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## THE IMPACT OF TECHNOLOGY ON PATIENT SAFETY: A LITERATURE REVIEW

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## INTRODUCTION

Patient safety is considered one of the main indicators of health quality and is defined by the World Health Organization as the absence of avoidable damage during the health care process, in addition to reducing the risk of unnecessary damage to an acceptable minimum. To achieve this goal, the implementation of technologies has been a strategy adopted to improve the quality of health services and reduce harm to the patient. However, it is important to highlight that health technologies can also have harmful effects, such as the emergence of new risks and increased complexity, which can affect the safety of the care provided.

A large part of the technological production is directed towards the practice of care, especially towards innovations related to hygiene, asepsis and medication administration - areas of prominence when it comes to patient safety. Thus, it is essential to discuss technology within the context of patient safety to promote improvements in the health system as a whole. When these two themes are combined, it is possible to optimize service time, perform procedures efficiently, control diseases, manage risks and improve the quality of services provided.

It is necessary to carry out a critical and reflective analysis of the routine use of technological resources in health care. It is also necessary that studies be carried out in the area to support the decision making of managers of health institutions, point out biases and discuss new points that are still little explored. Therefore, the general objective of this work was to discuss the impact of technologies used in nursing care on patient safety.

The research carried out in this work was a qualitative and descriptive literature review. Electronic and physical sources were consulted, such as books, dissertations and scientific articles, including the CAPES

theses and dissertations database and the main databases, such as “SciELO”, “Pubmed” and “Google Scholar”. 23 works published in Portuguese and English in the last ten years that deal with the proposed theme were selected, excluding those that did not contemplate the subject or that covered other areas.

## PATIENT SAFETY

Patient safety consists of reducing risks and unnecessary harm to an acceptable minimum. This subject has been gaining space in discussions in the scientific community and in health services, being fundamental to guarantee the quality of health care (World Health Organization, 2017).

From the 2000s, errors associated with health institutions began to receive greater media attention, after the publication of the report *To err is human* by the Institute of Medicine, which disclosed alarming numbers of deaths caused by medical and care errors (KOHN et al, 2000). This report was a landmark in the patient safety debate and drew attention to the magnitude of the problem.

An error or incident is an event or circumstance that could have resulted, or resulted in unnecessary harm to the patient, whether intentional or unintentional. When they do not affect the patient, or are detected earlier, they are called near miss; when they affect the patient, but do not cause obvious harm, they are called incidents without harm; and when they result in obvious damage, they are called incidents with damage or adverse event (DUARTE et al., 2015). The adverse event (AE) is an unintentional injury or damage that results in disability or dysfunction, temporary or permanent, with prolonged hospitalization time or death as a consequence of the health care provided (BRASIL, 2014).

The World Health Organization created a

program focused on patient safety, responsible for several educational initiatives, research, development of taxonomy and specific tools, and for launching campaigns such as “Hand hygiene” and “Safe surgery saves patients’ lives” (SOUSA; MENDES, 2019). In Brazil, in 2013, the National Patient Safety Program was instituted, through Ordinance No. 529/13 of the Ministry of Health and Resolution of the Collegiate Board (RDC) 36/2013, with the aim of contributing to the improvement of quality of health care in all health facilities in the country (BRASIL, 2014).

One of the actions taken is the notification of adverse events, an important evaluative parameter. A recent report that gathers data on events reported in Brazil from January 2014 to May 2019 pointed to the occurrence of 330,536 events reported in the Notivisa

system, 8,506 of which resulted in harm considered serious to the patient and 1,694 resulted in death ( BRASIL, 2021). These numbers show the need for studies on patient safety.

According to the World Health Organization (WHO, 2017), surgical procedures are responsible for the most common failures (27%), followed by medication errors (18.3%) and infections associated with health services (12.2%). On the other hand, the most recent report on adverse events related to health care in Brazil, referring to the period from September 2020 to August 2021, points out that the most frequent occurrences are pressure ulcers, failures in health care and related failures. to venous catheters, respectively, as shown in figure 1 (BRASIL, 2021).

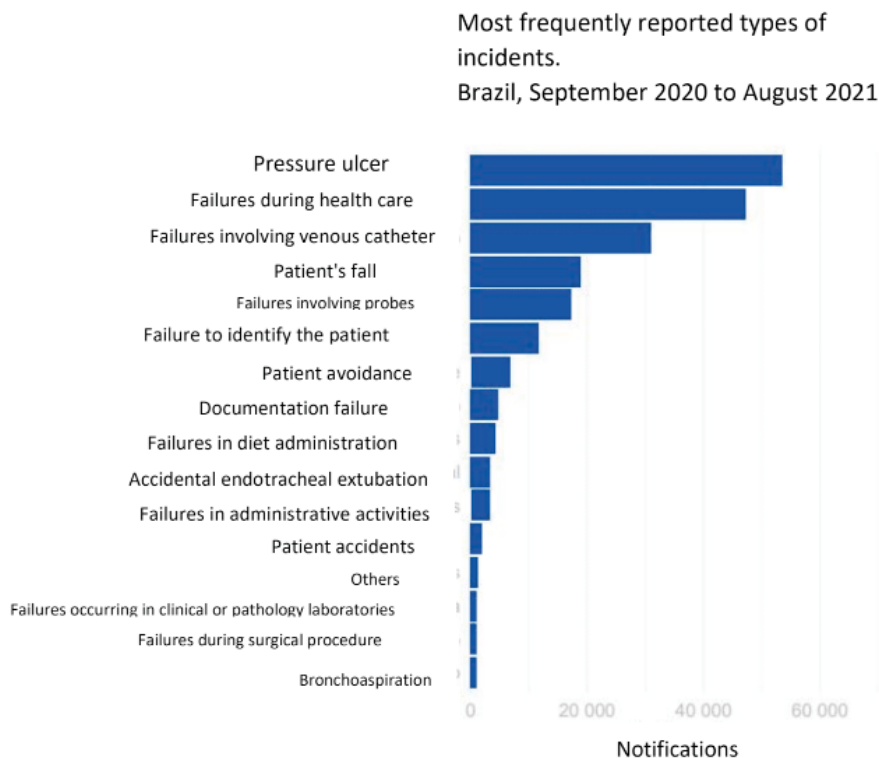


Figure: Types of incidents reported most frequently.

Source: Brazil (2021)

From adverse event reports, it is possible to identify risks in patient care, determine their causes and propose safe practices to reduce these risks and ensure patient safety in health services. A study showed a significant reduction in the occurrence of adverse events in audiovisual documents after the implementation of patient safety campaigns in 2013 (MOURA et al., 2018).

To promote patient safety, the Conselho Federal de Enfermagem has developed a booklet with 10 steps to patient safety, including patient identification, clean and safe care, safe surgery, fall prevention and pressure ulcer prevention. However, for these steps to be effective, it is necessary that the patient safety culture be disseminated and understood throughout the organization (COREN-SP, 2010).

The patient safety culture is a fundamental component to ensure safer and quality care. It is considered one of the pillars of patient safety and favors the implementation of safe practices and the reduction of adverse events. According to RDC nº 36, the safety culture is defined as:

Set of values, attitudes, skills, and behaviors that determine commitment to health and safety management, replacing blame and punishment with the opportunity to learn from failures and improve health care (BRASIL, 2013).

In 2010, Sammer et al. identified seven subcultures that characterize patient safety culture: leadership, teamwork, evidence-based practice, communication, learning, justice, and patient-centered care. It is crucial to continually assess patient safety culture, which is a complex phenomenon, to gauge organizational conditions that can lead to patient harm.

A study carried out in a university hospital evaluated the perception of the health team in relation to the patient safety culture in

12 dimensions. Teamwork was the second most highly evaluated dimension, indicating its importance for patient safety, as lack of cooperation and work overload can be associated with adverse events (COTOVICZ, 2020).

However, the dimension that received the worst evaluation was the non-punitive response to errors, which was identified as a weak area for the patient safety culture. Professionals reported being afraid of a punitive culture in the institution, where they believe that their mistakes can be used against them and are registered in their functional files. A shift in thinking is needed to strengthen the patient safety culture.

Although there have been advances in patient safety, human error is still a worrying factor and episodes of error involving health professionals are often reported by the press, causing great social commotion. Work overload, wage gap in the category and inappropriate physical environment are also associated with the occurrence of adverse events (MOURA et al., 2018).

Patient safety is an increasingly important concern in patient care at all levels of care. Nurses have a number of contributions to ensure patient safety, including hand hygiene, care in the management and administration of medications, identification of risks to patient safety, use of information systems and application of instruments and scales to assess patient safety. patient safety.

In this context, nursing plays a fundamental role with a view to safe and effective care, contributing from educational methods of re-education so that there is a culture of safety to the identification of errors, not as a punitive method, but as an aid to improve safety of the patient. Therefore, the use of technology gains space by facilitating this work and enabling even better services.

## **TECHNOLOGIES USED IN PATIENT SAFETY**

Technological advances are present in all areas, including health. Health technology is composed of products that contribute to the improvement of patient care, such as hospital equipment, health materials, vaccines, medicines, diagnostic tests, prostheses and information systems (GOMES et al., 2017).

The implementation of technologies in the health area is a measure to improve the quality of services provided, reduce harm to patients and favor safety in the care offered, in addition to improving the performance of professionals working in health institutions (GOMES et al., 2017). Therefore, it is important to talk more and more about the subject in order to improve and avoid undesirable impacts.

The National Policy for the Management of Health Technologies, established in 2010 in Brazil, aims to guide professionals in the area on the evaluation, incorporation, dissemination and removal of technologies in health services, ensuring the use of the most appropriate ones (BRASIL, 2010 ). However, it is important to highlight that this policy does not cover the research and development phases, although it can support the identification of priorities in the life cycle of health technologies (BRASIL, 2010).

Most of the technologies produced in the health area are focused on the practice of care, with emphasis on inventions related to hygiene and asepsis and medication administration. This is justified by the search to optimize the service time, effectiveness in carrying out procedures and disease control (KOERICH et al., 2011). Technologies in the health area can be classified as hard technology, represented by materials such as equipment and furniture; soft-hard technology, which includes structured knowledge in disciplines that work in the health area, such as dentistry, clinical medicine and epidemiology; and light

technology, which inserts the production process of communication, relationships and other areas (NIETSCHE et al., 2012).

Technological production in the area of nursing arises from the practical needs of everyday life. However, most products launched on the market for nursing care are not created by health professionals. According to Koerich et al. (2011), 60% of patents for nursing care products are registered by engineering professionals.

An integrative review of the technologies used by nurses to promote patient safety showed that 60% of the analyzed studies focused on incorporating good health practices to promote patient safety, including the construction, validation and adaptation of safety instruments, identification of risks and medications. Cestari et al. (2017) found that 75% of technologies used by nurses for patient safety were soft-hard technologies, emphasizing the importance of health education and improving knowledge and skills.

As for hard technologies, in 58.3% of the analyzed studies, these involve intravenous infusion control devices, hemodialysis equipment, software and computers, mechanical ventilators and cardiac monitors. Gomes et al. (2017) found that 66.7% of the studies related to safety in prescribing, using and administering medications, 50% to effective communication between health professionals, and only 8.3% addressed the importance of reducing the risk of pressure ulcers, despite their high prevalence.

According to Koerich et al. (2011), patents for technological productions registered in the nursing area are led by the user's basic needs related to hygiene and asepsis, representing 36% of patented inventions, followed by patient comfort (12%). This may be related to the fact that these needs require more time and physical effort from the professional. The

study also showed that 28% of inventions were related to medication administration.

Medication administration is a growing area of innovation in partnership with the pharmaceutical industry, due to the high prevalence of medication-related incidents in healthcare services. In this sense, hard technologies have been widely used, such as smart pumps, which identify the specific characteristics of patients and avoid unsafe situations (CESTARI et al., 2017).

In addition, simpler technologies also have a great impact on reducing the occurrence of medication errors. An experience report showed that the construction of a material to guide the nursing team in relation to the preparation and administration of injectable drugs resulted in care, management and educational transformations, in addition to reducing the occurrence of adverse events and fostering the safety culture of the patient (MORAES; ALMEIDA, 2021). This demonstrates the importance of using technologies at all levels in nursing.

An example of hard technology in healthcare is the deployment of electronic health records, which provide a more detailed level for transfer reporting, evaluating administrators, saving costs from reducing medication errors, time spent on documentation, improving nursing records and communication with the team (CESTARI et al., 2017). Furthermore, the use of electronic medical records is associated with improvements in nursing care, care coordination, and patient safety. A study carried out in 316 hospitals in the United States between 2006 and 2007 showed that only 7% had an electronic records system implemented in all patient care units, but that nurses in these hospitals had better results and were less likely to report outcomes unfavorable when compared to those who did not use this technology (KUTNEY-LEE; KELLY, 2011).

Good health practices are also a form of health technology, involving the actions adopted by institutions and their employees to enable the safe and agile identification and resolution of problems, providing better assistance. They can be applied through the construction and validation of several predisposition scales for the occurrence of adverse events, such as the use of checklists and scripts (CESTARI et al., 2017).

A study carried out in three intensive care units in São Paulo evaluated good health practices and compared the units in terms of changing positions, preventing falls, nosocomial infection and other aspects. The units showed important differences in these aspects, but items such as egg crate mattress, patient sitting and raised rails to prevent falls, bed identification, headboard raised above 30°, faucets protected with “luer cone” and diuresis collection bag below the level of the bladder were effective in more than 90% of the institutions (BARBOSA et al., 2014). Based on this, institutions must maintain and improve risk management policies, preventing errors and seeking to improve care.

There are also educational technologies, which are philosophically grounded for the development of the individual and characterized by new theories, teachings, research, concepts and techniques to update education. Health professionals need support in continuing education to stay up-to-date with new guidelines, such as handling modern equipment, administering recent medications, improving care, and working as a team. Nurse training can range from simple hand hygiene to medication administration (CESTARI et al., 2017; NIETSCHKE et al., 2012).

Although it is a basic practice, hand washing is an important strategy for patient safety, preventing infections for both the patient and the professional. A study carried out in Nigeria trained 202 health workers in correct hand



hygiene. After training, the authors found 75.3% adherence to correct hand washing, especially after contact with body fluids and when touching the patient. The adherence rate was higher in nurses, reinforcing that this class stands out in terms of patient safety in various types of care (UNEKE et al., 2014).

On the other hand, more elaborate technologies are also highlighted. The integration of artificial intelligence (AI) into the healthcare system not only changes the dynamics and role of healthcare professionals, it also creates new potential for improving patient safety outcomes and quality of care. Many studies have been carried out to analyze the performance of AI in healthcare, mainly as a diagnostic and prognostic tool. While there is a lack of standardization and heterogeneity in reports, most report a positive impact on their use. When implemented correctly, AI can help increase patient safety by improving error detection, patient stratification and medication management. Future work is still needed for the robust validation of these systems in prospective and real clinical settings to understand how AI can predict safety outcomes in healthcare settings (CHOUDHURY; ASAN, 2020).

Currently, the discussion on the use of technologies aimed at patient safety is wide and there is a considerable importance of nursing in the construction of a body of knowledge directed to this theme to promote quality care. For technologies to be positive for patient safety, health professionals need to receive support from continuing education, seeking to update new guidelines, such as handling modern equipment, ways to administer recent medications, strategies to improve care and teamwork. As highlighted by Cestari et al. (2017) and Nietzsche et al. (2012), nursing training can range from simple hand hygiene to medication administration.

## **IMPACTS OF RESOURCE USE ON PATIENT SAFETY**

Currently, the discussion on the use of technologies in patient safety is wide and the importance of nursing in building a body of knowledge directed to this theme to promote quality care is recognized (COSTA et al., 2016). However, it is essential that health professionals receive support from continuing education to update new guidelines and technologies, as well as strategies to improve care and work as a team (BRASIL, 2010).

The use of technologies in patient safety can bring benefits, but it is necessary to plan and ensure that the financial resources intended for public health are used without prejudice to equity and the principles of universality and integrality of the SUS (BRASIL, 2010). To ensure completeness, the incorporation of new technologies must favor those that are effective and safe, whose benefits outweigh the risks and that benefit everyone who needs them, without jeopardizing the care of other segments of the population. Equity, on the other hand, must be guaranteed by the health technology management process, so that the use of existing resources is distributed effectively and equitably (BRASIL, 2010).

Despite the positive impacts, advanced technology can bring disadvantages, such as unforeseen adverse events in drug therapy, ethical problems, need for constant training and strong financial investment (GOMES et al., 2017). In addition, the insertion of technologies in the health environment can raise concerns about the dehumanization associated with the excessive use of equipment in nursing care.

The interaction between nursing and technology still presents challenges, such as the lack of formal education on health technology and the management of complex technologies that can harm the patient if used incorrectly (RUPPEL; FUNK, 2018). It is important to

consider that most of these technologies are created by people who are not familiar with the nursing workflow. These challenges can increase patient safety risks and cause adverse effects.

According to Ferreira et al. (2019), nurses have a positive view on the use of technologies in health. In a qualitative research carried out in a hospital in the south of Brazil, the participants pointed out that the computerized system contributes mainly to the safe administration of medications, when many errors related to nursing care occur. However, there are some weaknesses that can harm patient safety, such as the eventual unavailability of the system and the lack of adherence of some professionals to the technology.

The use of health technologies not only promotes agility in diagnosis and treatment, but also improves patient safety and increases both patient and nursing staff satisfaction (LEE et al., 2017). Information technology is seen as an important tool by nurses, who perceive its contribution to data management, risk prevention and optimization of checking prescriptions and medication use (FERREIRA et al., 2019). Alotaibi and Frederico (2017) also emphasize the importance of information technology in improving patient safety, but highlight the need to invest in technologies with proven evidence in the health area.

For Alotaibi and Frederico (2017), health information technology improves patient safety, reducing medication errors, reducing adverse drug reactions and improving compliance with practice guidelines. There must be no doubt that health information technology is an important tool to improve health quality and safety, however, health organizations need to be selective in which technology to invest, as the literature shows that some technologies have evidence limited in improving patient safety outcomes

(ALOTAIBI; FEDERICO, 2017).

Lorenzetti et al. (2012) reflect on the implications of technology for the health sector, highlighting its association with the idea of health as a greater good and the impact in the areas of clinical practice, epidemiology, mental health, the cultural dimension of the health-disease process and models of work organization and management. They emphasize that material technological innovations are more evident, but that non-material innovations, such as those related to organization and labor relations, also play an important role.

Lorenzetti et al. (2012) highlight several ethical problems related to the use of technologies in the health area, including the side effects of medications, the excessive medicalization of life, the increase in iatrogenesis, the emergence of resistant bacteria due to the indiscriminate use of antibiotics and the conduct of research involving human beings. It is necessary to carry out a critical analysis of these phenomena, using ethical criteria to minimize their negative effects and prioritizing the use of technologies to solve structural and global problems of humanity. This can contribute to improvements in the health sector and to building a fairer and more sustainable society.

However, it is important to remember that each hospital unit is different and works with specific demands and services, therefore, it is not possible to define a single and ideal model of technological advances to be followed. Each institution must define its investments and approaches according to its situational and regional reality so that technological advances occur appropriately to the service model to which the hospital unit proposes (MOTTA; PONCETTI; ESTEVES, 2019).

Therefore, it is crucial that medical organizations seek continuous improvements and constantly check which technologies are



being used in patient care, evaluating their positive and negative effects. This process can encourage the practice of safe and resolute care, with a reduction in the occurrence of adverse events.

## **FINAL CONSIDERATIONS**

Patient safety is the main concern in nursing, and efforts must be made to avoid adverse effects and promote a culture of patient safety throughout the multidisciplinary team. Nurses must make evidence- and research-based decisions to ensure patient safety.

The use of technologies in health services can be very beneficial to ensure safe care. Although there are many technologies available, it is important that professionals are trained to use them properly, to avoid new adverse effects.

Investing in technology to improve patient safety and work environments is a challenge that requires negotiation and management, but which results in safer healthcare, with greater quality and satisfaction for staff and patients. More research is needed to better understand the topic and establish protocols based on scientific evidence. In addition, with the constant advancement of technology, it is essential to continue monitoring and studying the subject.