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What is the future of Dermatology; hospital versus office based, NHS versus private?

The future of dermatology is looking very promising with the growing crop of new technologies. Historically, medicine was a luddite profession which reluctantly accepted new technologies to change the interface of work. Now, artificial intelligence - defined as machines being able to act more intelligently (1) - and smartphone apps are promising to revolutionise the future, on the background of workforce crisis where 50% of consultants are working full-time (2). This essay aims to explore whether there is substance to hospital-based dermatology and discuss a new model of injecting private services into the specialty.

Does dermatology belong in the hospital?

Artificial intelligence (AI) provides a novel way to change the delivery of dermatology in the hospital. Within AI are *machine learning* and *convolutional neural networks (CNN)*. Machine learning uses a statistical technique to learn data via training over time and neural networks are effectively computers that think like a human brain (3).

A dermatoscope is used to investigate skin lesions on patients. In cases in which a lesion may straddle two similar diagnoses, such as an early seborrheic keratosis and a melanoma, a second opinion is warranted to ensure that correct management pathway is followed. This can be time consuming, especially if multiple lesions look similar, and it has the potential of disrupting clinical workflow, especially with busy clinic lists.

As such, CNNs are showing promise in the nascent field of medical AI. Google's own CNN was utilised in a study which investigated its accuracy in identifying pathologies (4). It was programmed to identify 129,450 images from 2,032 diseases. The comparator was dermatologists who used biopsy-proven images in comparing two cases (keratinocyte

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carcinomas and seborrheic keratoses; malignant melanomas and benign naevi). The results underlined the strength of AI as the CNN achieved a performance on-par with dermatologists.

The study has promising implications. CNNs could be used as 'expert systems' (5), in which they could mimic the decision-making capabilities of humans. For example, in cases of ambiguity regarding skin lesions, dermatologists could input clinical metrics into the system, which could then use its capabilities to provide diagnostic and management pathways based on previous learning. PwC reports that AI is already showing promise in mammograms in the USA with a 99% accuracy in reviewing them, compared to false positives of 50%, as well as a growing global appetite to use new technologies in healthcare (6). Although this is an exciting prospect, it should be viewed with caution as this is a nascent technology where error rates, no matter how small, could have negative implications for patient care in the case of misdiagnosis.

On the contrary, a move away from outpatients-based dermatology seems appealing, with the emergence of smartphone apps that offer services remotely at the office or at home. Digital health companies, such as SkinVision, are at the forefront of the app revolution, using AI to help diagnose skin lesions through the smartphone camera. The notion of these apps is to provide a spot-diagnosis of skin lesions: the user is prompted to take a photo of the lesion and the back-end architecture uses AI to sift through a repository of images that match the lesion to provide an instant diagnosis. This could potentially signify a change in the clinical landscape of moving care out of the hospital.

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However, a shift in the current paradigm must be viewed with scepticism in which a smartphone app acts as a clinician. Chuchu *et al* conducted a Cochrane review to investigate the accuracy of smartphone applications (7) in excluding invasive melanomas and melanocytic variants, on the background of a 134% rise in melanoma incidence from 1993-1995 to 2014-2016 (8).
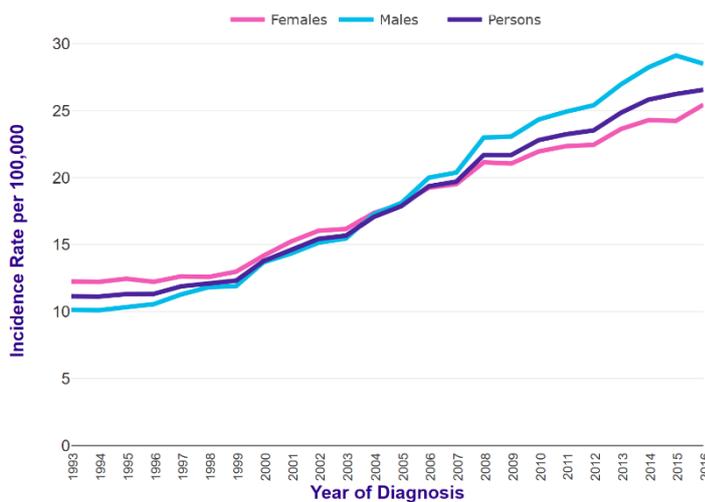

Figure 1 Melanoma incidence 1993-2016 (8)

The review used five apps which could identify lesions as the index and a reference of histology images coupled with expert opinion. Two cohorts of lesions were used in two studies which studied 332 lesions and 86 melanomas. The results showed that the sensitivities for classifying images as melanomas ranged from 7% (95% CI 2% to 16%) to 73% (95% CI 52% to 88%) and specificities of 37% (95% CI 29% to 46%) to 94% (CI 87%-97%). The results paint a disappointing picture for smartphone apps, especially given how broad the sensitivities in correctly identifying melanomas lie, although the quality of evidence was not strong enough to firmly dismiss their potential.

However, the review does not consider patients' preferences. PwC reported (6) a reasonable global demand for patients to adopt new technologies, with the European, Middle East and Africa markets demonstrating a 54% willingness, with Nigeria particularly showing a 94% willingness. The 18-24-year-old age bracket expressed the highest willingness at 69%, with this number staying relatively constant up to the 35-44-year-old age

group. This could potentially signify a change in the delivery of dermatology to the office in emerging economies, especially in younger populations which have a higher smartphone usage (9). The reach of dermatology services could potentially vastly be increased as patients could have the ability to see a dermatologist over a video-calling app. This could save patients money, in terms of not travelling to the hospital, reduce non-attendances and streamline the clinical workflow. A similar operation for general practice is already being rolled-out in the UK (10).

Public versus private: the longstanding debate

Whilst the adoption of technology may be an exciting prospect, a pragmatic view needs to be taken to understand the efficiencies of teledermatology in the NHS and the need for private involvement.

Morton *et al (11)* examined the efficiency of store-and-forward teledermatology for skin cancer in 411 patients in a prospective observational study within the NHS. It compared it to a reference of 231 electronic referrals with the measure of benefit being the proportion of patients receiving definitive care at the hospital. The results strongly underline the strength of NHS delivering dermatology, as 91% of teledermatology patients received definitive care, compared to 63% with routine referral. This highlights the efficiency measures being undertaken by the NHS, as the study also showed that the intervention diverted 72% of referrals from skin cancer clinics to the relevant clinics, thereby improving clinical workflow.

However, cost effectiveness analysis by Eminovic and colleagues (12) investigating non-urgent referrals from dermatology did not show much economic promise, in an RCT which compared store-and-forward services to electronic referral in total costs (travel and

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productivity losses). Mean costs for teledermatology were greater at 387 EUR (95% CI 281.0 EUR to 502.50 EUR) than electronic referral at 354 EUR (95% CI 228.0 EUR to 484.0 EUR). The authors concluded that costs could only be saved if patients travelled more than 75km.

Is it time for the NHS to become more amenable to offering private services? Sandwell and West Birmingham Hospitals NHS Trust have introduced private laser surgery for patients (13) who have conditions which require laser surgery, such as port-wine stains and skin pigmentations

The benefits are two-fold. Firstly, it offers the Trust another stream of income, other than that provided by the annual NHS England budget, to increase its fiscal reserves. In turn, the money can be reinvested back into dermatology to provide a better level of service. This may be achieved by fully or partly funding another member of staff if there is a regular stream of patients. A new specialist nurse could help relieve pressure on the department by running more clinics.

Secondly, it ensures that money invested through private treatment remains flowing through the NHS. Section 75 under the Health and Social Care Act 2012 (14) provides Clinical Commissioning Groups the power to tender contracts to private healthcare companies, such as Virgin Care, to bid for NHS services. This has led to the private sector offering NHS-funded care. The Trust has effectively bypassed this Act, thereby ensuring that funds remain within public-ownership, and not under private healthcare companies, who may be motivated financially to provide services.

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The verdict

There is a lot of noise to sift through to identify where the future of dermatology lies. Within the 'office-hospital' domain, I believe that given the evidence, it is likely to see a large continuation of dermatology delivery in the hospital, augmented by the use of AI acting as expert systems to help with diagnoses and streamline clinical workflows. Although a stronger evidence base is needed for smartphone apps, I believe that eventually they will have the ability to route patients into the relevant clinics based on initial diagnosis, bypassing the GP referral system to a certain degree. Figure 2 shows my impression of how dermatology could be delivered in the future.
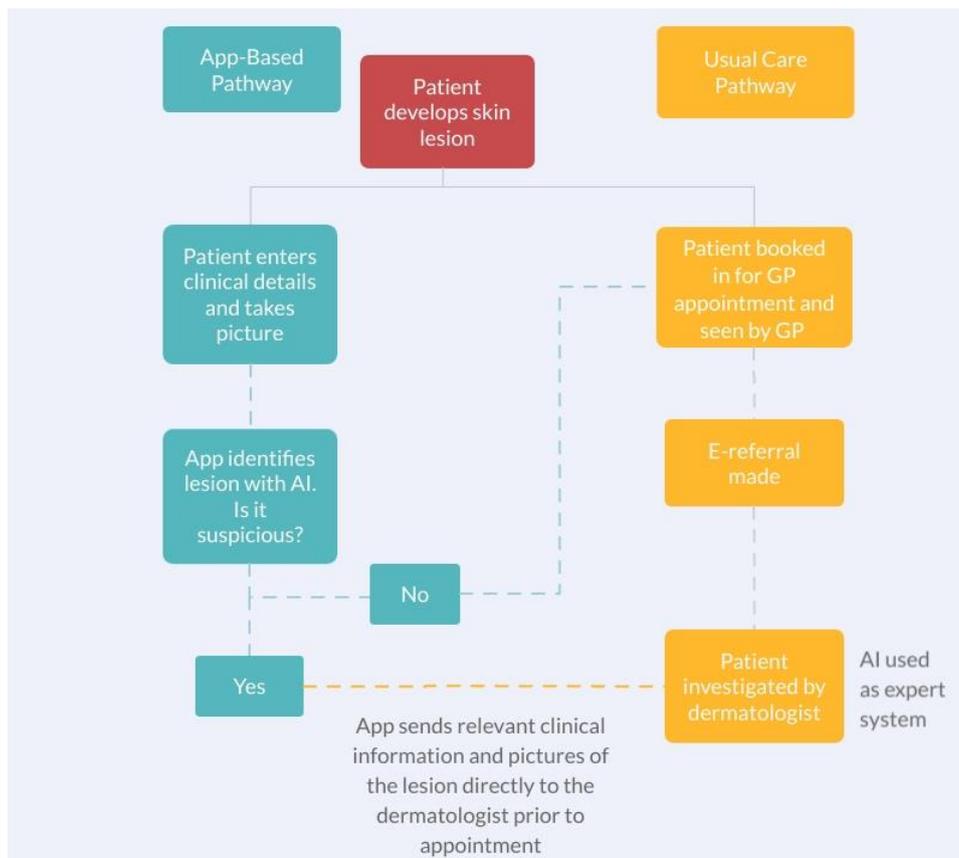

Figure 2 An impression of future dermatology

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Within the public-private debate, the evidence tips in the balance of the NHS retaining services, given the economic efficiencies of teledermatology. There is scope for the NHS to offer private services to patients for dermatological conditions not normally treated, but this should not come at a cost of expanding private services at the expense of neglecting the current public offering.

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