Commentary: Artificial intelligence and smartphone fundus photography – Are we at the cusp of revolutionary changes in retinal disease detection?

The number of people who require retinal examination for diabetic retinopathy (DR) in India is over 70 million.[1] The role of artificial intelligence (AI) in DR screening is more recognized in last few years. IDx-DR was the first AI model to be approved for DR detection. Of late, studies have demonstrated the efficacy of various algorithms that are available on other platforms.[1,2] In recent times, there are evidences of real-time implementation of AI algorithms for DR screening.[3,4]

In DR, AI programs detect retinal landmarks to orient the image. Recognition and exclusion of images with insufficient image quality is necessary to minimize false negatives. Thereafter, features relevant in the context of detection or quantification of disease patterns are identified by the AI model as the algorithm has optimized itself from analysis of large sets of labeled expert graded images.[5]

Most AI programs require access to cloud databases and therefore, availability of the Internet is *sine qua non* for deployment of these programs. Although Internet connectivity in India has seen significant improvement in recent years, there are areas that are still outside the coverage of major network providers. When compared to global standards, India lags behind in speed of connectivity.[6] Hence, a model that offers an offline AI tool is definitely better suited for our country in the present scenario. From this perspective, Sosale, *et al.* have studied the efficiency of Medios AI algorithm where image processing and reporting is independent of the internet.[7] As the images are not uploaded to a server, and remains with the screening ophthalmologist/healthcare professional, the fear of misuse of the image data by a third party would also be avoided by an offline platform.

The ubiquitous smart phone has, apart from other uses in ophthalmology, lent itself to retinal imaging. By extension, DR screening with images obtained by smartphones has shown high specificity and sensitivity.[8] Smartphone fundus photography along with the use of AI in Indian eyes was first reported by Rajalakshmi *et al*. The specificity and sensitivity of AI in detecting DR was similar to the present study. Of particular note, the former study used a different AI program (EyeArt ™ software, EyeNuk Inc., Los Angeles, CA). They also used a four-field approach analyzing a macula-centered image, a disc-centered image, the superotemporal quadrant and the inferotemporal quadrant.[9] The present study has used images from three fields – a macula-centered image, the nasal field and the superotemporal quadrant. More recently, Natarajan and colleagues have reported their results using the same camera and AI program that does not require internet connectivity.[10] They studied three fields – the posterior pole, the nasal and temporal fields. However, the challenge of the smart phone based cameras is relatively more ungradable images when used in non-mydriatic mode. In the study, the authors have used the camera with mydriasis.

The four components addressed by Sosale, *et al.*[7] – smartphone-based fundus photography, AI for DR detection, trained technicians for image acquisition and non-dependence on the internet – are equally important in their own right when we intend to identify those in need by taking screening out into the community and vast hinterlands of our country. AI based programs, particularly in high volume physician-based practices, has the advantage of offering more convenient, cheaper, accessible and satisfactory screening models for DR. Given that DR is a leading cause of vision loss in the working age group, it is prudent, on the economic front, to minimize loss of productivity and wages for an average patient who is likely to give up on eye consultations if they are not perceived as immediately rewarding.

Current evidence on AI for DR screening addresses issues like accuracy and real time implementation but do not address the issue of clinical effectiveness: do patients directly benefit from the use of these AI systems? The question may be "Do patients ultimately have better visual outcomes when this system is used?" We need to have prospective clinical trials with much larger number of patients/images and with pre-specified primary and secondary endpoints. It is also important to highlight that diagnostic accuracy does not necessarily equal clinical effectiveness. Previous experience with decision support systems for mammography is a case in point. In the 1990s, automated mammography analysis tools were developed which showed very high diagnostic accuracy but which, after more than 10 years of use, did not translate to better clinical outcomes. Therefore, in some areas of clinical AI, it may be necessary to move towards randomized controlled trials.

Introduction of AI into routine clinical practice will bring new challenges. Questions related to patient confidentiality, data storage, ownership, and access have to be addressed. Legal frameworks have to be outlined in this regard. Nevertheless, these are minor issues that will necessarily be tackled in the near future.

As innovations progress, we can expect improvements in smartphones and AI models. They will eventually help ophthalmologists widen their reach. Elimination of preventable blindness is the goal and in order for it to materialize, a paradigm shift in focus towards primary prevention needs to take precedence and AI will undoubtedly play a major role. There are exciting times ahead if we are prepared to embrace and adapt to such technological advances.

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Website:
www.ijo.in

DOI:
10.4103/ijo.IJO_2175_19

Cite this article as: Madanagopalan VG, Raman R. Commentary: Artificial intelligence and smartphone fundus photography – Are we at the cusp of revolutionary changes in retinal disease detection? Indian J Ophthalmol 2020;68:396-7.