Editorial

Artificial Intelligence in Dermatology: Prospects and Where Bangladesh Stands

The evolution of machines runs parallel to human eager, spirit and enterprise, and has evolved from simple tools to modern-day high-tech computers. Dependence and reliance on machines have penetrated almost every aspect of human life including medicine. One of the most discussed advancements of modern technologies in recent times is artificial intelligence (AI).

John McCarthy defined Artificial intelligence as "the science and engineering of making intelligent machines, especially intelligent computer programs" .[1] The term applies to a broad range of items in medicine such as robotics, medical diagnosis, medical statistics, and human biology.

Artificial intelligence has been applied in the field of medicine since as early as the 1950s when physicians made the first attempts to improve their diagnosis using computer-aided programs. AI is continuously evolving from conventional AI (100% humans) to machine learning (50% humans and 50% computers) to deep learning (10% humans and 90% computers) .[2] One of the key components of AI is artificial neural network, which is a subset of machine learning, based on algorithms that are designed to recognize patterns that are inspired by the human neural network.

Artificial intelligence is used for medical tasks like diagnosis, prognosis, and therapy with the assistance of different imaging techniques. The difference between traditional statistical analysis and artificial intelligence is that the later utilizes data-mining and pattern recognition capabilities to analyze structured and unstructured data. AI techniques approved by the US Food and Drug Administration (FDA) for clinical use by September 2018 include products to identify signs of diabetic retinopathy in retinal images, recognize signs of stroke in CT scans, visualize blood flow in the heart, detect skin cancer from clinical images captured using a mobile app.[2]

In the last decade or so, AI is gradually finding its relevance in different fields of dermatology including skin cancer, eczema, and psoriasis. Automated detection of skin lesion using images has extended beyond melanoma to encompass pigmentary skin lesions, non-melanocytic skin cancers, psoriasis, skin rash, and onychomycosis among other skin diseases.[3] Researchers have been exploring the usefulness of AI to improve or supplement current screening processes in melanoma and non-melanoma skin cancer.

Stanford University published a study on deep learning of skin tumors. They demonstrated classification of skin lesions using a single convolutional neural network. They trained a convolutional neural network using a dataset of 129,450 clinical images of 2,032 different diseases. They tested its performance against 21 board-certified dermatologists on biopsy-proven clinical images with two critical binary classification of cases: keratinocyte carcinomas versus benign seborrheic keratosis; and malignant melanomas versus benign nevi. It was found that the machine had a competence comparable to board-certified dermatologists in identifying and classifying skin cancer.[4] Fujisawa et al. develop an efficient skin cancer classification system with a relatively small dataset (4867) of clinical images obtained from 1842 patients diagnosed with skin tumors. Overall classification accuracy was 76.5%.[5] Han et al. tested the use of a deep learning algorithm to classify the clinical images of 12 skin diseases including melanoma with the average sensitivity and specificity for all the conditions was 85.1% and 81.3%.[6] Brinker et al. also advocated for a melanoma classification benchmark, which they derived from their result for future comparisons. Their benchmark found that dermatologists had an overall sensitivity of 89.4% and specificity of 64.4% in detecting melanoma.[7] Shrivasta et al., compared the ability of several applications at classifying the severity of psoriasis lesions. The systems described achieved average sensitivities between 93.81 and 99.76% and average specificities between 97 and 99.99%.[8] Beyond psoriasis, applications have been described classifying acne, lichen planus, pityriasis lichenoides and dermatomyositis. Huang et al. developed a multi disease classifier that could analyze 34 attributes (e.g., erythema, scaling, definite borders, etc.) and differentiate several papulosquamous diseases such as psoriasis,

seborrheic dermatitis, lichen planus, pityriasis, and chronic dermatitis.[9] Seite et al. developed A smartphone that grades and classifies types of acne lesions (e.g, comedonal, inflammatory, post inflammatory hyperpigmentation, etc.[10]

Although most of these experiments relied on images of skin, one application assessed muscle ultrasound images and differentiated between normal muscle, dermatomyositis, polymyositis, and inclusion body myositis with accuracies between 76.2 and 86.6%.[11] There are artificial neural networks for differentiating atopic dermatitis from unaffected skin using information derived directly from images.

Machine learning has been used in various aspects of patient identification, risk prediction, diagnosis, disease subtype classification, disease progression and outcome and monitoring and management of autoimmune disorders like systemic lupus erythematosus, systemic sclerosis, vitiligo, psoriatic arthritis, rheumatoid arthritis, and systemic vasculitis.

Different techniques have been applied in the field of AI. Confocal microscopy is a technique that uses lasers and fluorescence to create a three-dimensional image of a sample. Direct immunofluorescence (DIF) is a technique used in the laboratory to diagnose diseases of the skin, kidney, and other organ systems. It is also called the direct immune fluorescent test or primary immunofluorescence. Digital dermoscopy is able to identify a number of skin lesion using a pattern recognition method. Trichoscopy software Trichoscale AI is a revolution in the quantification of hair growth and pattern of hair loss.

Although AI is fast emerging in the field of dermatology, the term artificial intelligence is still novel in the context of Bangladesh. Dermatologists are is still lagging behind in terms of using updated methods for diagnosing dermatological disease, e.g dermoscopy, trichoscopy and onychoscopy. DIF still has limited use, not available countrywide. A very lower percentage of dermatologists have their dermoscopy in place which is now widely being used in developed countries. Developing a dataset with pattern recognition images through neural network is the key step in combining AI with conventional methods. Such tool or software need to be developed for diagnostic accuracy. Correlation of clinical disease with biopsy proven skin lesion is the key to diagnosis, where there is limited option to cross check or compare with other similar lesions; thus, increasing the probability of human error. Moreover, the competency of pathologists is crucial here which often poses a barrier in diagnosis. AI can offer a second opinion with better accuracy if it can be utilized properly. Not only development of tool is necessary, giving training to a vast majority of dermatologists is also essential to make it operational.

AI is fast emerging in the field of dermatology. The most progress thus far has taken place in the field of melanoma diagnosis, followed by ulcer and psoriasis assessment tools, then followed by numerous less frequently studied applications. It can revolutionize patient care, particularly in improving the sensitivity and accuracy of screening of skin lesions including malignancies. The success of such technology in dermatology will depend on the benefits it provides to the vast majority of the general population and also to the treating doctor. The application of computational methods is being used in dermatology for faster data processing to give better and more reliable diagnoses. Currently, most of the data are based on Western studies; hence, studies from this part this world are essential. Particularly a country like Bangladesh where disease burden is high with variable presentation and limited scopes to achieve diagnostic accuracy.

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