INTENSIVE CARE UNIT: SAFETY AND MONITORING OF ADVERSE EVENTS
UNIDADE DE TERAPIA INTENSIVA: SEGURANÇA E MONITORAMENTO DE EVENTOS ADVERSOS
UNIDAD DE TERAPIA INTENSIVA: SEGURIDAD Y MONITOREO DE EVENTOS ADVERSOS

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ABSTRACT

Objective: to know publications about the monitoring of adverse events in patients admitted to the Intensive Care Unit. **Method:** this is a bibliographical study, type integrative, of articles published between 2013 and 2017, indexed in the databases LILACS, BDNF, MEDLINE and Science Direct. A critical and descriptive analysis was performed, classifying the articles by the level of evidence. The results were presented in figure form. **Results:** 21 articles were included, 80% in English, most extracted from MEDLINE, with low evidence from descriptive studies, addressing adverse events and medication-related monitoring, communication, coping and education strategies, related factors, accidental extubation, falls and hand hygiene. **Conclusion:** it is evaluated that the publications address the monitoring of adverse events in the ICU as a complex, continuous and systemic approach. It is recommended the use of protocols, teamwork, assertive communication, education, demystification of adverse events, empowerment of the leaders engaged in the theme and promotion of knowledge about the theme. **Descriptors:** Patient Safety; Monitoring; Medical Errors/Adverse Effects; Patient Harm; Intensive Care Units; Quality of Health Care.

RESUMO

Objetivo: conhecer publicações sobre o monitoramento de eventos adversos em pacientes internados na Unidade de Terapia Intensiva. **Método:** trata-se de estudo bibliográfico, tipo revisão integrativa, de artigos publicados entre 2013 e 2017, indexados nas bases de dados LILACS, BDNF, MEDLINE e Science Direct. Realizou-se a análise crítica e descritiva, classificando os artigos pelo nível de evidência. Apresentaram-se os resultados em forma de figura. **Resultados:** incluíram-se 21 artigos, 80% em inglês, a maioria extraída da MEDLINE, com evidências baixas, provenientes de estudos descritivos, abordando eventos adversos e formas de monitoramento relacionados à medicação, comunicação, estratégias de enfrentamento e educação, fatores relacionados, extubações acidentais, quedas e higiene de mãos. **Conclusão:** avalia-se que as publicações abordam o monitoramento dos eventos adversos na UTI como um processo complexo, contínuo e de abordagem sistêmica. Recomenda-se o uso de protocolos, trabalho em equipe, comunicação assertiva, educação, desmistificação dos eventos adversos, empoderamento das lideranças engajadas na temática e fomento do conhecimento acerca do tema. **Descritores:** Segurança do Paciente; Monitoramento; Eventos Adversos; Dano ao Paciente; Unidades de Terapia Intensiva; Qualidade da Assistência à Saúde.

RESUMEN

Objetivo: conocer publicaciones sobre el monitoreo de eventos adversos en pacientes internados en la Unidad de Terapia Intensiva. **Método:** se trata de estudio bibliográfico, tipo revisión integrativa, de artículos publicados entre 2013 y 2017, indexados en las bases de datos LILACS, BDNF, MEDLINE y Science Direct. Se realizó el análisis crítico y descriptivo, clasificando los artículos por el nivel de evidencia. Se presentaron los resultados en forma de figura. **Resultados:** se incluyeron 21 artículos, 80% en inglés, la mayoría extraída de MEDLINE, con evidencias bajas, provenientes de estudios descriptivos, abordando eventos adversos y formas de monitoreo relacionados a la medicación, comunicación, estrategias de enfrentamiento y educación, factores relacionados, extubaciones accidentales, caídas e higiene de manos. **Conclusión:** se evalúa que las publicaciones abordan el monitoreo de los eventos adversos en la UTI como un proceso complejo, continuo y de abordaje sistémico. Se recomienda el uso de protocolos, trabajo en equipo, comunicación asertiva, educación, desmitificación de los eventos adversos, empoderamiento de los liderazgos comprometidos en la temática y fomento del conocimiento acerca del tema. **Descriptores:** Seguridad del Paciente; Monitoreo; Errores Médicos; Daño del Paciente; Unidades de Cuidados Intensivos; Calidad de la Atención de Salud.

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INTRODUCTION

Quality of care and patient safety have become fundamental. The World Alliance for Patient Safety (WHO) was proposed in 2004 by the World Health Organization (WHO), whose main purpose was to organize its concepts and definitions.¹ It was also suggested measures for risk reduction, mitigation of adverse events and elaboration of guidelines that sought, among other things, to promote political and population commitment to the search for solutions that promote safety in health care.¹⁻²

"Patient safety" is defined as the minimally acceptable reduction of the risk of unnecessary and avoidable harm associated with health care, according to the WHO International Classification for Patient Safety ICPS.² It should be noted that such damages may be due to unintentional or intentional incidents. Incidents are classified as near miss, when the incident does not reach the patient, incident without damage or with harm to the patient, also known as adverse event. It is known that adverse events (AE) are unwanted complications caused by patient care and not attributed to the natural course of their underlying disease.²⁻⁴

It is observed that the high incidence of AEs in health care has led to the establishment of measures that minimize their occurrence; these measures began with the publication of the report entitled *To Err Is Human: Building a Safer Health System* of the United States Institute of Medicine (IOM).⁵ It was estimated by the authors that the total cost of medical errors for the health system was \$17 billion to \$29 billion per year, as well as estimating about 44,000 to 98,000 preventable deaths per year.⁵⁻⁶

It is noted that the context of AEs is complex and challenging, and the most described examples in the literature of avoidable events are those that violate good practices related to drug care and administration, blood transfusions, surgeries, falls, pressure ulcers and communication.⁵⁻⁷

It is believed that AEs are capable of reflecting from problems in the quality of service offered, through social and financial costs to the health system and patient, to the suffering of all involved.⁶ Therefore, the search for the most effective methodology for its monitoring is essential. In this way, the quality of health care can be evaluated, contributing decisively to changes in clinical practice.⁶⁻⁸

Several methods for monitoring AE in the studies are described, such as spontaneous reports with computerized alerts, direct observation, medical or medical records control software, review of clinical processes or a combination of methodologies, according to the purpose defined by the institution.⁸ In addition, voluntary reporting

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by the professional is the most frequent method.⁸⁻⁹

A strategy to improve risk management in health services, called the Sentinela network, was implemented in 2001 in Brazil by the National Health Surveillance Agency (ANVISA).¹⁰ Sentinela hospitals are responsible for the vast majority of voluntary notifications of AE in the country, registering problems related to products, equipment and procedures.¹⁰⁻¹ There are evidences of more than 118 thousand notifications made through this system between the years 2006 and 2011 and, of these, 37,696 are related to AE with medicines, 29,880 with medical articles, 19,105 with blood components, among others.¹²

It is known, however, that most of the incidents are not reported by the workers, and the low adherence to the registry may be associated with culpability and punitive culture secondary to AE. Voluntary reporting is estimated to translate about 10% to 20% of events that actually occur.^{8-9,12}

It is related to the occurrence of AE with more severe damage to Intensive Care Units (ICUs), operating rooms and emergencies⁵⁻⁷ and, in relation to the ICU, there is a greater vulnerability to care failures compared to other units due to their seriously ill patients, the requirement for complex intensive care, the longer the hospital stay, the different health professionals for the care and expertise needed to handle various technologies.¹³

In relation to the multidisciplinary care of the critical patient, the nursing team is the largest staff responsible for care actions, therefore, in a privileged position to reduce the possibility of failures that affect the patient. It is pointed out that, in addition to detecting complications early, it can perform the necessary conducts to minimize damage.¹³ Some aspects in Nursing are pointed out as probable risk factors associated with AE, for example: higher workload, stress, burnout, characteristics of the profession, the environment of Nursing practices, professional satisfaction and their perception of safety culture.¹³⁻⁴

It is necessary to deepen the subject in the face of evident efforts in the detection of fragilities related to patient safety, the importance of monitoring the AEs, the methodologies, often costly, with limited sensitivity or low efficiency.⁹ It was decided, therefore, to carry out this integrative review, in order to contribute with knowledge and support decisions regarding the adoption of more relevant strategies to guarantee the highest quality and safety in care.

OBJECTIVE

- To know publications about the monitoring of adverse events (AE) in patients admitted to the Intensive Care Unit.

METHOD

It is a bibliographical study, of integrative review type.¹⁵⁻⁶ Six steps were taken to structure it: 1) identification of the theme and elaboration of the guiding question of research; 2) selection of databases, definition of eligibility criteria and search strategies; 3) data collection and categorization of selected studies; 4) critical analysis of the studies included in the integrative review; 5) interpretation and discussion of the results and 6) presentation of the revision and synthesis of the knowledge produced.¹⁶

As a guiding question of research, "What has been published about patient safety and monitoring of adverse events in patients admitted to the ICU?".

The databases were Medical Literature Analysis and Retrieval System Online (MEDLINE), Latin American and Caribbean Literature in Health

Sciences (LILACS) and Nursing Database (BDENF), Cochrane (Reviews), and Science Direct.

The following inclusion criteria were adopted: published scientific articles from 2013 to 2017 in the English, Portuguese or Spanish languages, with online access and free complete texts on the monitoring of adverse events in patients admitted to the ICU. The following exclusion criteria were listed: publications outside the stipulated period; with main subject outside the scope of the research; duplicate articles; abstracts published in annals of congress or with restricted access.

Descriptors were selected from the Health Sciences Descriptors (DeCs) and the Medical Subject Headings (MeSH) were chosen: patient safety; monitoring; medical errors/adverse effects; patient harm; intensive care unit and quality of health care. The descriptors were combined with the boolean operators "AND" and / or "OR". The combinations shown in figure 1.

Databases	Combination of descriptors with Boolean operators
BDENF	<i>"patient safety" AND "monitoring" AND "medical errors/adverse effects" OR "patient harm" AND "intensive care units" AND "quality of health care"</i>
MEDLINE	<i>"patient safety" AND "monitoring" AND "medical errors/adverse effects" OR "patient harm" AND "intensive care units" AND "quality of health care"</i>
LILACS	<i>"patient safety" AND "monitoring" AND "medical errors/adverse effects" OR "patient harm" AND "intensive care units" AND "quality of health care"</i>
COCHRANE (reviews)	<i>"patient safety" AND "monitoring" AND "medical errors/adverse effects" OR "patient harm" AND "intensive care units" AND "quality of health care"</i>
SCIENCE DIRECT	<i>"patient safety" AND "monitoring" AND "medical errors/adverse effects" OR "patient harm" AND "intensive care units" AND "quality of health care"</i>

Figure 1. Search strategy in the databases through the descriptors. Porto Alegre (RS), Brazil, 2018.

The third and fourth stages were carried out in the period from August to October 2018, with the selection of the studies through the reading of the titles and abstracts to select the articles that met the objective traced. The data were then collected and the descriptive and careful analysis of those studies that met the eligibility criteria was followed by a full reading of the articles. Thus, 21 articles were included in the final sample, according to the flowchart of the selection process (Figure 2), adapted from the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA).¹⁷

Figure 2. Flowchart of the process of inclusion of scientific articles adapted from PRISMA. Porto Alegre (RS), Brazil, 2018.

For the fifth stage of interpretation and discussion of the results, an instrument was created, contemplating the following relevant aspects: repository; title; methods; results; authors name; year and place of publication and name of the journal or journal.

Tables were drawn up to present the included articles, denominating them with the letter "A", associating an arabic number according to the growing sequence of the year of publication. In view of this, the discussion and analytical description correlated with the literature were facilitated.

The articles were also evaluated for their scientific rigor and were classified in relation to the level of evidence and degrees of recommendation, according to validity and reliability. An instrument based on the Rating System for the Hierarchy of Evidence for Intervention / Treatment Question was used to classify the level of evidence of the studies (Figure 3).¹⁸⁻⁹

Level of evidence	Study outline
Level 1	Systematic reviews or meta-analyzes of relevant randomized controlled trials
Level 2	Randomized clinical trials
Level 3	Controlled clinical trials without randomization
Level 4	Control cases and cohort studies
Level 5	Systematic reviews of descriptive studies and qualitative studies
Level 6	Evidence of descriptive or qualitative studies
Level 7	Expert Opinion Reports / Experience Report

Figure 3. System Rating Scale for the Hierarchy of Evidence for Intervention / Treatment Question. Porto Alegre (RS), Brazil, 2018.

The sixth stage presented the knowledge produced and the conclusion through the results organized in order to help the understanding of the subject matter of this review.

RESULTS

Twenty-one studies were selected in this review, whose predominant language was English (n = 17), followed by Portuguese (n = 2) and Spanish (n = 2); of the 17 English-language articles, in descending order, ten were produced in the United States, two in England and one in each country, namely China; Saudi Arabia; Portugal; South Korea and the Kingdom of Bahrain (Middle East); of articles in Portuguese, one from Santa Catarina and the other from São Paulo, and the two articles in Spanish come from Spain.

It was found that included publications were extracted from MEDLINE (n = 15), Science Direct (n = 4), LILACS (n = 1) and BDENF (n = 1). Six studies found at Cochrane (Reviews) were excluded

because they did not meet the eligibility criteria because the focus of the main subjects differed from the scope of the research.

Articles were identified with different methodological delineations. The majority of quantitative descriptive studies (n = 13) followed by pre and post intervention studies (n = 3), non-randomized clinical trial (n = 1), cohort study (n = 1) (n = 1), experimental study (n = 1) and longitudinal study with intervention (n = 1). It should be noted that four studies did not clearly describe their methodologies, however, according to the reading of the articles, the applied methodologies were inferred.

The characteristics of the studies included in the sample are shown in Figure 4.

Article	Journal	Year and country	Title	Language	Method	Level of evidence
A1	Farmacia Hospitalaria	2013, Spain	Gestión de riesgos en un servicio de Medicina Intensiva: conciliación de la medicación ²⁰	Spanish	Related experience. Sample: multidisciplinary team that worked on the pharmacy management program of a Spanish intensive medicine service. Instrument: not applicable.	N7
A2	Critical Care	2013, England	Safety by DEFAULT: introduction and impact of a paediatric ward round checklist ²¹	English	A prospective, pre-intervention and post-intervention study. Sample: Medical and Nursing team of a tertiary pediatric ICU (UTIP), with 12 beds, from 2009 to 2011. Instrument: checklist with mnemonic resource "DEFAULT" created by the risk management group of the PICU.	N6
A3	Nursing Journal UERJ	2014, Brazil	Occurrence of adverse events as indicators of quality of care in an intensive care unit ²²	Portuguese	Descriptive, quantitative study with a prospective approach. Sample: patients hospitalized in the ICU between August and September 2012. Instrument: notification by instrument created and placed in an ICU urine, associated with the observation of the researcher	N6

					and another trained professional to evaluate the risks for the occurrence of AE.	
A4	Anaesthesia	2014, England	An analysis of patient safety incidents associated with medications reported from critical care units in the North West of England between 2009 and 2012 ²³	English	Descriptive, quantitative study with retrospective approach. Sample: patient hospitalized in the 29 intensive care units, between 2009-2012. Instrument: Incident report software. The incidents were reviewed by a member of the medical team or nursing unit and sent to the researcher.	N6
A5	Intensive medicine	2014, Espanha	Análisis de los factores contribuyentes en incidentes relacionados con la seguridad del paciente en Medicina Intensiva ²⁴	Spanish	Multicenter, observational, cohort, prospective study. Sample: all patients enrolled in the SYREC study. Instrument: a manual questionnaire filled out by the professionals of intensive care services, evaluated by the team manager and transcribed by electronic mail to the study's principal investigator.	N4
A6	Journal of the American Medical Informatics Association	2014, United States	Phenotyping for patient safety: algorithm development for electronic health record based automated adverse event and medical error detection in neonatal intensive care ²⁵	English	Descriptive, quantitative study with retrospective approach. Sample: 753 electronic health records of patients from the Neonatal ICU of a pediatric university hospital. Instrument: proprietary hospital records software, implemented as of 2010 at the institution, and automated AE detection program.	N6
A7	BMC Medical Education	2014, United States	Participation in EHR based simulation improves recognition of patient safety issues ²⁶	English	Descriptive study. Sample: multidisciplinary team. Instrument: not applicable.	N6
A8	BMJ Quality and Safety	2014, United States	Characterizing the Complexity of Medication Safety using a Human Factors Approach: An Observational Study in Two Intensive Care Units ²⁷	English	Cross-sectional, retrospective, quantitative study. Sample: 630 hospital admissions in the two ICUs, during six months. Instrument: medical record review.	N6
A9	Therapeutics and Clinical Risk Management	2015, China	Quality improvements in decreasing medication administration errors made by nursing staff in an academic medical center hospital: a trend analysis during the journey to Joint Commission International (JCI) accreditation and in the post-accreditation era ²⁸	English	A prospective, pre-intervention and post-intervention study. Sample: medical records of the university hospital. Instrument: improvement models used by JCI.	N6
A10	Global Journal of Health Science	2015, Saudi Arabia	Improvement critical care patient safety: using nursing staff development strategies, at Saudi Arabia ²⁹	English	Experimental implementation study. Sample: nurses from the three work shifts. Instrument: Safety Attitudes Questionnaire (SAQ) - version of the ICU, to measure the safety culture. Checklist of procedures to assess attitudes that could affect patient safety, applied	N6

					before and after the implementation of the education program.	
A11	BMC Anesthesiology	2015, United States	An analysis of near misses identified by anesthesia providers in the intensive care unit ³⁰	English	Descriptive, quantitative study with retrospective approach. Sample: ICU anesthesiologists. Instrument: computerized system of voluntary and anonymous notification of errors and near misses that occur during the delivery of anesthesia to the patient.	N6
A12	Respiratory Care	2015, United States	Plan to Have No Unplanned: A Collaborative, Hospital-Based Quality-Improvement Project to Reduce the Rate of Unplanned Extubations in the Pediatric ICU ³¹	English	Descriptive, quantitative study with retrospective approach. Sample: Pediatric ICU patients. Instrument: computerized reports.	N6
A13	Asian Nursing Research	2015, South Korea	Teamwork and Clinical Error Reporting among Nurses in Korean Hospitals ³²	English	Quantitative, cross-sectional study. Sample: Nurses from Korean hospitals in various areas, including ICUs. Instrument: Team Work Perceptions Questionnaire.	N6
A14	Journal of Infection and Public Health	2015, Kingdom of Bahrain (Middle East)	Effectiveness of an electronic hand hygiene monitoring system on healthcare workers' compliance to guidelines ³³	English	Non-randomized clinical trial. Sample: nurses and physicians from the ICU's Salmaniya Medical Complex (SMC) in the Kingdom of Bahrain, Middle East. Instrument: electronic hand hygiene monitoring system.	N3
A15	Cogitare Nursing	2016, Brazil	Medication errors and degree of damage to the patient in a school hospital ³⁴	Portuguese	Descriptive, quantitative study with retrospective approach. Sample: hospitalized adult patients who have undergone some medication-related event, reported through a computerized system, from 2014 to 2015. Instrument: computerized fact sheets for reporting adverse events.	N6
A16	Pediatric Critical Care Medicine	2016, United States	Transforming the Morbidity and Mortality Conference to Promote Safety and Quality in a Pediatric Intensive Care Unit ³⁵	English	A prospective, pre-intervention and post-intervention study. Sample: 33 patients discussed pre- and 31 post-conference. Instrument: not applicable.	N6
A17	Hospital Pediatrics	2016, United States	Improvement in Patient Transfer Process From the Operating Room to the PICU Using a Lean and Six Sigma-Based Quality Improvement Project ³⁶	English	Quantitative, descriptive study, pre- and post-intervention. Sample: pediatric surgical patients of the Pediatric ICU. Instrument: standardized handoff tool (checklist).	N6
A18	Procedia - Social and Behavioral Sciences	2016, Portugal	Improving the Evaluation of Risk of Fall through Clinical Supervision: An Evidence ³⁷	English	Quantitative, descriptive study. Sample: patients hospitalized for 30 days of observation in a Portuguese ICU. Instrument: not applicable.	N6
A19	Journal of Biomedical Informatics	2016, United States	Development and validation of an electronic medical record-based alert score for detection of inpatient deterioration outside the ICU ³⁸	English	Retrospective, analytical study. Sample: Data extracted from 649,418 episodes involving 374,838 patients. Data group for analysis had 48,723,248 hourly observations (data extracted through	N6

A20	Nursing Research	2017, United States	Facilitated Medication-Related Event Reporting to Improve Medication Management Quality and Safety in Intensive Care Unit ³⁹	Nurse	English	Datamining). Cross-sectional, observational, quantitative study. Sample: ICU nurses. Instrument: application of Behavioral Task Analysis (BTA).	N6
A21	Pediatrics	2017, United States	Evaluating Strategies for Preventing Wrong-Patient Orders in the NICU ⁴⁰	Serial	English	Longitudinal, quantitative and retrospective study of three periods (baseline period, patient re-identification and combined intervention). Sample: medical records of patients from the Neonatal and Pediatric ICUs of NY. Instrument: Wrong-patient retract-and-reorder (RAR).	N6

Figure 4. Distribution of articles included in the sample according to periodical, year, country, title, authors, language, method and level of evidence. Porto Alegre (RS), Brazil, 2018.

Only articles with similar themes, such as medication adverse events (n = 7), communication-related AEs (n = 4), strategies to cope with AE and education (n = 3) and softwares were grouped for analysis (n = 2). It is pointed out that five studies had associated approaches such as: occurrence of AE in general (n = 1); factors

related to AE (n = 1); monitoring of accidental extubations (n = 1); monitoring of falls risk (n = 1) and monitoring of infection related to hand hygiene / care (n = 1).

A summary of the selected articles published in the period between 2013 and 2017 is presented in Figure 5.

Article	Objectives	Results
A1 ²⁰	Explain the process of implementing drug reconciliation, as a measure included in the risk management program, in an intensive care department.	Multidisciplinary team was set up to work on risk management program. Meetings held from January to December 2011. Development in stages: identification of potential risks; analysis and evaluation; management; Assembly; Implementation; monitoring and reassessment. In total, 17 potential risks were identified. Medication reconciliation was included as an improvement measure to manage the risk of medication errors. The pharmacist was in charge of the implementation and responsible for the monitoring and reassessment process, to ensure its effectiveness, designing periodic monitoring indicators.
A2 ²¹	To improve the effectiveness of shared information in bedside rounds in a Pediatric Intensive Care Unit.	Led by a nurse. The application of the checklist lasted about 27 seconds and there was a median of 1.4 problems encountered / bed; 24 questionnaires distributed to the medical and nursing staff about satisfaction with the use of the checklist, 12 returned and the feedback was positive. The application of the checklist has helped younger nurses, providing points of greater patient care. The acronym DEFAULT was standardized. The doctors found the tool useful and also appreciated that the nurse was responsible for guiding the round with the help of the checklist. Negative points and suggestions raised: tool not comprehensive, not always fulfilled, be more generic and include 'S' for social issues. There was a reduction in the number of accidental extubations and a greater number of children ventilated with tidal volume in the target.
A3 ²²	To evaluate the quality of care and patient safety through the occurrence of Adverse Events (AE).	Performed by ICU professionals, 31 reports of AE of gastrointestinal catheter loss, pressure ulcer, loss of central venous catheter and accidental extubation. Most prevalent were gastrointestinal (54.8%) and pressure ulcer (25.8%) losses. Of the 102 observations made by the researcher and one other professional, 137 risks for AE were raised in 65 patients, with a higher risk of pressure ulcer (54%) and gastrointestinal (23.4%) leakage. The work shift with the highest number of AEs reported was the night shift.
A4 ²³	Analyze patient safety incidents involving drugs from 29 intensive care units each year in north-west England between 2009 and 2012.	Analyzed 2,238 incidents involving medications. Of these, 20% generated harm to the patient and 65% were considered preventable. The drugs most

		involved were noradrenaline, heparin, morphine and insulin. Among the steps in the medication process, administration of the drug was the most reported stage in the incidents, as well as damage to patients.
A5 ²⁴	To analyze the contributing factors (CF) for the appearance of undamaged incidents and adverse events to the critical patient and to study their relation with the classification, severity and relation with health care, based on the results of the SYREC study. Post-hoc analysis of the SYREC study (multicenter, observational, cohort, prospective, 24-hour follow-up study in the 79 intensive care settings).	There were 79 intensive care services belonging to 76 hospitals. 1,017 patients included. In 591 (58%) there was at least one incident reported. A total of 1,424 incidents related to patient safety and 2,965 contributing factors (CF) were reported: 943 incidents without harm to the patient (66%) related to 1,729 CF (58.3%) and 481 adverse events with damage (44%) related to 1,236 CF (41.69%). In 1,247 incidents without harm to the patient (87.57%), one or more contributing factors were reported. The most frequent factors were related to the patient (21.9%), working conditions (19.9%) and individual factors of the professional (19.4%). Most of the notified CF were in incidents classified as less severe (67.8%) and considered "undoubtedly avoidable" (69.7%). Most of the notifications were made by nurses.
A6 ²⁵	Evaluate two AE detection algorithms in order to compare with Trigger tool notifications and also with voluntary incident reports.	AE were the extravasation of intravenous infusions. The algorithm identified one more event than the Trigger tool and eight more events than incident reporting. The algorithm and the tool Trigger tool had a 100% agreement in the identification of excessive administration of narcotics.
A7 ²⁶	Describe the creation of simulated ICU cases with electronic health records (EHR) and their performance.	Two cases of ICU were created in the EHR simulation environment. Each case contained 14 safety issues; 116 subjects were enrolled, 25 undergoing repeated simulated tests. Participation in the EHR simulation improved the use of registries and identification of patient safety issues.
A8 ²⁷	To examine the safety of medications in two ICUs and to evaluate the complexity medication errors and AE.	An average of 2.9% AE of preventable or potentially preventable medications occurred at each admission (0.4 AE per patient / day). The AE rate of potential medication was 276/1000 patients / day, and the rate of preventable AE was 9.2 / 1000 patients / day. Most medication errors occurred in the prescription phase (32%) and administration (39%).
A9 ²⁸	Reduce errors in medication administration through Joint Commission International's improvement methodology in patients hospitalized at a 3,200-bed university hospital, including critical patients.	Number of medication administration errors reduced over the study period (60.9% decrease in errors). Errors related to high vigilance drugs were reduced by 57.9%. Most frequent errors were omissions. The endovenous route was related to greater chances of error. More experienced nurses were associated with fewer errors. Number of errors in the surgical ward was twice as high as in the clinical ward and there were more errors in the area of critical care compared to non-critical.
A10 ²⁹	Implement staff development strategies through the patient safety educational program, minimize medical errors and improve patient outcomes at the hospital, evaluate the effectiveness of implementing patient safety strategies for ICU staff nurses.	Implemented for 50 nurses in different ICUs. Low knowledge of patient safety in the pre-test, improving after the program. Improvements were observed in safety climate, teamwork climate and Nursing turnover rates. Full knowledge, skills and attitude of nurses have been improved in relation to patient safety dimensions and adverse events.
A11 ³⁰	Characterize near miss computerized reports and compare them with anesthesiologists reports from other hospitals.	There were almost 1,811 reported errors, of which 22 originated in the ICU. They were more associated with airway management and less associated with airway issues.
A12 ³¹	To describe the context in which a quality improvement project was implemented, specific local problems, risk factors and dysfunction that were addressed in order to improve the care process, manage sedation and care with intubated patients.	All planned and unplanned extubations were evaluated over a one-year period (2010). There was improvement in the process and safety results in the pediatric critical patient, focusing on identified local risk factors, followed by education and monitoring. Despite its local focus, the project generated new insights into the risk factors for unplanned extubation, monitoring, and how to improve systems to improve patient outcome by reducing the serious adverse events related to accidental extubation.
A13 ³²	To examine the levels of teamwork and their relationships with clinical error communication (AE).	The 674 nurses received the questionnaire with a response rate of 85.5%. The team work score was 3.5 (out of five possible points), with 522 nurses responding who had experienced at least one AE in the last six months. Only 53% answered that they always or almost always report AE. Teamwork was

		significantly associated with a higher rate of AE reports.
A14 ³³	To evaluate the impact of a hand hygiene monitoring technology on the health care of critical patients.	Hand hygiene compliance increased from 38% to 60% at baseline, rising to an average of 75% at the end of the 28 day assessment. It was possible to reach membership rates close to 100% at some times.
A15 ³⁴	To verify the incidence of errors and almost medication errors, as well as the degree of damage to the patient and to identify association between the degree of damage and the sociodemographic and hospitalization characteristics.	There were 113 error notifications and almost error. The characterization was performed considering only the patients with described errors. There was a significant correlation between incidents with greater severity and patients attended by supplementary health, hospitalized in closed units, with their length of hospital stay and who were discharged from hospital. The majority did not cause any damage to the patient, followed by mild (25.7%), moderate (14.1%) and severe (7.1%) damages. In most cases, notification was made by the nurse.
A16 ³⁵	To determine the effectiveness of a structured conference on morbidity and mortality in improving the process of review and response to AE in a Pediatric ICU.	Significant increase in the number of participants in the discussions following the implementation of the structured conference. Significant increase in the number of quality improvement interventions suggested and implemented.
A17 ³⁶	Describe the process implemented to improve transference of the pediatric patient from the surgical room to the Pediatric ICU.	The communication error rate improved from 1.9 to 0.3 errors per handoff of the patient. Inefficiency (waiting time for the patient without any team activity) was reduced from 90 to 32 minutes. The content of the transfer has been improved with fewer information omissions. Staff satisfaction improved significantly.
A18 ³⁷	Improve the ability of nurses to assess the risk of falls in patients and improve patient safety and quality of nursing through a clinical supervision model.	The 132 patients observed during one month. The morse fall scale was applied in 69.2% and the risk of falls was monitored every 48 hours in 98.5% of the cases, whereas in a previous study, only 33% and 84.1% happened respectively.
A19 ³⁸	To describe the development and performance of an automated early warning score (EWS) for electronic medical record data with a view to patient safety.	The early warning score (EWS) performed better than NEWS and eCART. Using the ROC curve, EWS presented an AUC of 0.82, compared to eCART (0.79) and NEWS (0.76).
A20 ³⁹	Explore the usefulness of facilitated communication of medication-related events in identifying system deficiencies, and their relationship between events and the workload of nurses in the ICU.	153 observations were collected from 109 ICU nurses. Medication-related events (MRE) occurred in 35% of the observations, in a total of 60 MRE events. The occurrence of MREs correlated with higher volume of tasks, higher workload, especially at night.
A21 ⁴⁰	Conduct a quality improvement study to evaluate the frequency of medical prescription errors in neonatal ICU, to verify the effectiveness of a patient re-identification intervention using information technology and to use a new naming convention among patients (first mother's name, followed by the letter "S", after the gender of the newborn and the mother's last name).	Over 850,000 prescriptions for Neonatal ICUs and more than 3.5 million prescriptions for Pediatric ICUs were reviewed over a period of seven years of study (2007-2015). The errors were more frequent initially in the Neonatal ICUs. The re-identification intervention reduced the frequency of errors by 48.7% and the combined intervention (new technology + naming convention) reduced the error by 61%.

Figure 5. Synthesis of articles included with their objectives, sample, instrument and results. Porto Alegre (RS), Brazil, 2018.

DISCUSSION

The ICU is associated with the sector of the hospital with a higher incidence of AE, as well as with more serious damages, that is, the sector with the highest risk for patient safety, either by the profile of the patients attended, by the high complexity of care, demand procedures, technologies involved or quantitative.²⁸

There are different approaches in the publications, and there is no consensus as to the best methodology for monitoring these incidents, even in publications with similar AEs, such as medication and communication related.^{20-1,23,27-8,34-6,39-40} It is understood that AEs are fruits of a multifaceted universe and derive from factors related to the work environment, the patient, the

professional, the multidisciplinary team, the institution, its organization and management, the procedures and activities carried out by all those involved.^{20-4,28-9,32,34,36,39}

It should be noted that, when grouping the similar themes, the findings with the greatest number were those of medication AE, corroborating the literature in general that treats the incidents in the medication process as the most prevalent.^{20,23,27-8,34,39-40} It is pointed out that the medication administration process requires a careful evaluation and adoption of several methods to prevent the errors associated with this moment. It is known that the steps of medication administration involve the choice of drug, its distribution, patient identification, standardization of medical prescription and readability, preparation, dilution, administration

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and observation.^{23,27}

It has been described that medication AEs can occur at any stage of the process, however, the most reported in the included articles occurred at the administration and prescription stage.^{23,27} They were associated, even with underreporting of AE, to the greatest number of incidents, intravenous route, night shift, and medications such as norepinephrine, heparin, morphine, insulin and other high vigilance drugs.^{23-4,28,34,39} It is pointed out that, for the monitoring of this type of AE, most of the studies described the voluntary notification with the registry being performed by the nurse.^{24,34} A study was carried out in a Spanish study on the reconciliation of drugs by the pharmacist as an effective strategy for monitoring and managing risks related to medication errors.²⁰

As another issue with similar approaches, communication-related AEs have been chosen because they are an important challenge in relation to safe care and the included studies carry the risk of error related to effective communication, information transfer and care transition.^{21,32,35-6} It should be noted that during the care, several problems related to communication involving the patient or the professional can arise, and for both cases, the solutions for improvement and monitoring of the risks involve a combination of protocols and checklists, constant education and engagement of stakeholders,^{21,35-6} in particular, nurses, for performing key roles in this communication process.³⁵⁻⁶ It was shown by a study in England that, in order to improve the passage of all necessary information and the subsequent retention of the information during multidisciplinary rounds of ICU patients, it was necessary to prepare a checklist adapted to the real needs of the patients, standardizing shared information through the use of an acronym to facilitate team membership.²¹ In another study with Korean nurses, the importance of safety culture and the perception of teamwork regarding the strengthening of self-report of incidents was recorded.³² It is pointed out that nurses' perception of teamwork and the absence of punitive culture of errors, associated to the incentive of learning through them, were shown to be essential for the increase in the index of AE reports.³²

Similar themes were also discussed, strategies for coping with AE and education. It was an article in Saudi Arabia about staff development through an educational program of patient safety where everyone sought to monitor, control and minimize errors. In this research, pre and post-tests were carried out to evaluate the knowledge of the ICU nurses in the field of study on the measures that could contribute to greater patient safety. Additionally, a checklist of procedures to evaluate

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attitudes that could affect safety was found: for each procedure performed, there was a checklist, which were applied before and after the implementation of the education program. In this way, the improvement of the patient's safety results was observed.²⁹

It was found in an American study that education based on the creation of simulated clinical cases using electronic health records improved the use of records and the identification of safety and AE questions.²⁶ In a study carried out in a New York hospital, it was concluded that education based on local risk factors (previously verified) was effective for a greater control and monitoring of AEs.³¹

Electronic systems were also used as tools for monitoring and prevention of AE, delimiting another theme: that of AE detection software.^{25,38} Increasingly, algorithms are being developed for patient safety. It was reported in a study carried out in the United States that the algorithm created for the detection of AE in a university hospital was successful, when compared to the global Trigger Tools method used by the institution, and presented a much higher performance in relation to the detection of AE by means of voluntary notifications.²⁵ In another American study, the performance of an automated early-warning score that identified the highest-risk patients was described in order to streamline care and reduce risk. It is recorded that the automated score presented superior results compared to NEWS and eCART.³⁸

Surveillance of other AEs was found in these studies included in the research, such as risk of falls, patient identification, and infection related to hand hygiene.^{33,37,40} It should be noted that the simple systematic supervision of the process in a Portuguese ICU led to the improvement of this monitoring.³⁷ In relation to identification, a new naming convention was created for newborns at an ICU in the United States, associated with the use of information technology that double-checked and monitored the use of the new convention of patient identification, that the errors were reduced by 61%.⁴⁰ In the Kingdom of Bahrain, the Middle East, as an important factor in monitoring hand hygiene and increasing adherence rates to this fundamental indicator, the use of an electronic system in ICUs, which links the use of alcoholic dispensers, employee badge and software that signals how is the cleaning of the hands of employees of an important hospital complex.³³

CONCLUSION

It is concluded, through the studies analyzed and included in this review, that there is no consensus as to the best method for monitoring adverse events, considering the importance of

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considering all aspects that address the overall management of patient safety, errors and adverse events.

It has been shown that optimal monitoring of adverse events requires a systemic approach in the ICU environment. It is a complex, continuous process with joint methodologies, in which one must learn from the results, anticipate the failures, and the prevention of adverse events turns out to be predictive, strategic and heterogeneous.

Possible limitations of this research are also considered, the low representativity of national studies and the prevalence of studies with a descriptive methodological design, thus being of low level of evidence.

However, it is believed that the use of simplified systems, optimizing information processing through protocols, reinforcing teamwork, assertive communication and education, demystifying adverse events, empowering leaders engaged in the issue and fostering knowledge about this so widespread and at the same time so challenging.

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