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# Applications of Artificial Intelligence in Dermatology

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## ABSTRACT

Artificial intelligence (AI) is becoming a more common research topic in medicine and is being used more frequently in dermatology. To assist direct and mould the future for medical care providers and recipients, it is necessary to comprehend how this technology is progressing. In order to assess the sorts of publications on the topic, the particular dermatological topics covered by AI, and the most difficult implementation barriers, we studied the literature. Only a few in-depth reviews exist despite the fact that numerous original articles and commentaries have been published to date. The majority of AI applications are concerned with identifying benign and malignant skin lesions, but there are also ones that deal with ulcers, inflammatory skin conditions, exposure to allergens, dermatopathology, and gene expression profiling. Applications frequently identify and analyse photographs, but there are also more and more tools available, such risk calculators. Despite the fact that many applications are technically feasible, significant implementation obstacles have been found, such as systematic biases, difficulties with standardisation, interpretability, and patient and physician acceptance. This evaluation sheds light on potential areas for and needs in future study. In dermatology, there is a critical need for clinical research that shows that the hurdles have been successfully overcome. With these objectives in mind, it's possible that AI will soon play a useful role in dermatology.

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## INTRODUCTION

Dermatology is a discipline where digitalization, telemedicine, and informatics are increasingly interacting (1).Numerous attempts have been made to use artificial intelligence (AI) for dermatological applications as a result of its expanding use in society (2). In a recent international study of 1,271 dermatologists, only 23.8% of respondents had high or excellent knowledge of AI, despite 85.1% of respondents being aware of it as an emerging topic in their area (3). Additionally, 79.8% said that AI should be taught to medical students, and 77.3% felt that it will improve dermatological care. Thus, it is important to educate stakeholders on the current state of AI in order to promote what dermatologists themselves see as a developing, advantageous, and maybe mandatory aspect of their profession. Numerous papers have been written about specific AI issues in dermatology, but few give a general overview and cover the entire field. In this article, we use three sections to review the current state of the literature on AI in dermatology. We begin by highlighting the many kinds of articles written about this topic. Finally, we highlight the main obstacles preventing AI application before turning our attention to the dermatologic disorders that AI is targeting.

## TYPES OF ARTICLES PUBLISHED

The large majority of publications that have been published to this point are original research pieces. These outline the architecture of AI programmes that can carry out activities linked to dermatology. For instance, papers have investigated instruments that may distinguish between benign and malignant skin lesions or segment a psoriasis lesion (4,5). These publications illustrate the technological viability of these AI tools and highlight the potential clinical relevance should they be further validated, despite the fact that they have not yet been used in clinical settings. Few dermatologists contribute as co-authors to the majority of these articles, which are written by engineering researchers.

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Despite this increase, only a small proportion of papers actually incorporate significant dermatologist involvement in the conception, design, and interpretation of the investigations. Collaboration with dermatologists is essential to overcoming established obstacles to clinical deployment.

In their recent assessment of melanoma screening applications, Zakhem et al. point out that the AI applications used substantially bigger patient datasets that were more typical of actual clinical settings when dermatologists were involved in the study design (6). Conducting prospective clinical studies is a crucial type of collaboration, but there are very few of these (7). Dreiseitl et al. did a significant study (8).

According to their approach, patients who appeared with unexplained pigmented lesions to a dermatological clinic were evaluated independently by both expert dermatologists and non-specialist clinicians using an AI device. As a result, the study's design matched an actual clinical practise setting. The results showed that the automated system was inferior, and regrettably, no subsequent investigations have been published. Uncertainty persists regarding the causes of the dearth of comparable studies, including publication bias or a knowledge gap.

## DERMATOLOGICAL APPLICATIONS OF AI

Research proving the early efficacy of AI applications in differentiating between benign nevi and melanoma is many and expanding (5,13–14).The primary idea underlying these applications is the ability to analyse individual pixels from dermatoscopic or non-dermatoscopic images of lesions. An application that analyses photographs pixel by pixel and extracts 60 attributes from each to forecast disease classification is provided as an illustration by Jafari et al (14). Usually, the accuracy of these applications' lesion diagnoses is compared to that of board-certified dermatologists (12). 48 melanoma-screening methods were included in a review of photo recognition software by Safran et al., and it showed a mean sensitivity and specificity of 87.60% and 83.54%, respectively (9). An international skin imaging competition was launched in 2016 and has been held every year thereafter due to the increased interest in this subject (15).

Despite the fact that these applications have grown more robust, prospective clinical studies are still uncommon, and known implementation obstacles are still being discussed.

The decisions produced by these technologies ultimately reflect the input data used to train the system, which is one of its key constraints (17). Theoretically, this means that apps can only be used with confidence in the populations they were designed to evaluate. The results are technically not generalizable and are vulnerable to systematic biases like overfitting when applications are developed for one group and tested on a different one. Han et al., for instance, tested a skin cancer detection algorithm and found that overall performance might be enhanced if trained with a range of data from various ethnic populations (16).More data alone won't necessarily address this issue, though. For instance, Navarrete-Dechent et al. used Han et alestablished .'s AI system that was tested using a special database of Caucasian Americans from the southern United States. The algorithm had been trained using a relatively diverse set of data. They discovered that the performance was inferior to what had previously been reported (18). Because of this, the problem of generalizability is not easily resolved and can need for either unique or extended data, depending on the make-up of the population being tested. Given the multiple demographic characteristics, including age, gender, race, and ethnicity to name a few, that influence establishing a diagnosis, this tendency for systematic bias has numerous consequences for dermatology.

Images of additional lesions must be comparable, even if the programme was trained using data from the correct population. What direction should the photo be taken? What kind of lighting should be in the space? What should the setting be like? Do you see any pen markings? These are elements that may influence how AI makes decisions. For instance, a study by Winkler et al. revealed that surgical markings severely hampered a system's capacity to correctly identify melanoma in dermatoscopic pictures and raised the percentage of false positives (19). In contrast to other disciplines (like radiology), dermatology has many non-standardized elements, which is why artificial intelligence depends on it (20). Despite the fact that databases are purposefully big in order to accommodate for variability, these variables give rise to an unlimited number of potential divergences.

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The standard procedure for making a diagnosis in dermatology involves taking a thorough history, performing a physical examination in a well-lit room, looking for texture, eliciting specific signs for a given lesion (such as the Darier, dimple, and buttonhole signs, etc.),(21) and concluding with a biopsy.

Additionally, it is acknowledged that while some diagnoses are based primarily on histologic findings or a combination of clinical and histologic data connection, others rest entirely on clinical findings. The inability of computer programmes to completely replace this holistic approach is regarded as one of the biggest obstacles to the adoption of AI (22). Many patients prefer to work with a doctor who cares about them and want to help them; they may not be content with isolated digital instruments (12).

**Liability**

The problem of liability is another (23). Is a dermatologist accountable if AI is used and a negative result occurs? A prevalent misconception is that AI will just serve as a guide tool rather than a complete diagnostic tool in light of this.

**Future Steps**

To date, a number of general proposals have been made to alleviate these obstacles.Clinical trials that are prospective are obviously needed. Studies that focus on the clinical encounter are essential if the question is whether AI may enhance a dermatologic clinical interaction (7). Collaboration amongst dermatologists has also been emphasised as crucial (6). Systems must receive training on the full range of human populations and clinical manifestations that dermatologists encounter in clinical practise (24). Standardization processes also need to be adopted for photographing new lesions, as well as inputs on other metrics available to clinicians, such as anatomic location, duration of the lesion, and photographs of unaffected skin (25). The lack of interpretability of many AI applications leads us to our last hypothesis: by improving the lay descriptions of the algorithms and research designs, we can increase the acceptance of these technologies by medical professionals and the general public. Additionally, this would help regulatory decision-makers who will have to take positions on responsibility.

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## CONCLUSION

In dermatology, AI is being investigated more and more. While identifying and analysing photos is the primary function of most apps, there are other tools available, such as risk calculators. The field of melanoma diagnosis has made the largest advancements thus far, followed by instruments for evaluating ulcer and psoriasis, and then many less commonly explored applications. However, there are considerable roadblocks and knowledge gaps that at this time severely restrict the use of AI in clinical practise. Technology papers and commentaries are required for the less prevalent applications to advance capabilities and pique interest. There is a greater demand for clinical studies that demonstrate therapeutic efficacy while successfully overcoming the highlighted barriers for the more oversaturated themes. An appropriate position for AI in dermatology may be attained with the help of these research objectives.

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