

# Teleophthalmology in the post-coronavirus era

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## ABSTRACT

173,766 New Zealanders suffer from visual impairment. The associated health-system costs are \$523 million in total, or \$3,008 per person. Yet eighty percent (80%) of blindness is avoidable if detected on time. Public health services have an increasing workload but are also limited by material and technical resources. Optometry practices continually increase referrals (up to 100% in one year) that cannot be solved on time, reducing the efficiency of the service. Teleophthalmology works by improving the efficiency of screening and monitoring and integrating eye healthcare and by decreasing referrals by up to 40%.

Offering excellent quality care to the population via our public healthcare system is one of our national priorities. To seek consultation from an ophthalmologist, patients usually make an appointment with an optometrist (or a general practitioner (GP)) before being referred. The continuously growing number of referrals from optometry practices (more than 100% in one year<sup>1</sup>) increases pressure on the public service. Telemedicine systems are an opportunity to implement new solutions and optimise eye care in the post-coronavirus era.

New Zealand patients receive government-funded care from ophthalmologists in the public sector. Patients typically visit an optometrist or GP to be referred to an ophthalmologist for further consultation. In the private sector, optometry practices are increasing the pressure of the public service with a continuously growing number of referrals.<sup>1</sup> In some cases, referrals increased 100%<sup>1</sup> in a year, representing, in the Auckland District Health Board (DHB), more than 1,000 patients per month. There are no practical solutions for this situation, and the sustainability of the system is at risk. Because there are many referrals, it is a challenge to review all patients in a timely manner.<sup>23</sup>

In 2020, before the coronavirus pandemic, more than 14,250 people within the Counties Manukau DHB were waiting to see an ophthalmologist.<sup>4</sup> The worst scenario is when patients are lost to follow-up, which happens in up to 38%<sup>5</sup> of cases, even in high-

risk-of-vision-loss conditions. This situation is particularly problematic in elderly people, diabetics with comorbidities and specific collectives, such as the Māori population, who face greater barriers to accessing the healthcare system.

The extra work inadvertently causes delays in clinic appointments and leads to vision loss in patients with chronic ocular diseases.<sup>3</sup> Our public healthcare system is facing increasing financial expenses to deliver quality eye care.<sup>23</sup> Telemedicine offers one opportunity to implement new solutions.<sup>6</sup>

## Coronavirus pandemic

A large portion of ophthalmology patients are at high risk for coronavirus mortality (patients with macular degeneration aged 85 years or more, people with diabetes and patients who are immunocompromised). Consequently, ophthalmic services reduced in-person consultations to minimise potential exposure to the disease for the eye care providers and at-risk populations. A recent international survey suggests that ophthalmology has been the most affected medical specialty, with a decrease of 79% in the number of visits.<sup>7</sup> For these reasons, delays in ophthalmology appointments significantly worsened, probably resulting in vision loss.<sup>8</sup> It is a priority to restart our services as soon as possible. In New Zealand, because of the coronavirus pandemic, an estimate of more than 40,000 patients have had their appointments postponed.

(The estimate comes from extrapolating the effect of lockdown in the Southern DHB across the New Zealand population).

## Inequalities in health and remote patients

New Zealand has a vast territory with a significant number of patients in rural and isolated areas. These people have limited access to health services, medical shortages and constrained financial resources. Receiving medical care implies travel to urban areas, which costs time and money.<sup>9</sup> Isolated communities suffer complications of eye diseases more than urban populations<sup>9</sup> due to inequitable access to public healthcare resources. Furthermore, there are gaps in the efficiency and quality of eye care services,<sup>9</sup> creating dissatisfaction with the provision of care.<sup>9</sup> Disadvantaged patients in urban areas are also isolated due to poverty, social conditions, ethnic discrimination, prejudice, cultural ethics and religion,<sup>9</sup> especially Māori, Pacific people and people with lower socioeconomic status, who experience highly inequitable health outcomes.

## New Zealand ophthalmology challenges

Our eye healthcare is challenged with offering equitable and efficient eye care at a sustainable cost. The Eye Health Workforce Service Review<sup>10</sup> established the need to create a clinical eye network for integrating New Zealand's clinical health services at the primary, secondary and tertiary levels. To increase access to health services, optimise workforces and develop innovative eye health roles, eye health screening should be standardised.

The way to improve our eye and vision healthcare is to integrate healthcare professionals' services into the ophthalmologists' practices. By offering devices to obtain and share clinical data between eye health professionals, we can deliver an optimised service to the community. New Zealand is continuously improving, and has some pioneer experiences.<sup>11</sup>

## What is teleophthalmology?

Teleophthalmology is the use of telecommunication and information services to remotely deliver eye healthcare. This includes telephone consultation, live video-

conferencing, telemonitoring and mobile healthcare.<sup>12</sup>

There are three main modalities of teleophthalmology. (1) *Store and forward technology* is the most common. Images and documents are taken and forwarded to the ophthalmologist for review. For example, an ophthalmologist reviews slit lamp or retina images. (2) *Real-time telemedicine* offers video consultation in real time, similarly to an in-person office visit. (3) *Remote monitoring* allows a distant follow-up.

Teleophthalmology helps with screening, diagnosing and monitoring patients, and includes, among others: (1) acute services: triage, diagnosis and treatment; (2) monitoring and follow-up on some conditions; (3) offering explanations to patients; (4) eye screening services.

A web-based application allows the user to remotely send information (eg. retinal images and patient data). Telehealth options must be implemented properly to minimise security risks. The software communication structure guarantees the protection of the data, which are secured and encrypted. The data are anonymised and they are reviewed by an ophthalmologist who looks for signs of pathology and decides the management. Analysed images and reports are forwarded to the user. Teleophthalmology can screen, refer, and monitor patient eye care while focusing on patient needs. There are different platforms available that can integrate with existing platforms for coordination with the hospital.

## Teleophthalmology evidence

There is a high level of agreement between optometrists who use teleophthalmology and conventional examination.<sup>13,14,15,16</sup> The agreement can be as high as 100% in retina disorders such as diabetic retinopathy and age-related macular degeneration,<sup>17</sup> and agreement can be above 87% in cases of glaucoma.<sup>14,16</sup> The implementation of teleophthalmology services may decrease the number of referrals to a hospital-based eye services by 40%,<sup>18,19</sup> and the actual benefits may vary depending on a large number of factors.

Teleophthalmology could lead to significant savings in time and travel expenses. In a pilot study connecting hospital ophthalmologists with optometrists, 96%

of patients were satisfied, mainly because of a reduction in travel (96%), cost (92%) and time (92%).<sup>20</sup> In addition to the eye care application, advantages of digital imaging systems include short examination time, electronic medical images and the ability of non-ophthalmologists to screen for eye diseases.<sup>6</sup> Teleophthalmology provides secondary specialist advice in the diagnosis and management of difficult cases.<sup>21</sup> It also supports real-time tele-mentoring and -teaching. The economic analysis supports the evidence of the cost-effectiveness of teleophthalmology for diabetic retinopathy and glaucoma.<sup>22</sup> Increasing screening could improve accessibility, especially for rural and remote populations.<sup>22</sup>

### The impact of eye diseases

Loss of vision has a devastating effect on daily life.<sup>52</sup> It is difficult to perform basic physical and social tasks<sup>24</sup> and complicates the management of other conditions. Depression is 3.5 times higher<sup>25</sup> in people with moderate to severe vision loss, and dementia progresses more rapidly. Loss of vision increases the risk of falls, multiplies the risk of fractures by 2.5 times, creates dependence and causes 4.23 times more admissions in nurse homes.<sup>26</sup>

In New Zealand, we have 173,766 New Zealanders suffering from vision loss. The disability's healthcare costs are \$523 million in total, or \$3,008 per person.<sup>27</sup> Most vision loss is preventable or treatable. The most common causes of blindness in New Zealand are macular degeneration (48%) and glaucoma (16%).<sup>27</sup> Eighty percent (80%) of blindness is treatable and/or preventable, according to the World Health Organization.<sup>28</sup> Strategies for restoring sight and preventing blindness are among the most cost-effective healthcare interventions worldwide.<sup>28</sup>

### Limitations

Improvements in technology-based services have decreased connectivity problems and storage limitations. Nevertheless, there are important limita-

tions.<sup>29</sup> The cost of ophthalmic imaging equipment and hardware can be prohibitive, and the spending may be inefficient. Also, teleophthalmology in the outpatient setting relies on the coordination of services to benefit from the evaluation. The current structures are already overburdened to perform additional tasks and ensure patient compliance with recommendations.

Medical perspectives must adapt to teleophthalmology services. The evaluations can be difficult; 59% of ophthalmologists reported low confidence when making decisions based only on images. The follow-up of chronic conditions can be complicated. Also, medical liability is a reason for concern.

Successful application of teleophthalmology requires the development of efficient structures and consistent training of the involved personnel. Improving image processing and integration of patient's medical care teleophthalmology may improve results.<sup>30</sup>

### Conclusions

Telemedicine has the potential to increase access to care, decrease costs and improve adherence to evidence-based protocols. Teleophthalmology may optimise the referrals and help to offer a more efficient service on time. Properly implemented, we anticipate perhaps a 40% decrease in the number of referrals to public ophthalmology services in New Zealand, which would improve the workflow in ophthalmology departments of public hospitals by about 20%. Connectivity solutions can help offer better eye healthcare by exploiting the benefits of teleophthalmology for remotely screening, referring and monitoring patients and integrating the services provided by eye health professionals. Now is the moment to implement innovations so as not to leave anyone behind. As remote consultations become available, healthcare organisations and clinicians will have to re-evaluate traditional care delivery models while still ensuring that evidence-based protocols improve outcomes.

**Competing interests:**

Ruth Large declares: I am the Chair of the New Zealand Telehealth Leadership Group, which is advisory to the Ministry of Health unrelated to decisions regarding funding. I am the Chief Clinical Officer for Whakarongorau Aotearoa (formerly known as Homecare Medical), which supplies the Ministry of Health contracted services. such as Healthline, COVID line and 1737. There are no direct relationships to ophthalmology service supply in the either of these two roles.

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