

## ACADEMIC: ESSAY

# Future-proofing dermatology: the role of artificial intelligence in dermatology clinics

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## Abstract

Artificial Intelligence (AI) involves the development of computer systems that mimic human cognitive processes. In recent years, AI has emerged as a promising frontier in the medical field. Given the inherently image-rich nature of dermatology, numerous studies have highlighted AI as a transformative prospect for clinical practice. This essay aims to explore the evolving role of AI in dermatology clinics by examining its current applications and future potential in New Zealand.

## Introduction

Imagine a world where doctors no longer spend hours writing consult notes, diagnoses can be aided by technology, and personalised treatment plans are generated instantly. Artificial Intelligence (AI) is transforming the landscape of healthcare, and this reality that seemed so out of reach might not be any longer. AI is making significant strides in dermatology, with numerous studies highlighting its applications at various stages of patient care.<sup>1</sup> As research and advancements in this field continue to grow, so will the influence of AI on dermatological practice. AI can be defined as the utilisation of algorithms and rules to create a machine system that replicates human cognitive processes such as learning and problem solving.<sup>2</sup> AI encompasses various techniques including machine learning (ML) and deep learning (DL). ML involves computer programs that recognise patterns in large datasets. This allows informed predictions to be made based on new inputs. DL is a subset of ML which utilises layered artificial neural networks (ANN), enabling it to learn from vast and complex datasets, and as a result, perform intricate tasks such as image recognition and analysis.<sup>3</sup> This article aims to discuss the impact of AI in dermatology by focusing on advancements in access and efficiency, diagnostic precision, and personalised treatments. Key challenges such as data limitations and ethical considerations will also be addressed.

## Enhancing access and efficiency in dermatology clinics

### 1. TELEDERMATOLOGY

According to Te Whatu Ora Counties Manukau, the average wait time for a routine dermatologist consultation is 24 weeks.<sup>4</sup> However, teledermatology has been shown to decrease wait times by up to 6 months in similar settings.<sup>5</sup> Teledermatology allows for access to dermatologic care in remote areas, while AI demonstrates immense potential in analysing skin images and assisting with various consultation tasks.<sup>1</sup> The integration of these two domains can make dermatological care more efficient, accurate, and accessible.

Synchronous teledermatology allows for doctor-patient interactions in real time via video channels, while asynchronous teledermatology allows patients to contact their doctors through store-and-forward technologies such as health portals and emails.<sup>6</sup> Synchronous consultations are often preferred as they enable dermatologists to comprehensively assess a case within a single session. In contrast,

asynchronous teledermatology may require multiple consultations to fully address the issue.<sup>7,8</sup>

A study on Dr. Derm Bot has found that the integration of AI into teledermatology bridges the gap between these two formats.<sup>5</sup> This will offer the immediacy of synchronous consultations alongside the flexibility of asynchronous care. Dr. Derm Bot is a GPT-based chatbot designed with the advanced capabilities of ChatGPT-4. Shapiro et al. analysed the effectiveness of Dr. Derm Bot by having the chatbot navigate a case of alopecia areata.<sup>5</sup> They identified several limitations in its current implications, notably its inability to interpret medical charts and handwriting. Recognising these challenges, they envisioned a plan for AI-integrated teledermatology that addresses these shortcomings. Their proposed plans involve the AI chatbot taking a preliminary history by screening patient clinical records and delivering personalised consult questions. Additionally, the chatbot can prompt patients to upload images of their skin condition and subsequently generate a differential diagnosis with a recommended management plan. By serving as a supportive tool for dermatologists throughout diagnosis and management planning, this proposed system carries the potential to enhance overall efficiency. However, it is important to note that these simulated cases might not have fully captured the complexity and variability seen in real world patients. Every patient presents with unique clinical and psychosocial factors that may be overlooked by a chatbot, highlighting the need for human oversight in patient care.

### 2. DIGITAL SCRIBE

The healthcare sector has witnessed a surge in clinician burnout driven by various factors such as administrative burden.<sup>9</sup> To combat this issue, the development of AI in the form of a digital scribe has been proposed. With the use of ML, automatic speech recognition and natural language processing, digital scribes can transcribe and convert consultations into structured clinical notes.<sup>10</sup> A digital scribe allows clinicians to focus on their patients without the distraction of manual documentation during consultations. This could enhance productivity, reduce clinician burnout, and strengthen the doctor-patient relationship. In New Zealand, this technology has been adopted by several general practices, yet many hospitals still rely on human medical scribes to compose outpatient letters.<sup>11,12</sup>

A pilot study in the US has found that the use of digital scribes saves clinicians an average of 3 hours per shift.<sup>13</sup> Another study indicated that dermatologists reduced their daily time spent on electronic health records by 22%.<sup>14</sup> This efficiency is especially beneficial in dermatology where resource constraints have been a significant challenge.<sup>15,16</sup> By improving workflow, dermatologists can increase their capacity to see more patients daily. While this technology is effective in minimising time spent on documentation, several limitations have been identified. For instance, errors in transcription of simulated medical conversations have been estimated to exceed 35%.<sup>17</sup> However,

with continued advancements in AI-powered digital scribes, we can anticipate significant improvements in transcription accuracy moving forward.

## Improving diagnostic accuracy and personalisation

### 1. AI AS A DIAGNOSTIC AID

New Zealand has one of the highest rates of skin cancer globally.<sup>18</sup> Skin cancers are classified into keratinocyte carcinomas (KC) and melanomas. KCs include basal cell carcinomas and squamous cell carcinomas which are more prevalent than melanomas. However, melanomas carry a significantly higher mortality rate.<sup>19</sup> Approximately 90,000 cases of KCs and 7,000 cases of melanoma are reported annually in New Zealand.<sup>20</sup> Most patients with suspected skin cancers initially present to primary care, where general practitioners face the challenging task of distinguishing between benign skin lesions and potentially malignant ones. Diagnostic uncertainty can lead to increased referrals to dermatology, a specialty already facing significant shortages in manpower.<sup>15,16</sup>

DL models, particularly convolutional neural networks (CNNs), have been trained to identify various skin conditions including skin cancers.<sup>21</sup> CNNs are designed with a grid-like structure that mimics the organisation of the human visual cortex. This allows for analysis of pixel values in digital images, which are also organised in two-dimensional grids.<sup>22</sup> The automaticity of CNN in screening for unique features without human input can thereby greatly enhance efficiency in image classification and improve overall diagnostic accuracy.<sup>23,24</sup>

A groundbreaking study published in 2018 compared the diagnostic accuracy of melanoma between a CNN system and 58 international dermatologists.<sup>25</sup> A hundred high quality, validated dermoscopic images were utilised for this study. Clinical information was provided in two levels – level 1, dermoscopy images only; and level 2, dermoscopy images plus patient data to simulate real life scenarios of having more than just visual data for formulating clinical diagnoses. The differentials and management decisions were generated by both groups. At both levels, the CNN system achieved higher sensitivity than the dermatologists, demonstrating the potential of well-trained CNN in enhancing the diagnostic accuracy of skin cancers.<sup>25</sup> A 2019 study by Fujisawa et al. yielded similar results, with the CNN model achieving an impressive accuracy of 92.4%, outperforming dermatology consultants and trainees who achieved an accuracy of 85.3% and 74.4%, respectively.<sup>26</sup> These outcomes mark an important advancement, but their generalisability to the New Zealand population remains limited without the inclusion of locally relevant data. To ensure clinical relevance, CNN models would need to be trained on datasets that reflect the unique demographics and skin type diversity of New Zealand.

### 2. PERSONALISED TREATMENT PLANS

As clinicians, it is crucial to recognise a one-size-fits-all approach is unfeasible in patient care. In the field of dermatology, this is particularly germane to the management of inflammatory skin diseases. Inflammatory skin diseases involve complex pathophysiologic mechanisms resulting in dysregulation of the immune system.<sup>27</sup> While recent advancements in targeted therapies have transformed the management of such skin disorders, the integration of AI has the potential to further enhance these breakthroughs.

Psoriasis, a common and debilitating inflammatory disease, serves as a key example. Psoriatic lesions are marked by extensive immune cell infiltration, elevated levels of various cytokines and chemokines, and hyperproliferation of keratinocytes.<sup>28</sup> Global prevalence rates sit at approximately 2 – 3% worldwide, equating to 125 million affected individuals.<sup>29</sup> Due to its complex nature, the pathogenesis of psoriasis is still not fully understood, with limited studies on its biomarkers. Hence, the current treatment of psoriasis largely involves a trial-and-error approach as patient response to available therapies are variable.<sup>30</sup> However, the use of AI has rendered the delineation of underlying molecular processes possible. Insights from recent studies have uncovered additional inflammatory pathways linked to psoriasis, suggesting that biomarker tracing could help dermatologists tailor

management plans for individual patients.<sup>31</sup>

In the 2023 study by Zhou et al., ML algorithms were employed to screen for genes associated with psoriasis.<sup>32</sup> This study identified 101 genes involved in the regulation of cell proliferation and immune functions. Notably, three psoriasis biomarkers – BTC, IGFL1 and SERPINB3 – were highly associated with psoriasis and demonstrated strong diagnostic value. These biomarkers play a crucial role in the infiltration of immune cells into the skin, which is the key process leading to psoriatic inflammation.<sup>32</sup> Another study evaluated the use of neural networks to predict psoriasis risk based on gene expression profiles.<sup>33</sup> This study found that neural network-based classifiers outperformed other biomarker identification models. While previous studies had profiled hundreds of genes associated with psoriasis, the lack of overlap in marker genes across these studies limited their robustness. In contrast, the neural network-based classifier identified upstream gene markers, achieving a prediction accuracy of 99.81% for psoriasis.<sup>33</sup>

AI-assisted biomarker identification not only enhances dermatologists' ability to monitor disease activity and therapeutic responses with greater precision, but it also facilitates effective risk stratification. This allows early identification and treatment of high-risk patients, ultimately reducing complications and improving health outcomes.<sup>34</sup> Given the rapid pace of technological advancement, the potential for more personalised and effective treatment strategies grows exponentially, making a pivotal step toward precision medicine.<sup>35</sup>

## Challenges and ethical considerations

### 1. DATA LIMITATIONS

Most of the current literature regarding AI in dermatology have been conducted abroad, thus its generalisability to New Zealand may not be applicable. One potential limitation of the development of AI models in New Zealand is our limited population. The success of any AI model in dermatology relies on vast datasets representing diverse demographics and skin conditions.<sup>36</sup> Furthermore, DL algorithms often operate as “black boxes,” meaning their decision-making processes are not easily explainable.<sup>37</sup> This lack of transparency can lead to the development of mistrust between doctors and patients as clinicians may struggle to justify AI-generated recommendations.

### 2. ETHICAL CONCERNS

Another key issue surrounding the integration of AI in dermatology includes patient confidentiality, potential algorithmic biases, and the risk of exacerbating healthcare inequities.<sup>38</sup> A digital divide may arise as this technology may not be equally accessible to all communities, especially those already struggling to access healthcare services. This presents a significant challenge in New Zealand, where Māori and Pacific populations are disproportionately affected by existing health disparities.<sup>39</sup> Moreover, public trust remains a challenge. A study conducted across five countries found that 63% of citizens are uncomfortable with the use of AI in healthcare, highlighting the need for careful ethical considerations and public engagement.<sup>40</sup> Additionally, resistance may be expected in the adoption of AI considering the cultural healthcare practices of New Zealand. Whakawhānau, the process of building relationships and trust, is a fundamental component of patient consultations — it can only be fully realised through personal and social interactions. As AI-driven approaches in dermatology shift towards greater efficiency and outcome-focused care, consultation times may be shortened, potentially diminishing the human connection that lies at the heart of medicine.

## Conclusion

To conclude, AI holds immense transformative potential in the field of dermatology and its integration could play a significant role in the future. AI has the capacity to enhance access through teledermatology and improve efficiency via digital scribes. It may also support diagnostic accuracy and enable personalised treatment plans for conditions such as psoriasis. However, these advancements are not without its limitations. In an increasingly fast paced clinical environment, the use

of AI may shorten consultation times, limiting opportunities for whakawhānauatanga and the establishment of meaningful doctor-patient relationships. Without careful implementation, this integration could risk creating a digital divide that may exacerbate health inequities among communities in New Zealand.

As the field evolves, so will the role of dermatologists, with greater emphasis likely placed on areas that AI cannot easily replicate such as surgical dermatology or managing complex clinical cases that require human judgement. To facilitate this transition, further research in New Zealand is essential to understand patient acceptance of AI in healthcare. This is necessary to ensure that AI models align well with our population by respecting cultural practices and promoting equitable healthcare. Rather than resisting this technological shift, clinicians should remain adaptable and proactive in learning how to harness its full potential. However, this promising future must be tempered with thoughtful consideration of current challenges before being fully implemented. By embracing AI as a tool, dermatologists can enhance patient care and improve efficiency while ensuring that technology complements, rather than replaces, the essential human aspects of medical practice. With ongoing research and advancements, the integration of AI in dermatology can be an achievable development in the foreseeable future.

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