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Will Artificial Intelligence and Automated Technology Replace the Need for Dermatologists to Diagnose Skin Cancer in the Future?

"I propose to consider the question, Can machines think?" – Alan Turing (1950), WWII Enigma code breaker [1]

High-speed computers and massive data sets have heralded a new age of artificial intelligence (AI) in medicine, aptly nicknamed the diagnostic stethoscope of the 21st century. Currently, dermatologists develop an innate sense of how skin cancers appear by examining thousands of malignant and benign lesions. This enables them to decide whether a suspicious skin lesion needs further investigation[2]. Consequently, skin cancer diagnosis is highly dependent on clinicians' experience and subjective judgement[3]. With recent scientific advancements, the 'Enigma' is could AI and automated technology (AT) revolutionise how physicians approach skin cancer diagnosis and reshape or even replace the role of dermatologists.

Artificial Intelligence in Skin Cancer Diagnosis

AI is software that writes, updates and renews itself at incomprehensible speeds. By learning through algorithms, it becomes independent and autonomous[4]. In dermatology, AI uses a deep learning convolutional neural network (CNN) to recognise and categorise patterns through repeated exposure to different images, thereby allowing it to distinguish between malignant and benign lesions[5].

AI vs. Doctors

Although engaging computer technology in skin cancer diagnosis has been hypothesised since 1975[6], only recently have results looked so promising. In 2017, Stanford's Artificial

Intelligence Laboratory trained a CNN using 129,450 images for the identification of malignant versus benign lesions. The CNN performed on par with 21 board-certified dermatologists. Additionally, a study published in May 2018 described a CNN that outperformed 58 dermatologists from 17 countries in accurately diagnosing melanomas[7]. Further positive clinical testing of AI could lead to improved diagnostic accuracy, fewer unnecessary surgeries and lower healthcare costs[5]. Through improved efficiency, dermatologists could have more time to place greater emphasis on building relationships, exercising empathy and utilising human judgement during clinics.

Surveillance

Targeted surveillance of high-risk melanoma patients results in early detection allowing surgical removal before spread[8]. AI with imaging technology, for example in smart phone applications, could automatically filter and signpost changing skin lesions, reducing a huge burden on dermatological services[9]. However, current 'apps' do not use AI and are not recommended by the British Association of Dermatologists due to a lack of rigorous safety checks. Nevertheless, patients could potentially be surveilled by 'apps', with the role of the dermatologist expanding to counsel patients on their appropriate use[10].

Extending the Reach of Dermatologists

AI promises to provide a more standardised level of care, regardless of a patient's location or doctor[11]. Microsoft recently announced a project to bring high-speed internet to rural communities in America[12]. This growing reach of technology could improve access to healthcare through telemedicine. Non-dermatologists could consult with decision-support AI systems, thereby aiding physicians with triage in areas where access to dermatologists is limited.

Can Artificial Intelligence Deliver its Promises?

For over 50 years, AI has promised to revolutionise medicine but failed to follow through. Therefore recent results, however optimistic, should not be over-interpreted. There are still barriers that can impact the future use of AI and AT in skin cancer diagnosis.

Viewing the Patient in Context

AI systems view skin lesion images in isolation without comparison to other lesions on a patient's body, therefore lacking context. Specifically, it is yet to be established whether AI will successfully diagnose atypical melanomas. These frequently lack pigment and may have irregular vessels[11]. Although diagnostic on dermoscopy, they are compressed by a contact plate when photographed making them difficult to visualise[13]. Therefore, for challenging skin lesions where AI would perhaps be most beneficial, the reliability is at its lowest.

Spotting the Lesion

A key element of dermatological consultations is the detection of lesions that patients themselves are unaware of, through full skin examinations[11]. Additionally, some lesions are more easily detected using a tactile approach[2]. Haptic perception provides important information pertaining to skin texture, profile and physical properties. Interestingly, AT has begun to include this through robotics. A recent study outlined an automated skin cancer diagnostic tool, *LesionAir,* which estimates tissue compliance by applying a vacuum force and measuring precise deflections. Though initial results are encouraging, this technology is still in its infancy and its incorporation in clinics could take years[14].

Will Patients Accept AI?

"Algorithm aversion" is the concept of placing trust in humans rather than digital software. Dietvorst et al found that people were less tolerant of algorithm's smaller miscalculations

than humans' larger mistakes. Additionally, individuals believe that humans are better than algorithms at learning from mistakes, improving with practice and detecting anomalies[15]. Algorithm aversion could be reduced by using AI as an adjunct to dermatologists in skin cancer diagnosis and through educating patients about its benefits.

Regulation

As AI develops and its use in dermatology becomes a distinct possibility, regulatory bodies must establish clear guidelines to prevent any safety, practical and legal issues[16]. Given the potentially fatal consequences of missing skin cancer, the safe integration and close monitoring of AI and AT for skin cancer diagnosis is imperative, even though this may ultimately decrease its immediate availability.

Conclusion -– Replace or Reshape Dermatologists?

Will your future doctor be entirely replaced by automated, artificially intelligent software? Mancillas and Ward, publishers of the landmark AI paper in 1975, concluded that best practice combines the machine's perfect memory and rapid analytic skills with the flexibility and experience of the dermatologist[6].

"Is the computer smarter than the physician? It's irrelevant. Together they can provide something better than either could alone" – Jonathan *Chen (2018), Stanford Department of Medicine*[17]

With the first AI integrated hospital opening in China this year[18], AI has progressed phenomenally since Turing's Enigma cracking achievements saved uncounted lives. It has potential to improve diagnostic accuracy, enhance efficiency, allow reliable home surveillance and extend the reach of dermatologists. However, this rapidly evolving technology has many barriers to overcome before it can be implemented in clinical

practice. Moreover, empathy, trust, compassion and the nuances associated with human judgement cannot be mimicked by automation. I believe its inclusion in the diagnostic paradigm will inevitably reshape, but not replace the role of the dermatologists in the diagnosis of skin cancer.

(Word Count: 996)

References

1. Turing AM. Computing machinery and intelligence. Epstein R, Roberts G, Beber G (Eds.) In: *Parsing the turing test.* Netherlands: Springer; 2009:23-65.

2. Mar VJ, Chamberlain AJ, Kelly JW, Murray WK, Thompson JF. Clinical practice guidelines for the diagnosis and management of melanoma: Melanomas that lack classical clinical features. *Medical Journal of Australia*. 2017;207(8):348-350.

3. Pehamberger H, Steiner A, Wolff K. In vivo epiluminescence microscopy of pigmented skin lesions. I. pattern analysis of pigmented skin lesions. *J American Academy of Dermatology*. 1987;17(4):571-583.

4. Russell S. *Artificial intelligence: A modern approach.* 3rd ed. Malaysia: Pearson Education Limited; 2016.

5. Esteva A, Kuprel B, Novoa RA, et al. Dermatologist-level classification of skin cancer with deep neural networks. *Nature*. 2017;542(7639):115.

6. Mancillas R, Ward A. Machine recognition in pathology. *Comput Biol Med*. 1975;5(1-2):39-48.

7. Haenssle H, Fink C, Schneiderbauer R, et al. Man against machine: Diagnostic performance of a deep learning convolutional neural network for dermoscopic melanoma recognition in comparison to 58 dermatologists. *Annals of Oncology*. 2018;29(5):1-7

8. Haenssle H, Vente C, Bertsch H, et al. Results of a surveillance programme for patients at high risk of malignant melanoma using digital and conventional dermoscopy. *European journal of cancer prevention*. 2004;13(2):133-138.

9. Rayner JE, Laino AM, Nufer KL, et al. Clinical perspective of 3D total body photography for early detection and screening of melanoma. *Frontiers in Medicine*. 2018;23(5):1-6.

10. Rat C, Hild S, Rault Serandour J, et al. Use of smartphones for early detection of melanoma: Systematic review. *J Med Internet Res*. 2018;20(4):e135.

11. Mar V, Soyer H. Artificial intelligence for melanoma diagnosis: How can we deliver on the promise? *Annals of Oncology*. 2018;29(5):1-6

12. Microsoft News Center. Declaration networks group and microsoft announce agreement to deliver broadband internet to rural communities in virginia and maryland. https://news.microsoft.com/2018/04/24/declaration-networks-group-and-microsoft-announce-agreement-to-deliver-broadband-internet-to-rural-communities-in-virginia-and-maryland/. Updated April 24, 2018. Accessed June 22, 2018.

13. Menzies SW, Kreusch J, Byth K, et al. Dermoscopic evaluation of amelanotic and hypomelanotic melanoma. *Arch Dermatol*. 2008;144(9):1120-1127.

14. Wortman TD, Carlson JD, Perez E, Slocum AH. LesionAir: An automated, low-cost vision-based skin cancer diagnostic tool. *Journal of Medical Devices*. 2018;12(2):021001.

15. Dietvorst BJ. *Algorithm aversion.* University of Pennsylvania; 2016.

16. Gottlieb S. Transforming FDA's approach to digital health. https://www.fda.gov/NewsEvents/Speeches/ucm605697.htm. Updated April 28 2018. Accessed June 22, 2018.

17. Nevin L. Human intelligence & artificial intelligence in medicine: A day with the stanford presence center. http://blogs.plos.org/speakingofmedicine/2018/04/24/human-intelligence-artificial-intelligence-in-medicine-a-day-with-the-stanford-presence-center/. Updated April 24 2018. Accessed July 17, 2018.

18. Yiting S. AI could alleviate china’s doctor shortage.

https://www.technologyreview.com/s/610397/ai-could-alleviate-chinas-doctor-shortage/.

Updated March 21, 2018. Accessed June 22, 2018.