drug shelves. . . . The wrong medication is often picked up by the nurse and given to the patient."[31(p. 7)]

Unsafe Practice Norms. In one study, nurses reported that they were often administering medications without an order.[34] This practice norm not only contributes to MAEs, it actually results in MAEs. As one nurse said, ". . . we are giving drugs when they are not actually prescribed. . . . So that is an error, um but it seems to be getting to be normal practice. . . ."[34(p. 58)] In another study, a nurse described a practice norm of administering all the evening intravenous doses before shift change, which eventually led to an MAE: ". . . it was drummed into me that we got the IV medications out before the night shift came on. . . . So I felt pressure that I had to get them [IV doses] all out before they came out of the staff room. . . ."[4(p. 5)]

DISCUSSION

Among the 16 studies included in this review, there was a fair amount of heterogeneity in the purpose of the studies (12 studies had a clear aim of exploring underlying causes of MAEs) and in the methods used (9 studies used semistructured interviews). Four studies had aims that were broader in focus and thus provided less in-depth findings and fewer exemplars on nurse perceptions of MAE causes. Studies varied in their settings, with 10 studies in generalized settings and 6 studies in specialized areas. With the exception of incorrect patient identification reported as a perceived cause of MAEs only in mental health settings, studies reviewed provided similar findings, even with the variations in purposes, data collection methods, and study settings.

Various perceived MAE causes were reported across the studies in this review. Although some perceived causes could clearly be identified as solely a personal factor (for example, negligence), the majority of personal and knowledge-based factors were interconnected with contextual factors. The presentation of purely qualitative evidence in this review, unlike prior reviews that presented findings from purely quantitative or both quantitative and qualitative studies, allowed these interconnections to be more fully uncovered (Figure 5). Authors of articles included in this review discuss interconnections between the different causes of MAEs identified in their studies,[4,17,18,35] particularly on how systems factors often underpin individual (that is, knowledge-based and personal) factors. Given these interconnections, interventions aimed to decrease MAEs must be multifaceted and involve systems changes.[4,17,35] Efforts made at the organizational level, such as addressing nurse shortages and heavy workloads, would then also indirectly address some individual/personal factors that lead to MAEs, such as nurse fatigue and stress.

Heavy workloads and lack of staff can lead to fatigue, physical exhaustion, and inattention in nurses—which were all perceived to contribute to MAEs in the studies reviewed. Research on nurses' workload has found that heavy nurse workloads lead to frequent interruptions, stress, and hasty performance, which can increase MAEs.[41] In addition, fatigue as a consequence of heavy workloads and a perceived MAE cause has been associated with increased medication error rates among emergency department physicans.[42] Lack

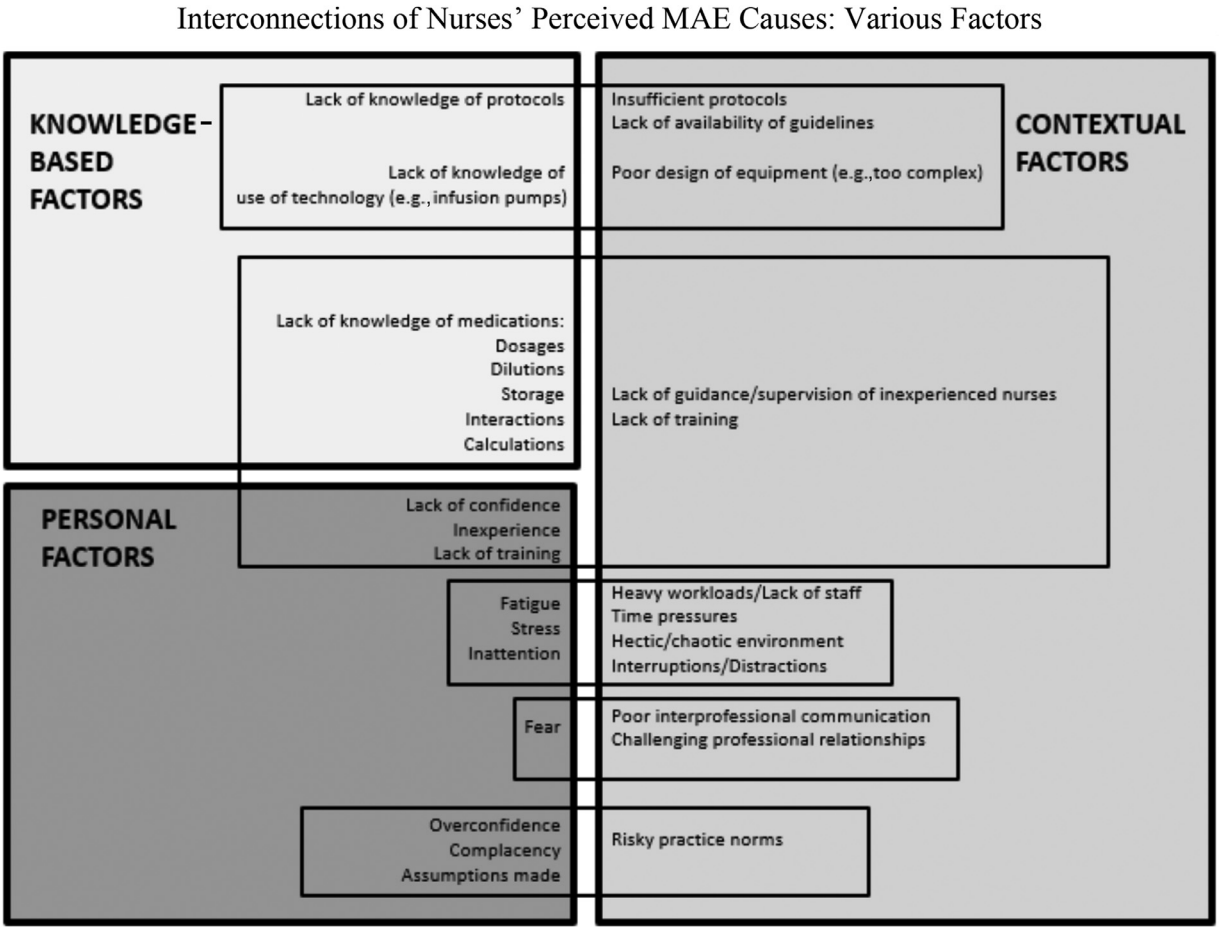


Figure 5: This figure is an illustration of some of the various factors perceived by nurses as contributing to medication administration errors (MAEs). These factors are infrequently isolated to the individual but are instead interconnected with systemwide issues (that is, contextual factors).

of staff creates heavier workloads for nurses; Driscoll et al. found through their systematic review and meta-analysis that higher nurse staffing levels were associated with decreased medication errors and reduced patient mortality.[43]

Interruptions and distractions were the most frequent contextual factors perceived to cause MAEs. Interruptions are known to be prevalent in health care settings and are associated with an increased frequency[44,45] and severity[45] of MAEs. This is congruent with the cognitive science literature that consistently reports higher error rates when switching between tasks.[46,47] Various interventions aimed to reduce interruptions during MA, such as nurses donning "do not disturb vests" or the creation of "no interruption zones," have been implemented in organizations with little success in decreasing interruption or MAE rates.[48] Hayes et al. recommend that nurses learn how to manage, or react to, interruptions in ways that can mitigate errors from occurring.[7] Cognitive science researchers Altmann and Trafton suggest managing an interruption by pausing to mark the step the nurse was in prior to engaging in the source of the interruption.[49]

Throughout the studies reviewed, inexperience, particularly when combined with lack of supervision, was perceived as making conditions particularly vulnerable to MAEs.[15,16] More than half (55%) of 168 recently graduated nurses in one study indicated that they had made a medication error since becoming a registered nurse and attributed their errors to being new, lack of experience, and no longer being on orientation.[17] Several nurses "noted the contrast between being on orientation and functioning on one's own with a full patient load."[17(p. 278)] In other words, lack of supervision, which takes place when on orientation, was indicated as a contributing factor to making errors.

Lack of confidence, a personal factor, in approaching a prescriber can be greatly influenced by contextual factors such as the working relationships among the team members[31] and interprofessional communication. Nurses reported fear of looking incompetent and expectation of a negative response (for example, anger) as reasons they did not seek out clarification on a medication order from a provider. Poor communication in health care settings has been established as a cause of errors.[50] Improvement in staff

Table 2. Recommendations to Address Nurses' Perceived Causes of Medication Administration Errors (MAEs)

Nurses' Perceived MAE Causes	Recommendations*
Lack of knowledge	**Increase education and training specific to medication administration practices:** Simulation-based education, compared to lecture-style education only, has produced significant results in reducing MAE rates by nurses.[52] **Increase awareness of MAEs that occur:** Staff have requested to be made aware of MAEs that occur in their organization, as they believe learning from incidents can be beneficial.[28,32] Development of an educational tool with a clear medication error identification and analysis strategy to be used to increase awareness and improve staff performance is suggested.[32]
Staffing levels/workload	**Address low staffing levels/high workloads:** Higher nurse staffing levels lead to a decrease in errors and lower patient mortality.[43] Tools are available to assess staffing needs.[16] These measures may have positive influences on additional factors reported as causing MAEs such as fatigue and exhaustion.
Interruptions	**Research strategies to manage interruptions:** Interventions aimed to reduce interruptions during the medication administration process have been implemented in health care settings with limited success in decreasing MAE rates.[48] Understanding the origins of interruptions[55] and identifying strategies to manage interruptions[56] are needed.
Challenging professional relationships/poor communication	**Increase efforts toward interprofessional collaboration:** Patient safety outcomes are shown to improve after implementation of Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS®),[53] an interprofessional teamwork and communication training model. Use of TeamSTEPPS is recommended.[50]
Lack of support/supervision	**Evaluate current practices of support for new and inexperienced staff:** Lack of supervision and support have been cited as perceived by nurses to lead to MAEs.[4,16,37]
Physical working conditions	**Examine and correct poor physical working conditions:** Poor lighting, lack of physical space,[14] and inadequate physical environments[30] have been reported by nurses as perceived contributors to MAEs.
Unsafe practice norms	**Assess and address unsafe practice norms:** The importance of following guidelines should be stressed with staff, as well as addressing the conditions that provide the grounds for unsafe practice norms.

* References can be found at the end of this article.

communication is one of The Joint Commission 2020 National Patient Safety Goals.[51] Less is known about the factors that lead to poor communication; however, this review offered some insights, such as nurses intentionally not communicating with a prescriber due to a fear of the prescriber's response.

Although the organizational culture is important when examining causes of MAEs, as Parry et al.[11] asserted in their quantitative review of registered nurse MAE contributing factors, individual accountability of the nurse must not be overlooked. The individual nurse must make every effort to ensure that MA is performed correctly and safely. Negligence and complacency, personal factors that were perceived to lead to MAEs in five studies in this review, are attributed to individual nurse behavior.

Limitations

A limitation of this review was that a single author performed all data extraction and analysis. However, as previously described, systematic methods were used and strict adherence to well-established guidelines were followed during the data extraction and analysis. Furthermore, the three authors had several meetings to review the findings and themes, and disagreements were discussed until a consensus was made. An additional limitation is that only studies published in the English language were included, which may have restricted the discovery of evidence from unpublished studies in different languages.

Implications and Recommendations for Nursing Practice and Education

Numerous factors perceived as causing MAEs were revealed throughout this review. Examining factors (Table 1) and the interconnections among factors (Figures 2–5) can be a starting point for administrators, researchers, policy makers, and educators to focus efforts to decrease MAEs. Clinical leaders can appraise their organizations for factors contributing to MAEs in their settings by surveying their staff, with particular attention to contextual factors. With the understanding that contextual factors are often to blame for errors, WHO launched a global effort in 2017 to reduce medication errors, with a primary aim to address the weaknesses in health systems that lead to medication errors.[2]

A list of recommendations to address nurses' perceived MAE causes are found in Table 2. These recommendations include, but are not limited to, the encouragement of educators to use evidence-based teaching modalities, such as simulation-based learning, for medication safety for nursing

students and nursing staff. Simulation-based education in particular has produced significant results in reducing MAE rates by nurses.[52] Administrators are recommended to perform an assessment of support for new and inexperienced staff, such as evaluating the current orientation program for inexperienced nurses and connecting new nurses with senior nurse mentors. Interprofessional communication and collaboration should also be promoted to decrease MAEs. The use of Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS®), an interprofessional teamwork and communication training model, has shown positive results in improving patient safety,[53] as well as attitudes, motivation and self-efficacy to working within interprofessional teams.[50]

Implications for Future Research

Continued research on interventions aimed to mitigate MAEs is required. This review discussed how single, isolated factors were rarely perceived by nurses to lead to errors. Instead, nurses more often reported multiple interrelated factors that contributed to errors and created the grounds for the occurrence for MAEs. Thus, as many authors in this review recommended, a multifaceted approach to interventions aimed at mitigating MAEs is warranted.[4,13,14,33,35] This recommendation is consistent with a recent review of findings from 16 systematic reviews on interventions designed to reduce MAEs in various health care settings. Lapkin et al. found that multifaceted approaches that involved education, use of risk management strategies, and use of bar code technology had more success in reducing MAEs compared to single approaches aimed to reduce MAEs.[54]

Research is particularly needed in the area of interruptions. Nurses commonly report interruptions as perceived MAE causes, and interruptions of nurses during MA are associated with increased risk for MAEs.[44,45] Recommendations for nurses to use interruption management strategies are found in the literature[7,55,56]; however, evidence-based strategies for use during MA have not been established. Altmann and Trafton's cognitive science-based model, which promotes the use of associative cues when interrupted, is a promising model for use in research of interruptions in health care.[49] When evidence-based strategies are developed and tested, these can be incorporated into multifaceted approaches used to mitigate MAEs.

In addition, further research on causes of MAEs in mental health settings is warranted. Unique to the two studies that took place in mental health settings, patient characteristics were identified as perceived causes of MAEs.[14,16] These characteristics, such as the patient's mental status and linguistic barriers, led to difficulties in correctly identifying the patient when administering medication and thus were perceived to lead to errors.

Within all health care settings, a patient's mental status or linguistic barriers between patients and nurses can inhibit a nurse's ability to collect accurate data, such as for a health history or assessment. For example, assessment of pain or other patient symptoms that cannot be objectively measured rely on communication from the patient. Inaccurate assessment data could lead to an incorrect deliverance or withholding of medication to patients.

CONCLUSION

This review presented numerous factors that nurses perceive as contributing to MAEs. Contextual, or systems, factors were frequently cited as perceived causes of MAEs and often underpinned knowledge-based and personal factors. Interconnections among the factors were highlighted throughout the review.

The findings suggest that multifactorial interventions, with an emphasis on systems changes, aimed at mitigating MAEs are required. Administrators, researchers, policy makers, and educators can use the findings as a starting point to focus efforts on identifying and modifying factors in their individual agencies. Addressing commonly perceived factors of MAEs such as heavy nurse workloads, poor professional relationships and communication among team members, and lack of support and supervision of inexperienced nurses, is necessary. When factors are identified within individual institutions, it is essential to then examine the relationships among factors, along with associated education and training needed, to promote safe patient care at the agency level. Moreover, it is imperative that all health care providers reflect on factors in their own personal practices to promote improved medication safety.

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