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Artificial Intelligence-Enabled Medicinal-Plant Discovery and Wound Management:An Integrative Evidence Review of Botanical Authentication, Bioactive-Compound Prioritisation, and Implications for Nursing Practice

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Abstract — Wound care requires accurate assessment, infection prevention, appropriate treatment selection and longitudinal monitoring. Medicinal plants contain diverse phytochemicals with potential antimicrobial, anti-inflammatory, antioxidant and tissue-repair activities. Artificial intelligence (AI) is increasingly applied to plant recognition, natural-product discovery and digital wound assessment. Yet the translation of AI-generated botanical predictions into safe nursing practice remains poorly integrated. An integrative evidence review was developed from identifiable peer-reviewed reviews and primary-source records located through online scholarly sources. Evidence was grouped into medicinal-plant image recognition, AI-enabled natural-product discovery, clinical herbal wound interventions, and AI-supported nursing/wound assessment. The synthesis distinguishes computational, laboratory/preclinical and human clinical evidence. A systematic review of deep learning for medicinal-plant recognition included 31 studies; 67.7% used private datasets, 96.7% used leaf organs, 83.8% used transfer learning and 64.5% used convolutional neural networks. A separate clinical review identified 26 herbal wound trials involving 45 plant species. A natural-product review describes AI applications in activity prediction and candidate discovery while emphasising dataset quality and validation. AI may support species screening, phytochemical prioritisation and wound monitoring, but predictions must be validated through botanical authentication, chemical characterisation, experimental testing and controlled clinical studies. Nurses should use only appropriately quality-assured products and validated decision-support tools, retaining professional judgement and patient-centred accountability.

Keywords— artificial intelligence; medicinal plants; nursing; wound healing; botanical authentication; phytochemicals; machine learning; clinical translation; evidence synthesis.

I. INTRODUCTION

Wounds arise from trauma, surgery, burns, pressure, vascular disease, diabetes and other pathological processes. Delayed healing can lead to infection, pain, reduced mobility, prolonged hospitalisation and substantial cost. Nursing care is central to assessment, dressing management, documentation, patient education, infection prevention and timely referral [1]. A complete assessment considers wound aetiology, dimensions, tissue type, exudate, surrounding skin, pain, perfusion, infection indicators, comorbidities and the patient's goals. Repeated measurement is particularly important because a single observation may not reveal deterioration or healing trajectory. Digital photography and AI-assisted image analysis may improve consistency in wound measurement and documentation. However, image-based systems can be affected by lighting, camera distance, skin tone, wound exudate, dressings, image quality and inconsistent acquisition protocols. AI outputs should therefore support, not replace, a comprehensive clinical assessment [2]. Medicinal plants produce specialised metabolites such as phenolic acids, flavonoids, tannins, terpenoids, alkaloids and saponins. Depending on species and preparation, these compounds may influence microbial growth, oxidative stress, inflammatory signalling, fibroblast activity, collagen deposition or re-epithelialisation. Such mechanisms provide a rationale for investigation, but they do not prove that a specific plant preparation improves healing in people.

Botanical interventions are chemically complex. Species, genotype, plant part, geography, harvest season, drying, storage, extraction solvent, concentration and formulation can all influence composition [3]. Misidentification, adulteration, pesticide residues, heavy metals, microbial contamination, allergenic compounds and interactions with medicines are

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relevant safety concerns [4]. A species name alone is not an adequate description of a clinical product.

AI methods include machine learning, deep learning, computer vision, natural-language processing and knowledge-graph approaches. In botany, computer vision can help classify plant images; in natural-product research, machine learning can prioritise compounds or predict biological activity; in wound care, image analysis may support segmentation, measurement and monitoring. Mullowney et al. describe the potential synergy between computational omics and AI for natural-product discovery, while identifying data quality and validation as essential challenges [5]. The research challenge is not simply to show that AI can identify a plant or that a plant extract has activity in a laboratory. It is to establish a traceable chain from correctly authenticated botanical material to reproducible chemistry, validated biological effects, safe clinical products and meaningful patient outcomes [6]. Nursing practice is the point at which these streams meet: nurses assess wounds, administer or apply prescribed products, monitor response, educate patients and escalate concerns [7]. The present review therefore examines both technological capability and the evidence required for clinical translation.

II. METHODOLOGY

Scholarly records were located through indexed sources including PubMed/PMC, publisher pages and the official PRISMA website. Search concepts included combinations of medicinal plant, phytochemical, wound healing, herbal formulation, artificial intelligence, deep learning, computer vision, natural-product discovery and nursing. Priority was given to peer-reviewed systematic reviews and methodological guidance with directly relevant scope. This targeted evidence identification is not equivalent to an exhaustive search of MEDLINE, Embase, Scopus, Web of Science, CINAHL and technical databases.

Table: 1 Shows the Evidence grouping

Evidence tier	Evidence included	Main synthesis question
A. Computational botany	Plant-image classification, AI-based authentication and natural-product prediction.	What can models predict, and how well are they validated?
B. Experimental biology	Chemical profiling, in-vitro bioactivity and animal wound models reported in the cited reviews.	Are predicted candidates experimentally supported?
C. Human clinical	Clinical studies of herbal wound formulations reported in a systematic review.	Are patient outcomes and harms adequately evaluated?
D. Nursing/digital care	AI applications in wound assessment, documentation and clinical decision support.	Can tools improve care without undermining judgement or safety?

Review workflow

The synthesis follows a transparent conceptual workflow. The stages below describe how the evidence was organised for this integrative review and how a future full systematic review should be conducted. They do not represent invented record counts or a completed PRISMA flow.

Figure 1. Review workflow and evidence-synthesis methodology



Eligibility and appraisal principles

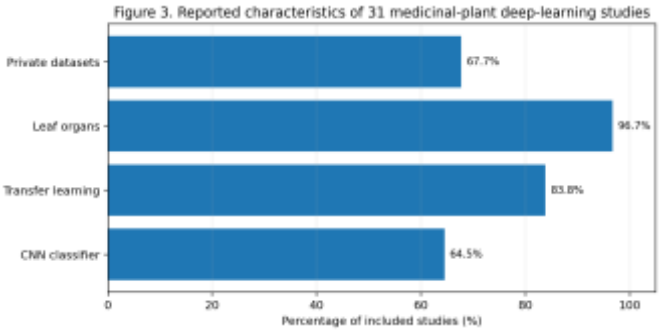
Included evidence was required to address at least one of the four evidence streams and provide identifiable publication details. Reviews were used to identify the state of evidence and key methodological issues; their numerical summaries are attributed to the original review rather than treated as newly extracted primary-study data. A definitive systematic review should retrieve primary studies directly, remove duplicates, use two independent screeners, document full-text exclusions and assess risk of bias with design-specific tools.

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Synthesis strategy
Findings were compared narratively within each evidence tier. Computational accuracy metrics were not compared directly with wound-healing outcomes. Clinical formulations were not treated as interchangeable merely because they originated from plants. The synthesis emphasises validation, generalisability, product standardisation, adverse-event reporting and nursing implementation.

III. RESULTS AND CRITICAL SYNTHESIS

AI-enabled medicinal-plant identification
Mulugeta, Sharma and Mesfin reviewed deep-learning approaches for medicinal-plant classification and recognition. Their review included 31 studies published between January 2018 and December 2022, selected from 1,644 records identified through their search process. The included studies originated from 16 countries. Their synthesis found that 67.7% used private datasets, 96.7% used leaf organs, 83.8% used transfer learning and 64.5% used convolutional neural networks [3].



These figures demonstrate active technical development but also expose a generalisability problem. A model trained on a private leaf-image dataset may not recognise roots, flowers, bark or fruits, and may fail when images are captured under unfamiliar lighting, devices or environmental conditions.

Botanical authentication and traceability
For therapeutic research, image classification should be regarded as an initial screening tool. High-risk or ambiguous identifications should be confirmed by a qualified botanist and, where appropriate, molecular methods. Studies should report accepted scientific names, taxonomic authority, voucher specimen numbers, herbarium deposition, collection location, plant part and provenance. These practices make it possible to reproduce the work and identify errors in the chain of custody.

Model validation requirements
Split data at the specimen or collection-batch level to prevent near-identical images appearing in both training and test sets.
Report class balance, confusion matrices, sensitivity, specificity, precision, recall and F1-score; use confidence intervals where possible.

Test external performance across geography, season, plant maturity, camera type and image conditions.

Report calibration, uncertainty and abstention behaviour, especially where the model cannot confidently distinguish similar species.

Publish data dictionaries, annotation protocols, code and appropriately licensed image data where possible.

AI for natural-product and phytochemical discovery
Natural products represent chemically diverse sources of potential therapeutic molecules. AI can assist by integrating genomic, metabolomic, chemical and phenotypic data; predicting molecular properties or biological activities; prioritising compounds for testing; and exploring relationships between compounds and molecular targets. Mullowney et al. describe how computational omics and AI can work together to uncover natural-product diversity and support drug discovery [8]. They emphasise that high-quality datasets and appropriate model validation are essential.

In wound research, this capability could help prioritise plant-derived molecules for antimicrobial screening, inflammation-related assays, oxidative-stress studies or tissue-repair experiments. Nevertheless, predicted bioactivity is a hypothesis. Docking scores, molecular similarity, classifier outputs or predicted targets cannot establish therapeutic benefit [9]. The model must be followed by chemical confirmation and independent biological experiments.

From plant sample to reproducible chemical evidence
A credible discovery pipeline begins with an authenticated plant sample and documented provenance. The plant part and processing conditions must be recorded. Chemical profiling may use chromatographic and spectrometric approaches to create a batch-specific fingerprint and quantify marker compounds [10]. AI models should use these chemical data rather than rely only on a plant's common name. This is important because two extracts from the same species can differ substantially.

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Table 2: Key Stages, Data Requirements, and Quality-Control Measures in AI-Assisted Medicinal-Plant Research

Stage	Key data	Quality safeguard
Botanical identity	Taxon, voucher, plant part, provenance	Expert identification; voucher deposited
Preparation	Solvent, extraction ratio, temperature, yield	Standard operating procedure; batch record
Chemical profile	Chromatographic/spectrometric fingerprint	Reference standards; marker quantification
AI prediction	Features, algorithm, training data, output	External validation; uncertainty; leakage checks
Biological test	Dose-response, assay, comparator, replication	Blinded protocols; positive/negative controls

Clinical evidence for herbal wound interventions

Ahmed et al. published a systematic review of clinical studies of herbal medicine for wound management. The publisher and PubMed records report that 623 documents were screened and 26 published clinical trials were identified, involving 45 distinct plant species. The review describes wound-related attributes such as antimicrobial, anti-inflammatory and antioxidant activity for a subset of these species, and discusses examples including Hypericum perforatum, Centella asiatica and Calendula officinalis [11].

The review reports that the included trials generally described wound-healing progress and that only one adverse effect was reported [12]. This should be interpreted cautiously. A small number of reported harms does not demonstrate absence of risk: trials may be too small to detect uncommon events, follow-up may be inadequate, and adverse-event collection may be inconsistent. The review itself calls for larger and better-designed trials.

Why botanical formulations cannot be pooled indiscriminately

A plant species may be used as a crude preparation, oil, gel, cream, ointment, extract or multi-ingredient formulation [13]. These products differ in concentration, extraction chemistry, route of application, stability, bioavailability and quality control. Wound aetiology also matters: evidence from burns cannot automatically be transferred to diabetic foot ulcers, venous leg ulcers, pressure injuries or surgical wounds. Clinical synthesis should therefore be stratified by product, wound type, comparator and outcome.

Table 3. Key Clinical Outcome Domains, Data-Extraction Measures, and Interpretive Considerations for Medicinal-Plant-Based Wound Management

Clinical domain	Outcomes that should be extracted	Interpretive caution
Healing	Complete closure, time to healing, wound-area change	Area reduction is not the same as complete healing
Infection	Clinical infection, culture results, antibiotic use	Colonisation and infection are not equivalent
Symptoms	Pain, odour, exudate, comfort	Patient-reported outcomes need validated measures
Safety	Allergy, irritation, systemic effects, withdrawals	Absence of reporting is not absence of harm
Care burden	Dressing frequency, nursing time, quality of life	Context and co-interventions influence results

Preclinical-to-clinical translation

In-vitro antimicrobial activity, antioxidant capacity, cell migration and animal wound closure provide mechanistic and preclinical evidence. They do not establish effectiveness in people. A candidate should pass a sequence of identity verification, chemical characterisation, dose-response testing, cytotoxicity assessment, relevant wound models and safety evaluation before clinical testing [14]. Human trials should use standardised preparations and clinically meaningful endpoints, with transparent adverse-event reporting.

AI-supported wound assessment and nursing practice

AI-based wound technologies may support image segmentation, area measurement, tissue classification, documentation and monitoring of healing trajectories. Their practical value depends on acquisition standards, reliability across patient groups, workflow integration and clinical impact. An algorithm may perform well on curated images but fail in routine care where images vary in lighting, angle, scale, skin tone, exudate, dressings and device quality.

Nurses should interpret AI outputs as decision support. A digital score cannot replace assessment of perfusion, pain, systemic illness, infection, patient goals or the broader clinical context. If an AI output conflicts with clinical findings, the concern should be escalated and documented rather than allowing automation bias to determine care.

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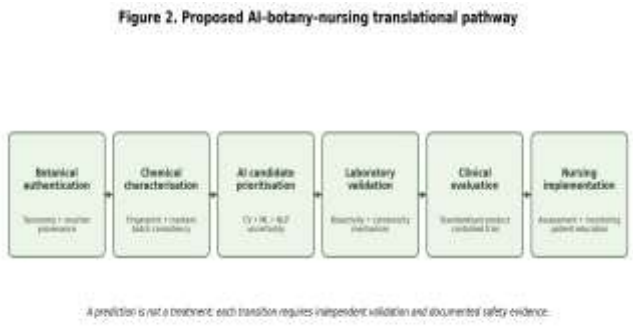


Figure 2. Proposed AI-botany-nursing translational pathway

Figure 2 illustrates the central argument of this review: AI can help prioritise botanical candidates, but translation requires a series of independent validation steps. Nurses enter the pathway at clinical evaluation and implementation, and also contribute to defining outcomes that matter to patients and care delivery.

Nursing responsibilities

- Assess wound aetiology, perfusion, infection, pain, tissue, exudate, dimensions and patient-specific risk factors.
- Confirm that any botanical product is appropriately quality-assured, standardised and authorised for its intended use.
- Review allergy history, possible sensitisation, medicine interactions and contraindications; seek pharmacy or specialist advice where necessary.
- Explain the distinction between traditional use, laboratory evidence, animal findings and demonstrated clinical benefit.
- Document the product, batch where available, wound status, co-interventions, response and adverse events.
- Escalate deterioration and avoid substituting unproven botanical products for indicated standard treatment.
- Protect patient photographs and health data; obtain consent and follow institutional privacy and data-governance policies.

IV. DISCUSSION

Deep-learning models can classify medicinal-plant images, AI can prioritise natural-product candidates, clinical studies have investigated herbal wound formulations, and digital tools may support wound assessment. The key finding is that these components do not yet constitute a validated end-to-end clinical pathway. Each stream has a different unit of analysis and a different standard of proof. The major gap lies between prediction and clinical evidence. Botanical classification answers whether an image resembles a labelled species; it does not establish the identity or chemical quality of a therapeutic batch. A molecular model predicts a property or activity; it does not show that a topical formulation is safe, stable or effective. A laboratory assay demonstrates activity under specified conditions; it does not establish improved healing in patients. A wound image model may measure an area; it does not independently determine the cause of a wound or the correct treatment. Nursing education should address digital literacy, critical appraisal of AI outputs, wound-image quality, privacy and the limits of botanical evidence. Nurses should be able to ask whether a plant is authenticated, whether the preparation is standardised, whether there is human evidence for the relevant wound type, and how harms were monitored. Interprofessional collaboration with botanists, pharmacognosists, pharmacists, microbiologists, wound specialists and AI researchers is essential.

V. CONCLUSION

The integration of artificial intelligence, medicinal-plant research, and nursing practice offers promising opportunities to improve medicinal-plant identification, bioactive-compound discovery, and wound management. However, computational predictions and traditional evidence must be supported by rigorous laboratory validation and well-designed clinical trials before therapeutic recommendations can be made. Nurses remain essential in treatment delivery, wound monitoring, patient education, and safety assessment. Ultimately, interdisciplinary collaboration and further clinical research are necessary to translate AI-driven botanical discoveries into safe, effective, and evidence-based wound-care interventions.

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