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# Information and Communication Technologies in the safety of critically ill patients: a scoping review and anxiety in graduate education

*Las Tecnologías de la Información y Comunicación en la seguridad del paciente crítico: revisión de alcance*

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**Ximena Jaqueline Aguila Estrada**
https://orcid.org/0009-0003-4970-2062
xguilae@unemi.edu.ec
Universidad Estatal de Milagro (UNEMI). Milagro, Ecuador

**Evelyn Adriana Elizalde Ordóñez**
https://orcid.org/0009-0004-0605-3960
eelizaldeo3@unemi.edu.ec
Universidad Estatal de Milagro (UNEMI). Milagro, Ecuador

**Joselin Tatiana Erazo Arévalo**
https://orcid.org/0009-0001-5352-759X
joselina3@unemi.edu.ec
Universidad Estatal de Milagro (UNEMI). Milagro, Ecuador

**Ligia Mercedes Pozo Vargas**
https://orcid.org/0009-0007-3230-8711
lpozov@unemi.edu.ec
Universidad Estatal de Milagro (UNEMI). Milagro, Ecuador

**Jennifer Lissette Ushca Pilco**
https://orcid.org/0009-0004-6876-7299
jushcap@unemi.edu.ec
Universidad Estatal de Milagro (UNEMI). Milagro, Ecuador

## Abstract

The safety of critically ill patients in Intensive Care Units (ICUs) is a top priority due to clinical complexity, physiological instability, the need for constant monitoring, and the high risk of adverse events associated with healthcare. In this context, strategies are needed to strengthen the quality of care and ensure safe and patient-centered care. Information and Communication Technologies (ICT) are essential tools for this purpose, as they facilitate the management of clinical information, optimize interprofessional communication processes, and support decision-making. Furthermore, in the field of nursing, they enable the optimization of care records, strengthen continuity of care, and raise safety standards. Therefore, the objective of this scoping review was to analyze the use of ICT as a tool to enhance the safety of critically ill patients in the ICU. The methodological recommendations of the Joanna Briggs Institute (JBI) and the PRISMA-ScR guidelines were applied, resulting in the selection of a total of 18 studies. The literature search included studies related to electronic health records, telemedicine, digital clinical support systems, artificial intelligence, and advanced monitoring. The results demonstrated that ICTs significantly contribute to critical patient safety by enhancing clinical surveillance, ensuring timely access to information, and supporting clinical decision-making. However, their effective implementation requires healthcare staff training, adequate technological infrastructure, and rigorous consideration of ethical aspects related to data protection.

**Keywords:** Information and Communication Technologies, patient safety, critical care.

## Resumen

La seguridad del paciente crítico en las Unidades de Cuidados Intensivos (UCI) constituye un desafío prioritario debido a la complejidad clínica, la inestabilidad fisiológica, la necesidad de vigilancia permanente y el alto riesgo de eventos adversos asociados a la atención sanitaria. En este contexto, se requieren estrategias para fortalecer la calidad asistencial y garantizar un cuidado seguro y humanizado. Las Tecnologías de la Información y la Comunicación (TIC) representan herramientas fundamentales para este fin, ya que favorecen la gestión de la información clínica, optimizan los procesos de comunicación interprofesional y apoyan la toma de decisiones. Asimismo, en el área de enfermería, permiten optimizar los registros asistenciales, fortalecer la continuidad del cuidado y elevar los estándares de seguridad.

Por ende, el objetivo de esta revisión de alcance fue analizar el uso de las TIC como herramienta para fortalecer la seguridad del paciente crítico en la UCI. Se aplicaron las recomendaciones metodológicas del Joanna Briggs Institute (JBI) y las directrices PRISMA-ScR, seleccionando un total de 18 estudios. La búsqueda bibliográfica abarcó investigaciones relacionadas con la historia clínica electrónica, telemedicina, sistemas digitales de apoyo clínico, inteligencia artificial y monitorización avanzada. Los resultados evidenciaron que las TIC contribuyen significativamente a la seguridad del paciente crítico mediante una mejor vigilancia clínica, el acceso oportuno a la información y el soporte a la decisión médica. Sin embargo, su implementación efectiva requiere la capacitación del personal sanitario, una infraestructura tecnológica adecuada y la consideración rigurosa de aspectos éticos vinculados a la protección de datos.

**Palabras clave:** Tecnologías de la Información y Comunicación, seguridad del paciente, cuidados críticos.

## Introduction

Critical care represents one of the most complex scenarios within health systems, owing to the severity of patients' clinical conditions, the field's heavy reliance on technology, and the need for rapid, precise intervention. Intensive care units require well-organized care processes capable of reducing risk and preventing adverse events associated with clinical practice. Patient safety, in turn, is an essential component of care quality, particularly in critical-care settings, where sudden clinical changes can carry serious consequences.

Humanized care remains an indispensable component of this process, since the incorporation of technology should complement, rather than replace, the therapeutic relationship between healthcare staff and patients (Guachi Caiza et al., 2025). Information and Communication Technologies (ICT) applied to healthcare encompass clinical information systems, electronic health records, digital platforms, telemedicine, and patient-monitoring tools, all of which help organize clinical data more effectively, facilitate interdisciplinary communication, and support timely clinical decision-making.

According to Regaira Martínez and Vázquez Calatayud (2020), the implementation of digital tools in intensive care can strengthen patient safety through continuous monitoring, early risk identification, and a reduction in care-related errors. Their use, however, calls for adequately trained staff and institutional strategies that ensure technology is applied safely, efficiently, and ethically.

Accordingly, this article set out to examine the available scientific evidence on the use of Information and Communication Technologies as a means of strengthening critical patient safety in the intensive care unit. Scoping reviews are particularly well suited to this kind of inquiry, as they make it possible to identify the key characteristics, concepts, and findings relevant to a given field of knowledge, following structured methodologies such as those proposed by the Joanna Briggs Institute and reported in accordance with PRISMA-ScR (Tricco et al., 2018).

This scoping review therefore aims to examine the use of Information and Communication Technologies as a tool for strengthening critical patient safety in the intensive care unit.

## Methodology

A scoping review was conducted to identify, analyze, and synthesize the available scientific evidence on the use of Information and Communication Technologies (ICT) as a tool for strengthening critical patient safety in intensive care units (ICUs). The review followed the methodological guidance of the Joanna Briggs Institute (JBI) for scoping reviews and was reported in accordance with the PRISMA-ScR extension (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews), ensuring transparency, methodological rigor, and reproducibility throughout the search, selection, and analysis phases.

The research question was structured using the PCC framework (Population, Concept, and Context). The population comprised critically ill adult patients hospitalized in intensive care units and the healthcare professionals involved in their care, particularly nursing staff. The concept under study was the use of Information and Communication Technologies applied to critical patient safety, including tools such as electronic health records, digital clinical information systems, telemedicine, tele-ICU, advanced monitoring, early warning systems, and artificial intelligence applied to critical care (Alruqi et al., 2024).

The context was defined as public and private hospital intensive care units, considering studies published between 2020 and 2025 in Spanish and English. The guiding research question was: how does the use of Information and Communication Technologies (ICT) contribute to strengthening critical patient safety in the intensive care unit? On this basis, the analysis criteria were established to identify the main technological tools used in critical-care settings, their benefits for preventing adverse events, and their influence on the quality and safety of care provided by healthcare professionals (Alzu'bi et al., 2021).

The literature search was carried out in recognized health-sciences databases, including PubMed/MEDLINE, Scopus, Web of Science, CINAHL, SciELO, and LILACS. Gray literature (academic documents, institutional reports, and publications related to patient safety, health technologies, and critical care) was also considered. The search strategy used standardized descriptors from DeCS (Health Sciences Descriptors) and MeSH (Medical Subject Headings), combined through the Boolean operators AND and OR. The main terms employed were "Information and Communication Technologies," "Health Information Systems," "Electronic Health Records," "Patient Safety," "Critical Care," and "Intensive Care Units," which broadened the retrieval of studies related to the application of ICT in critically ill patients.

Eligible studies were those addressing the use of ICT and critical patient safety in the ICU, including quantitative, qualitative, and mixed-methods designs, systematic reviews, and integrative reviews, published between 2020 and 2025, available in Spanish or English, and accessible in full text. Studies conducted outside the critical-care setting, duplicate articles, editorials, letters to the editor, studies lacking sufficient scientific evidence, and publications with limited methodological relevance to the stated objective were excluded.

Study selection proceeded through a progressive review of titles, abstracts, and full texts, applying the previously established inclusion and exclusion criteria. The selection process followed the phases recommended by PRISMA-ScR: identification, screening, eligibility assessment, and final inclusion of studies. The information obtained was then organized in a data-extraction matrix that recorded author, year, country, methodological design, study population, type of technology used, main findings, and identified limitations.

**Figure 1.** *PRISMA-ScR flow diagram of the study selection process.*

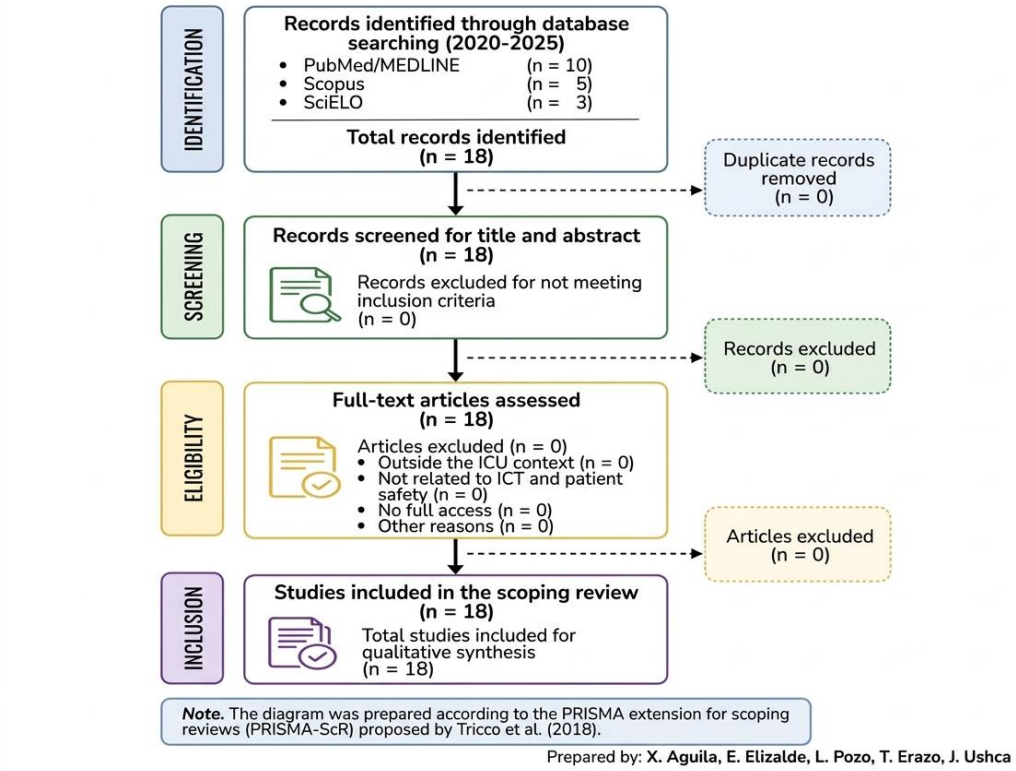



**Table 1.** *General characteristics of the included studies.*

| No. | Authors | Country | Design | Technology analyzed | Main findings |
|---|---|---|---|---|---|
| **1** | Chariguamán & Franciso-Pérez (2024) | International | Scientific review | Patient safety | According to nursing professionals, patient safety in the ICU is strengthened through safety protocols |
| **2** | Ibujés Pozo (2026) | International | Scientific review | | ICT improve the quality of care in terms of patient safety, communication channels, resource optimization, and other areas. |
| **3** | Suárez Lima et al., (2026) | International | Scientific review | Telemonitoring | Telemonitoring can improve clinical surveillance, facilitate the detection of physiological changes, and support safer care. |

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| **4** | Ramírez Ochante et al. (2026) | Peru | Scientific review | TeamSTEPPS™ training program, SBAR toolkit, and adapted communication tools (whiteboards, pictograms) | Clinical simulations, escape rooms, and workshops proved successful, yielding improvements in leadership, teamwork, and adverse-event reporting |
| **5** | Guachi Caiza et al. (2025) | Ecuador | Scientific review | Communication tools | Promoting training in humanized care and skills to strengthen therapeutic communication and improve the experience of both patients and ICU staff |
| **6** | Jiménez Darias (2025) | International | Scientific review | Digital health tools | Double-checking procedures, technologies such as electronic prescribing, and the active involvement of nursing staff in safety strategies are key to reducing the incidence of this problem. |
| **7** | Regaira Martínez & Vázquez Calatayud (2020) | Spain | Descriptive study | ICT | ICT use remains limited among nursing professionals and tends to decline with age, largely due to gaps in knowledge. |
| **8** | Nin-Vaeza et al. (2024) | Ecuador | Quantitative study | AI and critically ill patients | AI contributes to the management of critically ill patients |
| **9** | Guan et al. (2024) | International | LASSO regression | Machine learning (ML) | A machine learning model was developed to predict the risk of NOAF in critically ill patients as a reliable tool. |
| **10** | Cajas et al. (2025) | International | Scientific review | ICT in nursing | Artificial intelligence–based systems and digital monitoring reduce adverse events |
| **11** | Cadillo-Morales et al., 2024 | Spain | Integrative review | ICT and training | Technology alone does not guarantee safe care, as it |

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| | | | | | must be integrated with organizational processes |
| **12** | Cajas-Jácome (2025) | Ecuador | Systematic review | Technology applied to critical care nursing | Improves surveillance and the efficiency of care |
| **13** | García et al. (2022) | Latin America | Scientific review | Patient safety tools | Digitalization reduces care-related risks |
| **14** | Alzu'bi et al. (2021) | International | Methodological review | Electronic health record | Improves data quality and clinical decision-making |
| **15** | Cervera & Goussens (2024) | International | Scientific review | Artificial intelligence and digital monitoring | Predictive models support the early detection of complications |
| **16** | Ibujés Pozo (2026) | International | Scientific review | Information technology in critical care | Digital systems optimize continuity of care |
| **17** | Martínez-Royert et al. (2025) | Venezuela | Scientific review | Technology in critical care | Supports safer care processes |
| **18** | Folha Scucuglia et al. (2026) | International | Qualitative study | Technology in critical care | Technical competence and attentiveness improve care practices |

**Note.** Prepared by the authors based on the data-extraction matrix.

## Results

The use of Information and Communication Technologies in intensive care units is an effective strategy for strengthening critical patient safety. Digital tools improve monitoring, optimize the management of clinical information, and support the early detection of complications.

The evidence reviewed points to clear benefits associated with the use of electronic health records, advanced monitoring systems, tele-ICU, and artificial intelligence; their implementation, however, requires ongoing staff training, adequate infrastructure, and institutional policies aimed at ensuring safe and ethical use.

Nursing professionals thus play a fundamental role in integrating these technologies into critical care, given their direct involvement in patient surveillance, clinical data interpretation, and adverse-event prevention. It therefore becomes essential to strengthen continuing-education programs in digital competencies for critical-care nursing staff.

It is likewise advisable to implement institutional protocols that incorporate digital tools for the prevention and early detection of adverse events, ensuring the maintenance, updating, and security of hospital technology systems, and to promote multicenter research evaluating the real impact of ICT on patient-safety indicators, all from an ethical, humanized approach to technology implementation within the ICU.

## Conclusions

In a sample of 393 graduate students, daily Internet use was significantly associated with the distribution of anxiety levels, $\chi^2(8) = 42.80$, $p < .001$. The strength of the association was low to moderate (Cramér's V = 0.233), indicating that connection time is a related factor but not the sole determinant of emotional distress. The evidence does not support the inference that Internet use causes anxiety, nor that individuals with longer connection times necessarily engage in problematic use.

The pattern observed was heterogeneous. Moderate anxiety was relatively more prevalent in the three-to-four-hour group, whereas severe and extremely severe levels were concentrated mainly among those using the Internet for more than four hours a day. This distribution underscores the need to assess not only the duration of digital use but also its purpose, quality, and degree of interference with daily functioning. University wellness programs could incorporate digital-hygiene strategies, academic workload management, sleep education, and timely, confidential referral pathways to psychological counseling.

Future studies are encouraged to employ probabilistic or multicenter samples, validated instruments specific to problematic Internet use, analyses adjusted for sociodemographic variables, and longitudinal designs. Furthermore, the final version submitted to a journal should include the corresponding ethical approval and keep the anonymized dataset and analytical protocol available to support scientific traceability. These improvements will help delineate more precisely the modifiable factors linked to anxiety and promote the healthy use of digital technologies among graduate students.

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