Implementing technology to improve global eye health

BY ELLIOTT TAYLOR, COVA BASCARAN, ISLAY MACTAGGART, FARHANA REHMAN-FURS, ANDREW BASTAWROUS, MARCIA ZONDERVAN AND MATTHEW BURTON

Teachers working with Peek Acuity, the smartphone vision check app. They are pictured here facing children being screened at a school in Kitale, rural Kenya, where the app in a school screening programme was tested in 2015. Credit: © Rolex/Joan Bardeletti.

Fundus images are taken during diabetic retinopathy screening in Arusha, Tanzania. Credit: Hugh Bassett.

Technological innovation is providing new solutions to transform global eye health [1–5]. In particular, research towards the development of artificial intelligence (AI) tools in ophthalmology has gained pace in recent years. However, there has been little research relating to its implementation within existing eye health systems, particularly in low- and middle-income countries (LMICs) [1,6]. To effectively deploy any technological innovation, and to mitigate associated risks, thoughtful attention to its implementation is needed [3]. This article focuses on three examples of technological innovation linked to the International Centre for Eye Health (ICEH), London School of Hygiene and Tropical Medicine (LSHTM), and explores how technology is being implemented to improve global eye health.

Peek Vision – Farhana Rehman-Furs (Head of Programme Partnerships, Peek Vision)

Peek Vision is a social enterprise initiated within ICEH which harnesses technological solutions to optimise eye health pathways in LMICs. Ophthalmologist Professor Andrew Bastawrous founded Peek Vision after undertaking a comprehensive survey of eye disease in Nakuru, Kenya [7]. Having observed challenges associated with traditional methods of vision screening, he set out to develop a smartphone-based vision testing application which can be used by anyone, anywhere.

The use of technology

Peek Vision and ICEH have developed and validated Peek Acuity – a smartphone vision test app which can accurately assess visual acuity and can be used effectively by non-healthcare personnel [8,9]. This test is integrated into Peek's main offering, a software and data intelligence platform which digitises and optimises eye health programming. The technology behind 'Peek-powered' programmes tracks every encounter along the care journey. Linking into existing health systems and tracking data in real time facilitates continual adaptation and improvement of the programme. The system also produces SMS referral reminders which are automatically sent to patients in their preferred language, leading to improved referral adherence. As of December 2023, Peek Vision is powering over 60 eyecare programmes across 12 LMICs.

Implementation challenges

One of the biggest challenges has been in relation to data ownership and protection. Governments are understandably concerned over the ownership and use of health data, and it is vital that patients' data is protected to the highest standards. To protect data, Peek Vision has implemented controls in accordance with international information security standards. When Peek Vision enters a new region there is a process in place to understand local data regulations and facilitate in-depth collaborative discussion with governments, ensuring adherence to their data standards.

Impact on global eye health

In 2022, an independent health economics analysis (unpublished) in four districts of Pakistan demonstrated that when compared to non-Peek-powered programmes, Peek-powered programmes were reaching two-and-a-half times more people, connecting 16 times more people to the treatment they need, and at six times lower cost per completed referral. It took 10 years to screen the first 1,000,000 people using Peek Vision, and then just over one year to screen the next 4,000,000 people. Of those screened, around 20% are identified as having unmet eye health needs, with around 40,000 people connected to the care each month.

Diabetic Retinopathy Network (DR-NET) – Cova Bascaran (Technical Lead, DR-NET)

The DR-NET is a global collaborative network formed in 2014 on the foundations of the VISION 2020 LINKS Programme [10,11]. The network aims to build capacity in LMICs to facilitate the set up and running of high-quality DR screening and treatment services. To achieve this, the DR-NET focuses on (i) development of national frameworks and guidelines, (ii) development of DR screening and treatment services, (iii) essential technology and infrastructure needed for DR services, (iv) clinical skills and knowledge exchange [11].

The use of technology

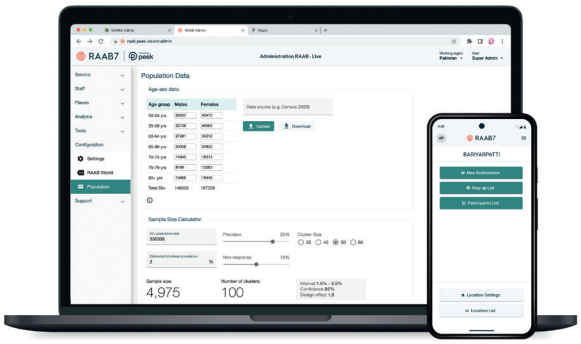
Technology is inherent to the screening and treatment of DR. When the DR-NET was established almost a decade ago, few screening programmes in LMICs were using digital retinal cameras. The expertise developed within the DR-NET has facilitated the exchange of knowledge regarding the most appropriate retinal cameras for specific DR screening programmes. The production of handheld, portable and affordable retinal cameras has been fundamental in making screening programmes a possibility in remote regions. In 2017 companies began approaching DR-NET members regarding the potential use of AI for DR screening. There is great potential for AI to revolutionise DR screening, for example by facilitating the task-shifting of DR screening to non-clinical staff, thus freeing up capacity of trained eye health personnel [12]. However, AI has been a challenging area to navigate for members of the DR-NET. The DR-NET has since held several workshops on AI for DR screening and has been working with members on 'real-world' implementation of AI tools. An example of this is a recent study conducted by members of the DR-NET on the evaluation of a portable, offline functioning, smartphone-based AI system within an existing DR screening programme in Dominica – this study showed that the AI system performed with "reasonable accuracy compared with a specialist grader" [13]. In addition, an ongoing study in Tanzania is assessing not only the accuracy of the AI system in grading retinal images, but also whether it improves the follow-up rate for individuals referred to the eye clinic following DR screening [14]. We hope that these studies will help inform policy and practice in the delivery of AI-augmented DR screening services both locally and globally.

Implementation challenges

Though AI DR screening systems have shown great promise in diagnostic accuracy, there are concerns about whether they will remain as accurate when deployed in different regions or populations to which the algorithm was developed [15,16]. Currently, there are few studies assessing whether AI tools are feasible and effective when implemented into real-world DR screening pathways in LMICs [6]. Therefore, it is crucial that these products are appropriately tested within existing screening programmes, before being deployed at scale. Another challenge relates to data security regulations, and where retinal image data is stored. There is also a need for AI systems which function without internet connection, to ensure usability in rural areas. Through close collaboration with eye health workers and key stakeholders within health ministries, the DR-NET is providing a platform to collaboratively develop solutions to overcome these challenges.

Impact on global eye health

The DR-NET provides a platform for global collaboration to strengthen health systems' capacity to address visual impairment and blindness due to DR. In the first five years of the DR-NET 36 DR screening and treatment centres in 17 LMICs increased the number of people screened by 88% and the number of people treated for DR by 47% from baseline. Digital photography is now implemented in all of these screening programmes and some have started to conduct AI validations to consider the use of this technology to support the limited human resources available for DR screening [17].



Peek software and data intelligence platform for RAAB7 (Rapid Assessment of Avoidable Blindness). Credit: Peek Vision.

Rapid Assessment of Avoidable Blindness (RAAB) surveys – Islay Mactaggart (Principal Investigator, RAAB Project at ICEH, LSHTM)

The Rapid Assessment of Avoidable Blindness (RAAB), established over 20 years ago, is a methodology for conducting relatively fast and affordable population-based eye health surveys [18,19]. RAAB assesses both prevalence and causes of vision impairment and blindness, generating locally relevant data for eye service planning [20]. Data from RAAB also significantly contributes to global estimates on vision loss [21].

The use of technology

The latest iteration of RAAB, RAAB7, was launched in 2021 and has been developed by ICEH and Peek Vision. RAAB7 is delivered digitally, facilitating more efficient, accurate and secure data collection. Paper data collection forms have been replaced by a bespoke smartphone app powered by Peek Vision and embedding the Peek Acuity visual acuity tool, facilitating faster and more cost-effective data collection. Collected data feeds into a web platform for live data monitoring and quality assurance. Automated data analysis and reporting has been built into the web platform, minimising cost and delays associated with traditional data analysis processes [22]. An online data repository at RAAB.world provides open access data from completed RAAB surveys, so that data can be used for further analysis and data synthesis [23].

Implementation challenges

As described above in the rollout of Peek's programmes, switching to a system where ICEH and Peek centrally store and manage data on users' behalf has opened discussions about data sovereignty in some settings. We have detailed written agreements in place between stakeholders to clarify roles, responsibilities, storage, management and ownership of data. It also requires written informed consent to be taken from each participant to confirm that they agree to how their data will be used.

As with any epidemiological survey, it is important to ensure data is collected accurately and consistently. There may be additional training required for survey teams who have less

experience in using a smartphone tool for data collection. To manage this and to support high-quality data collection, all RAAB survey teams receive a week of standardised training on completing a RAAB from a qualified RAAB trainer prior to data collection.

Impact on global eye health

While the primary purpose of RAAB is to facilitate evidence-based local eyecare service planning, monitoring and evaluation, the data from RAAB surveys have made significant contributions to the global understanding of the causes and prevalence of vision loss. To date, over 370 RAAB surveys have been conducted in 84 countries. The technological component of RAAB7 supports the ongoing generation of high-quality epidemiological data relating to global eye health. Demand for RAAB surveys continues to grow, such that we have just trained a new cohort of 18 trainers to support its delivery. We are also seeing an increase in demand for national-level RAAB surveys for national eye health service planning, in line with World Health Organization recommendations.

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[All links last accessed July 2024]

AUTHORS

Elliott Taylor,
NIHR Academic Clinical Fellow, International Centre for Eye Health, London School of Hygiene and Tropical Medicine, London, UK.

Cova Bascaran,
DR-NET Technical Lead and Research Fellow, ICEH, LSHTM, UK.

Islay Mactaggart,
Associate Professor in Disability and Global Eye Health, ICEH, LSHTM, UK.

Farhana Rehman-Furs,
Head of Programme Partnerships, Peek Vision.

Andrew Bastawrous,
Professor in Global Eye Health, ICEH, LSHTM, UK; Co-Founder & CEO, Peek Vision.

Matthew Burton,
Professor of Global Eye Health and Director of the International Centre for Eye Health, LSHTM; National Institute for Health Research Biomedical Research Centre for Ophthalmology at Moorfields Eye Hospital NHS Foundation Trust and UCL Institute of Ophthalmology, London, UK.

SECTION EDITOR

Marcia Zondervan,
Programme Manager, VISION 2020 LINKS Programme, International Centre for Eye Health, LSHTM, UK.
www.iceh.lshtm.ac.uk
matthew.burton@lshtm.ac.uk

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