AI-Based Dermatology Diagnostic Tools: Promise, Limits, and Their Role in Mismedicine

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Introduction

Artificial intelligence (AI)-based dermatology diagnostic tools are software systems designed to help identify and classify skin lesions, often through the analysis of clinical or dermoscopic images (Behara et al., 2024; Choy et al., 2023). Interest in these tools has grown because skin cancer remains one of the most commonly diagnosed cancers worldwide, with over 1.5 million new cases estimated globally in 2022 (International Agency for Research on Cancer [IARC], 2024). During that same year, approximately 330,000 new melanoma cases and nearly 60,000 melanoma deaths were estimated globally (IARC, 2024). Because outcomes are often better when suspicious lesions are recognized early, dermatology has become one of the clearest areas for image-based AI development (Behara et al., 2024). This article examines how AI-based dermatology diagnostic tools work, their benefits and limitations, and how they may either reduce or contribute to mismedicine.

What They Are and How They Work

AI-based dermatology diagnostic tools are generally trained on large image datasets to recognize patterns associated with specific skin conditions (Behara et al., 2024; Choy et al., 2023). Using machine learning, particularly deep learning, these systems can assist in detecting conditions such as melanoma, basal cell carcinoma, squamous cell carcinoma, and certain inflammatory skin diseases (Behara et al., 2024; Choy et al., 2023). Since these tools are designed to support the detection of complex skin conditions, they are generally not intended to replace dermatologists; instead, they function as decision-support systems that help clinicians interpret lesions more consistently and efficiently (Behara et al., 2024; U.S. Food and Drug Administration [FDA], 2025).

Most systems are developed using labelled datasets made up of images already linked to known diagnoses (Behara et al., 2024; Choy et al., 2023). During training, the model learns to associate visual features with diagnostic categories. After training, it can evaluate a new image and generate outputs such as a probability score, a ranked list of possible diagnoses, or a recommendation for further review (Behara et al., 2024; Chanda et al., 2024). However, performance depends on more than the algorithm alone. Image quality, lighting, camera type, lesion appearance, patient skin tone, and broader clinical context can all affect how well a system performs (Choy et al., 2023; Groh et al., 2024). For that reason, AI in dermatology is usually described as a support tool rather than a replacement for clinical judgment (Behara et al., 2024; FDA, 2025).

Benefits and Clinical Relevance

One major benefit of AI-based dermatology tools is their potential to improve the early recognition of suspicious lesions (Behara et al., 2024; Krakowski et al., 2024). Reviews of the field show that AI has achieved strong performance in image-classification tasks, especially in skin cancer detection (Behara et al., 2024). There is also evidence that AI assistance can improve the diagnostic accuracy of clinicians in certain settings. A systematic review and meta-analysis by Krakowski et al. (2024) found that AI assistance had a measurable effect on the accuracy of skin cancer diagnosis in human users.

These tools may also be useful where specialist access is limited. In primary care settings or remote areas, AI-based support may help identify lesions that require urgent referral, which could reduce delays in assessment and treatment (Behara et al., 2024; World Health Organization [WHO], 2025). This is important because timely diagnosis and referral are key parts of improving cancer outcomes (WHO, 2025). In this way, AI may strengthen triage and support earlier specialist involvement when used appropriately.

Limitations, Risks, and Mismedicine

Despite their promise, AI-based dermatology tools also have important limitations. One of the most serious concerns is bias related to dataset composition and unequal performance across populations (Choy et al., 2023; Groh et al., 2024). Groh et al. (2024) showed that both clinicians and AI-supported diagnoses can vary across skin tones, which raises concerns about fairness in real clinical settings. If training data do not adequately represent diverse patient groups, the system may be less reliable for people who are already underserved in healthcare (Choy et al., 2023; Groh et al., 2024).

Another concern is overconfidence in the technology. If clinicians rely too heavily on an algorithm's recommendations, an incorrect output may influence decision-making rather than improve it (Krakowski et al., 2024). Although AI support can improve accuracy in some situations, it can also affect human judgment in ways that are not always helpful, especially if the user assumes the system is more objective or reliable than it actually is (Chanda et al., 2024; Krakowski et al., 2024). There are also broader concerns about the research base, since many studies rely on selected image datasets instead of prospective, real-world clinical environments (Choy et al., 2023).

These concerns connect directly to the idea of mismedicine. Mismedicine, a term coined by Dr. Pooya Beigi, refers to medical acts or system-level failures that result in harm, inefficiency, or a failure to meet the standard of care (Beigi, 2023). AI in dermatology could help reduce mismedicine by supporting earlier detection, better triage, and more consistent assessment (Behara et al., 2024; Krakowski et al., 2024). At the same time, it could contribute to mismedicine if biased data lead to misclassification, if patients receive false reassurance, or if healthcare systems adopt these tools before they are properly validated across diverse populations and real-world settings (Choy et al., 2023; Groh et al., 2024).

Conclusion

AI-based dermatology diagnostic tools represent an important development in modern healthcare. They offer real potential to support earlier detection of skin cancer, improve diagnostic support, and expand access to dermatologic assessment in some settings (Behara et al., 2024; Krakowski et al., 2024). However, their limitations are significant, especially when it comes to bias, unequal performance across skin tones, and the risk of overreliance on algorithmic output (Choy et al., 2023; Groh et al., 2024). These issues make AI in dermatology a strong example of how innovation can either reduce or contribute to mismedicine. Moving forward, healthcare systems and researchers should prioritize diverse validation, real-world testing, and continued clinician oversight to reduce the risk of mismedicine.

Q&A

What are AI-based dermatology diagnostic tools?

AI-based dermatology diagnostic tools are software systems that analyze clinical or dermoscopic images to help identify and classify skin lesions. They are usually trained on large image datasets and are designed to support clinician judgment rather than replace it (Behara et al., 2024; Choy et al., 2023).

Can AI replace dermatologists?

At this stage, AI is better understood as a support tool than a replacement for dermatologists. These systems may assist with pattern recognition and triage, but diagnosis still depends on clinical history, physical examination, and professional judgment (Behara et al., 2024; U.S. Food and Drug Administration [FDA], 2025).

What are the main benefits of these tools?

Their main benefits include earlier recognition of suspicious lesions, improved diagnostic support, and the possibility of expanding access to dermatologic assessment in settings where specialist care is limited (Behara et al., 2024; Krakowski et al., 2024; World Health Organization [WHO], 2025).

What are the main risks or limitations?

Important concerns include bias in training datasets, unequal performance across skin tones, overreliance on algorithmic recommendations, and limited validation in real-world clinical settings

(Choy et al., 2023; Groh et al., 2024; Krakowski et al., 2024).

How does this topic relate to mismedicine?

This topic relates to mismedicine because AI can either reduce harm or contribute to it, depending on how it is developed and used. It may reduce mismedicine by helping clinicians detect serious lesions earlier, but it may also worsen it if biased or poorly validated systems lead to misclassification or false reassurance (Beigi, 2023; Choy et al., 2023; Groh et al., 2024).

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