AI, are dermatologists' days numbered?

By Zara Ali

Introduction

Artificial intelligence (AI) is a branch of computer science dedicated to the development of machines capable of simulating human intelligence processes. Multiple industries across the globe are increasingly utilising AI, with healthcare AI projects attracting substantial financial backing.[1] The predictive analytical powers of AI can aid drug discovery, disease diagnosis, and treatment plan design. In November 2018 the UK government boosted funding for AI healthcare projects to an impressive £50 million.[2]

AI possesses superior pattern recognition and learning ability that places it in direct competition with medical specialities involved in detecting and interpreting patterns in data, such as dermatology. The medical community has met AI with both excitement and scepticism, many fearing change and redundancy. "AI Is Better Than Dermatologists At Diagnosis"[3] and "Artificial Intelligence Beats Dermatologists At Diagnosing"[4] were just two of many articles published during the past year. The diagnostic power of AI-driven smartphone applications are set to become directly accessible to the patient, and may bypass the doctor altogether. This essay aims to explore the current and future uses of AI in dermatology, and to address whether fears it will render dermatologists obsolete are warranted.

What is AI?

In 1955 Professor John McCarthy defined artificial intelligence as "the science and engineering of making intelligent machines, especially intelligent computer programs." In medicine the ability of AI to classify and categorise visual data is of particular interest. First generation AIs used machine learning to examine differences between features in pre-labelled images, generating a predictive algorithm by which they could classify novel unlabelled data. These systems could only examine data via features manually pre-set by the programmer, hence they possessed limited accuracy as they lacked the ability to adapt and self-improve.

Recent interest in AI has been driven by an evolution in machine learning resulting in the arrival of 'deep learning.' Given sufficient dataset size and processing power, deep learning uses convolutional neural networks (CNNs) to convert pre-labelled images into vector representations, discovering the most predictive features of a category. As it learns directly from the dataset without human direction, deep learning is able to account for inter-data variability and process unstandardized data.

Today AI can already analyse large amounts of data at a pace that far outstrips human capabilities. Quantum computers with processing powers outperforming existing computers by several factors are in development[5] as are photonic computer chips that will allow machines to process data at the speed of light.[6] AI is predicted to reach 'singularity' by 2045, whereby it will surpass the combined brainpower of all human beings alive.[7]

How is AI being used in medicine?

AI-based systems capable of diagnosis through image classification have been developed for use in several specialities. AI algorithm performance is on par or better than individual human specialists in the diagnosis of diabetic retinopathy,[8,9] congenital cataracts,[10] melanoma,[11] and onychomycosis.[12] AI correctly outperformed current gold-standard risk score algorithms for the prediction of cardiovascular disease,[13] and dementia.[14]

Outside clinical care, AI is being employed to support and potentially replace the roles of healthcare managers in resource, staffing, and financial management. AI can facilitate automated note taking, medical coding, and triage systems. Online pilots for an AI-powered NHS 111 service were launched in early 2018.[15]

Current applications of AI in dermatology

The alarming articles promulgating the superiority of machines over the dermatologist[3,4] were inspired by a study published in 2018.[11] Over 100,000 dermoscopic images were used to train a Google CNN to distinguish between melanomas and benign moles. On a test set of 100 images, the resulting algorithm outperformed fifty-eight dermatologists in specificity and sensitivity of melanoma diagnosis. AI's concordance with dermatologists in keratinocyte cancer diagnoses has also been described.[16]

Early detection of skin cancers is critical; melanoma five-year survival drops from 99% to 14% based on earliest versus latest stage detection. Technology

utilising AI's ability to diagnose melanoma is already in use by both physicians and patients. MoleScope consists of a smartphone app and an iPhone clip-on mobile dermatoscope. Users take a dermoscopic image of their lesion and an AI retrieves the most visually similar image from a library of pre-labelled pathology images to suggest diagnoses. Apps FirstDerm, Skin IO, and SkinVision operate similarly but without the mobile dermatoscope function, consequently suffering a drop in diagnostic accuracy to below that of a specialised clinician.[17] Skin IO can also be of value to a dermatologist. Physicians are encouraged to input full body photo-sets taken in clinic into the Skin IO system, building and annotating an objective visual timeline of the patient's skin and lesions which can be shared with the patient via the Skin IO app. As melanoma prevalence escalates, so does the demographic requiring regular six-monthly full skin examination. In the future this could be managed by an AI system.

While most current applications focus on the monitoring and diagnosis of skin lesions, there is a market for AI applications in other areas of dermatology. Start-ups PROVEN Beauty and HelloAVA use an AI-driven questionnaire to assess user skin type and recommend personalised skincare products. Modernising Medicine is a cloud-based database that uses IBM's AI supercomputer Watson to generate recommendations for a given dermatological scenario by cross-referencing patient outcome data with the latest clinical research.

Strengths and challenges of AI

Today's NHS is facing severe financial and staffing pressures with demands set to intensify. While avoiding human fatigue and error, AI has the potential to take over administrative and managerial tasks, act as a superior screening and triage tool, deliver more accurate and quicker diagnoses, and facilitate the personalisation of medicine. AI diagnostic algorithms could easily be adapted for educational use by physicians and medical students, and even for health promotion and education of the public. AI incorporated into smartphone technology could reduce outpatient referrals and transform health care in rural or marginalised communities with poor access to services.

However successful implementation of AI in our healthcare system is not without its challenges. Large training datasets are difficult to acquire but requisite to avoid inherent bias in AI algorithms. Of particular concern is potential inaccuracy in diagnosis of dark-skinned individuals as training data is primarily sourced from light-skinned patients.[18] An AI data governance framework accounting for patient consent, data ownership, and data security must be developed; an NHS trust was recently declared in breach of privacy laws by sharing patient data with Google's DeepMind Streams app.[19]

Also disputed is the wisdom of outsourcing clinical responsibility to the patient. Diagnostic power is diminished when a dermatoscope is not used for image capture,[17] areas such as the scalp are inherently challenging to photograph oneself, and AI cannot currently account for image variation in angle, zoom, and lighting. Furthermore dermatology is a tactile speciality; subtle melanomas may

only become apparent when stretched or palpated. Computers could only deliver this with the development of an integrated AI-robotic system.

The lack of evidence proving safety and efficacy of AI systems is critical. Who would be accountable for errors made by an AI? AI becomes increasingly opaque as it becomes more powerful. Deep learning systems differentiate data via the creation of internal rules we are not privy to. No system is infallible; when mistakes inevitably occur it will be difficult to pinpoint why the error was made and who should shoulder the blame. The AI's creators? The doctor? The NHS Trust that funded it?

Will AI take over the role of a dermatologist?

The ideal imaging system should increase diagnostic accuracy, be time and cost efficient, reduce benign biopsies, and be accessible to all demographic and socioeconomic groups.[16] It is apparent that AI will soon be superior to a human dermatologist in executing these aims. AI is set to revolutionise diagnosis and treatment in all medical fields, functioning as a clinical decision support tool that boosts physician confidence, accelerates care, and reduces workload.

However AI is not a substitute for a thorough history, clinical examination, and consultation. A physician's role is not solely to make a diagnosis; they are responsible for delivering the news compassionately, interpreting and responding to patient needs, and creating a personalised management plan. Even accounting for technological advances and future AI capabilities, a doctor will

retain the uniquely human qualities of emotional intelligence, judgement, and empathy that are essential to the doctor-patient relationship and delivery of care. The future dermatologist must embrace AI and its role in clinical practice. The human doctor will not perish, they will simply adapt as their skill-set expands in areas that will never be supplanted by machines.

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