

Use of artificial intelligence to prevent aggressions against health professionals

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Abstract

The alarming rise in assaults against healthcare professionals is a public health and occupational issue that threatens staff well-being and care quality. Violence in this sector includes physical, verbal, and psychological aggression, posing a serious risk. Four main types of workplace violence in healthcare have been identified: External violence with no prior relationship (Type I), violence by patients against professionals (Type II, the most frequent), internal or institutional violence (Type III), and personal violence (Type IV). This issue is global, with an increasing trend and significant underreporting. Its consequences are severe at multiple levels: individually (burnout, anxiety, depression), institutionally (absenteeism, staff turnover), and in patient care quality. Artificial intelligence (AI) has emerged as a promising tool to prevent and mitigate such violence. Its applications include surveillance and monitoring systems, enhanced communication between staff and patients, workflow optimization, staff training, and predictive analysis of potentially aggressive patients. However, AI implementation presents ethical challenges related to data protection, privacy, bias risks, prediction reliability, and potential dehumanization. Addressing these concerns is crucial to ensuring safe and equitable AI use, always under human supervision. Effective prevention requires a comprehensive approach that integrates technology with organizational and educational measures.

KEYWORDS: Artificial intelligence. Aggressions. Health professionals. Prevention. Workplace violence. Underreporting.

Uso de la inteligencia artificial para prevenir agresiones a profesionales de la salud

Resumen

El aumento de agresiones contra profesionales de la salud es un problema de salud pública y laboral que afecta el bienestar del personal y la calidad de la atención. La violencia en este sector incluye agresiones físicas, verbales y psicológicas, representando un riesgo significativo. Se distinguen cuatro tipos principales de violencia laboral: externa sin relación previa (Tipo I), de pacientes hacia profesionales (Tipo II, la más frecuente), interna o institucional (Tipo III) y personal (Tipo IV). Este problema es global, con una tendencia creciente y un subregistro considerable. Sus consecuencias afectan a nivel individual (burnout, ansiedad, depresión), institucional (absentismo, rotación de personal) y en la calidad de la atención. La inteligencia artificial (IA) se presenta como una herramienta prometedora para prevenir y mitigar estas agresiones. Sus aplicaciones incluyen vigilancia y monitoreo, mejora en la comunicación, optimización del trabajo, formación del personal y análisis predictivo de pacientes agresivos. No obstante, su implementación plantea desafíos éticos como la privacidad, el sesgo, la fiabilidad de predicciones y el riesgo de deshumanización. Para garantizar su uso seguro y equitativo, es esencial abordar estas cuestiones bajo supervisión humana y complementar la tecnología con estrategias organizativas y educativas.

PALABRAS CLAVE: Inteligencia artificial. Agresiones. Profesionales de la salud. Prevención. Violencia laboral. Subregistro.

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Introduction

Assaults on healthcare staff, whether manifested through physical violence or any other type of violence, have increased alarmingly in recent decades,¹ becoming a major public and occupational health problem. This phenomenon not only affects the well-being of healthcare staff but also compromises the quality of care provided to patients. In this context, artificial intelligence (AI) emerges as a promising and potentially transformative tool to help prevent and mitigate these events, offering innovative solutions to transform safety management in healthcare environments.²

Violence in the healthcare workplace constitutes a growing problem with serious implications for the physical and mental health of affected professionals, quality of care, and health systems. This complex, persistent, and apparently underreported phenomenon requires innovative interventions that leverage new technologies, particularly AI, for early identification, prevention, and effective management.

Definition of the phenomenon

Violence in the healthcare environment transcends mere physical aggression to encompass a broader spectrum of harmful behaviors. Specifically, violence against healthcare workers comprises any act of aggression – physical, verbal, or psychological – that can manifest through various channels and with different levels of intensity, directed against health professionals during the performance of their duties or as a consequence thereof.^{3,4} This phenomenon has become an issue of growing relevance in the healthcare sector, recognized as a significant threat to the well-being of professionals and to the quality of care.⁵

The complexity of studying this problem partially lies in the lack of a precise definition that encompasses the multiplicity of forms in which it manifests.⁶ However, there is consensus in considering that these aggressions constitute a violation of fundamental rights with both individual and collective impact, affecting not only the person attacked but also the functioning of the healthcare system as a whole.^{7,8}

Typology

The classification established by the occupational safety and health administration (OSHA)⁹ distinguishes workplace violence in healthcare into four

Table 1. Types of workplace violence

Type	Description	Example
I	Perpetrator has no association with the workplace or employees.	Person with criminal intent commits armed robbery.
II	Perpetrator is a customer or patient of the workplace or employees.	Intoxicated patient punches nurse's aide.
III	Perpetrator is a present or former employee of the workplace.	Recently fired employee assaults former supervisor.
IV	Perpetrator has a personal relationship with employees, none with the workplace.	Ex-husband assaults ex-wife at her place of work.

Adapted from: European Agency for Safety and Health at Work.⁹

types: Type I (External Violence), involving perpetrators with no prior relationship to the institution, often linked to crimes, such as robbery; Type II (User-Professional Violence), the most common, occurring between healthcare workers and patients or their associates due to service-related tensions; Type III (Internal or Institutional Violence), involving conflicts among employees or hierarchical abuse; and Type IV (Personal Violence), where the aggressor has a personal relationship with an employee but no direct connection to the workplace (Table 1).

Prevalence and underreporting problem

The phenomenon of workplace violence in healthcare has reached alarming global levels, with a clear upward trend that jeopardizes the sustainability of healthcare systems.^{3,4} The World Health Organization reports that between 8% and 38% of healthcare workers experience physical violence at some point in their careers, highlighting the magnitude of the issue.⁵ However, a concerning aspect of this problem is the significant underreporting of incidents, often described as the “tip of the iceberg” in scientific literature, indicating that official statistics only capture part of the reality.^{6,7}

Studies show that a large percentage of aggressions go unreported due to various reasons. For example, a study in Andalusia found that 67.6% of incidents were not registered, as workers believed reporting was useless or that violence was part of the job.⁸ Other studies from Spain and Italy also highlight underreporting rates of up to 73%.^{10,11} Factors contributing to underreporting include dissatisfaction with how past incidents were handled, lack of policies

Table 2. Selected data by geographic context

Data	Geographic context	Official source	Date of data
One-year prevalence estimates for 61,800 health care professionals from 30 countries. About one in five health care professionals experienced workplace physical violence	Global	Systematic review and meta-analysis ²⁰	2000-2018
Up to 38% of health workers suffer physical violence at some point in their careers	Global	World Health Organization ²¹	2023
Health care and social assistance experienced the highest counts and annualized incidence rates for workplace violence of any private industry sector over the 2-year period from 2021 to 2022	United States	U.S. Bureau of Labor Statistics ²²	2022
Healthcare workers accounted for 73 percent of all non-fatal workplace injuries and illnesses due to violence in 2018	United States	U.S. Bureau of labor statistics ²³	2018
23% of the EU's health workers "experienced at least one form of negative social behavior during the past 12 months of work"	Europe	European nurses research foundation ¹²	2021
4.8% of active health workers experience verbal or physical violence	Europe	EU-OSHA ¹³	2020-2022
Violence against healthcare staff has increased with '23% of the EU's health workers experiencing at least one form of negative social behavior during the past 12 months of work	Europe	European federation of nurses associations ¹⁴	2024

Author's elaboration based on referenced data.

ensuring justice, the perception that violence is normal, and the cumbersome or time-consuming reporting process.¹²

Profiles and risk factors

Studies show defined patterns in both victims and aggressors. The most frequent profile of an assaulted healthcare worker corresponds to women, with an average age of 37 years, predominantly nursing professionals working in emergency services or primary care during the morning shift.¹

Regarding aggressors, the predominant profile is that of patients or family members, predominantly men, with an average age of 42.5 years.³ Emergency and urgent care services consistently appear as higher-risk areas, possibly due to the combination of stress, waiting times, severity of cases attended, and altered emotional states.⁸

Violence against healthcare professionals is a global issue, with its manifestation influenced by sociocultural contexts and healthcare system characteristics. In Europe, studies show that between 48% and 65% of healthcare workers experience workplace violence, with Italy and the United Kingdom reporting high incident rates.^{9,13,14} Spain saw 14,749 cases in 2023, primarily in primary care,^{1,15} driven by factors such as work overload and patient dissatisfaction. In

Latin America, countries, such as Argentina and Peru report similarly high rates, with 89.56% of healthcare staff in a public hospital in Corrientes perceiving violence in the past year,¹⁶ and 11.1% of Peruvian healthcare workers experiencing physical aggression.¹⁷ In the United States, 81.6% of nurses faced workplace violence in 2023.¹⁸

Meanwhile, healthcare workers in Asia and Africa face heightened risks due to armed conflicts and weakened health systems, as evidenced by 70% of healthcare staff in Nigeria reporting workplace violence.¹⁹ These findings highlight the global scope of the issue, which varies regionally. Implementing specific policies to protect healthcare professionals is crucial to ensuring their safety and well-being. On the other hand, the temporal trend of reported cases indicates an increase in episodes of violence against healthcare professionals, suggesting a progressive deterioration in relationships between users and professionals of the healthcare system, possibly exacerbated by growing healthcare pressures, limited resources, and unmet expectations (Table 2).^{4,5,20-23}

Consequences

Workplace violence in healthcare has far-reaching consequences, impacting professionals by increasing the risk of burnout (emotional exhaustion 37.6%,

Table 3. Potential uses of AI

Advanced surveillance and monitoring systems
Communication between healthcare staff and patients
Workflow optimization
Training and education of health workers
Predictive analysis of potentially aggressive patients

Author's elaboration.

depersonalization 59.6%, low personal accomplishment 44.0%), anxiety, depression, and reduced quality of life.^{3,7} Institutions face higher absenteeism, decreased work performance, deteriorated organizational climate, increased staff turnover, and elevated costs related to incident management.^{5,7} In addition, patient care is affected through impaired professional-patient communication, defensive attitudes, and diminished trust in therapeutic relationships.^{7,8}

Applications of AI for preventing aggressions

The complexity and magnitude of this problem require innovative and multidimensional approaches. In this context, technologies based on AI emerge as promising tools for early identification of risk situations, prevention of incidents, and efficient management of adverse events in the healthcare environment.^{2,24-28}

The applications of AI in this field can be classified into five main categories (Table 3):

Advanced surveillance and monitoring systems

One of the main ways in which AI may contribute to the prevention of assaults in healthcare settings is through the implementation of advanced surveillance and monitoring systems.² These AI-powered security solutions can analyze video images in real time to detect unusual behaviors or potential threats, allowing immediate intervention by security personnel.

AI algorithms can be trained to recognize patterns of anxiety, nervousness, or aggression in interactions between healthcare staff and patients and their companions. This enables alerts about possible conflicts before they occur, which can prevent violent incidents.^{2,24} For example, the use of computer vision techniques and deep learning, such as convolutional

Table 4. AI-based strategies for managing aggression in psychiatric settings

Strategy	Description	Example
Predictive analysis	Risk prediction based on historical and clinical data	Random forest applied to schizophrenic patients
Virtual simulations	Interactive training for de-escalation	AI-moderated virtual patient scenarios
Advanced monitoring	Early detection of aggressive behavior	Computer vision-based systems

Author's elaboration.

neural networks, facilitates the analysis of live video streams to detect unusual activities and reduce the need for continuous human monitoring.^{29,30}

The integration of AI in surveillance systems offers several benefits:

- Reduction of Human Monitoring: By automating the detection of abnormal behaviors, the workload of security personnel is reduced, minimizing fatigue and human errors.^{29,31}
- Improved Precision: AI-based systems can analyze large amounts of visual data with greater precision than human observers, which reduces false alarms and improves efficiency in threat detection.³²
- Learning Capacity: AI algorithms can learn from collected data and improve their ability to recognize unusual behavior patterns over time, allowing continuous adaptation to new scenarios.³²

Although advanced surveillance systems offer significant advantages, they also present challenges related to privacy and ethics, particularly in healthcare environments where confidentiality is paramount. Their effectiveness depends on the quality of training data and their integration with existing security systems. Nevertheless, when properly implemented, AI-powered surveillance and monitoring can serve as powerful tools for preventing violence in healthcare settings by enabling early and accurate detection of unusual or threatening behaviors. To maximize their benefits while safeguarding user privacy, it is essential to address the associated ethical and technical challenges.^{29,33}

Improving communication between healthcare personnel and patients

The implementation of AI-based technologies can play a crucial role in improving communication

between healthcare professionals and patients. This effective communication is essential for preventing misunderstandings that could trigger conflict situations. Natural language processing (NLP) tools can be used to analyze interactions with patients and their caregivers, identifying emotions that might indicate frustration or dissatisfaction.³⁴ The use of NLP allows for analysis of the language used in interactions to detect signs of emotional distress. By identifying these signs at early stages, healthcare professionals can address situations in a timely manner, thus reducing the potential for conflicts to arise.²⁵ For example, a study on the use of language models such as GPT-3.5 in diabetes prevention demonstrated how NLP tools can provide personalized responses and emotional support to users, suggesting their potential to improve communication in other healthcare contexts.³⁵

Improved communication not only reduces conflicts but also contributes to a better patient experience and greater satisfaction with the care received. A systematic study on factors influencing patient experience highlighted the importance of professional-patient communication in improving the quality of care.³⁶ Furthermore, effective communication allows healthcare professionals to anticipate and resolve problems before they escalate, which can improve the work environment and reduce stress in the healthcare setting.

On the other hand, it is crucial to ensure that these tools are accessible to all users, regardless of their level of digital literacy or cultural characteristics. In addition, the implementation of these technologies must be accompanied by clear policies on data protection and transparency in the use of collected information. However, it is important to address the associated ethical and technical challenges to ensure their successful implementation while respecting user privacy.

Workflow optimization

Workflow optimization is a crucial area where AI can contribute significantly to the healthcare sector. By automating routine administrative tasks, such as scheduling, documentation management, and other repetitive or adaptable tasks, AI allows healthcare professionals to focus more on patient care rather than these administrative duties.^{26,37} AI algorithms applied to healthcare management have demonstrated significant effects in reducing potentially conflictive situations.

The automation of administrative tasks not only reduces the workload of healthcare professionals but also enhances job satisfaction and lowers the risk of stress-related incidents.^{27,38} By minimizing bureaucratic burdens, professionals can dedicate more time to clinical activities and direct patient care, improving service quality and reducing emotional exhaustion. In addition, AI-based systems optimize resource allocation by ensuring that healthcare facilities are adequately staffed and equipped to meet patient needs. This includes proactive expectation management, case prioritization based on clinical criteria, and efficient distribution of human and material resources.

Studies indicate that AI-driven workflow optimization can significantly reduce stress and burnout among healthcare professionals. For instance, research on automated documentation tools in dermatology has shown that these technologies alleviate administrative burden, allowing physicians to focus on patient interaction, thereby reducing burnout and improving job satisfaction.³⁹ However, successful implementation requires overcoming challenges such as integration with legacy systems, robust data privacy protection, and continuous training programs to maximize the benefits of AI. Addressing these challenges is crucial for the effective and sustainable adoption of AI solutions across the healthcare ecosystem.

Training and education of healthcare personnel

Training and education of healthcare personnel are fundamental aspects for preventing aggression in the healthcare sector. AI plays a crucial role in this field by improving the capacity of healthcare personnel to manage conflictive situations. AI-based simulation platforms have revolutionized the training of healthcare personnel, allowing them to practice and perfect their skills in safe and controlled environments.

These simulation platforms allow healthcare professionals to rehearse highly complex scenarios, such as managing agitated patients or interpersonal conflicts, without risks to real patients. A study on the use of simulation in the management of medical emergencies in radiology found that this type of training significantly improved the knowledge and confidence of professionals to manage critical situations, such as cardiac arrests and airway obstruction.⁴⁰ By equipping healthcare personnel with the necessary skills to manage difficult situations, a work environment based on safety and mutual respect is fostered. This not only

reduces the risk of aggression but also improves job satisfaction and reduces work-related stress. A study on conflict resolution training in the hospital environment showed that educational interventions can decrease relational, task, and procedural conflicts, promoting problem-solving strategies.⁴¹

AI-based simulation platforms deliver substantial benefits for healthcare training while simultaneously presenting several implementation hurdles. These include effective integration with established educational curricula and the requirement for appropriate technological infrastructure. Resolving these challenges is essential to ensure these advanced training technologies can be implemented effectively and sustained over time in healthcare education programs.

Predictive analysis for potentially aggressive patients

The application of AI in healthcare settings can also contribute to the development of predictive analysis tools that identify patients predisposed to aggressive behaviors. By analyzing historical data and clinical antecedents, AI models can detect behavioral patterns and patients with a history of unusual conduct, allowing healthcare personnel to take preventive measures in advance.

These models are typically based on unsupervised learning techniques, which enable the identification of patterns in large datasets without the need to previously label the data. A study published in JAMA Network Open utilized a machine learning approach to evaluate the risk of violence in hospitalized patients through clinical notes routinely collected in electronic health records.²⁸ This approach not only improves the occupational safety of healthcare personnel but also facilitates the delivery of personalized care by ensuring that individuals receive the appropriate level of care and support.⁴²

The early identification of patients at risk of aggressive behavior allows healthcare personnel to adopt proactive measures, such as the assignment of additional staff or the implementation of specific protocols to manage potentially conflictive situations. Furthermore, this approach contributes to more personalized care, as it allows the adaptation of the level of care and support according to the specific needs of each patient. A study on the use of predictive analysis in the management of critical patients found that AI-based tools can significantly improve accuracy in identifying high-risk patients, enabling early and personalized interventions.⁴³

Implementing AI-based predictive analysis tools in healthcare settings presents both opportunities and challenges. While these technologies enhance the identification of patients at risk for aggressive behavior, they introduce significant concerns regarding data privacy and model accuracy. Healthcare organizations must prioritize system transparency, prediction reliability, and patient confidentiality to uphold ethical standards during implementation. The successful integration of these analytical tools depends on overcoming workflow compatibility issues and navigating complex regulatory frameworks that currently limit widespread adoption.^{42,43}

The development of AI-powered predictive systems represents a strategic approach to enhancing occupational safety in healthcare environments. By identifying potentially aggressive patients before incidents occur, these tools enable proactive interventions and facilitate personalized care delivery. The healthcare sector must balance technological innovation with ethical considerations, addressing technical limitations and privacy concerns to ensure these systems operate effectively while maintaining strict adherence to patient confidentiality standards. Success ultimately depends on creating implementation frameworks that simultaneously advance patient care and protect individual privacy rights.^{44,45}

AI-BASED STRATEGIES FOR MANAGING AGGRESSION IN PSYCHIATRIC SETTINGS

Mental health work environments pose distinct and intensified challenges with regard to workplace violence, with research suggesting that mental health practitioners are at risk of up to three times more patient-initiated aggression than in other healthcare settings. The heightened risk is attributed to several factors, including the characteristics of psychiatric disorders, which can encompass impaired impulse control, paranoia, or psychosis; the involuntary admission status of many patients; the impact of medication on patient behavior; and the inherent strain in therapeutic relationships that frequently address complex psychological concerns. Healthcare professionals in psychiatric environments often have to manage unpredictable patient behavior while striving to build and maintain trustful relationships and uphold patients' rights and dignity.⁴⁶⁻⁴⁸

In environments where aggression is a concern, AI technology provides particularly promising tools to mitigate these risks, considering the intricate connections between clinical, environmental, and interpersonal

factors that often lead to violent incidents. Unlike traditional risk assessment methods that focus on static information, AI-powered techniques can combine various real-time data sources, such as medical records, present behavioral observations, and past trends, to deliver more detailed and timely risk assessments. These applications are particularly useful in psychiatric care, where conventional prevention methods may be restricted by the cognitive and behavioral traits of the patient group. These specialized AI applications include:

- Predictive analysis of aggressive behavior: Machine learning models, such as random forest and support vector machines, have demonstrated high accuracy in predicting violent behavior in psychiatric patients, particularly those with schizophrenia or a history of violence. For example, a recent study showed that the random forest algorithm achieved an area under the curve of 0.955 in predicting aggression in psychiatric hospital settings.^{49,50}
- Risk assessment platforms: Tools, such as electronic hamilton anatomy of risk management integrate clinical and historical data to predict and manage specific risks of violence in psychiatric patients. These platforms enable personalized and timely interventions, improving safety for both staff and patients.⁵¹
- Simulations with virtual patients: AI-driven simulations that replicate typical aggressive behaviors in psychiatric patients have proven effective in training healthcare staff on de-escalation techniques and emotional management.
- Continuous monitoring through advanced systems: Monitoring systems based on computer vision can detect early signs of agitation or aggression, allowing preventive interventions before violent incidents occur.^{50,52}

Limitations and ethical considerations

The integration of AI-based technologies to prevent aggression in healthcare introduces critical ethical challenges. These challenges encompass data privacy concerns, as video surveillance and behavior analysis systems process sensitive biometric and behavioral data, raising issues of confidentiality, as shown by a study in China on biomedical data usage for national security and corporate purposes.⁵³ In addition, poorly designed algorithms may reinforce existing biases, with bias and discrimination emerging as widespread ethical problems in various sectors,

including healthcare.⁵⁴ The use of automated analysis for facial expressions and behaviors also brings up concerns about cognitive self-determination and neuroethics, specifically regarding brain privacy and autonomy.⁵⁵ Furthermore, AI's predictive capabilities are limited, and inaccurate predictions may affect patient autonomy or dignity, making accuracy and transparency essential.⁵⁶ Excessive dependence on technology may also lead to neglecting human and organizational aspects, which can dehumanize healthcare practices and reduce the quality of professional-patient interactions. Finally, addressing algorithmic biases is crucial to ensure fairness and prevent discriminatory or erroneous decisions that could impact vulnerable groups. Therefore, AI systems must always be implemented under the oversight of healthcare professionals to ensure that final decisions are guided by human judgment and fairness.

Conclusions

AI has the potential to reduce professional overload and prevent assaults by predicting and mitigating stressful situations, thereby enhancing healthcare safety, care quality, and cost efficiency. When integrated into a comprehensive strategy that includes organizational, training, and environmental factors, AI can play a key role in preventing violence against healthcare professionals.

Promising applications include intelligent surveillance, workflow optimization, communication enhancement, simulation-based training, and risk prediction models. However, ethical and technical challenges must be addressed through a multidisciplinary approach involving healthcare professionals, technology experts, ethicists, and patient representatives.

Ultimately, effective aggression prevention requires more than technology; it demands a holistic strategy incorporating adequate staffing, communication training, safe space design, and zero-tolerance policies against violence.

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Conflicts of interest

The authors declare that they have no conflicts of interest in relation to this article.

Ethical considerations

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