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RESEARCH ARTICLE (ORIGINAL)

Interruptions and distractions during the preparation and administration of high-risk medications: A cross-sectional study

Interrupções e distrações durante a preparação e administração de medicamentos de alto risco: Estudo transversal

Distracciones e interrupciones durante la preparación y administración de medicamentos de alto riesgo: Estudio transversal

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Abstract
Background: Interruptions have been reported to contribute to clinical errors and procedural failures.
Objective: To analyze the interruptions experienced by nurses during the preparation and administration of high-risk medications.
Methodology: A cross-sectional study was conducted in an intensive care and inpatient unit. The interruptions experienced by nurses during the medication process were observed through two checklists. The sample was selected by convenience in April-May 2019. Descriptive statistics was used to analyze quantitative data in IBM SPSS Statistics software, version 24.0, while content analysis was used to analyze qualitative data.
Results: In 193 medication processes, there were 137 interruptions. Other members of the healthcare team initiated most interruptions through conversations. These interruptions were mostly negative and occurred during the preparation phase. The multitasking strategy was used to manage them.
Conclusion: Interruptions during the medication process were primarily associated with professional and social communications. The impact of these interruptions varied depending on the phase of the process.

Keywords: hospitalization; intensive care units; medication errors; nursing; patient safety

Resumo
Enquadramento: Estudos indicam que as interrupções contribuem para erros clínicos e falhas em procedimentos.
Objetivo: Analisar as interrupções vivenciadas pelos enfermeiros durante a preparação e administração de medicamentos de alto risco.
Metodologia: Foi realizado um estudo transversal numa unidade de cuidados intensivos e numa unidade de internamento. As interrupções vivenciadas pelos enfermeiros durante o processo de medicação foram observadas com a ajuda de duas *checklists*. A amostra foi selecionada por conveniência em abril e maio de 2019. Os dados quantitativos foram analisados através de estatística descritiva no programa IBM SPSS Statistics, versão 24.0, enquanto os dados qualitativos foram tratados por meio da análise de conteúdo.
Resultados: Observaram-se 137 interrupções em 193 processos de medicação. A maioria das interrupções foi iniciada por outros membros da equipa de cuidados de saúde por meio de conversas. Estas interrupções foram maioritariamente prejudiciais e ocorreram durante a fase de preparação. A estratégia multitarefa foi utilizada para as gerir.
Conclusão: As interrupções ocorridas durante o processo de medicação eram maioritariamente associadas com comunicações profissionais e sociais. A sua relevância diferiu consoante a fase do processo.

Palavras-chave: hospitalização; unidades de terapia intensiva; erros de medicação; enfermagem; segurança do paciente

Resumen
Marco contextual: Se ha reportado la participación de distracciones en errores clínicos y fallos de procedimiento.
Objetivo: Analizar las distracciones del personal de enfermería durante la preparación y administración de fármacos de alto riesgo.
Metodología: Estudio transversal desarrollado en una unidad de cuidados intensivos y una unidad de hospitalización. Se observaron distracciones del personal de enfermería durante el proceso de medicación a través de dos listas de control. La muestra fue seleccionada por conveniencia (abril-mayo 2019). Los datos cuantitativos se analizaron mediante estadística descriptiva (IBM SPSS Statistics, versión 24.0). Los datos cualitativos se analizaron mediante análisis de contenido.
Resultados: Hubo 137 distracciones en 193 procesos de medicación. La mayoría de las distracciones fueron iniciadas por otros miembros del equipo sanitario a través de conversaciones. La mayoría se produjeron en la fase de preparación y fueron negativas y se gestionaron mediante la estrategia multitarea.
Conclusión: Las distracciones durante el proceso de medicación se referían principalmente a las comunicaciones profesionales y sociales. La importancia de esas distracciones variaba en función de la fase del proceso.

Palabras clave: hospitalización; unidades de cuidados intensivos; errores de medicación; enfermería; seguridad del paciente

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Introduction

Interruptions are a harmful result of the work environment and lack of team cohesion and, as such, can severely impact the step-by-step execution of a procedure, especially when handling high-risk medications (HRMs) such as tramadol, norepinephrine, and electrolytes (ISMP-España, 2012; Westbrook et al., 2010). HRMs are drugs that have complex preparation and administration processes, narrow therapeutic windows, and require double-checking of the physician's prescription. HRM preparation is time-consuming and involves drug presentation, dilution, complicated dosage calculations, and infusion pump administration. They also require physiological parameters (weight, age, vital signs) and laboratory parameters (serum levels, renal function) for their indication and monitoring (Cohen, 2007; Elfering et al., 2015; Kane-Gill et al., 2010). Consequently, the preparation and administration of HRMs can be prone to interruptions, which can have negative consequences for patients, healthcare providers (known as second victims), and the community who bears the social and economic burden of these consequences. This study aims to analyze the interruptions experienced by nurses during the preparation and administration of HRMs.

Background

Previous studies have shown that one third of medication errors involved HRMs (such as anticoagulants, electrolytes, vasoactives, and sedoanalgesics), half of which caused moderate to severe harm due to communication errors, procedural failures, lack of education or training, work environment characteristics, and lack of teamwork (Cohen, 2007; Tyynismaa et al., 2017). The errors mentioned above occurred sequentially, starting with the prescription and continuing through the administration phase, which means that multiple health professionals were involved, including physicians, pharmacists, nurses, and nursing assistants, suggesting that the errors could have been prevented and were caused by multiple factors (Tyynismaa et al., 2017).

Interruptions are responsible for more deaths per year than breast cancer, motor accidents, or acquired immune deficiency syndrome (Kohn et al., 1999). Interruptions can harm interpersonal relationships and cause treatment delays, leading to increased morbidity in patients. They are heterogeneous and reiterative and can harm the healthcare process, potentially leading to unsafe practices (Tucker, 2004).

Psychological experiments show that interruptions and demanding scenarios, such as hospitalization and intensive care units, can lead to rapid forgetting of the intentions that motivate an action, resulting in errors (Einstein et al., 2003). Similarly, literature shows that interruptions are associated with delays in healthcare (Rivera-Rodriguez & Karsh, 2012), lower-than-expected performance in terms of time and quality (Capasso et al., 2012), institutional economic burden (Tucker, 2004), and extra activities required to manage the interruption and return to the interrupted task (Donaldson et al., 2014; Westbrook et al., 2010).

There are two complementary approaches to the concept of interruption in nursing: a macrosystemic approach proposed by Theresa Pape (2003) and a microsystemic approach proposed by Juliana Brixey (Brixey et al., 2007). Pape's view places interruption in a multilevel open system that includes healthcare organizations, units, and nurses. Interruption is one of many other elements that surround clinical practice and can interact to facilitate or hinder nursing activities. Dr. Brixey proposes a microsystemic view, which not only provides a model of how interruption occurs but also a taxonomy for future researchers to use.

Research question

What are the interruptions experienced by nurses during the preparation and administration of HRMs?

Methodology

This is a quantitative cross-sectional study conducted in an adult inpatient and intensive care unit in two high complexity healthcare institutions in southwestern Colombia. The hospitals serve 42 towns and approximately 3,789,874 people. The intensive care unit has 19 nurses working in 6-12 hour shifts, with two nurses per shift and a nurse-patient ratio of 1:4-5. On the other hand, the inpatient unit has seven nurses working in 6–-2 hour shifts, with two nurses assigned to day-time shifts during weekdays, one responsible for nursing care and the other for administrative functions. The nurse-patient ratio is 1:11. Medications are reconstituted, diluted, or transferred in a clean room that is solely dedicated to medication preparation. The room is equipped with supplies, personal protective equipment, a handwashing sink, an alcohol-based disinfectant, a waste bin, and a refrigerator. Administration of medications takes pace in patient rooms. The units lack a double-checking system as part of their medication preparation and administration protocol.

This study examined the interruptions that occur during the preparation and administration of HRMs performed by nurses. The sample consisted of 26 nurses working across morning, afternoon, and evening shifts from Monday to Sunday in both care units. Participants were selected based on convenience and the inclusion criteria required that both phases of the medication process were fully observable. The study excluded medication processes performed by nurses in training, nursing assistants, personnel outside the unit, or those related to an emergency. Two researchers collected data between April and May 2019, using the structured observation technique guided by two checklists. The first checklist, "The Medication Administration Distraction Observation Sheet (MADOS)", recorded the *frequency* and *source of interruptions* (Gaitan Gómez et al., 2022). The second checklist, "Interruptions

Characterization Sheet", was created by the authors based on the literature (Bower et al., 2015; Hayes et al., 2015). It collected information on the *duration of interruptions* in seconds using a stopwatch on the HUAWEI Mate 20 lite SNE-LX3 v. 9.1., the reason for the interruption (*content of the interruption*, open response), and the impact of the interruption to the ongoing activity (classified as positive if it provided significant information to patient care or negative if it was disruptive and did not benefit patient care).

The nurse's *management strategy* for coping with interruptions was classified as *immediate* when they stopped the primary activity to find a solution to the interruption, *negotiation* when they discussed or decided to deal with it at a better time, *mediation* when they delegated the secondary activity to another person (interruption), scheduling when they adjusted their list of priorities and assigned a sequence for task execution, and *multitasking* when they performed both tasks at the same time, meaning that they prepared and administered HRMs while avoiding interruptions (Brixey et al., 2007).

Descriptive statistics, including measures of central tendency, frequency, and proportion, were used to analyze all data in IBM SPSS Statistics, version 24.0. For open responses, Bardin's content analysis technique was used to systematically group statements into categories that captured the essence of the message while preserving the original meaning. The purpose of this process was to operationalize the codes in frequencies and proportions. The researchers performed this process manually and individually, and the results were triangulated, which could be audited by the nurses in a meeting (Bardin, 2010).

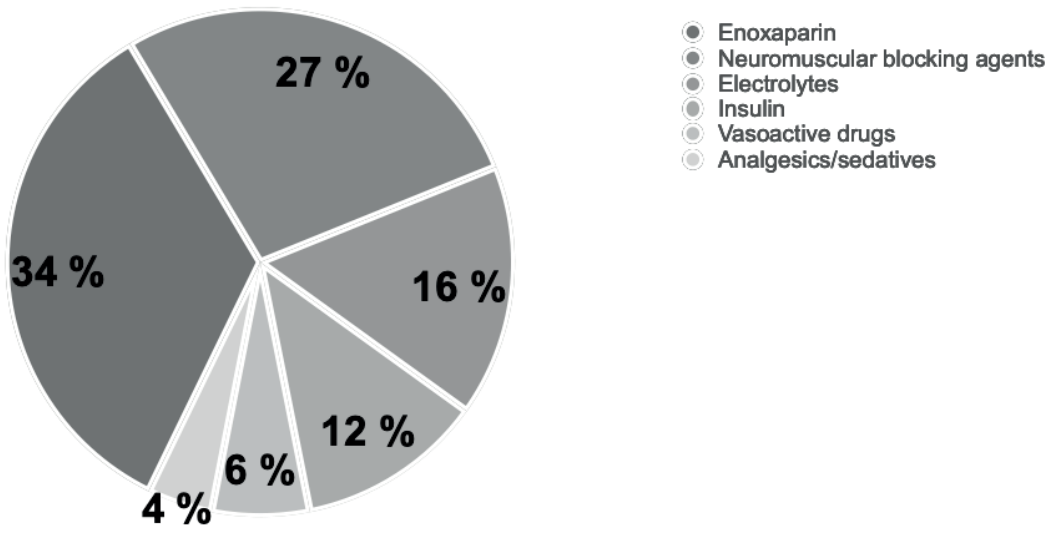
The study was approved by the Research Ethics Committee of the School of Nursing of the National University of Colombia (AVAL 050-18) and the Ethics Committees of the health institutions of southwestern Colombia. Twenty-six nurses agreed to participate in the research by signing a written informed consent, and none of them withdrew their consent. The investigators maintained confidentiality and custody of the information collected by limiting access to the data to the principal investigators only. The data were stored in password-protected files. The nurses received the information through an educational activity, while the institutions were informed through a presentation that highlighted areas for improvement in the future. The study posed minimal risk to the subjects as it did not involve any biological, psychological, or social variables. This document follows the STROBE checklist for cross-sectional studies.

Results

The study observed 193 HRM preparation and administration processes. Seventeen drugs from five therapeutic groups were identified (Figure 1). The drugs were administered during the day (n = 150; 77.7%) and on weekdays (Monday-Friday; n = 164, 85%). At least one interruption occurred in 113 processes, and more than two interruptions occurred during the administration of cisatracurium and morphine.

Figure 1

High-risk medications



Interruptions occurred at a rate of 1.4 per medication process (n = 193 HRM/137 Ds). Tables 1 and 2 present the characteristics of these interruptions. The main sources of interruptions were conversations, medical staff, other members of the institution, and communications (phone calls or text messages) in both phases. The most commonly used management strategy was multitasking.

Table 1

Characteristics of interruptions during the preparation and administration of high-risk medications

Phase	Number of interruptions*	Frequency		Duration of interruption (s**)	Source	Frequency		Duration per source (s**)
		n	%			*n*	%	
Preparation	1	77	84.6	26.4 (*SD* = 10.7) Issues with working materials	Verbal-auditory interference	86	94.5	26.4 (*SD* = 19.8)
	2	7	15.4		5	5.5	73.9 (*SD* = 53.2)	
Administration	1	36	78.3	27 (*SD* = 20.2) Issues with working materials	Verbal-auditory interference	41	89.1	27 (*SD* = 20.2)
	2	2	8.7		5	10.9	49.4 (*SD* = 33.6	
	3	3	13					

Note: n = Frequency of interruptions; % = Percentage; *SD* = Standard deviation; * = Number of interruptions during medication processes. ** = Seconds. Verbal-auditory interference: conversations, calls, medical personnel, other staff members, and noise; Inconvenience with work materials: problems with medication, equipment, and others.

Table 2

Impact and content of interruptions, and management strategy during the preparation and administration of high-risk medications

Phase	Characteristics of interruptions		Frequency	
			n	**%**
Preparation	**Impact**	Positive	33	36.3
		Negative	58	63.7
	Interruption management	Immediate	15	16.5
		Multitasking	76	83.5
	Content	Conversations between nursing staff and other members of the institution on care and non-care-related topics	56	61.5
		Management of administrative processes	12	13.2
		Activities related to medical staff	9	9.9
		Various interruptions (searching for supplies, performing care activities not previously done, or intense surrounding activity)	14	15.4
Administration	**Impact**	Positive	30	65.2
		Negative	16	34.8
	Interruption management	Immediate	11	23.9
		Scheduling	1	2.2
		Multitasking	34	73.9
	Content	Conversations between nursing staff and other members of the institution, family members, and patients about care-related issues	30	65.2
		Various interruptions (searching for supplies, performing care activities not previously done, and management of administrative processes)	4	8.7
		Conversations with colleagues about issues non-work-related topics and intense surrounding activity	8	17.4
		Traffic and noise near the workplace	4	8.7

Nota. *n* = Frequency of interruptions; % = *Percentage.*

Discussion

The study conducted in high complexity departments of reference hospitals in Colombia found that interruptions were frequent during the HRM preparation phase. Weekdays and daytime shifts were the most susceptible to interruptions. Professional and social communication were the main sources of interruptions, with varying impacts depending on the phase of the medication process. However, the most commonly used interruption management strategy was multitasking, where the nurse integrated secondary activities into their primary course of action. Half of the medication processes were interrupted at least once due to communication needs, as reported in surgical and medical units (Thurayya et al., 2022). The frequency of interruption during medication events ranges from 1-3 (Johnson et al., 2017). The duration of interruptions is a challenge due to the lack of reported data in most studies. When reported, it is often based on primary activity (e.g., the entire shift, all medication rounds, or just one medication round), which may not align with this study's timeframe. However, interruptions during the medication process ranged from 1 to 5 minutes. According to Duruk et al. (2016), verbal sources, such as face-to-face conversations and phone calls, were longer than those measured in this study. This suggests that previous research may have overlooked certain attributes that could impact nursing work.

The content of the interruptions reported in the study align with the literature findings for each phase. During the preparation phase, personnel engage in both professional conversations (such as information requests and decision-making) and social conversations (such as family issues and meals) in the medication preparation room. This room is accessible to certain personnel, which allows for more personal conversations. Conversations during the administration phase, however, should focus entirely on patient and family education. This is the ideal opportunity to discuss aspects of care such as skin condition, venous access, elimination patterns, and intravenous drips with the care team (Prates & Silva, 2016).

Regarding the impact, over half of the interruptions experienced by the nurses during the administration phase were positive. These communications were necessary for the activity and should not be considered interruptions, but rather warnings or notifications. It is important to evaluate whether all the sources reported in the literature, including the patient, family, infusion pump alarms, and monitors, or conversations between professionals about care-related topics, should be referred to as interruptions. Instead, these activities should be carried out more effectively and without any coercion in clinical scenarios. The preferred management strategy is *multitasking*, where the nurse efficiently incorporates interruptions into their course of action, without avoiding or refusing them. This may be due to the perception of being in charge of the service or not seeming rude to others (Craker et al., 2017). Johnson et al. (2017) found that the *immediate* strategy, which involves accepting and dealing with the interruption immediately, is not always preferred. Other strategies include *negotiation*, *mediation*, and *scheduling*. Nurses may prioritize interruptions by assessing their importance to the primary activity and selecting the most appropriate strategy. This strategy may help control unexpected situations by reducing the likelihood of errors. However, it is unclear whether the development of such a system and coping strategies is due to anticipation, experience, the example of colleagues, or trial and error. It is also unclear whether this coping mechanism differs between experienced and novice nurses. The impact of each strategy on the phases of the medication process has not been determined, nor what is the most beneficial process.

Numerous measures were implemented in the study institutions to prevent medication errors with this type of medication. These measures included not storing the medication in the service stock, labeling them in bright colors according to the risk they represent, double-checking the physician's prescription by the nurse and the pharmacist, requesting and receiving medications and supplies from a healthcare professional (physician and/or nurse), reviewing medication process protocols during shift deliveries, annual updating of related topics, peer and self-assessment of knowledge and practices, and training sessions. It is important to address incidents and adverse events constructively.

This study had a methodological limitation as observations were conducted face-to-face instead of using technology. The Hawthorne effect was minimized by repeatedly exposing the nursing staff to the observer, immersing them in the scenario over several weeks, exhibiting discreet behavior, using the same uniform, and employing careful verbal and nonverbal expressions that make it easier for the observer to go unnoticed. This practice allowed the personnel to return to their usual behavior. The study used the most comprehensive instruments available in the literature to capture the variables. However, considerate is considered that short and specific instruments could be useful in future studies and would allow flexibility in sampling.

Conclusion

This study found that one out of every two medication processes involved an interruption that diverted attention of the healthcare professional from the HRMs for approximately 27 seconds. The most frequent interruptions were conversations with colleagues, other healthcare team members, and administrative staff. The impact of the interruption was positive during administration and negative during preparation. The most common management strategy selected was multitasking.

This study aims to contribute to the understanding of the concept of interruption by introducing four new attributes: duration, impact, management, and content. These characteristics have received little attention in previous analyses of the concept and empirical indicators.

Most interruptions are conversational, so effective clinical communication is crucial. This involves promoting clear,

complete, and timely dialogue patterns through a process of relearning. Healthcare professionals must take responsibility for controlling disruptive interruptions that may affect their colleagues during critical moments of care, such as invasive procedures. In addition, they must obtain the necessary information to complete the task efficiently and avoid interruptions that do not serve a therapeutic purpose. While social interactions are common in work teams that spend several hours a day over the course of years, trivial conversations should be limited to specific spaces and moments.

Future studies should examine additional attributes that have not yet been explored, such as the setting in which interruptions occurs and the impact of physical changes in the environment to mitigate them, the effectiveness of nurses returning to their primary task and how professionals develop skills to mitigate the disruptive effects of interruptions during their early years of professional practice. Furthermore, it is crucial to investigate the actual effects of interruptions on professional performance and to examine the associated costs to both the institution and the healthcare system. Finally, research on communication mechanism and quality could enable the development of interventions that target the true source of interruptions.

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Writing - review & editing: Gomez, O. L., Bueno-Robles, L. S., Camargo-Figuera, F. A.

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