Original Article

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☑ Implementation science in nursing, health, and education

Implementation of bedside medication preparation in intensive care: post-improvement cycle

Implementação do preparo de medicação à beira-leito em terapia intensiva: auditorias clínicas pós-ciclo de melhoria

Implementación de la preparación de medicamentos en la cabecera del paciente en cuidados intensivos: auditorías clínicas posteriores al ciclo de mejora

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ABSTRACT

Objective: To assess the implementation of the bedside medication preparation process in an Intensive Care Unit, following a quality improvement cycle.

Method: A quasi-experimental study with non-paired samples, pre- and post-implementation, conducted in an Intensive Care Unit of a public hospital in southern Brazil, from September 2022 to April 2023, following the guidelines of the Standards for Quality Improvement Reporting Excellence 2.0. Adherence to bedside medication preparation, interruptions during preparation, adequate storage, identification and validity of multidose medications, and recording of storage refrigerator temperature were evaluated. Shapiro-Wilk and Mann-Whitney U tests were used for data analysis, and Carter's Positivity Index was used to determine compliance with observed practices.

Results: Forty-five audits were conducted pre-intervention and 122 audits three months after the implementation of the improvement cycle. All variables showed significant improvements. Overall compliance increased from 46% to 80% in the pre- and post-implementation periods, respectively, indicating a transition from "undesirable" to "safe" care stratum.

Conclusion: The study revealed a positive relationship between the implementation of a quality improvement cycle focused on medication preparation and improvements in patient safety.

Descriptors: Patient safety. Medication errors. Intensive care units.

RESUMO

Objetivo: Avaliar a implementação do processo de preparo de medicamentos à beira-leito em um Centro de Terapia Intensiva, após um ciclo de melhoria.

Método: Estudo quase-experimental com amostras não pareadas, pré e pós-implementação, realizado em um Centro de Terapia Intensiva de um hospital público no sul do Brasil, de setembro de 2022 a abril de 2023, seguindo as diretrizes do Standards for Quality Improvement Reporting Excellence 2.0. Avaliou-se a adesão à preparação do medicamento à beira-leito, interrupções durante o preparo, acondicionamento adequado, identificação e validade de edicamentos multidose, e registro da temperatura da geladeira de armazenamento. Para análise dos dados utilizaram-se os testes de Shapiro-Wilk e Teste U de Mann-Whitney, e para determinar a conformidade das práticas observadas, utilizou-se o Índice de Positividade de Carter.

Resultados: Realizaram-se 45 auditorias pré intervenção e 122 três meses após a implementação do ciclo de melhoria. Todas as variáveis apresentaram melhorias significativas. A conformidade geral aumentou de 46% para 80% nos períodos pré e pós-implementação, respectivamente, indicando a transição do estrato de assistência "indesejada" para "segura".

Conclusão: O estudo revelou uma relação positiva entre a implementação de um ciclo de melhoria da qualidade, centrado no preparo de medicamentos, e melhorias na segurança do paciente.

Descritores: Segurança do paciente. Erros de medicação. Unidades de terapia intensiva.

RESUMEN

Objetivo: Evaluar la implementación del proceso de preparación de medicamentos en la cabecera del paciente en una Unidad de Cuidados Intensivos, tras un ciclo de mejora de la calidad.

Método: Un estudio cuasiexperimental con muestras no pareadas, antes y después de la implementación, llevado a cabo en una Unidad de Cuidados Intensivos de un hospital público en el sur de Brasil, desde septiembre de 2022 hasta abril de 2023, siguiendo las pautas del Estándar para la Excelencia en la Presentación de Informes de Mejora de la Calidad 2.0. Se evaluó la adherencia a la preparación de medicamentos en la cabecera del paciente, las interrupciones durante la preparación, el almacenamiento adecuado, la identificación y la validez de medicamentos multidosis, y se registró la temperatura del refrigerador de almacenamiento. Se utilizaron las pruebas de Shapiro-Wilk y U de Mann-Whitney para el análisis de datos, y el Índice de Positividad de Carter se utilizó para determinar la conformidad con las prácticas observadas.

Resultados: Se llevaron a cabo 45 auditorías antes de la intervención y 122 tres meses después de la implementación del ciclo de mejora. Todas las variables mostraron mejoras significativas. La conformidad general aumentó del 46% al 80% en los períodos antes y después de la implementación, respectivamente, lo que indica una transición de un estrato de atención "indeseable" a "seguro".

Conclusión: El estudio reveló una relación positiva entre la implementación de un ciclo de mejora de la calidad centrado en la preparación de medicamentos y las mejoras en la seguridad del paciente.

Descriptores: Seguridad del paciente. Errores de medicación. Unidades de cuidados intensivos.

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INTRODUCTION

Medication errors and unsafe practices in medication-related processes are the main safety incidents with avoidable harm reported in global healthcare systems. In order to reduce these damages, the World Health Organization (WHO) launched, in 2017, the third Global Patient Safety Challenge with the theme "Medication Without Harm", which sought to reduce these failures by 50% over the subsequent five year and remains an issue to be addressed[1].

In Brazil, the National Patient Safety Program (PNSP) was implemented through Ordinance 529/2013, in order to promote safe practices and contribute to a better quality of care. One of its goals was to reduce the risk of unnecessary harm associated with health care to an acceptable minimum[2]. One of the goals established by the PNSP focused on the occurrence of events in the drug therapy process. Thus, the Safety Protocol on medication prescription, use and administration[3] was published, which aimed to promote safe practices in the use of medications in healthcare establishments. This theme was one of the points of care of the Global Action Plan (GAP), launched in 2021 by the WHO.

The GAP redefined the concept of patient safety, from a more comprehensive perspective towards a framework of organized activities that creates cultures, processes, procedures, behaviors, technologies and environments in healthcare, which consistently and sustainably reduces risks, reduces the occurrence of preventable harm, makes errors less likely and decreases the impact of harm when it occurs, and is aimed to eliminate preventable harm in healthcare systems by 2030[4].

Therefore, concern for patient safety in processes involving medication has become a priority in the health sector in recent years and it is necessary to advance the issues that permeate this topic.

The process of preparing and administering medications is an activity inherent to the care practice of the nursing team in Intensive Care Units (ICU). Furthermore, it is a complex and key procedure in the organization of health care for patients, and errors can occur at any stage of drug therapy, causing harm to the patients. Also unstable and critically ill patients requiring broad, dynamic and complex pharmacology, as well as continuous monitoring are admitted to ICUs. Hence, these units are potentially more vulnerable to errors and more serious consequences[5,6].

Adverse events (AE), described as "incidents that result in harm to the patient", according to the World Health Organization's International Patient Safety Classification, deserve greater attention and careful analysis, given the severity and instability of hospitalized patients in intensive care, which make them more susceptible to unfavorable outcomes. These unintended complications can result in prolonged hospital stay and, consequently, additional costs for the health institution, temporary or permanent harm, increased risk of infections and death[7,8].

Medication-Related Errors (MRE), defined by the National Coordinating Council for Medication Error Reporting and Prevention (NCC-MERP) as preventable events that may or may not cause harm to the patient, at any stage of medication therapy, are common in healthcare and represent a potential risk to patient safety, due to their possible consequences, from prolonged hospital stay or even death[9,10]. Studies indicate a higher frequency of MRE in ICUs, with more serious consequences for patients compared to clinical hospitalization units, as an ICU is a more complex environment, and patients may be in unstable clinical conditions, at different levels of severity and undergo invasive procedures[11].

Furthermore, MREs can occur at any stage of the medication process, from prescription to preparation and administration of the medication. Regarding its characteristics, medication errors during the prescription phase include administration of drugs contraindicated to a given patient due to patient factors, such as hypersensitivity, interaction with other medications or comorbidities. In the preparation phase, errors involve dose, drug dilution and concentration errors, and in the administration phase, wrong medications, route of administration and patient, in addition to double dose. Furthermore, certain working conditions are associated with MRE as contributors to such outcomes, such as distractions, interruptions during medication preparation, stress, lack of training and fatigue[12,13].

Medication errors can harm patients, prolong periods of hospitalization, interfere with treatment, increase healthcare costs and destabilize the global healthcare system. Therefore, it is crucial to adopt strategies that identify and minimize the risk factors that increase the likelihood of these errors occurring[6].

Collaboration between healthcare professionals plays a fundamental role in reducing errors in the preparation and administration of medications. The integration of different specialties allows for a comprehensive approach to the different aspects of the medication process. Furthermore, the application of implementation science methodology provides a systematic framework to evaluate, implement, and adjust evidence-based interventions to improve the safety and effectiveness of medication preparation and administration. This involves identifying inappropriate practices, implementing standardized protocols, forming multidisciplinary teams and continuously evaluating results[14].

In view of the above, it is crucial to implement more effective and safe healthcare systems throughout the medication phases, seeking to carry out interventions and reformulations that help improve patient safety. Therefore, the present study aimed to evaluate the implementation of the bedside medication preparation process in an ICU, following a quality improvement cycle.

METHOD

This is a quasi-experimental study with unpaired samples, designed following the guidelines of the Standards for Quality Improvement Reporting Excellence 2.0 (SQUIRE) [15].

The study was conducted between September 2022 and April 2023, in the ICU of a tertiary care public teaching hospital located in southern Brazil, consisting of three clinical intensive care units and two specific surgical units for adults, totaling 50 beds. In these units, the nursing team comprises 196 nursing technicians and 73 nurses.

Given the weaknesses in the medication process, identified by the multidisciplinary team of the ICU Quality and Safety Committee, a cycle of improvements was carried out led by a multidisciplinary Working Group (WG), focused on the medication preparation process at the ICU. The WG was made up of 21 professionals who expressed interest in participating, after a formal invitation sent to all employees of the service. The WG was composed of nurses, nursing technicians, pharmacists and members of the administrative team.

The improvement cycle was developed in five distinct phases, each with its own specific steps:

In Phase 1, during two face-to-face meetings, the main weaknesses of the process were identified and opportunities for improvement were highlighted. At this time, decentralization of medication preparation was prioritized, as until then medications were prepared exclusively at the units' nursing station.

In Phase 2, three WG meetings were held, resulting in the reformulation of the bedside preparation process. A guide was prepared detailing the steps from storage to checking of medications.

During Phase 3, in a meeting, through a PDCA (Plan-Do-Check-Act) cycle, the criteria were established to evaluate the quality and safety of the new process: adherence to bedside medication preparation, frequency of interruptions during medication preparation, proper packaging of medications, identification and validity of multidose medications as well as adequacy and recording of the temperature of the storage refrigerator[16].

Then, Phase 4 began, where a pilot test was conducted in one unit for 45 days before implementation across the entire ICU. In this phase, all professionals were properly trained, starting with the pilot unit and, later, after minimal adjustments made at a WG meeting, in the other units.

The training offered included a two-hour face-to-face theoretical activity for all professionals of the service and clinical simulations of all phases of medication preparation and administration for nursing professionals, which lasted one hour. Furthermore, visual communication strategies were adopted, such as the use of physical posters with a description of the guide posted in all beds, and digital materials to reinforce new practices.

In phase 5, the new process was monitored through audits, with the aim of evaluating compliance in adherence to standardized practices in the morning, afternoon and night shifts.

The audits were conducted randomly. When the evaluator visited the unit, she would evaluate the professionals who were beginning the medication preparation process. Each audit consisted of non-participant observation (compliant or non-compliant) of the process of preparing and administering one or more medications prescribed for the specific time at which the observation occurred.

After the audits, the professionals observed during the period received reports detailing the aspects to be improved or maintained in their care practices. These reports were presented through infographics sent to each unit, demonstrating adherence to each monitored good practice, without identifying individual professionals.

Convenience and purposive sampling was used, which included 167 audits carried out during the preparation and administration of medications. Of these, 45 were carried out in the pre-intervention period and 122 in the post-intervention period in all units that make up the ICU.

During the data collection periods of the study, the following inclusion criteria were used in the audits: nursing professionals who have successfully completed theoretical and practical training, and who have been fully observed by the evaluator during all stages, from preparation until the medication is administered. Professionals on leave from work were excluded from the audits, as well as those who approached the evaluator to clarify doubts or questioned whether that specific moment was the time to carry out the evaluation and, aware of this, could distort the real perception of the practices. To minimize any potential bias, the evaluator carried out the observations during other routine activities in the units, thus ensuring a more natural and non-intrusive approach.

Data collection was conducted by a scientific initiation scholarship holder, previously trained by the main researcher and who participated in all training sessions. The variables, described in Phase 3, were collected at two different moments: Time 0, before the implementation of the good practices defined by the WG, over a period of 15 days, and Time 1, after implementation. Collection began three months after the introduction of the new process in all units. A digital form containing the study variables was used, filled out at the bedside. All audits carried out were included in the analyses.

The data were entered into an Excel® spreadsheet and analyzed using the Statistical Package for the Social Sciences v. statistical program. 20 (SPSS). Continuous variables with normal distribution were expressed as mean and standard deviation, while asymmetric variables were expressed as median and interquartile range (25th and 75th percentile). Categorical variables were presented in absolute numbers and percentages. The Shapiro-Wilk test was used to verify data normality.

To determine the expected compliance of observed practices, Carter's Positivity Index (PI) was used[16]. In this index, 100% positivity indicates desirable care; 90 to 99% indicate adequate care; 80 to 89% indicate safe care; 70 to 79% indicate borderline care; and less than 70% indicate undesirable care. For this study, a PI of 90 to 99% was established as expected compliance, corresponding to adequate care. Comparison of results between the pre- and post-intervention periods was performed using Mann-Whitney U Test.

This study was conducted in accordance with the guidelines and regulatory standards for research involving human beings, as approved by the National Health Council through resolution No. 466/12, and by the Research Ethics Committee (CEP) of the participating institution. The WG participants and the observed professionals consented to participate in the intervention and signed the Free and Informed Consent Form.

The authors declare that they have no conflicts of interest and that all expenses related to the study were covered by the researchers.

RESULTS

In total, 167 audits were carried out in the units investigated: 45 in the first stage, pre-intervention, and 122 in the post-intervention.

During the implementation phases of the improvement cycle, a total of 269 employees were trained, divided into four face-to-face theoretical training classes for all professionals in the multidisciplinary team, in addition to twenty specific practical training classes for nursing professionals, who were convened.

There were seven face-to-face meetings of the WG, which, in addition to implementing the new routine, officially published a specific Standard Operating Procedure (SOP) for the bedside medication preparation and administration in the ICU, in addition to educational and informative materials.

After the implementation of the improvement cycle in the bedside medication preparation process, significant improvements were observed in all monitored care areas. Bedside medication preparation stands out, achieving 96% post-intervention compliance. Likewise, there was an improvement in the adequate packaging of medications, from 27% to 74% of compliance, and in the identification and validity of multidose medications, from 24% to 83%. Furthermore, compliance in the preparation carried out without interruptions varied from 62% to 85%, and adequate checking of the temperature of storage refrigerators increased from 49% to 93%. These results reflect positive developments in all stages of the medication preparation process.

In Carter's PI analysis, the evolution in overall compliance between the pre- and post-implementation periods of the new process went from 46% to 80%, indicating, according to Carter's PI classification, the transition from undesirable/passable care to safe care in the evaluated process. All variables evaluated showed statistically significant improvements and are detailed in Table 1.

DISCUSSION

The quality improvement cycle is an approach recognized as a cyclical form of learning designed to improve quality in a specific area or process**.** In this context, implementation science plays a central role, offering a methodological framework for planning, implementing and evaluating changes in healthcare practices[14].

By adopting evidence-based approaches such as the quality improvement cycle, healthcare professionals can identify areas of opportunity, implement effective interventions, and continually monitor results to ensure sustainable improvements in the quality of care provided to patients. Therefore, implementation science complements the quality improvement cycle by providing tools and guidelines to transform knowledge into action and promote positive changes in clinical practice [14].

By analyzing the data using Carter's PI[17], used to evaluate the level of compliance of care practices, this study demonstrated a general improvement in the safety of practices related to bedside medication preparation in an ICU, thus reinforcing the importance of improvement cycles in clinical practice.

Table 1 – Comparison of care before and after the improvement cycle related to bedside medication preparation and Carter's Positivity Index, (n= 167). Porto Alegre, Rio Grande do Sul, Brazil, 2023.

Variables	Pre (n = 45)	Post (n = 122)	p
Bedside medication preparation	0 (0%)	117 (96%)	< 0.001*
Properly packaged medications and solutions	12 (27%)	90 (74%)	< 0.001*
Paused solutions removed from the infusion pump	35 (78%)	57 (47%)	< 0.001*
Multidose medications identified and valid	11 (24%)	101 (83%)	0.001*
No interruptions during preparation	28 (62%)	104 (85%)	<0.001*
Proper checking of the temperature of the storage refrigerator	22 (49%)	113 (93%)	< 0.001*
Carter's Positivity Index (%) – Classification of Care			
Bedside medication preparation	0%	96%	
Classification of Care	Undesirable	Safe	
Properly packaged medications and solutions	27%	74%	
Classification of Care	Undesirable	Borderline	
Paused solutions removed from the infusion pump	78%	47%	
Classification of Care	Borderline	Undesirable	
Multidose medications identified and valid	53%	88%	
Classification of Care	Undesirable	Safe	
No interruptions during preparation	24%	84%	
Classification of Care	Undesirable	Safe	
Proper checking of the temperature of the storage refrigerator	49%	93%	
Classification of Care	Undesirable	Safe	
Overall care compliance	46%	80%	
	Undesirable	Safe	

Source: Research data, 2023. Categorical variables expressed as n (%).
*Mann-Whitney U test.

A study carried out in a Brazilian hospital concluded that the application of improvement cycles in favor of patient safety could bring significant gains. After implementing the intervention, an absolute and relative improvement was observed in the quality criteria that had defects before the intervention, with statistical significance ($p < 0.001$). These results highlight the effectiveness of improvement cycles in promoting patient safety and improving the quality of healthcare[18].

Regarding the variable "preparation carried out without interruptions", the present study found that interruptions decreased significantly in the post-intervention period, evolving from undesirable care to safe care. However, they still represent a potential risk, since in 16% of observations professionals were interrupted while preparing medications.

Interruptions during the process of preparing and administering medications are recognized as elements inherent to the predisposing conditions for the occurrence of errors. The

intrusive nature of these interruptions can compromise the concentration and attention of healthcare professionals, leading to lapses in the proper execution of tasks. Furthermore, such interruptions can disrupt the sequence of planned actions, causing a break in the process continuity, which in turn can make it difficult to efficiently and accurately resume the interrupted activity[19].

According to a study carried out in Spain, which identified medication errors through direct observation of nurses during medication administration, interruption was the most frequent error at this stage[20]. Furthermore, the nursing team is cited as the main source of interruption, through parallel conversations and exchange of information, with the preparation phase being the most affected[21]. This complex dynamics highlights the importance of effective strategies to minimize or manage interruptions during medication administration, aiming to improve the safety and quality of care provided to patients.

Regarding adherence to the implementation of bedside medication preparation, this measure reached an adherence percentage of 96% in the post-intervention period, demonstrating safe care according to Carter's PI. A study that attempted to identify distractions and interruptions during the preparation and administration of medications in hospital inpatient units revealed that 69% of distractions occurred during medication preparation, as well as 64% of interruptions, the main reason being side conversations initiated by third parties[22].

After the improvement cycle, a 44% increase in compliance was recorded regarding "properly packaged medications and solutions". As stipulated by the Safety Protocol on Medication Prescription, Use and Administration Safety Protocol, it is essential that these products are stored in places with restricted access to patients, family members and other professionals. The absence of this control in ICUs can directly compromise the quality of care offered, increasing the risk of errors during the preparation or administration of medications, especially because different medications may be visually similar in packaging or else their names have spelling similarities [23].

A study conducted at a teaching hospital in the northeast region of Brazil revealed that more than 90% of medication errors are associated with medications such as electrolytes, heparin and psychotropic drugs, frequently found in ICUs. Inadequate segregation of medications after preparation increases the risk of errors, putting patients at greater risk, especially those using High Surveillance medications (MAVS). Furthermore, occupational risks for professionals related to addiction also increase due to the lack of standardization and organization in the storage and administration of medications, making the potential risks to patients and professionals even more worrying[23].

Regarding the work environment, it is imperative to provide an appropriate environment, free from elements that could interfere with professionals' concentration and attention while performing tasks such as preparing bedside medications. This is justified because in inappropriate circumstances, such as, for example, in situations of interruptions due to the exchange of information, side conversations and response to alarms, health professionals are more vulnerable to making medication errors and consequently, the likelihood of adverse events occurring increases[24].

Regarding the variable "multidose medications identified and valid", the present study identified satisfactory compliance related to this item in the post-intervention period, as 88% of the medications were identified and valid. The adequacy of these parameters plays a fundamental role, as non-observance can compromise the safety of the medication preparation and administration process, in addition to representing a significant risk factor for the occurrence of drug iatrogenic events, such as poisoning, undesirable effects and lack of effectiveness in drug therapy[25].

A study that analyzed the compliance of care and adherence of nursing professionals to the safe administration of medications in an ICU of a public hospital in Sergipe revealed that in 49.5% of the situations observed, nursing professionals did not properly identify medications to be administered. Errors in medication preparation can be explained by exhaustive work overload and the reduced number of employees available, aggravating the physical and mental fatigue of health professionals and making patient safety vulnerable[11,26].

With regard to properly checking the temperature of the refrigerator used to store medications, this study documented a compliance rate of 93% regarding this practice, indicating an improvement of 44% compared to the periods before and after the intervention. However, some professionals continued to neglect daily recording or incorrectly record the temperature of the storage refrigerator after the intervention. It should be noted that checking this temperature is one of the indirect responsibilities of the nursing team and must be performed daily. This check must be carried out because of the potential impact of temperature variations, which can trigger instability in medications and oxidation, compromising effectiveness and posing risks to hospitalized patients[27].

Furthermore, it should be noted that one of the aspects that had less effective adherence to safety measures was the variable related to "paused solutions removed from the

infusion pump". Such an occurrence exposes patients to a potential risk of inadvertent activation of the infusion pump (IP), which could lead to errors or adverse events. It is crucial to understand that the infusion pump is an electromechanical device strategically integrated into hospital operations that aims to improve the accuracy and safety of intravenous infusions, which in turn plays a vital role in ensuring safety during medication administration[28].

In the context of safe medication administration, normalization of deviations may occur when flaws in the medication process are ignored or not immediately corrected. This passive acceptance of inadequate practices poses a serious risk to patient safety and compromises efforts to promote a culture of safety in the healthcare environment. Normalization of deviations is a phenomenon that occurs when inappropriate practices or behaviors become tolerated or acceptable in a specific environment even though they contradict established standards or safety guidelines[29].

In the hospital environment, on average, around 80% of patients undergo intravenous therapies, and this percentage is even higher in ICUs. Therefore, failures when preparing medications and ineffective communication between members of the multidisciplinary team are associated with inadequate practices in the use of infusion pumps (IP) [30]. Furthermore, as it is a technology connected directly to the patient, it is essential to pay more attention to the care and details related to this equipment[31].

Therefore, it is of utmost importance to recognize the challenges inherent in the appropriate use of IPs, especially given their wide use in intravenous therapies, aiming to promote safety and effectiveness in the administration of medications in hospital environments. Moreover, to further improve drug safety, programs that promote multidisciplinary collaboration, education and training are essential, through a systemic approach[32].

By adopting multidisciplinary approaches and the implementation science methodology, healthcare professionals can work together to minimize errors, ensuring safer and more efficient care for patients. Clinical research continues to contribute knowledge that can improve clinical and health care outcomes. However, integrating evidence into routine care is challenging, resulting in a gap between knowledge and practice. In this context, the field of implementation science offers a valuable approach for nurses to translate evidence into their daily clinical practice[14].

In intensive care, bedside medication preparation is a critical practice that requires maximum precision and efficiency to ensure patient safety. By implementing the improvement cycle based on the implementation science methodology, we seek to continuously improve this fundamental process. Facilitators, barriers and intervention sustainability strategies were identified in the implementation process. By understanding and addressing these elements, it was possible to optimize the effectiveness of medication preparation in the ICU.

Facilitators included availability of adequate resources, effective staff training, and an organizational culture that values patient safety. On the other hand, barriers have arisen due to time constraints, miscommunication between team members, or resistance to change.

To ensure the sustainability of the intervention, continuous monitoring, regular review of processes and the active involvement of the entire team were essential. In this way, we sought to ensure that the improvements implemented in medication preparation in the ICU are lasting and have a continuous positive impact on the safety and quality of care provided to patients.

Considering all the aspects discussed, the present study has some limitations, such as the use of convenience sampling and the fact that the study was carried out in a single center, which restricts the generalization of the results. However, it is important to highlight the great relevance of the study within the institution, as it offers important insights into the dynamics of a large service and emphasizes the fundamental role of clinical audits as collaborative tools in managing patient safety.

CONCLUSION

In the present study, a positive relationship was found between the implementation of a quality improvement cycle related to the bedside medication preparation in an ICU and better results in patient safety. The introduction of a good practice protocol played a significant role, revealing areas of weakness and opportunities for improvement, as seen in the post-improvement cycle.

The results obtained provide an initial basis for the development of educational programs, with an emphasis on the adoption of good practice protocols in teaching. Furthermore, as far as research is concerned, they may inspire future investigations into the effectiveness of similar interventions in different healthcare contexts and the factors that influence their successful implementation. In care and management, they can guide nurses in adopting best practices, prioritizing patient safety and implementing organizational changes that promote a culture of patient safety and encourage collaboration between different healthcare teams.

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