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AI for patient safety: tools that monitor data in real time.

to identify clinical problems

AI for patient safety: tools that monitor data in real time to identify clinical problems.

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Summary

Artificial intelligence applied to patient safety utilizes tools capable of monitoring clinical data in real time, integrating information from electronic medical records, vital signs, and laboratory results. These systems identify risk patterns and alert healthcare professionals to changes that may indicate adverse events, such as infections, falls, or medication errors. Continuous analysis allows for faster and more accurate decisions, reducing diagnostic delays and increasing the efficiency of interventions. Furthermore, machine learning algorithms improve with use, enhancing predictive capabilities and personalizing care.

However, its implementation requires data protection, clinical validation, and staff training to ensure safe and ethical use. Thus, AI becomes a strategic ally in preventing harm and improving the quality of care.

Keywords: artificial intelligence, patient safety, real-time monitoring, adverse events, machine learning.

Abstract

Artificial intelligence applied to patient safety uses tools capable of monitoring clinical data in real time, integrating information from electronic health records, vital signs, and laboratory results. These systems identify risk patterns and alert healthcare professionals early to changes that may indicate adverse events such as infections, falls, or medication errors. Continuous analysis enables faster and more accurate decisions, reducing diagnostic delays and increasing the effectiveness of interventions. In addition, machine learning algorithms improve over time, enhancing prediction and personalized care.

However, implementation requires data protection, clinical validation, and staff training to ensure safe and ethical use. Therefore, AI becomes a strategic ally in preventing harm and improving care quality.

Keywords: artificial intelligence, patient safety, real-time monitoring, adverse events, machine learning.

Introduction

Patient safety has become one of the main pillars of quality in healthcare.

in recent decades, driven by international recognition that events

Adverse factors represent a significant cause of preventable morbidity and mortality. Environments

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Healthcare providers deal with great complexity, a high turnover of information, and
Multiple professionals are involved in care, which increases the risk of errors.
related to diagnosis, treatment, and clinical monitoring. In this context, the
The need for strategies capable of anticipating risks and supporting decisions in a more...
fast and accurate (Moura et al., 2025). Artificial intelligence (AI), previously restricted to
In technological and industrial contexts, it has come to occupy an increasingly important space in the health field.
by demonstrating the potential to analyze large volumes of data and identify patterns.
hidden and generate real-time alerts, contributing to the prevention of damage to
patient.

The expansion of electronic health records, continuous monitoring systems, and...
The digitization of hospital processes has created a favorable environment for the use of AI.
The amount of data produced by a single patient can include vital signs, tests.
Serial laboratory tests, diagnostic images, clinical evolution, and medication records.
For healthcare teams, interpreting this information in an integrated and continuous way is a
Challenge in intensive care units, emergency rooms, and high-risk sectors.
Complexity. AI-based tools can process structured and unstructured data.
structured, recognizing trends that precede clinical deterioration. Therefore
In this way, algorithms can identify signs of sepsis and the risk of cardiac arrest.
cardiorespiratory injuries, falls, medication errors, or postoperative complications.
allowing for faster and more effective interventions.

Another relevant aspect is the continuous learning capacity of AI systems.
Unlike rigid protocols, machine learning algorithms
They improve their performance as they receive new data, becoming more accurate.
This reduces the likelihood of false alerts and increases the teams' confidence in their system.
The integration of these tools does not replace clinical judgment, but...
It functions as additional support to reduce the cognitive overload of professionals.
In high-pressure environments with multiple simultaneous demands, AI contributes to this.
to transform a reactive incident response model into a proactive model,
focused on prevention and anticipation of risks.

However, incorporating AI into patient safety requires attention to challenges.
Important. Protecting sensitive data is fundamental, considering that systems
Healthcare professionals handle personal and confidential information. Furthermore, algorithms...

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They need to be clinically validated before widespread adoption, ensuring that they are
Safe, effective, and applicable to different population profiles and care contexts.
Another critical point is the risk of algorithmic biases, which can arise if the data
The individuals used in training may not represent the diversity of patients. To mitigate
Given these risks, healthcare institutions must adopt transparent, standardized processes.
and based on scientific evidence, involving ethics committees, teams
multidisciplinary approaches and continuous performance evaluation.
Successful implementation also depends on the engagement and empowerment of
professionals. The introduction of new technologies can generate resistance when
perceived as threatening or complex, if it results in an increase in tasks or
Abrupt changes in workflow. Training programs should emphasize that
AI acts as a support tool and not as a substitute for clinical knowledge. Furthermore...
Furthermore, it is necessary to ensure that the alerts generated are relevant and actionable.
avoiding what is known as "alarm fatigue," a situation in which excessive notifications can
to be ignored. The harmonious integration between technology and healthcare practice requires
planning, monitoring and gradual adjustments (Lopes et al., 2025).
Despite the challenges, the potential benefits of AI in patient safety are...
recognized (Klingelfus, 2025). International studies demonstrate a reduction in events.
adverse events, improved early detection of clinical deterioration, and a decrease in errors.
Prescription and greater efficiency in resource allocation. In a health system
pressured by increasing demands, financial constraints, and the need for care.
With more personalized solutions, AI emerges as a strategic ally. Its application allows for targeted marketing.
attention to patients at higher risk, optimizing team time and strengthening a
A safety culture based on prevention, learning, and decision-making.
informed (Moura et al., 2025).
Therefore, the use of artificial intelligence in patient safety does not
It represents not only a technological innovation, but a structural advancement in the way...
Care is conceived and executed (Santos, 2024).
As systems become more precise, ethical, and integrated, the possibilities expand.
possibilities for transforming data into applicable knowledge, promoting a
Safer, more efficient, and patient-centered care. Therefore, understanding your
Functioning, potential, and challenges are essential to guide its implementation.

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responsible and sustainable, ensuring that the benefits of technology translate into real improvements in the quality of care and in the prevention of harm in different health contexts.

Theoretical Framework

The discussion about patient safety gained worldwide prominence starting in the 1980s. 2000, following the publication of the report "To Err is Human," which highlighted the impact of Adverse events have impacted hospital mortality and healthcare system costs. Since So, international organizations like the World Health Organization began to... to guide policies and strategies aimed at reducing healthcare errors, strengthening Surveillance practices, safety culture, and continuous risk monitoring. No However, even with structural advances, the increasing complexity of care and the The increasing number of patients with multiple comorbidities continues to challenge the The ability of services to identify situations of clinical deterioration. This scenario This highlights the need for innovative solutions capable of providing more effective answers. quick and assertive, incorporating artificial intelligence as a promising resource in Strengthening patient safety (Jorge et al., 2025).

The digital transformation of the healthcare sector has contributed to this movement. The adoption of electronic health records, automated prescribing systems and platforms of Monitoring has increased the availability of clinical data. However, the simple The existence of this information does not guarantee its effective use for decision-making. decision. Healthcare professionals face a large volume of records, often fragmented, updated at different times and distributed across multiple platforms. In high-demand environments, such as emergency rooms and intensive care units. In an intensive field, interpreting all these variables can be unfeasible. Artificial intelligence It emerges as an alternative capable of integrating real-time data and recognizing patterns. complex and generate early warnings that help prevent adverse events, contributing to safer and more efficient care.

In the clinical context, AI-based tools are already being used to identify specific risks, such as sepsis, respiratory failure, and cardiorespiratory arrest, with the ability to detect subtle changes before they become clinically evident. This type of continuous monitoring reduces reliance solely on observation.

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It is humane and reduces the time between patient deterioration and necessary intervention.
Furthermore, intelligent systems can track vital sign trends and adjust
Alert thresholds according to individual profile and prioritize patients who need
immediate evaluation. This change represents a significant step forward compared to...
Traditional models, which are based on the reactive detection of problems after the...
worsening of the clinical picture.

Another relevant element is the applicability of AI in different stages of care. In
Medication management: algorithms can identify dangerous interactions and dosages.
Inadequate and redundant therapies. In infection control, the analysis
Automated epidemiological data processing allows for the recognition of hospital outbreaks with
greater speed, reducing transmission and complications. In fall prevention,
Sensors and intelligent systems analyze patterns of mobility and behavior.
estimating individual risks and guiding targeted interventions. These are examples.
They demonstrate that AI does not act in isolation, but as part of a network of
Integrated strategies that enhance the responsiveness of teams and strengthen
Institutional patient safety programs.

However, the use of advanced technologies requires attention to structural and ethical issues.
Data quality is a determining factor in the performance of algorithms;
Incomplete, inconsistent, or non-standardized records can compromise...
results and generate misinterpretations (Lopes et al., 2025). Furthermore, the
Excessive reliance on automated systems can create a false sense of security.
when not accompanied by adequate clinical supervision. Another critical point involves
privacy and confidentiality of information in countries that follow strict laws
Data protection, such as the General Data Protection Law in Brazil. Implementation
Ethics requires transparency in the criteria used by algorithms, and scientific validation.
and ongoing audit mechanisms to prevent bias and ensure equity in care.
(Moura et al., 2025).

In Brazil, the adoption of artificial intelligence in healthcare still faces challenges.
important issues related to technological infrastructure, inequalities between services
public and private issues and connectivity limitations in remote regions. Despite this,
National initiatives have made progress in digitizing processes and integrating...
systems, creating opportunities for expanding the use of smart tools

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focused on patient safety. Telehealth programs, interoperability and
Hospital computerization favors the construction of broader databases and
reliable, essential for training and improving algorithms. As
As these transformations consolidate, the potential for using AI as part of [something] grows.
Institutional strategies for quality and safety, contributing to the reduction of incidents.
adverse events, optimize resources, and promote more preventative and patient-centered care.
patient (Klingelfus, 2025).

Thus, the current context reveals that artificial intelligence is not just a trend.
technological, but a response to the growing demands for safer care,
efficient and evidence-based (Santos, 2024).

Its application in patient safety is related to the capabilities of the systems to
health: transforming data into useful knowledge, anticipating risks, and supporting decisions.
integrated clinics. The continuous advancement of these technologies, combined with training.
professional and proper regulation represents a fundamental step towards
to consolidate a new care approach based on harm prevention and on
Continuous improvement in the quality of care.

Methodology

This analysis was developed following a descriptive and qualitative design.
focusing on the identification and interpretation of information available in the literature about
the use of artificial intelligence tools applied to real-time monitoring
For patient safety, a problem and scope definition was performed.
thematic to ensure that the study remained restricted to the proposed objective,
considering technologies capable of detecting clinical risks and supporting decisions
preventive measures in healthcare settings. Based on this delimitation, a...
structured search strategy, including terms related to intelligence
artificial intelligence, continuous monitoring, adverse events, and patient safety, in order to
to ensure comprehensiveness and consistency in the selection of sources.

Data collection was carried out through a literature review in recognized databases.
including PubMed, SciELO, and Google Scholar, prioritizing articles published between 2015 and
2024 to ensure the information is up-to-date. Original studies were included,
systematic reviews, institutional guidelines, and documents from health organizations

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that addressed the application of artificial intelligence in clinical contexts. Works that
They dealt with other digital technologies, without integration with real-time monitoring.
In reality, some were excluded. The initial screening considered titles and abstracts, and the full reading was not reviewed.
The selection of texts allowed us to assess their relevance to the central theme.
After selecting the sources, the next step was to organize and categorize them.
contents. The data were grouped into defined thematic areas, involving
Clinical applications of AI, types of tools used, observed benefits,
limitations and implementation challenges. This step allowed for the identification of patterns.
recurring and relevant differences between the studies analyzed. The treatment of
The information was gathered through content analysis, seeking to interpret not only
the results presented, but also the contexts in which the technologies were
applied and their implications for patient safety.
To ensure methodological rigor, reliability and validity criteria were adopted in
Data interpretation. Aspects such as the type of design of the were considered.
studies included, sample sizes, algorithm validation methods and
Indicators used to measure clinical impact, such as event reduction.
adverse effects, response time, and improved diagnostic accuracy. Furthermore, there were...
taking into account possible limitations of the studies themselves, such as reliance on databases.
limited data, heterogeneity in the populations analyzed, and variation in parameters
monitoring methods were used. A critical analysis of these variables allowed for contextualization.
to analyze the findings and reduce interpretive biases.
The discussion of the results was constructed in an integrative way, relating the data.
raised against the current scenario of healthcare practice and with recommendations of
security measures established by national and international institutions were sought.
to understand how the available evidence supports the use of AI as
a tool to support the early detection of risks and the factors that influence them.
Applicability in different care settings. Ethical, regulatory and...
Operational factors were also considered, as they interfere with adoption and...
effectiveness of technologies.
Finally, the methodology adopted allowed for the synthesis of relevant and up-to-date information.
offering a structured view of the impact of artificial intelligence on security
patient. Although the analysis was based on available literature, it is acknowledged that

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Future studies with primary data collection, multicenter evaluation and
Longitudinal monitoring can broaden the understanding of performance.
These tools are useful in real-world scenarios. Even so, the procedures adopted ensure...
consistency and foundation for the reflections presented, contributing to providing a basis.
Discussions and support for decisions regarding the responsible and strategic use of AI in practice.
assistance.

Results

The analysis of the selected studies revealed that the use of intelligence tools
Artificial intelligence systems geared towards real-time monitoring have demonstrated an impact.
significant for patient safety in different care settings. Most
The publications described results related to the early detection of deterioration.
clinical aspects, with emphasis on the early identification of sepsis and cardiac arrest.
Cardiorespiratory and respiratory failure (Moura et al., 2025). In several studies,
Algorithms were able to recognize subtle physiological changes between 2 and 12 hours.
before evident clinical manifestations appear, allowing for faster interventions and
increasing survival rates. This finding reinforces the potential of AI in
Transforming reactive models into preventative strategies in high-demand sectors.
complexity (Lopes et al., 2025).
Another recurring result was the reduction of adverse events associated with errors in
medication and failures in conventional monitoring. Intelligent systems integrated into
Electronic prescriptions have shown a decrease of up to 30% in drug interactions.
dangerous and involving therapeutic duplications. Furthermore, platforms that cross-referenced data
Vital signs, laboratory tests, and clinical alerts demonstrated greater accuracy in
Identifying high-risk patients, reducing false positives and preventing
Team overload. Studies have also reported improvements in continuity of
Be careful, since the real-time alerts facilitated communication between
professionals working shifts with lower staff availability (Jorge et al., 2025).
Regarding the performance of the algorithms, significant variation was observed between the
The models used. Machine learning-based tools presented
superior sensitivity when compared to fixed rule systems in scenarios with
A large amount of data. However, specificity still proved to be a challenge.

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In some studies, when the algorithms were applied to populations distinct from
used in initial training. This difference highlights the need for validation.
External and local adaptation prior to widespread implementation. Multicenter studies.
They emphasized that the performance of the tools depends on the quality, frequency, and
Standardization of data entered into the system.

The results also highlighted significant operational benefits. Institutions that
Those that adopted AI-mediated continuous monitoring reported a reduction in average time.
Response from the teams, reduction of unnecessary hospitalizations in units of
Intensive care and better distribution of healthcare resources (Klingelfus, 2025). In
In some cases, there was a drop of up to 15% in the hospital readmission rate, attributed to...
Early identification of complications after discharge. In addition, environments with overload.
Healthcare providers, such as emergency services, demonstrated a greater capacity for prioritization.
of cases, avoiding delays in critical care. These results suggest that, in addition
In addition to security, AI can contribute to organizational efficiency and sustainability.
services.

Despite the benefits, the analysis revealed important limitations. Part of the studies
highlighted difficulties related to integrating the systems with existing platforms.
existing, which resulted in inconsistencies in data transmission and delays in
generating alerts. Another critical point was the initial resistance from professionals, in
institutions without a consolidated culture of technological innovation. In some contexts, the
The occurrence of excessive alerts led to fatigue and a devaluation of notifications.
compromising the real impact of the tools. Few studies have addressed the results.
long-term studies or assessed effects on vulnerable populations, such as frail elderly people and
patients with multiple comorbidities.

Finally, there was a consensus among the publications that the successful adoption of
AI tools depend on gradual implementation, continuous training, and
Monitoring performance after deployment. The results indicate that, when
Integrated in a structured way and accompanied by clear protocols, the technologies
Real-time monitoring contributes to damage prevention and decision-making.
Clinical decision-making and the improvement of healthcare quality indicators. Although still
Despite technical and ethical challenges, the synthesized findings demonstrate that intelligence

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artificial intelligence represents a promising and expanding strategy for strengthening the...
Patient safety in different care settings.

Discussion

The results presented demonstrate that the application of artificial intelligence in
Real-time monitoring has significant potential to transform security.
of the patient, but they also reveal important challenges that need to be considered.
before its widespread adoption. Early detection of clinical deterioration, noted as
One of the main benefits reinforces the shift from a reactive model to a
A preventative approach, allowing for early interventions and a greater likelihood of success.
favorable outcomes (Moura et al., 2025). However, although studies indicate
Significant reductions in adverse events and improvements in healthcare response, effectiveness
The effectiveness of these tools depends on the quality of the data used and the capacity
institutional goal of integrating technology into existing processes (Santos, 2024).
One of the central points observed in the literature is that the performance of the algorithms
It varies depending on the context in which they are applied. Models trained on populations
Specific scenarios may exhibit reduced accuracy when implemented in certain contexts.
distinct, which reinforces the need for external validation, local adaptation and
Continuous monitoring after deployment. This aspect highlights that AI should not
It cannot be understood as a universal solution, but as a technology that requires constant review.
Updating and aligning with the characteristics of each health service. Furthermore, the risk
The presence of algorithmic biases remains a relevant concern when banks...
The data used for training do not represent the diversity of patients, which
This can lead to disparities in care and compromise fundamental ethical principles.
(Lopes et al., 2025).
The discussion also highlights that the incorporation of AI cannot be dissociated from...
human intervention. Although real-time monitoring systems reduce human intervention.
While cognitive overload can help prioritize appointments, it does not eliminate the need for it.
The need for clinical judgment. In some studies, the occurrence of excessive warnings
This led to team fatigue, decreasing adherence to recommendations and compromising the...
effectiveness of the tools. This finding reinforces that implementation should be
accompanied by gradual adjustments, proper parameterization, and periodic review of

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Alert thresholds to avoid unnecessary interruptions in routine care. A
The involvement of professionals from the initial stages of the process is fundamental for
Increase acceptance, reduce resistance, and promote safe and collaborative use.
Another relevant aspect involves infrastructure and technological inequalities. Institutions
with fragmented systems, limited connectivity, or lack of electronic health records.
They have greater difficulty integrating AI platforms, which may increase
Disparities exist between healthcare services. In the Brazilian context, this reality is evident.
since many hospitals are still in the process of digitizing and standardizing
data. Thus, the advancement of AI depends not only on technological development,
but also structural investments, consistent public policies and
Interoperability between systems. The most successful implementation observed in
The studies took place in environments with a consolidated culture of quality and safety, workflow.
organized care and trained teams to interpret and respond to
generated information (Klingelfus, 2025).
The discussion also points out that, although immediate benefits are identified, there are still...
There is a lack of evidence regarding long-term impacts. Few studies have assessed the...
continuity of results after months or years of use, nor did they explore the effects on
vulnerable groups, such as frail elderly people or patients with multiple disabilities.
comorbidities. This point suggests a need for multicenter research and evaluations.
longitudinal and comparative studies that allow for a better understanding of
The behavior of algorithms in real-world scenarios, not just in environments.
controlled. Furthermore, the lack of standardization in the indicators used makes it difficult.
The comparison between studies limits the possibility of generalizable conclusions (Jorge et al., 2025).
Despite these limitations, the findings discussed indicate that AI represents progress.
important for patient safety, especially when integrated in a way
strategic and ethical. Its value lies not only in its ability to identify risks, but
also in supporting decision-making, optimizing resources and strengthening a culture
Preventive. Technology, however, does not replace the complexity of human care, but
It complements clinical practice by expanding observation capabilities, reducing delays, and...
to offer data-driven support. Thus, the discussion reinforces that responsible adoption
The future of artificial intelligence must balance innovation, security, and scientific evidence.

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ensuring that its benefits translate into real improvements in care and in
patient protection.

Conclusion

The analysis carried out throughout this study showed that Indigenous School Education in
Brazil has undergone transformations resulting from both political changes and...
growing mobilization of the indigenous peoples themselves. The results indicate that, although
the school has been used as an instrument of cultural assimilation and erasure.
Regarding identity, the contemporary scenario reveals a redefinition of this space, which is undergoing
to act as a tool for cultural strengthening, community autonomy and
recognition of rights.

Based on the 1988 Federal Constitution and the specific policies that were consolidated
In the following decades, bilingual and intercultural education ceased to be just one
The claim became an official guideline. However, the findings indicate that the
The implementation of these guarantees still faces significant obstacles, such as a lack of
adequate materials, insufficient training of indigenous teachers, bureaucratization of
educational processes and regional disparities. Even so, it is observed that the presence
The growing number of indigenous teachers and the expansion of decision-making spaces represent
key milestones for consolidating an educational model aligned with
sociocultural realities of each people.

The data analyzed also demonstrate that the “encounters”, movements and articulations
The input of indigenous and pro-indigenous organizations was crucial in shaping proposals.
alternative pedagogical approaches, capable of breaking with homogeneous and integrationist logic.
which marked previous periods. These processes reinforce that education, when
Built in a participatory manner, it has the potential to act not only as
transmission of school knowledge, but as a practice of resistance, memory and
historical continuity.

Given this scenario, it can be concluded that Indigenous School Education is in...
It is a constant process of construction and depends on continuous efforts from the State and institutions.
formative and, above all, of the indigenous communities themselves. The achievements obtained so far
The current situation does not negate the existing challenges, but it demonstrates that real progress is being made.
possible when education is recognized as a specific right and not as

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instrument of cultural framing. Thus, it is reaffirmed that the strengthening of Differentiated public policies, combined with indigenous leadership, are essential for to ensure that the school continues to be a space of autonomy, diversity, and justice. social.

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