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Artificial Intelligence in the Initial Assessment of Acute Burn Wounds: A Narrative Literature Review

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Abstract: Accurate initial assessment of acute burn wounds is essential for determining severity, healing potential, referral needs, and treatment strategy. However, this assessment remains challenging because burn wounds evolve over time and conventional methods often depend on clinician experience or specialized imaging technologies. Artificial intelligence offers a potential approach to improve the objectivity and efficiency of early burn assessment. **Objective**: This study aims to analyze current applications of artificial intelligence in the initial assessment of acute burn wounds and evaluate its potential, methodological challenges, and clinical implementation. **Methodology**: This study employed a narrative literature review. Scientific publications were retrieved from PubMed and Google Scholar from database inception to May 2026. Eligible publications included original research articles, systematic and narrative reviews, clinical practice guidelines, and AI reporting guidelines related to AI-assisted burn assessment. The selected literature was synthesized narratively by comparing evidence on burn detection, burn-depth classification, wound segmentation, total body surface area estimation, prediction of surgical requirements, multimodal AI, and methodological quality. **Findings**: AI has demonstrated promising performance in burn detection, burn-depth classification, wound segmentation, total body surface area estimation, and prediction of surgical requirements. Recent studies have also expanded AI applications toward multimodal assessment by integrating clinical images with physiological and electronic medical record data. Nevertheless, current evidence is constrained by heterogeneous reference standards, retrospective designs, limited external validation, inconsistent image-acquisition protocols, and inadequate representation of diverse skin tones. **Implications**: AI should be implemented as a clinical decision-support tool that complements, rather than replaces, serial clinical assessment by burn specialists. **Originality**: This review integrates technical advances in artificial intelligence with clinically relevant considerations, including burn wound progression, image-acquisition timing, treatment status, reference-standard heterogeneity, external validation, skin-tone diversity, and workflow integration.

Keywords: artificial intelligence; acute burn wounds; burn depth assessment; clinical decision support; total body surface area.

INTRODUCTION

Burn injury remains a critical global health problem because it contributes to mortality, long-term disability, disfigurement, psychological distress, social stigma, and economic burden. The World Health Organization estimates that burns cause approximately 180,000 deaths annually, with the highest burden occurring in low- and middle-income countries (World Health, 2023). In clinical practice, the early assessment of burn depth and burn extent is essential because it influences emergency triage, referral decisions, conservative wound care, excision, skin grafting, and prediction of healing potential. Monstrey emphasized that burn-depth assessment is closely related to wound-healing potential and treatment planning (Monstrey et al., 2008). However, acute burn wounds are often difficult to assess accurately during the initial examination because wound appearance may change over time due to edema, inflammation, tissue hypoxia, infection, impaired perfusion, and burn wound conversion. This condition creates a practical challenge, particularly in emergency departments, primary care settings, district hospitals, and remote areas where burn specialists and advanced imaging technologies may not be readily available.

Previous studies on burn wound assessment can be categorized into three major areas. First, clinical and objective imaging studies have emphasized the importance of visual examination, tactile assessment, laser Doppler imaging, thermography, hyperspectral imaging, and other perfusion-based technologies to estimate burn depth and healing potential. Jaspers reported that several measurement techniques have been used to improve the assessment of burn wound depth and healing potential (Jaspers et al., 2019). Wang also showed that laser Doppler imaging has strong diagnostic value for assessing burn depth (R. Wang et al., 2020). However, these technologies may be limited by cost, accessibility, technical requirements, and operator dependence.

Second, studies on artificial intelligence and machine learning have reported promising results in burn detection, burn-depth classification, wound segmentation, total body surface area estimation, and prediction of surgical requirements. Abubakar demonstrated the use of deep-learning features for burn-depth assessment (Abubakar et al., 2020), while Wang developed an artificial neural-network model for real-time burn-depth recognition (Y. Wang et al., 2020). Cirillo further applied semantic segmentation to pediatric scald images (Cirillo et al., 2021), and Chang developed a deep-learning-assisted model for burn wound diagnosis (Chang et al., 2021).

Third, review studies indicate that AI applications in burn care are expanding beyond image classification toward wound-healing prediction, complication diagnosis, outcome forecasting, and clinical decision support. Huang described machine learning and automation in burn wound evaluation as a promising but still developing field (Huang et al., 2021). Similarly, Taib and Holm highlighted that AI in burn care still faces challenges related to validation, clinical integration, and methodological heterogeneity (Holm et al., 2026; Taib et al., 2023). Despite these developments, several limitations remain, including retrospective study designs, small or single-center datasets, heterogeneous reference standards, limited external validation, inconsistent reporting of image-acquisition timing, and insufficient representation of diverse skin tones.

Based on these gaps, this narrative literature review aims to analyze the role of artificial intelligence in the initial assessment of acute burn wounds. Specifically, this review discusses AI applications in burn detection, burn-depth classification, wound segmentation, total body surface area estimation, prediction of surgical requirements, diagnostic performance, validation strategies, clinical workflow integration, and implementation barriers. This review also evaluates clinically relevant issues that are often underreported in previous studies, including the timing of image acquisition, wound-treatment status, reference standards, skin-tone diversity, and the dynamic progression of burn depth during the early post-injury period. By addressing these aspects, this study seeks to provide a clinically oriented synthesis that connects technical AI performance with practical decision-making in early burn care.

This review argues that artificial intelligence has the potential to support the initial assessment of acute burn wounds by reducing subjectivity, improving documentation, assisting non-specialist clinicians, and supporting referral or surgical consultation decisions. However, AI should not be interpreted as a definitive replacement for clinical judgment because burn wounds are dynamic and require serial reassessment. The central argument of this review is that AI-based burn assessment will be clinically useful only when models are validated across diverse populations, standardized imaging conditions, different post-injury time points, and real-world care settings. Therefore, AI should be positioned as a supportive clinical decision-support tool that complements, rather than replaces, specialist evaluation in acute burn management.

RESEARCH METHOD

This study employed a narrative literature review design to examine the application of artificial intelligence (AI) in the initial assessment of acute burn wounds. The unit of analysis comprised published scientific evidence describing AI-based clinical decision-support systems for burn assessment, including studies on burn detection, burn-depth classification, wound segmentation, total body surface area (TBSA) estimation, prediction of surgical requirements, and multimodal AI approaches. In addition, clinical guidelines and methodological guidance relevant to burn assessment and medical artificial intelligence were included to provide broader clinical and methodological perspectives.

A narrative literature review was selected because the available evidence is highly heterogeneous in terms of study design, patient characteristics, imaging modalities, reference standards, AI algorithms, outcome measures, and validation strategies. Unlike a systematic review that primarily focuses on quantitative synthesis, the narrative approach allows comprehensive interpretation and critical comparison of diverse evidence while identifying methodological strengths, limitations, research gaps, and future research directions. This approach is appropriate for emerging research areas such as AI-assisted burn assessment, where technologies continue to evolve rapidly and standardized evaluation methods have not yet been fully established.

The data sources consisted of peer-reviewed scientific publications retrieved from PubMed and Google Scholar. The literature search covered publications from database inception to May 31, 2026. Search terms included combinations of "artificial intelligence," "machine learning," "deep learning," "burn wound," "burn depth," "acute burn," "assessment," "classification," "segmentation," "total body surface area," "triage," "surgical requirement," and "wound healing." Only English-language publications were considered. Eligible sources included original research articles, diagnostic accuracy studies, systematic reviews, scoping reviews, narrative reviews, clinical practice guidance, and reporting guidelines relevant to AI-assisted assessment of acute burn wounds.

The literature collection process was conducted through database searching followed by manual screening of titles, abstracts, and full-text articles according to predefined eligibility criteria. Duplicate records and publications unrelated to acute burn assessment were excluded. Studies focusing exclusively on non-burn wounds, animal experiments without direct clinical relevance, editorials, conference abstracts lacking sufficient methodological information, and non-clinical computer-vision studies were not included. Additional reference-list screening was performed to identify relevant studies that might not have been retrieved during the initial database search. After the selection process, twenty publications and guidance documents were included in the narrative synthesis, while one World Health Organization publication was incorporated to provide epidemiological context.

The selected literature was analyzed using a narrative synthesis approach. Information from each publication was extracted and organized according to predefined analytical themes, including the clinical importance of burn assessment, AI imaging modalities, burn detection, burn-depth classification, wound segmentation, TBSA estimation, prediction of surgical requirements, diagnostic performance, reference standards, image-acquisition timing, model validation, skin-tone representation, implementation challenges, and future research directions. The findings from individual studies were then compared to identify consistent evidence, methodological differences, current limitations, and potential implications for the clinical implementation of AI in the initial assessment of acute burn wounds.

RESULT

Characteristics of the Included Literature

The narrative synthesis included twenty publications and guidance documents related to artificial intelligence (AI) for acute burn wound assessment. These consisted of seven original AI studies, four systematic, scoping, or narrative reviews, six clinical burn-assessment publications, two AI reporting guidelines, and one clinical technology guidance document. An additional publication from the World Health Organization was included to provide epidemiological context. Overall, the reviewed literature covered burn detection, burn-depth classification, wound segmentation, total body surface area (TBSA) estimation, prediction of surgical requirements, multimodal AI applications, wound-healing assessment, complication prediction, and clinical outcome forecasting.

Table 1. Comparison of selected burn assessment approaches

Approach	Main input	Clinical strength	Key limitation
Clinical examination	Visual and tactile wound features	Immediate, inexpensive, widely available	Subjective and experience-dependent
Laser Doppler imaging	Microvascular perfusion	Objective perfusion assessment with substantial supporting evidence	Cost, availability, motion sensitivity
Thermography	Skin surface temperature	Non-contact physiologic information	Affected by environment and timing
RGB photography with AI	Standard wound images	Scalable and telemedicine-friendly	Sensitive to lighting, camera quality, acquisition conditions, and dataset bias

Multispectral or hyperspectral imaging with AI	Spectral tissue signatures	May capture physiologic changes beyond visible color	Requires hardware validation and workflow integration

Note. Synthesized from Monstrey et al. (2008), Jaspers et al. (2019), Huang et al. (2021), Cirillo et al. (2021), Chang et al. (2021, 2023), Taib et al. (2023), Rahman et al. (2025), and relevant modality-specific literature.

Artificial Intelligence for Burn Detection and Depth Classification

Seven original studies investigated AI-assisted burn assessment, with burn-depth classification representing one of the most frequently reported applications. Deep-learning techniques, including convolutional neural networks and semantic segmentation models, were applied to classify burn depth from clinical images. Although the reviewed studies consistently demonstrated the feasibility of automated burn-depth assessment, they differed in image modality, burn classification system, dataset characteristics, reference standards, and validation strategies.

Artificial Intelligence for Wound Segmentation and Total Body Surface Area Estimation

Several studies demonstrated the application of AI for automated wound segmentation and TBSA estimation. Deep-learning models were capable of identifying burn boundaries and calculating burn extent at the pixel level using digital images. Most segmentation systems employed convolutional neural-network architectures such as U-Net and Mask R-CNN. These models supported objective wound measurement and provided quantitative information that may facilitate burn documentation and clinical assessment.

Artificial Intelligence for Prediction of Surgical Requirements

The reviewed literature also reported AI applications for predicting surgical requirements. Rather than focusing solely on burn classification, these models estimated whether surgical intervention would be required based on burn images and reference labels. This represents an extension of AI from image interpretation toward clinical decision support, although the predicted outcomes remained dependent on the reference standards used during model development.

Multimodal Artificial Intelligence Approaches

Recent studies have expanded AI applications by integrating multiple sources of clinical information, including digital photographs, ultrasound tissue Doppler imaging, and electronic medical records. These multimodal approaches were designed to improve burn-depth assessment by combining visual, physiological, and clinical data. In addition, review articles reported that AI research has progressively expanded toward wound-healing assessment, complication prediction, and clinical outcome forecasting.

Methodological Characteristics of AI Studies

The methodological quality of the reviewed studies varied considerably. Differences were observed in dataset size, patient characteristics, image acquisition protocols, reference standards, validation strategies, and intended clinical applications. Most studies relied on retrospective datasets and internal validation, whereas prospective and multicenter validation remained limited. Reporting of skin tone, burn mechanism, timing of image acquisition, and wound-treatment status was also inconsistent.

Table 2. Practical framework for evaluating AI studies in burn assessment

Domain	Questions to assess	Why it matters
Dataset	How many patients and images were included? Were skin tones, ages, and burn mechanisms diverse?	Small or homogeneous datasets increase overfitting and bias.
Reference standard	Was depth confirmed by healing time, surgery, histology, LDI, or expert consensus?	Different reference standards can produce different model labels.
Model validation	Was external, prospective, or multicenter validation performed?	Internal accuracy may not transfer to real clinical settings.
Image acquisition	Were lighting, distance, camera type, and timing standardized?	Non-standard images can reduce reliability in practice.
Clinical workflow	Does the model support a decision such as referral, grafting, or follow-up?	AI should improve care pathways, not only report technical metrics.
Timing and treatment status	Was the interval from injury reported? Was the wound untreated, dressed, debrided, infected, or previously treated?	Burn appearance evolves, and model validity may depend on wound stage and treatment condition.
Transparency and safety	Are intended use, uncertainty, failure cases, and model limitations reported?	Clinicians need to understand when model outputs may be unreliable.

Note. Author-developed framework informed by CLAIM, DECIDE-AI, and burn-imaging literature (Tejani et al., 2024; Vasey et al., 2022).

DISCUSSION

The present narrative review demonstrates that artificial intelligence has emerged as a promising clinical decision-support technology for the initial assessment of acute burn wounds. The reviewed literature consistently shows that AI has been applied to several clinically relevant tasks, including burn detection, burn-depth classification, wound segmentation, total body surface area (TBSA) estimation, prediction of surgical requirements, and multimodal burn assessment. Nevertheless, the findings also reveal considerable methodological variability among published studies, particularly regarding dataset characteristics, reference standards, validation strategies, and image-acquisition protocols. These variations indicate that although AI performance continues to improve, current evidence remains insufficient to support unrestricted implementation in routine clinical practice.

The encouraging performance of AI can largely be explained by recent advances in deep-learning algorithms and computer vision, which enable automated extraction of complex image features beyond human visual perception. Convolutional neural networks and semantic-segmentation architectures are capable of identifying subtle differences in color distribution, tissue texture, wound margins, and spatial patterns that may reflect burn severity. However, burn wounds represent dynamic biological injuries rather than static imaging objects. Tissue perfusion, inflammatory response, edema, infection, and burn wound conversion continuously alter wound appearance during the early post-injury period. Consequently, an AI model trained using images obtained immediately after injury may produce different results when applied to wounds that have undergone dressing changes, debridement, topical treatment, or natural progression. This biological variability explains why AI predictions should be interpreted as probabilistic clinical support rather than definitive diagnostic conclusions.

The findings of this review are consistent with previous literature reporting the growing role of artificial intelligence in burn care. Huang described AI-assisted burn assessment as a rapidly developing field with considerable diagnostic potential (Huang et al., 2021), while Taib concluded that AI can improve burn management through automated image analysis and predictive modelling (Taib et al., 2023). More recently, Bhattachan and Holm highlighted expanding AI applications in complication prediction (Bhattachan et al., 2026; Holm et al., 2026), wound-healing assessment, and clinical outcome forecasting. However, this review extends previous publications by emphasizing several clinically important aspects that have received comparatively less attention, including the influence of image-acquisition timing, wound-treatment status, burn progression, heterogeneous reference standards, external validation, and skin-tone diversity. Rather than focusing exclusively on model performance, this review integrates technical evidence with practical considerations required for safe clinical implementation.

From a clinical perspective, the findings suggest that AI should be positioned as an adjunctive decision-support system rather than an autonomous diagnostic tool. The principal contribution of AI lies in supporting standardized wound documentation, assisting healthcare professionals with limited burn experience, facilitating referral decisions, and improving communication between primary care facilities and specialized burn centers. This perspective reinforces the concept that successful implementation of medical AI depends not only on algorithmic accuracy but also on transparency, explainability, clinical workflow integration, and clinician oversight. Therefore, the practical value of AI should be evaluated according to its ability to improve patient management and decision-making rather than solely by conventional performance metrics such as sensitivity, specificity, or classification accuracy.

Despite these promising developments, several limitations remain evident across the current body of evidence. Many published studies rely on retrospective data collected from single institutions, increasing the possibility of selection bias and limiting model generalizability. The inconsistent reporting of demographic characteristics, skin pigmentation, burn mechanisms, image-acquisition conditions, and treatment status further complicates comparison among studies. Moreover, differences in reference standards—including expert opinion, healing time, histopathology, laser Doppler imaging, and operative findings—may produce substantially different ground-truth labels for similar burn wounds. These methodological issues indicate that improvements in dataset quality, reporting standards, and external validation are equally important as advances in AI model architecture.

The findings of this review have several implications for future research and clinical practice. Researchers should prioritize prospective multicenter studies involving diverse patient populations, standardized imaging protocols, transparent reporting practices, and clinically meaningful outcome measures such as referral accuracy, need for grafting, time to epithelialization, scar quality, functional recovery, and cost-effectiveness. Healthcare institutions should consider AI as part of an integrated clinical decision-support framework that complements serial patient assessment rather than replacing specialist evaluation. Furthermore, future regulatory frameworks should promote explainable AI, robust external validation, data privacy protection, and equitable model performance across different patient populations before widespread implementation in routine burn care.

CONCLUSION

This narrative literature review demonstrates that artificial intelligence has considerable potential to support the initial assessment of acute burn wounds by improving the objectivity and consistency of burn evaluation. The reviewed evidence indicates that AI has been successfully applied to clinically relevant tasks, including burn detection, burn-depth classification, wound segmentation, total body surface area (TBSA) estimation, prediction of surgical requirements, and multimodal burn assessment. Nevertheless, the clinical usefulness of these technologies depends not only on algorithmic performance but also on appropriate reference standards, standardized image-acquisition procedures, external validation, and integration into clinical workflows. Accordingly, AI should be regarded as a clinical decision-support tool that complements, rather than replaces, serial clinical assessment and specialist judgment because burn wounds are dynamic and may evolve throughout the early post-injury period.

The primary scientific contribution of this review is the integration of technical developments in artificial intelligence with clinically relevant considerations for acute burn management. Unlike previous reviews that primarily focused on diagnostic performance or algorithm development, this review highlights the importance of image-acquisition timing, wound-treatment status, burn progression, reference-standard heterogeneity, external validation, skin-tone diversity, and workflow integration as essential factors influencing the safe implementation of AI in clinical practice. In addition, the proposed framework for evaluating AI studies provides practical guidance for clinicians and researchers in assessing the methodological quality and clinical applicability of future AI-based burn assessment systems.

This review has several limitations. As a narrative literature review, it does not include a formal risk-of-bias assessment or quantitative meta-analysis, and the synthesized evidence depends on the quality and reporting of the included publications. Furthermore, the currently available literature remains dominated by retrospective studies, relatively small datasets, and limited multicenter external validation. Future research should therefore prioritize prospective multicenter studies, standardized imaging protocols, diverse patient populations, explainable AI models, and clinically meaningful outcomes, including referral accuracy, need for skin grafting, wound-healing time, scar quality, functional recovery, and cost-effectiveness. Addressing these issues will strengthen the evidence base and facilitate the responsible integration of artificial intelligence into routine burn care.

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