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APPLICATION OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN THE PREDICTION AND MANAGEMENT OF COMPLICATIONS AND MORBIDITY AND MORTALITY IN POLYTRAUMATIZED PATIENTS: A SYSTEMATIC LITERATURE REVIEW

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Abstract: INTRODUCTION: Artificial Intelligence (AI) and Machine Learning (ML) are emerging tools in medicine, capable of analyzing large volumes of clinical data to identify patterns and predict patient outcomes. In trauma medicine, where the management of polytraumatized patients is particularly complex, accurate prediction of complications is essential. Although the Trauma and Injury Severity Score (TRISS) is widely used as a predictive method, it has important limitations, such as its inability to capture the dynamic and individual complexity of trauma responses. OBJECTIVES: To evaluate the effectiveness of AI and ML-based tools in predicting complications in polytraumatized patients. METHODS: The following descriptors were searched in the Cochrane, Scopus and PubMed databases: "Artificial Intelligence", "Machine Learning", "polytrauma" and "predictive analytics", using the "AND" operator. Studies addressing the use of AI and ML in the management of polytraumatized patients were included, covering systematic reviews, clinical trials, meta-analyses and longitudinal observational studies published between 2019 and 2024. Duplicate, unrelated and unavailable studies were excluded. Data extraction was carried out by two independent authors. RESULTS: Of the 18 studies identified, 14 were included in the review. DISCUSSION: Studies such as Gondim et al. (2023) have shown that ML algorithms outperform traditional models such as TRISS in predicting mortality in real time. Unlike linear models, ML considers risk factors in a non-linear and interactive way, better reflecting clinical reality. ML has also been effective in predicting specific complications, such as acute traumatic coagulopathy (Wang, 2020), venous thromboembolism (Li, 2021), acute kidney injury (Liu, 2022) and sepsis (Gelbard, 2019). AI-based tools have also proven useful in contexts of limited resources and war situations (Perkins, 2021), optimizing management and resource allocation. Innovations such as risk calculators for mobile devices (Maurer, 2021) have facilitated access to pre-hospital care. CONCLUSION: Artificial Intelligence and Machine Learning show great potential in predicting complications in polytraumatized patients, offering greater accuracy compared to traditional models.
Keywords: Artificial Intelligence. Machine Learning. Multiple Trauma. Morbidity and mortality indicators.

INTRODUCTION

Artificial Intelligence (AI) and Machine Learning (ML) have emerged as revolutionary technologies in medicine, providing the ability to analyze large volumes of clinical data efficiently. These technologies are particularly valuable in the field of trauma medicine, where the complexity and diversity of cases require a high level of precision in decision-making. Predicting complications in polytraumatized patients, for example, is fundamental to successful clinical management, since treatment involves a multidisciplinary approach and the rapid assessment of multiple injuries, some of which can rapidly evolve into critical conditions. In the trauma context of pre-hospital and in-hospital care, this can result in better prioritization of interventions, allocation of resources and reduced time to initiation of critical treatment. Although the Trauma and Injury Severity Score (TRISS) is widely used to predict outcomes in trauma patients, this method still has significant limitations. Among the main limitations of the TRISS is its inability to consider the dynamic and individualized response of patients to trauma, as well as the complexity of integrating clinical, laboratory and imaging data in real time. These limitations can have a direct impact on risk estimates and clinical management planning. As a result, new approaches, such as the use of AI and ML, are gaining prominence as promising alternatives for overcoming these limitations and improving forecasting accuracy.

OBJECTIVES

The aim of this study is to evaluate the effectiveness of tools based on Artificial Intelligence and Machine Learning in predicting complications in polytraumatized patients. The study seeks to investigate the ability of these emerging technologies to predict clinical outcomes, identify specific complications and provide a more accurate view of the patient's individual risk, taking into account variables that are often difficult to capture with conventional methods.

METHODS

To carry out this systematic review, an in-depth search was conducted in the Cochrane, Scopus and PubMed databases, using the descriptors: "Artificial Intelligence", "Machine Learning", "polytrauma" and "predictive analytics", with the "AND" operator. The inclusion criteria covered studies that specifically investigated the application of AI and ML in the management of polytraumatized patients, including systematic reviews, clinical trials, meta-analyses and longitudinal observational studies published between 2019 and 2024. Duplicate studies, articles with no direct relevance to the research topic, and those whose full version was not available were excluded. After collecting the articles, two independent reviewers critically read the texts and systematized the data to ensure the consistency and quality of the information.

RESULTS

Initially, 18 studies were identified, of which 14 were included in the final review, meeting the established criteria.

DISCUSSION

Several studies, such as that by Gondim et al. (2023), show the superiority of Machine Learning algorithms in predicting mortality, with some models achieving more accurate results in real time than TRISS, which is based on fixed and linear parameters. One of the great advantages of using AI/ML is its ability to deal with the non-linearity of clinical data, taking into account the complexity of the interactions between multiple risk factors and the individual variability of patients. In addition, AI/ML tools can quickly process large amounts of data, providing dynamic and adjusted predictions as new information becomes available. Machine learning models have also proven effective in predicting specific complications, such as acute traumatic coagulation (WANG, 2020), venous thromboembolism (LI, 2021), acute kidney injury (LIU, 2022) and sepsis (GELBARD, 2019), among others. These advances are particularly important in resource-limited settings or in contexts of war conflicts (Perkins, 2021), where accuracy in predicting outcomes is crucial for guiding clinical and therapeutic management, as well as optimizing the distribution of resources. The use of AI in resource-limited environments was also observed in a study that proposed a risk calculator for mobile devices (MAURER, 2021), a practical tool that facilitates access to predictive information and can improve the response in emergency situations.

CONCLUSION

Artificial Intelligence and Machine Learning show promising potential in predicting complications in polytraumatized patients, offering greater accuracy compared to traditional models. AI/ML algorithms not only improve the prediction of clinical outcomes, but also provide a deeper understanding of the interactions between risk factors, which allows for more personalized and effective mana-

gement. Although these models still require further validation and adaptation for different clinical scenarios, their capabilities have already demonstrated some positive impact on the management of trauma patients, especially in resource-limited settings. The adoption of AI and ML-based technologies could represent a significant advance in trauma medicine, helping to save lives and optimize the use of resources in intensive care.

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