Artificial Intelligence in Burn Care: A Review of Early Warning Systems and Clinical Outcome Prediction

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Intro:

Burn injuries are a serious health problem that can lead to complications, prolonged hospital stays, disability, and even death. The World Health Organization estimates that burns cause approximately 180,000 deaths worldwide each year (World Health Organization, 2023). Patients with severe burns are also at high risk for complications such as sepsis and organ failure and can quickly deteriorate, making early identification of high risk patients essential . Recognizing warning signs earlier could help doctors make more timely treatment decisions and monitor patients more closely.

Artificial intelligence (AI) is becoming more common in healthcare and may help identify high-risk patients by analyzing patient characteristics and clinical information such as a age, burn size, vital signs, and laboratory results to predict adverse outcomes . Previous research has demonstrated the potential of AI and machine-learning models to predict outcomes in burn patients. One study of 1,064 hospitalized burn patients found that an artificial neural network predicted mortality with about 96% accuracy (Çınar et al., 2024). Another study of 731 critically ill burn patients found that a Random Forest model predicted mortality after burn surgery with an AUC of 0.922 (Seo et al., 2022). Other studies have also evaluated different AI models and clinical variables to predict mortality and assess burn severity. However, many of these studies have relied on retrospective patient data from single institutions and have primarily focused on mortality rather than other important outcomes, such as complications and length of hospital stay. Additionally, limited research has directly compared AI models with traditional clinical prediction methods or evaluated whether their use improves patient outcomes. Further research is therefore needed to better understand the potential role of AI-based early warning systems in burn care. This review aims to address the following research question: In hospitalized burn patients, how do AI-based early warning systems, compared with traditional clinical methods, perform in predicting mortality, complications, and length of hospital stay?

Methods:

We conducted a literature review using PubMed to identify studies examining the use of artificial intelligence and machine learning in burn care. We included peer-reviewed studies published between 2022 and 2026 that investigated AI or machine-learning models used to predict mortality, assess burn severity, or support clinical decision-making.

The literature search used keywords including “artificial intelligence,” “machine learning,” “health care,” “burn patients,” “mortality,” and “morbidity.” Studies were eligible for inclusion if

they examined AI or machine learning related to burn care, especially those related to predicting patient outcomes. For each study, we reviewed patient population, type of AI model, outcomes, key findings, and limitations.

The review initially focused on healthcare providers' experiences using AI in clinical practice. However, as research was limited on this topic as related to burn care, the scope was expanded to include AI models used to predict patient outcomes. One study involving trauma patients (including burn patients) was also included as it evaluated healthcare providers' experiences using a real-time AI mortality prediction system, providing insight into the potential clinical applications of AI in acute care settings.

Results:

Seven studies published between 2022 and 2026 met our inclusion criteria. Most of the studies used retrospective patient data to evaluate the performance of AI models in predicting mortality in burn patients. One study looked at using AI to determine burn severity, while another study surveyed healthcare providers on the clinical use of AI to predict mortality in trauma patients.

Çınar et al. published a retrospective study in 2024 that looked at 1,064 burn patients who were hospitalized between 2016 and 2022. They used 40 different patient characteristics, including age and lab results, to test different AI models and see how well they could predict mortality. The artificial neural network (ANN) demonstrated the highest accuracy (96%). One limitation was that the study was conducted at a single institution, limiting the generalizability of its findings to other patient populations and clinical settings.

Fransén et al. published a proof-of-concept study in 2022 that looked at 92 burn patients in the intensive care unit (ICU). The researchers evaluated the performance of several AI models against Baux and revised Baux scores, two established clinical tools used to predict mortality in burn patients. The AI models had area under the curve (AUC) values between 0.83 and 0.92, while the Baux and revised Baux scores had AUC values of 0.84 and 0.85. Some of the AI models performed slightly better, but the differences were not significantA key limitation was the small sample size, highlighting the need for validation in larger patient populations.

Seo et al. published a retrospective study in 2022 that looked at 731 critically ill burn patients who required surgery. They tested different AI models, including Random Forest, AdaBoost, Decision Tree, SVM, and Logistic Regression, to see how well they could predict mortality within 90 days after surgery. Random Forest demonstrated the strongest predictive performance, with an AUC of 0.922. The most influential predictors included total body surface area (TBSA), red cell distribution width (RDW), and age. One limitation was that the study was restricted to

critically ill patients requiring surgery, potentially limiting the applicability of its findings to the broader burn patient population.

Yazıcı et al. published a retrospective study in 2023 that looked at 363 burn patients. They tested six different AI models using information such as age, gender, TBSA, full-thickness burn area, burn type, and inhalation injury to predict mortality. AdaBoost demonstrated the highest predictive accuracy (approximately 90%). These findings suggest that AI models may be able to predict mortality using clinical information routinely collected during burn assessment. However, the study relied on retrospective data from a single burn center, highlighting the need for external validation.Lee et al. published a retrospective study in 2025 that looked at using AI to determine burn depth and severity by analyzing burn images.[6] They trained the AI using 1,684 burn images and tested it using 144 patient charts. They compared it with laser Doppler imaging (LDI), which is already used to assess burns. The AI was about 85% accurate at identifying burn severity and about 92% accurate at identifying the burn area. A key limitation was that the study focused on burn assessment rather than clinical outcomes, such as mortality or complications. Additionally, the relatively small testing sample may limit the generalizability of the findings.

Motamedi et al. published a retrospective study in 2026 that looked at 1,094 burn patients from one hospital.[7] They tested AI models including Random Forest, Extra Trees, and CatBoost to predict early and delayed mortality. Some of the most important factors for predicting mortality were TBSA, weight, debridement, escharotomy, age, and burns in the perineogenital area. A key limitation was the single-center study design, which limits generalizability and highlights the need for external validation.

Park et al. published a prospective survey study in 2024 that looked at an AI system called the Parkland Trauma Index of Mortality (PTIM).[8] The system predicts mortality in trauma patients and updAmong 40 surveyed healthcare providers, approximately 77% reported that the system supported treatment decisions, while 66% reported that it assisted with decisions regarding surgical intervention. However, the study assessed provider perceptions rather than objective improvements in clinical outcomes. Additionally, the small sample size and focus on general trauma patients limit its direct applicability to burn care.**Discussion:**

The studies in this review suggest that AI has potential as a clinical decision-support tool for identifying burn patients at increased risk of mortality. Using patient data such as age, lab values, and burn size, several AI models tested throughout the studies we reviewed were able to predict patient mortality as well as or better than traditional methods. Early identification of high-risk patients could help clinicians prioritize monitoring, guide treatment planning, and allocate hospital resources more effectively. For patients who are at higher risk, this information could also help doctors when planning treatments or deciding if an intervention like surgery or an escharotomy may be needed. This is especially important for burn patients because they can

be high acuity and their condition can deteriorate rapidly. As previously discussed, severe burn patients can develop serious complications such as infection, sepsis, or organ failure (World Health Organization, 2023). Earlier recognition of patients at increased risk could give doctors more time to monitor them and decide what treatment they may need.

An additional potential benefit of AI-based prediction models is their ability to incorporate routinely collected clinical data, including age, TBSA, vital signs, and laboratory results. Integration of these models into electronic health records could provide clinicians with real-time risk estimates without requiring extensive additional data collection. There is not sufficient evidence to determine whether AI is equipped to make treatment decisions without physician input. Rather, these tools should complement clinical expertise and physician judgment.

Successful implementation of AI in clinical practice also depends on healthcare providers' acceptance and willingness to use these technologies.. In the Park et al. study, 77% of healthcare providers said the AI system helped with treatment decisions and 66% said it helped with deciding when to perform surgery. These findings suggest that clinicians may perceive AI-based tools as useful in clinical practice.

Several limitations of the available literature should be considered when interpreting these findings. First, this review included only seven studies, reflecting the relatively limited evidence identified on AI applications in burn-related risk prediction. Additionally, the studies evaluated different AI algorithms, patient populations, predictor variables, and clinical outcomes, limiting direct comparisons across studies. Many studies were also conducted at single institutions using retrospective data, which may limit generalizability to other healthcare settings and patient populations. Furthermore, most studies primarily evaluated mortality prediction, with comparatively limited investigation of other clinically important outcomes, such as complications and hospital length of stay. Importantly, strong predictive performance does not necessarily demonstrate that implementing an AI model will improve clinical outcomes.

Future research should expand the evaluation of AI models beyond mortality prediction to include additional outcomes such as infection, other complications, or whether a patient will need surgery. Researchers could also study these AI tools in other types of trauma patients besides burn patients. Direct comparisons of different AI models using standardized datasets and evaluation metrics would also help identify which approaches provide the most reliable predictions. Finally, future studies should look at what happens when these tools are actually used in hospitals and whether they lead to better outcomes for patients, not just whether the AI can make an accurate prediction.

Conclusion:

Overall, this review suggests that AI-based models show promise for predicting mortality risk among hospitalized burn patients. However, evidence regarding their ability to predict complications and hospital length of stay remains limited. Although AI may provide valuable information to support clinical decision-making, further research is needed to establish its generalizability and clinical utility. These tools should be used to complement, rather than replace, physician judgment.

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