Diabetic Retinopathy and Artificial Intelligence Screening

Background:

More than 3.77 million Canadians were living with Diabetes in 2020 and this number is expected to rise to nearly 4.89 million by 2030[1]. Diabetic retinopathy (DR) is the most common cause of blindness in working-age adults[2]. Early detection and treatment can prevent diabetes-related visual impairment[3], which is seen in 20% of newly diagnosed cases of diabetes[4]. As there are often no symptoms associated with the early stages of DR, optometrists are well positioned to monitor for ongoing retinal changes and work collaboratively with a patient's diabetes care team (endocrinologists, general practitioners, nurse practitioners, dieticians, etc.). With early detection, timely treatment, and appropriate follow-up care, the risk of vision loss can be reduced.

Policy Issue:

Artificial Intelligence (AI) applications have the potential to revolutionize the Canadian healthcare system. For optometrists, AI can aid in the diagnosis and treatment of a variety of eye diseases, including DR. AI platforms have been developed to screen specifically for diabetic retinopathy, which aid in detection and triage for further assessment by an eye care professional. Ensuring high quality image capture of the peripheral retina while the patient is dilated is the first obstacle to acquiring data that AI can screen. A recent paper by Boucher et al. (2020) has proposed a standardized and evidenced-based national approach to diabetic retinopathy tele-screening.[5] This approach utilizes two 45° image fields, or a single wide-field or ultra-wide field image, with preferable use of OCT imaging, combined with a focus on local quality control measures. Without high quality image capture, including the peripheral retina, many signs of DR may be missed, even with the best AI technology.

Even with perfect images, these systems are still limited in their scope, as they only screen for one issue in isolation of a patient's overall condition and are not equivalent to a dilated eye health assessment by an optometrist. Patients offered this type of screening may falsely believe the single test assures them that their eyes are disease-free, which may not be the case as many eye diseases are asymptomatic. In fact, 14.4% of asymptomatic patients have eye disease they were unaware of.[6] While AI systems have the potential to perform diagnostic tasks like DR screening as well as or better than humans, they still do not consider an individual's comprehensive eye health. As AI systems are unable to screen all structures of the eye and cannot screen for all eye diseases, an optometrist should always supervise when AI is utilized in practice.

More than 6,670 optometrists provide care in urban and rural communities across Canada. However, socioeconomic realities might necessitate the use of DR screenings for select

populations. Allowing optometrists to use AI and telehealth will significantly enhance access to care for these population groups. Although AI systems are inferior to an in-person, dilated eye examination, they offer a way for patients who would otherwise not have the opportunity to receive any care from an optometrist. AI and telehealth systems may expedite triage for further dilated eye health assessment through an in-person visit to an optometrist. That optometrist can then properly manage a patient's condition, whether that be with regular monitoring and coordination of care, or timely referral for secondary or tertiary intervention. Optometrists may also provide the most cost-effective means for monitoring DR. With in-person care or remote-synchronous care, optometrists may also utilize the opportunity to educate patients with DR about their condition and ensure they follow-up with co-managing diabetic healthcare team members. AI does present legal and cybersecurity challenges. As patient privacy is of utmost importance, safeguards are required to ensure it is protected. From a bioethics and accountability perspective, an autonomous AI system must also include monitoring functions for patient outcomes, correct result validation, reference standards, design, and data usage[7]. Even with autonomous AI diagnosis, optometrists should confirm a diagnosis, provide ongoing monitoring, and coordinate care.

Given the number of optometrists who practice in communities across the country, optometry is ideally positioned to take part in both the analysis of AI results and the use of telehealth to deliver remote optometric care. As AI and telehealth systems continue to evolve, the CAO supports optometrists leveraging their education and training to ensure every Canadian with diabetes has access to timely and convenient DR screenings. Though nothing can replace a comprehensive eye examination, rapid advances in diagnostic imaging and assessment technologies for eye care have created an opportunity for Canada's optometrists to enhance patient care through telemedicine.

Policy Position:

The Canadian Association of Optometrists believes that dilated ocular health examinations remain the gold standard for detection of diabetic retinopathy. However, CAO supports a national strategy for AI implementation that utilizes optometry to supervise, interpret, and coordinate care for diabetic retinopathy screenings. It supports AI and telehealth systems that meet the requirements and high standards of Health Canada.

CAO supports fully integrated telehealth chronic care models in which professionals provide full-scope care, including services such as diet education, on-site labs, neuropathy testing, endocrinology, and eye examinations in tandem.

References

1. https://diabetes.ca/DiabetesCanadaWebsite/media/Advocacy-and-Policy/Backgrounder/2020_Backgrounder_Canada_English_FINAL.pdf

2. Diabetes Control and Complications Trial Research Group. Effect of pregnancy on microvascular complications in the diabetes control and complications trial. The diabetes control and complications trial research group. Diabetes Care 2000;23:1084–91.

3. Ting, D., Cheung G., Wong, T. (2016). Diabetic Retinopathy: global prevalence, major risk factors, screening practices and public health challenges. Clinical and experimental Ophthalmology: Diabetes Special Issue. 44(4).

4. Harris, M. et al. 1992. Onset of NIDDM occurs at least 4-7 years before clinical diagnosis. Diabetes Care; 15(7):815-9.

5. Boucher MC, Qian J, Brent MH, Wong DT, Sheidow T, Duval R, Kherani A, Dookeran R, Maberley D, Samad A, Chaudhary V; Steering Committee for Tele-Ophthalmology Screening, Canadian Retina Research Network. Evidence-based Canadian guidelines for tele-retina screening for diabetic retinopathy: recommendations from the Canadian Retina Research Network (CR2N) Tele-Retina Steering Committee. Can J Ophthalmol. 2020 Feb;55(1 Suppl 1):14-24. doi: 10.1016/j.jcjo.2020.01.001. PMID: 32089161.

6. Robinson B. Prevalence of Asymptomatic Eye Disease. Can J Optom 2003;65:175–80

7. Abramoff M., Tobey D., and D. Char. 2020. Lessons learned about autonomous AI: finding a safe, efficacious, and ethical path through the development process. American Journal of Ophthalmology; 214:134-42.

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