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PERSPECTIVE PIECE

Evaluating Artificial Intelligence and Telemedicine-based Care Models in Dermatology

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Abstract : Access to dermatology services in rural and remote Australia is challenged by geographical isolation, expense and long waiting periods for specialist consultations. This is particularly concerning as Australia is a country with one of the highest rates of melanoma and melanoma mortality in the world. Advances in Artificial Intelligence and telemedicine can increase access to dermatological care disease.

This perspective piece evaluates these technologies and the issues faced during previous implementation attempts in Australia.

Key words: "Teledermatology" "Telemedicine" "Mobile Health" "Dermatology" "Artificial Intelligence" "Public Health"

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Introduction

Artificial Intelligence (AI) and telemedicine have the potential to play a significant role in dermatology given the visual nature of most dermatological conditions. This is particularly in rural or remote areas where access to specialists is limited. Clinical images or histopathological images of sufficient quality may be utilised in various platforms to obtain a diagnosis either via consultation with a dermatologist, dermatopathologist, or artificial intelligence algorithms.

This perspective piece seeks to examine the implications and potential impact of AI and telemedicine, and to evaluate where these have been implemented around the world as shown in case studies.

Mobile Applications

The proliferation of mobile applications (apps) for dermatology has faced minimal regulation with over 225 new dermatology mobile applications created since 2012 [1]. As mobile smartphone functions become more integrated to include voice, text, audio recording, images, and geographic information services (GIS) tracking [2], they have the capacity to screen and improve management of cancers and chronic diseases by facilitating specialist assessments and consultations, and providing patients with greater access to information related to their condition [3].

Artificial Intelligence in Dermatology

Artificial Intelligence (AI) refers to the capacity for computers to perform tasks attributed to human intelligence. AI has garnered interest amongst researchers due its potential to assist doctors and complement clinical decision-making with larger quantities of data and evidence [4]. In 2017, researchers at Stanford University developed an algorithm to diagnose skin malignancy with the same accuracy as board-certified dermatologists. The team trained a convolutional neural network with a large dataset of 129,450 clinical images with 2032 different diseases. The team used the Google Inception v3 CNN architecture, which was trained using 1.28 million specialist-graded images. When the performance of this CNN was tested against 21 board certified dermatologists the CNN was found to classify the cancer at a similar level to the trained dermatologists [5].

Australia has the highest incidence of non-melanoma skin cancer (basal cell carcinoma and squamous cell carcinoma) in the world [6]. Australia also has one of the highest rates of melanoma and melanoma mortality in the world [7]. In 2016 approximately 2000 Australians died from melanoma and other malignant neoplasms of skin [8]. This is largely due to the country's high proximity to the equator and high levels of ultraviolet (UV) light exposure. An AI screening tool for skin cancer has the potential to improve patient care outcomes by being able to provide fast and accurate diagnosis for patients who would otherwise be unable to access specialist care due to long wait times or geographical location.

Telemedicine in Dermatology

Telemedicine is the remote provision of healthcare using telecommunications and information technology to improve access to care in regions with specialist shortages, and encourage continuity of care by allowing the primary care physician to drive patient care.

Broadly there are 2 service models implemented for telemedicine in dermatology: Live Interactive (LI) and Store and Forward (SAF). The LI model provides two-way interaction between the patient, primary care physician (PCP) and dermatologist simultaneously. This model allows the dermatologist to directly converse with the PCP and patient to provide live diagnosis and input for complex cases. This model is limited by expense as all parties must have access to video conference equipment, and an additional logistical barrier of time scheduling for all parties involved.

The SAF model requires the PCP to obtain images of the lesion, relevant patient data and history to send to the consulting dermatologist. This is a more common service model than LI model as barriers to setup are lower and less expensive. The dermatologist can review the case at his convenience, and high bandwidth is not required. The SAF model lacks capacity for the specialist to ask the patient and doctor questions for clarification, or to revise images captured that are unsuitable or of poor quality. The low cost and simplicity of the store and forward model, with nurses and technicians being able to assist doctors with image acquisition, also makes it highly suitable for implementation in dermatology. SAF models also mitigate medico-legal risk as written notes and images can be easily referenced and recorded [9].

Cost effectiveness of the store and forward model

An analysis of the costs of implementing the various forms of tele dermatology also support SAF service model the most scalable and hence preferred form for large scale implementation. The capital costs for SAF model generally include a digital camera for photography and dermatoscope. It is foreseeable that improvements in smartphone camera resolution will reduce the capital costs and barriers associated with SAF teledermatology.

A systematic review on the cost effectiveness of SAF teledermatology found the model to be cost-effective when used to triage patients, particularly in instances where patients were required to travel significantly long distances to see a specialist dermatologist [10]. Furthermore a prospective analysis of teledermatology consultations in The Netherlands found that SAF resulted an 18% reduction in healthcare expenditure and prevented 74% of in-person referrals [11].

An Australian case study: Tele-Derm

In Australia dermatology practices are more concentrated in metropolitan areas which presents challenges for rural and remote patients seeking specialist care, which is of significant concern considering approximately 30% of Australian live in rural and remote areas [12].

Tele-Derm is a free online consultation service that aims to assist clinicians in geographically and professionally isolated locations in the management of dermatological presentations. Tele-Derm was established in 2004 by the Australian College of Rural and Remote Medicine (ACRRM) in collaboration with the Queensland Divisions of General Practice. This service employs the SAF model where the PCP uploads a patient's clinical notes with a photographed image of the lesion, and a dermatologist provides the patient with advice typically within 24 hours. In order for Tele-Derm to be effective it is essential that primary care physicians provide an image of sufficient quality. In a 12 month period, 73% of the 406 cases submitted to Telederm included clinical photos of sufficient quality for dermatologists to provide advice [13]. There has been Australia-wide utilisation of Tele-Derm

National, with even some Australian doctors working overseas in the Pacific Islands, New Zealand and South East Asia utilising the service. Tele-Derm is an example of how telemedicine can reduce the impact of geography on patient access to specialist advice.

Australian Barriers to Teledermatology Implementation

In rural and remote Australia the primary barriers to telemedicine implementation include funding, lack of time or incentives for PCP to set up teleconsultations, and lack of required infrastructure, equipment or training [14]. A study of clinicians' attitudes towards the Tele-Derm project found that 15% of doctors cited lack of remuneration as a negative aspect of using the service [15]. Additional consultation time spent taking and uploading the photograph and relevant data is not billable in the present MBS. The same survey found 38% of doctors felt Tele-Derm increased their workload and 45% felt it was too time consuming in comparison to regular in person consultations. Whilst teledermatology services such as Tele-Derm may provide significant savings for patients in terms of cost savings in travel time and productivity loss, it is clear that sufficient incentives for specialists and PCPs are required for successful implementation.

Conclusions

Artificial Intelligence and telemedicine have the potential to improve access to specialist advice and reduce healthcare costs, particularly when used in tandem and applied to the contexts of rural and remote areas with reduced access to dermatologists and dermatopathologists. Greater awareness, incentives and the barriers to adoption for primary care physicians and specialists should be explored in order to implement these technologies, together with the careful validation and software regulation to ensure the ongoing provision of accurate and high standard of care.

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