

Scoping Review

Interruptions during therapy preparation, administration and monitoring while caring for the paediatric population: a scoping review

Citation: Parente E., Cialdi A., Frangioni G., Ciofi D., El Aoufy K. "Interruptions during therapy preparation, administration and monitoring while caring for the paediatric population: a scoping review" (2022) *infermieristica journal* 1(2): 99-111. DOI: 10.36253/if-1931

Received: December 12, 2022

Revised: December 22, 2022

Just accepted online: December 23, 2022

Published: December 27, 2022

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Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Competing Interests: The Author(s) declare(s) no conflict of interest.

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Abstract

Background: Nurses perform many actions during the therapy process. However, the time dedicated to the process of drug therapy is very important for the children's safety; indeed, assessing the factors that can impact on the whole therapy process represent an important objective.

Aim. The primary aim of this scoping review is to investigate the factors associated to the interruptions of the therapeutic process (i.e., preparation, administration and, monitoring) for inpatient paediatric population. The secondary aim is to investigate possible implementation strategies to prevent interruptions and, thus, prevent medical administration error (MAE).

Materials and method: A scoping review was performed, following the PRISMA guidelines using the keywords 'paediatric' AND 'interruption to therapy administration/preparation/monitoring'. The search was performed during April 2022.

Results: Out of 242 records retrieved, 8 full text studies met the inclusion criteria and therefore, included in the review. The included full texts were grouped according to the stage of the therapy process they addressed. The majority of the studies adopted an observational design and highlighted how interruptions can occur due to environmental reasons and people. All the included studies focused on the "negative" consequences of interruptions, although, they reveal that the nurses constitute a resilient profession, because they can implement adaptive strategies in extremely disruptive environments and organizations. However, development of

new strategies to reduce interruptions during the therapy process is highly needed to guarantee the safety of the children. **Conclusion:** we recognize that prioritization is an ongoing challenge, indeed the first step is a cultural change in order to implement new organizational and clinical models where “positive” disruptions are allowed and the “negative” ones are blocked or prevented.

Keywords: Interruptions, Therapy Process, Paediatric, Children.

Background

The therapeutic process consists in a series of related interactions that consecutively alter the nature of the relationship between therapist and patients, in paediatrics children and their parents¹. In fact, the basic data includes the totality of interactions from the first hello to the final good-bye; thus, we cannot consider only the single act of administration as the whole process. Instead, the therapeutic process as a totality can be broken down in small parts in order to maintain better technical control over the process, and that's the most challenging part for clinicians and health professionals involved.

Nurses are the health professionals who play a pivotal role in the therapeutic process. The time dedicated to the treatment process is very important for the children's safety; indeed, evaluating the factors that can impact positively or negatively on the process represents an important objective². Additionally, the paediatric context is characterized by its complexity and the presence of various actors, given the presence of the parents. Also, medication administration to infants and children requires complex calculations, individualized dosing and the use of off-label medications which has limited prescribing information available³.

The preparation and administration phase are composed by very intimate actions that require a high level of attention; however, unfortunately, they are usually subjected to several interruptions. By interruption, we refer to an event that breaks the continuity of a primary task and causes a switch of the attention from the primary task, as the disrupting new event requires an immediate response; however, while the healthcare professional deal with this event usually continues the preparation of the primary task^{3,4}.

Generally, nurses operate in an unpredictable healthcare environment that is also characterized by involvement of significant cognitive load. Indeed, being interrupted and able to be multitask imposes heavy cognitive loads on individuals, with

the result of impairing the attention and leading to errors⁵. Interruptions and multitasking are considered a source of concern that negatively affect the memory of the individual⁶. Healthcare professionals have to memorize several elements at the same time; however, when an interruption occurs there might be an important loss of information previously stored⁷. In the literature, Westbrook et al., (2010) reported a significant dose-response relationship between interruptions, and procedural failures and clinical errors in medication administration within the hospital settings, with an increase of 12.1% in procedural failures and an increase of 12.7% in clinical errors for drug administration. Their results showed that the more interruptions the nurses received, the greater the number of errors. Furthermore, the severity of errors worsened when the numbers of interruptions increased within a single drug administration process. In particular, the risk of a patient experiencing a major clinical error was doubled in case of four or more interruptions⁸.

In 2000, the report “*To err is human*” of the Institute of Medicine already identified interruptions as a likely contributing factor to medical errors⁹. Thus, reducing interruptions in therapeutic process means reducing both the frequency and severity of errors.

However, medication errors are frequent in the health care environment¹⁰; for instance, an error is reported every five medication dosages¹¹. In addition, the literature highlights that infants and children may have a three times higher risk of medication errors than the adults^{12,13}. Accordingly, as reported in the study of McPhillips et al., (2015)¹⁴ the authors noticed that the proportion of errors involving children under four years was higher than expected, compared to older children.

Interruptions can cause therapy errors resulting from near missing to a real damage, with potential long-term negative effects on the lives of the patient, their relatives and healthcare professionals, also leading to high financial burdens on the healthcare

system¹⁵.

Nurses, compared to the other healthcare professionals, are more subject to interruptions during the preparation and monitoring of the therapy¹⁶. Additionally, an integrative review of the literature¹⁷ investigating interruptions in paediatric nurses' work and the systems issues related to interruptions in nursing work environments. The literature is generally focused on interruptions that are strictly linked to therapy administration, and medical error administration (MAE). In the study of McGillis et al., (2009) information on sources, types, and causes of interruptions are provided and, interruptions resulted both very common in clinical practice and a main cause of the therapy errors; indeed, during one of the phases of therapy process, interruptions have negative effects on the performance and can affect the quality of the decision-making process, generating frustration, stress and job dissatisfaction¹⁸.

Despite some interruptions are unavoidable during the care process and provide healthcare professionals with the necessary information (e.g., monitor alarms that report abnormal vital signs, or a parent who raises doubts about the child's therapy), it is worth to underline that interruptions of a complex process, such as the therapy, can significantly decrease attention, memory and perception¹⁹.

Most studies focus on errors in the phase of therapy administration; it is interesting to analyse how the interruptions contribute to therapy errors, understand if there is a classification and what are the main containment strategies implemented. Thus, the primary aim of the present scoping review is to search for all the factors associated to interruptions of the therapeutic process (i.e., preparation, administration and, monitoring) for inpatient paediatric population. The secondary aim is to investigate possible implementation strategies to prevent interruptions and, thus, MAE.

The team involved in this scoping review was composed by children's nurses, an ergonomist, and a research nurse, who discussed the relevance of the research question and agreed on the research strategy and the inclusion criteria. Medline (through Pubmed) and Google Scholar databases were searched. A scoping review was performed following the PRISMA Extension for Scoping Review checklist (PRISMA-ScR)²⁰. The research question was formulated according to the PEO (Population, Exposition and Outcomes) methodology as reported below:

P: paediatric population

E: interruptions during preparation, administration and, monitoring of therapy

O: any kind of outcomes

Keywords used were 'paediatric' AND 'interruption to therapy administration/preparation/monitoring'. The search was performed between April 1, 2022, and April 30, 2022, (EP, KEA, AC). Keywords were the following: 'pediatr*' AND 'patients' safety' AND ('interruptions to therapy administration' OR 'interruptions to therapy preparation' OR 'interruptions to therapy process'), resulting in 242 records, that has been screened for titles and abstracts according to inclusion and exclusion criteria.

Inclusion criteria were indexed articles, written in English and Italian language, with a clear exposition of the objective concerning interruptions in clinical practice, in full text, and published not earlier than 2010. This timeframe was adopted because it was starting from 2010 that the problem of interruptions became increasingly relevant and studied internationally. The exclusion criteria were articles that faced business interruptions developed by healthcare professionals other than nurses, and book chapters or letters to readers.

First, the title of the article was read followed by a careful reading of the abstracts to verify whether the inclusion criteria had been met. Titles and abstracts of retrieved papers were screened for inclusion criteria by two independent reviewers (EP and AC). Full texts were then downloaded and screened for inclusion and exclusion criteria. A data-charting form was jointly developed by two reviewers to determine which variables to extract. Two reviewers independently completed the form for data extraction and discussed the results. Data extracted was type of patients and setting, study design, results, and outcomes considered (see Table 1).

Materials and Methods

	Authors (year) country	Study title	Patients and setting	Study design	Results	Outcome
1	McGillis Hall (2010) Canada	Interruptions and pediatric patient safety.	Nurses during the shift while performing routine tasks. Four units in a tertiary-care pediatric academic-affiliated teaching hospital participated in this study.	Mixed method (observative and focus groups)	A total of 5,325 interruptions were observed in this study; of these, 1430 (26.9%) took place on the surgical unit, 1373 (25.8%) on the complex medical and surgical unit in critical care and 1206 (22.6%) on the medical unit.	Most interruptions to nursing practice that were observed in this study could have negative consequences (88.9%); almost two thirds of the interruptions resulted in a delay of the original work that the nurse was engaged in when interrupted, whereas just over one quarter of the interruptions resulted in a loss of concentration or focus from the original work.
2	Lacey Colligan and Ellen J Bass (2012) USA	Interruption handling strategies during paediatric medication administration.	Nurses of the Division of Neonatology who followed case studies on discontinuation strategies.	Mixed method: interviews, simulation, observation	Four case studies of medication administration highlight four interruption handling strategies (engaging, multi-tasking, mediating, blocking) Nurses prioritize task execution based on both risk and workflow efficiency assessments. Specific interruption handling depends on both task and experience related factors.	Paediatric nurses have developed sophisticated strategies to manage interruptions and maintain patient safety and work efficiency during medication administration. To support a more resilient healthcare system, interruption management strategies should be supported through process, task support tools and education.
3	Junwen Zhao et al (2019) China	Interruptions experienced by nurses during pediatric medication administration in China: an observational study.	Convenience sample of pediatric registered nurses working in the 2 reference hospitals (general tertiary hospitals classified as three-A level)	cross-sectional observational study.	The frequency of interruptions in pediatric settings during medication administration is high, with 241 interruptions out of a total of 255 observations. The most common sources/causal factors of interruptions during medication administration included the environment, caregivers, physicians, other staff nurses, and communication issues.	Study findings indicate the importance of creating an interruption-free environment for safe medication administration to improve the quality of patient care. This study found that interruptions during medication administration lead to medical errors.
4	Fenella Gill, et al. (2011) Australia	An exploration of pediatric nurses' compliance with a medication checking and administration protocol	The study was conducted in an Australian metropolitan paediatric tertiary hospital: for the first part was used a questionnaire, and for the second part a focus group, that consisted of in-depth interviews group setting.	Mixed method study (descriptive observational study + focus group)	Both from the interviews and from the focus group it emerges that the interruptions affect the application of the protocol of the correct management of the therapy.	Actions are needed to minimize both prescribing and administration errors.

5	Dadlez NM et al (2017) USA	Ordering Interruptions in a Tertiary Care Center: A Prospective Observational Study.	The study was conducted at an urban tertiary care academic children's hospital on 3 non-intensive care inpatient units. All 3 units are medical-surgical floors; Inpatient orders for all patients are primarily placed by pediatric interns, residents and physician assistants.	prospective observational study	Sixty-nine structured observations were conducted with a total of 414 orders included. The interruption rate was 65 interruptions per 100 orders during rounds, 55 per 100 orders in the afternoons and 56 per 100 orders in the evenings. The majority of interruptions were in-person (n =144, 61%). Interruptions from overhead announcements occurred most often in the mornings, and phone interruptions occurred most often in the evenings (P= .002). Nurses initiated interruptions most frequently. Attending physicians and fellows were more likely to interrupt during rounds, and coresidents were more likely to interrupt in the evenings (P=.002).	The majority of interruptions were in person or by phone and overall the individuals initiating the interruption most commonly were nurses. The vast majority of these interruptions were non-urgent. Interventions to decrease interruptions during medication administration have reduced the number of interruptions by 43% to 75%. Interventions have included marked no-interruption zones in medication preparation areas, having nurses wear a visible symbol to indicate the process of medication administration time, designation of specific protected medication rounding time, and scripting for nurses to defer interruptions.
6	Lépée C. et al. (2012) France	The use of a consultant-led ward round checklist to improve paediatric prescribing: an interrupted time series study.	The study was conducted on two paediatric wards, in London. Care was provided by 28 nurses, six medical consultants and 18 doctors in training posts (ranging from 4 months to over 10 years' experience in paediatrics). Consultant-led ward rounds were conducted every day clinically appropriate and clearly written and to perform medication reconciliation. The pharmacist did not routinely attend consultant ward rounds. This study was a service development project and NHS ethics approval was not required.	interrupted times series design with a concurrent control measurement.	In this study data were collected on two types of error: technical prescription writing errors ("technical errors") and prescribing errors involving clinical decision making ("clinical errors"). The primary outcome measure was the rate of technical errors. After adjusting for trends in the quality of the medical notes, the average baseline technical error rate was 6.9 % with a significant increase of +0.2 % per half-week (p00.002). After introduction of Check and Correct, there was a significant drop of -5.0 % (-37.7 % relative decrease; p<0.0001) in the technical error rate, with the error rate level remaining stable during the remaining post-intervention period. There was no significant auto-correlation, and the final model accounted for 60.4 % of total variance.	The adoption of a Check and Correct checklist for local paediatric use resulted in an improvement in technical errors in prescription writing. There was no change in the prevalence of clinical errors, as might be expected, since the checklist focuses on technical aspects of prescription writing. The control data also showed an improvement, but the positive impact of Check and Correct on technical errors remained after accounting for this. A Check and Correct prescribing checklist, adapted for local paediatric use, led to an improvement in the quality of prescription writing.

7	Stratton Karen M. et al. USA 2004	Reporting of Medication Errors by Pediatric Nurses	Staff nurses of 300 units in 50 hospitals currently in progress.	Cross-sectional study	<p>Usable responses were received from 284 RNs (227 adult nurses and 57 pediatric nurses) from 33 acute care units (27 adult and 6 pediatric) in 11 hospitals in 2 states (40% response rate). Three hospitals were from a Midwestern rural consortium working for more than 10 years on quality management processes, the remaining eight hospitals were from urban areas in the Rocky Mountain region of the United States.</p> <p>Pediatric nurses estimated that 67% of all medication errors on their patient care units are reported. This finding is considerably higher than the 56% reported for all medication errors by adult nurses ($p < .05$). This report focuses on the responses from nurses on pediatric units. Analysis by type of unit was not performed because there were too few units of any particular specialty, with responses from adult units are used to enhance interpretation.</p>	Findings from this study suggest that medication administration error occurrences are underreported. The overall average estimate of medication error reporting on pediatric units was 67%; Results of this study suggest that nurses working on pediatric units are more likely to report medication administration errors than nurses on adult units are.
8	Bonafide C. et al (2019) USA	Association Between Mobile Telephone Interruptions and Medication Administration Errors in a Pediatric Intensive Care Unit	Participants included 257 nurses and the 3308 patients to whom they administered medications.	retrospective cohort study	The overall rate of errors during 238540 medication administration attempts was 3.1% (95% CI, 3.0%-3.3%) when nurses were uninterrupted by incoming telephone calls and 3.7% (95% CI, 3.4%-4.0%) when they were interrupted by such calls 1.21; 95% CI, 1.03-1.42; $P = .02$). Incoming text messages were not associated with error (OR, 0.97; 95% CI, 0.92-1.02; $P = .22$).	This study's findings suggest that incoming telephone call interruptions may be temporally associated with medication administration errors among PICU nurses. Risk of error varied by shift, experience, nurse to patient ratio, and level of patient care required.

Results

Out of the 8 items selected, four were from the USA, one from Canada, one from France, one from Australia, and one from China. In the following section we grouped the studies by the phases of the therapy process they dealt with, in order to analyse the issues linked to each phase. An overview of the studies divided on the basis of the therapy phases process is reported in Table 2.

Studies of McGillis (2010) and Colligan (2012) are focused on factors influencing the interruption management strategy choice^{18,21}. The first one aimed to investigate the context of interruptions in nursing work through work sampling and focus groups with nurses in paediatric, acute care units in a teaching hospital in Toronto, Canada. An exploratory research design was used which involved observation of people in their natural working environment. Four units of a university children's hospital participated in this study. Overall, 5,325 interruptions were observed in the nursing work environment during the work observation study period. The observed interruptions were differentiated by source, cause, and type. The sources of interruptions to nursing work included the environment, other staff nurses, patients, family members, the individual nurse herself/himself, physicians, other health care providers, support staff, and others. Factors within the work environment itself accounted for a third of the interruptions, overall. Most interruptions to nursing practice that were observed in this study could have negative consequences (88.9%), whereas few could lead to a positive outcome (11.0%).

The results of this scoping review highlight the complexity of nursing work environments in paediatric settings and how this can have a direct influence on interruptions of nursing work and related outcomes in terms of patient safety. In general, the work environment and other nurses are the predominant sources of interruptions. Examining the results of the study together it is evident that these environmental and interruptions by fellow nurses take the form of intrusions and distractions, at a time when the nurse is engaged in assessments, procedures or documentation of patient care. From the point of view of patient safety, the interruptions are often negative, with delays and loss of concentration or attention.

While the study conducted by Colligan et al., (2012)²¹ used semi-structured interviews in paediatric settings to identify the types of interruptions and understand the strategies for

managing interruptions. This article introduces a taxonomy of interruptions and provides illustrative examples based on empirical observations and interviews. The complexity of interruptions and the ability of the nurses to handle them are highlighted. The question is asked how it is possible to create a system in which 'positive' interruptions are allowed and 'negative' interruptions are blocked. The first change required is cultural while recognising that prioritising tasks is a constant challenge. Lepee's study focused on the prescription phase²².

A Check and Correct prescribing checklist, adapted for local paediatric use, led to an improvement in the quality of prescription writing. In this study, data were collected on two types of errors: technical prescribing errors ('technical errors') and prescribing errors involving clinical decision-making ('clinical errors'). The primary outcome measure was the rate of technical errors. After adjustment for trends in the quality of medical notes, the average technical error rate at baseline was 6.9% with a significant increase of +0.2% per half week. After the introduction of Check and Correct, there was a significant decrease of 5.0% in the technical error rate, and the level of errors remained stable during the remaining post-intervention period.

Other authors are focused on the phase of therapy administration^{23,24}. The study design is cross-sectional observation. Forty-three nurses were observed for more than 180 shifts of therapy administration. An evaluation form previously validated by the authors themselves was used, which includes information on frequency, sources, and outcomes of interruptions. The frequency of interruptions in paediatric settings during medication administration is high. According to the observational data, this study found that nurses working in general paediatric units reported a higher frequency of interruption than nurses in neonatal intensive care units. This could possibly be due to the fact that a general paediatric unit has patients with age ranging from 0 to 18, resulting in the large variety of medications and medication dosages²⁵. Therefore, relevant medication management strategies are required to develop and ensure a decrease in the frequency of interruptions in general paediatric units. The most common sources/causal factors of interruptions during medication administration included the environment, caregivers, physicians, other staff nurses, and communication issues. Study findings were consistent with previous research, with a third of interruptions experienced

by nurses attributing to the work environment¹⁸. In their retrospective cohort study, Bonafide et al.²⁴ set out to investigate whether mobile phone call interruptions and incoming text messages are associated with subsequent medication errors among nurses in paediatric intensive care units (PICUs). In this cohort study it was shown that incoming calls on nurses' institutional mobile telephones occurring in the 10 minutes before medication administration were significantly associated with increased risk of error. The risk was higher during night shifts and among nurses with fewer than 6 months' experience, and it also varied by nurse-to-patient ratio and level of patient care required. This study's findings suggest that, although communication-related interruptions cannot be eliminated, interventions to reduce the frequency and adverse consequences of interruptions should include consideration of time of day, nurse experience, nurse to patient ratio, and level of patient care required.

This study of Gill et al. (2011)²⁶ was developed to explore nurses' self-reported compliance with the hospital protocol for the checking and administration of medications. First, a questionnaire was designed to collect data from nurses on their drug administration practices and to identify issues related to compliance with existing hospital protocol for the on their drug administration practices. The results of part one identified reported non-compliance with the medication administration protocol. The findings did not, however, account for why noncompliance occurred. In the second part, focus groups were organised to explore the following open questions. This study identified discrepancies between the medication administration protocol and nursing practice. Unclear aspects of the protocol, inadequate role modelling, and inappropriate perception of risk contributed to noncompliance. The concerning results beg the question of compliance with medication administration protocols in other settings. To effectively reduce medication errors,

it is imperative that we understand what leads to those errors. Additional research across settings is necessary to achieve that aim.

In the prospective observational study conducted by Dadlez et al.²⁷ 1-hour-long structured observations on morning rounds and afternoons and evenings in the resident workroom. The primary outcome was the number of interruptions per 100 orders placed by residents and physician assistants. We assessed the role of ordering provider, number, type and urgency of interruptions and person initiating interruption. The interruption rate was 65 interruptions per 100 orders during rounds, 55 per 100 orders in the afternoons and 56 per 100 orders in the evenings. The majority of interruptions were in person. Efforts should be made to decrease interruptions during the ordering process and track their effects on medication errors.

In the descriptive study of Stratton et al.,²⁸ surveyed a convenience sample of paediatric and adult hospital nurses regarding their perceptions of the proportion of medication errors reported on their units, why medication errors occur, and why medication errors are not always reported. In this study, which focuses on paediatric data, paediatric nurses indicated that a higher proportion of errors were reported (67%) than adult nurses indicated (56%). The medication error rates per 1,000 patient-days computed from actual occurrence reports were also higher on paediatric (14.80) as compared with adult units (5.66). The results of this study indicate the need to improve the accuracy of medication error reporting by nurses and to provide a hospital environment conducive to preventing medication errors from occurring. Reasons that medication errors occur included both system factors such as staffing and medication administration procedures as well as patient needs and condition. The most important step in reducing medication errors appears to be in knowing the accurate rate of occurrence.

Interruption regarding therapy preparation		
Authors (year)	Who?	What?
Lépée C. et al. (2012) France	Prescribing physicians	Implementing a checklist to an improvement in the quality of prescription writing
Interruption regarding therapy preparation		
Authors (year)	Who?	What?
McGillis Hall (2010) Canada	Nurse, patient, family member, self, physician, other health care provider, support staff	Environment
Interruption regarding therapy administration		
Authors (year)	Who?	What?
Lacey Colligan and Ellen J Bass (2012) USA	Paediatric nurse	Handling strategies during paediatric medication administration
Junwen Zhao et al (2019) China	Caregivers, physicians, other nursing staff	Working environment, communication issues
Fenella Gill, et al. (2011) Australia	Paediatric nurse	Discrepancies between the medication administration protocol and nursing practice.
Dadlez NM et al (2017) USA	Nurse, physician, physician assistant	Interventions to decrease interruptions during medication administration
Stratton Karen M. et al. USA 2004	Paediatric nurse, nurse	Reporting of medication administration errors.
Bonafide C. et al (2019) USA	Nurse	Association between mobile telephone interruptions and medication administration errors
Interruption regarding therapy monitoring		
Authors (year)	Who?	What?
N/A	N/A	N/A

Discussion

As specified in the introduction, the primary aim of the present scoping review is to search for all the factors associated with the interruptions of the therapeutic process (i.e., preparation, administration and, monitoring) for inpatient paediatric population. While the secondary aim is to investigate eventual implementation strategy to prevent interruptions and, thus, MAE. Eight studies were included because they dealt with at least one of the phases of the therapeutic process. Results were classified based on the three different phases of therapeutic process: preparation, administration, and monitoring, since there isn't a similar partition in literature; those factors were further divided according to whether they were in person or made by environment. Interruptions concerning prescription drugs are dealt with by L  p  e C et al.²² In this study, we particularly appreciated how the introduction of a check list significantly increases the quality of the prescription moment.

Interruptions regarding therapy preparation were reported by five authors, three from the USA, one from Canada and another one from Australia. In the 2010 mixed method study from Canada the various factors causing interruptions were in person and environment, resulting in a delay of the original work that the nurse was engaged in when interrupted and a loss of concentration. In the 2012, mixed method study from the USA, Colligan et al.²¹ reported that the principal causes of interruptions in their study were the patient's mother, colleague, ward clerk, without citing factors associated with the environment. They found that paediatric nurses have developed sophisticated strategies to manage interruptions and maintain patient safety and work efficiency during medication administration. Gill et al. (Australia, 2011)²⁶ don't specify the type of factors causing interruptions, asserting that they affect the application of the protocol of the correct management of the therapy. Dadlez et al. (USA, 2017)²⁷ found that the majority of interruptions were in person or by phone and overall, the individuals initiating the interruption most commonly were nurses, in addition to the fact that the vast majority of these interruptions were non-urgent. They developed various interventions, including marked no-interruption zones in medication preparation areas, having nurses wear a visible symbol to indicate the process of medication administration time, designation of specific protected medication rounding time, and scripting for nurses to defer interruptions. All those interventions allowed them to reduce the number

of interruptions by 43% to 75%.

The part of the administration of the therapy is more studied than that of the prescription and preparation. This turns out to be the last stage in which an error can be intercepted. At this stage the nurse is certainly more exposed to interruptions: doctors, nurses, patients. To minimize interruptions, actions have been introduced such as tabard, user education, continuous staff training. These actions have had a significant impact described on areas such as that of the adult.

For the paediatric field we do not have any article that described how the implementation of these tools has contributed to the reduction of interruptions and consequently to therapy errors. The studies analysed on the part of the administration in the paediatric field are for the most part observational. The sample studied is represented by the nurses who work in the settings involved. Objectives of studies such as that of Zhao et al.²³ are describe the frequency, the source of the interruptions during the administration of therapy. No validated measurement instruments were used but only instruments created based on the context analysed. Only in the study of Zhao et al.²³ a previously validated tool was used for a previous study conducted by the authors in 2016²⁹.

Nurses' response to outages is resilient as suggested by the article by Colligan et al.²¹ It shows a first attempt to classify the interruptions and through four exemplary cases it shows how the response of nurses is a priority to the requests. Prioritisation of tasks depends on assessment of clinical and situational workload factors. All tasks are not created equal; some interruptions present a high priority task that must be addressed immediately and other interruptions present tasks that can wait. Paediatric nurses indicate that task-specific factors and personal experience affect their choices of interruption handling.

The process of administering therapy for close and extremely complex actions can lead to the occurrence of errors while you are interrupted especially by phone. The results of the study conducted by Bonafide et al.²⁴ suggest that phone call interruptions were associated with probabilities significantly increased to make mistakes especially in the presence of nurses with minimal periods of experience in the clinical field. Surprisingly, for interruptions regarding therapy monitoring no data were extracted, as no study referred to this specific phase.

Finally, from the articles analysed, however, we can deduce that the work of health professionals

to reduce the rate of interruptions must focus on 3 levels: (I) behavioural level: first of all, we must change our habits. Wrong behaviours are the greatest cause of interruptions during the activities of health workers (pharmacological process, handover patient identification, electronic file management, food distribution, etc.); (II) organisational level: we need to rethink our activities and procedures. We work in complex systems where activities and processes are hardly ever thought through with respect to human factors. Interruptions find their breeding ground within unorganised processes with delays and confusion in the performance and conduct of tasks; and (III) structural level: this is the most complex level in terms of time and resources where only knowing the improvement objectives is possible to plan future implementations. Poor design of hospital environments can generate latent criticalities that are difficult to eliminate once implemented. Good room design (natural and natural and artificial lighting, technologies, temperature and humidity temperature and humidity, air quality and space acoustics) can prevent interruptions, improving the well-being of operators and patients.

Conclusions

The therapeutic process is a very complex and articulated process, thus, educational interventions are needed to prevent errors and complications due to any interruption of the process. Clearly, as already stated by systematic reviews and meta-analysis there is no 'one-size-fits-all' solution in reducing medication administration errors, however the scoping review was focused on the interruptions to the process rather than the consequent errors. Indeed, identifying the causes of the interruptions and classifying them into evitable or not could be the starting point. Then, assessing the potential error linked to any type of interruption may allow a better management of the therapy process when taking care of children. In fact, in paediatric settings, efforts should be made to reduce interruptions to the minimum permissible during the various critical activities; in order not to create isolated areas such as aircraft cockpits, but structured and organised systems that respond to interruptions²⁷. Moreover, there is a lack of validated tools for detecting interruptions in paediatric settings, thus further studies and researches are needed.

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