Will artificial intelligence and automated technology replace the need for Dermatologists to diagnose skin cancer in the future?

BSDS Medical Student Essay Prize - July 2021

Laura Leeves

King's College London GKT School of Medical Education

Will artificial intelligence and automated technology replace the need for Dermatologists to diagnose skin cancer in the future?

With growing financial constraints, longer waiting times and staff shortages, the NHS has been depicted as being in crisis(1). Artificial intelligence (AI) and automated technology (AT) have been proposed as a potential solution. A landmark study by DeepMind published in Nature demonstrated an AI algorithm was able to perform as well as or better than ophthalmologists in predicting retinal disease progression(2). Visual diagnostic specialties have been the focus of applications of AI in healthcare thus far, with the use of image recognition being popular in radiology, pathology, and dermatology(3)(4)(5).

Chapter Five of the NHS long-term plan is to "use decision support and artificial intelligence (AI) to help clinicians in applying best practice"(6). With political pressure to use this technology, dermatologists may question whether they will be replaced by AI in diagnosing skin cancer. I aim to argue that this technology should not be feared but celebrated for assisting dermatologists in the diagnosis of skin cancer.

Machine learning (ML), a form of AI, refers to algorithms and statistical models that learn from labelled training data, from which they are able to recognise and infer patterns. A particular form used in dermatology are convolutional neural networks (CNNs)(7), which are trained to classify image data based on pattern recognition. Within dermatology, this can be applied via image recognition at a macroscopic scale or at a cellular level when analysing histological slides.

Skin cancer detection

Attempts to apply AT to image classification have been made for over 30 years(8), however promising results have only been seen recently in the use of CNNs for the diagnosis and monitoring of skin cancer lesions and inflammatory dermatoses(9)(10). The use of a deep learning model has shown to outperform 136 of 156 dermatologists from junior to consultant level when tasked to classify melanoma(11). As we are aware, early detection of skin cancers vastly improves prognosis, particularly individuals with malignant melanoma(12). The application of these AI tools can lead to earlier and more accurate diagnosis and ultimately improved patient outcomes.

Application to Mohs surgery

Histological analysis of dermatological specimens is performed on formalin-fixed paraffin-embedded sections from biopsies and frozen sections during Mohs micrographic surgery (MMS). MMS is typically indicated for the treatment of skin cancers on the face, most commonly basal cell carcinoma (BCC), and allows for real time histological mapping of any residual tumour between excisions. With incidence rates of BCC rising each year(13), this places an ever growing burden on dermatologists and histopathologists. CNN models developed are deemed to be a feasible option in the automatic detection and classification of BCC based on whole slide image during MMS(14), which will allow for timely reassurance of complete cancer resection, improving the clinical workflow.

From primary to secondary care

The rapidly expanding role of AI can particularly be noted at the interface between primary care and dermatology, whereby GP referrals to 2 week wait skin cancer screening clinics make up 50% of the one million dermatology referrals(15). Of these referrals, approximately 6% receive are diagnosed with melanoma or squamous cell carcinoma(15). Various mobile applications have been developed to integrate deep learning technology(16)(17), which are designed to screen for skin cancers, however the accuracy of these do not match that of a dermatologist. Although in theory these applications may help limit GP referrals, we need to consider the safety of them when used in the absence of expert clinical judgement.

Bias within the dataset

AI is dependent on the dataset it is trained on with large datasets being essential to achieve high quality ML algorithms. When applied to dermatology one study has identified that, despite their CNN being trained on 150 images for both darker and lighter skin, AI diagnostics have lower sensitivity and specificity in patients with darker skin compared with lighter-skinned patients when programmed to distinguish between melanoma and BCC(18). Different techniques are currently being applied to overcome this disparity and compensate for the lack of diversity in images of darker skin available to train CNN models(18).

Tying the knots together

The technology used in AI may be able to exceed doctors' abilities at specific tasks, however, as of yet, a general AI has not been developed. Arriving at a diagnosis relies on combining history, examination and investigation findings. These are all different processes which AI may be applied to independent of one another, but a clinician is still needed to tie these processes together.

Conclusion

There is undoubtedly a role for AI and AT in diagnosing skin cancer. In certain aspects ML will be able to outperform humans using large datasets for a specific task. However, it will remain the clinician's responsibility to tie these together with the patient's clinical needs. Therefore, I would argue it will not replace doctors in diagnosing skin cancer but be used as a tool to aid them in the diagnosis.

Word count: 799

References

1. NHS workforce: our position [Internet]. The King's Fund. [cited 2021 Jul 30]. Available from: https://www.kingsfund.org.uk/projects/positions/nhs-workforce

2. Clinically applicable deep learning for diagnosis and referral in retinal disease | Nature Medicine [Internet]. [cited 2021 Jul 20]. Available from: https://www.nature.com/articles/s41591-018-0107-6

3. Hosny A, Parmar C, Quackenbush J, Schwartz LH, Aerts HJWL. Artificial intelligence in radiology. Nat Rev Cancer. 2018 Aug;18(8):500–10.

4. Tizhoosh HR, Pantanowitz L. Artificial Intelligence and Digital Pathology: Challenges and Opportunities. J Pathol Inform. 2018 Nov 14;9:38.

5. Du-Harpur X, Watt FM, Luscombe NM, Lynch MD. What is AI? Applications of artificial intelligence to dermatology. Br J Dermatol. 2020;183(3):423–30.

6. Plan NLT. Chapter 5: Digitally-enabled care will go mainstream across the NHS [Internet]. NHS Long Term Plan. [cited 2021 Jul 30]. Available from: https://www.longtermplan.nhs.uk/online-version/chapter-5-digitally-enabled-care-will-go-mainstream-across-the-nhs/

7. Krizhevsky A, Sutskever I, Hinton GE. ImageNet classification with deep convolutional neural networks. Commun ACM. 2017 May 24;60(6):84–90.

8. Cascinelli N, Ferrario M, Tonelli T, Leo E. A possible new tool for clinical diagnosis of melanoma: the computer. J Am Acad Dermatol. 1987 Feb;16(2 Pt 1):361–7.

9. Shrivastava VK, Londhe ND, Sonawane RS, Suri JS. A novel and robust Bayesian approach for segmentation of psoriasis lesions and its risk stratification. Comput Methods Programs Biomed. 2017 Oct;150:9–22.

10. An Automatic Diagnosis Method of Facial Acne Vulgaris Based on Convolutional Neural Network | Scientific Reports [Internet]. [cited 2021 Jul 30]. Available from: https://www.nature.com/articles/s41598-018-24204-6

11. Brinker TJ, Hekler A, Enk AH, Klode J, Hauschild A, Berking C, et al. Deep learning outperformed 136 of 157 dermatologists in a head-to-head dermoscopic melanoma image classification task. Eur J Cancer Oxf Engl 1990. 2019 May;113:47–54.

12. Jerant AF, Johnson JT, Sheridan CD, Caffrey TJ. Early Detection and Treatment of Skin Cancer. Am Fam Physician. 2000 Jul 15;62(2):357–68.

13. Flohil SC, de Vries E, Neumann HAM, Coebergh J-WW, Nijsten T. Incidence, prevalence and future trends of primary basal cell carcinoma in the Netherlands. Acta Derm Venereol. 2011 Jan;91(1):24–30.

14. Zon MCM van, Waa JD van der, Veta M, Krekels GAM. Whole-slide margin control through deep learning in Mohs micrographic surgery for basal cell carcinoma. Exp Dermatol. 2021;30(5):733–8.

15. CancerData [Internet]. [cited 2021 Jul 28]. Available from: https://www.cancerdata.nhs.uk/cwt_conversion_and_detection

16. SkinVision | Skin Cancer Melanoma Detection App | SkinVision [Internet]. [cited 2021 Jul 30]. Available from: https://www.skinvision.com/

17. SkinIO | Advanced Skin Imaging and Mole-Mapping [Internet]. [cited 2021 Jul 30]. Available from: https://skinio.com/

18. Aggarwal P. Artificial Intelligence (AI) image recognition of dermatological diseases in people with skin of color. Poster presented at: 17th Annual Skin of Color Society Scientific Symposium; March 13, 2021. 2021 Mar.