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Telerehabilitation for people with low vision (Review)

Bittner AK, Yoshinaga PD, Wykstra SL, Li T

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TABLE OF CONTENTS

[Intervention Review]

Telerehabilitation for people with low vision

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ABSTRACT

Background

Low vision affects over 300 million people worldwide and can compromise both activities of daily living and quality of life. Rehabilitative training and vision assistive equipment (VAE) may help, but some visually impaired people have limited resources to attend in-person visits at rehabilitation clinics to receive training to learn to use VAE. These people may be able to overcome barriers to care through remote, Internet-based consultation (i.e. telerehabilitation).

Objectives

To compare the effects of telerehabilitation with face-to-face (e.g. in-office or inpatient) vision rehabilitation services for improving vision-related quality of life and near reading ability in people with visual function loss due to any ocular condition. Secondary objectives were to evaluate compliance with scheduled rehabilitation sessions, abandonment rates for VAE devices, and patient satisfaction ratings.

Search methods

We searched the Cochrane Central Register of Controlled Trials (CENTRAL) (which contains the Cochrane Eyes and Vision Trials Register) (2019, Issue 6); Ovid MEDLINE; Embase.com; PubMed; ClinicalTrials.gov, and the World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP). We did not use any language restriction or study design filter in the electronic searches; however, we restricted the searches from 1980 onwards because the Internet was not introduced to the public until 1982. We last searched the electronic databases on 24 June 2019.

Selection criteria

We planned to include randomized controlled trials (RCTs) or controlled clinical trials (CCTs) in which participants diagnosed with low vision were undergoing low vision rehabilitation using an Internet, web-based technology compared with an approach involving in-person consultations.

Data collection and analysis

Two review authors independently screened titles and abstracts and then full-text articles against the eligibility criteria. We planned to have two review authors independently abstract data from the included studies. Any discrepancies were resolved by discussion.

Main results

We identified two ongoing studies, but did not find any completed RCTs and CCTs that met the inclusion criteria for this review. We did not conduct a quantitative analysis. We discussed review articles on telemedicine for facilitating communication with elderly individuals or for providing remote ophthalmological care.

Authors' conclusions

We did not find any evidence from RCTs or CCTs on the efficacy of using telerehabilitation for remote delivery of rehabilitation services to individuals with low vision. Given the disease burden and the growing interest in telemedicine, the two ongoing studies, when completed, may provide evidence in understanding the potential for telerehabilitation as a platform for providing services to people with low vision.

PLAIN LANGUAGE SUMMARY

Telerehabilitation for people with low vision

What is the aim of this review?
This review aimed to evaluate the benefits of providing vision rehabilitation services remotely (via telerehabilitation) for people with low vision. Telerehabilitation uses an Internet-based approach rather than the usual office-based consultations. The main outcome of interest was vision-related quality of life, but we were also interested in visual function measures such as how fast people can read, and compliance with scheduled sessions and patient satisfaction.

Key messages
Given the disease burden and the growing interest in telemedicine, the two ongoing studies, when completed, may provide evidence in understanding the potential for telerehabilitation as a platform for providing services to people with low vision.

What was studied in the review?
Low vision is a reduction in visual function that cannot be fixed by eyeglasses, contact lenses, or other medical and surgical treatments. People with low vision may find it difficult to perform daily activities such as reading and driving. About 300 million people have low vision worldwide. One way to help people with low vision is rehabilitation, during which individuals are taught to use magnification devices and techniques to make the most of their remaining vision; they are also evaluated periodically to reinforce skills. Office-based rehabilitation training for low vision has been shown to be effective; however, transportation to the doctor's office may be a barrier to patients. The effectiveness of magnification devices and techniques is compromised if training is not provided. Technology has made it possible to provide low-vision rehabilitation services through the Internet (i.e. telerehabilitation). Telerehabilitation reduces the challenges related to transportation to in-office visits, and also offers the convenience of rehabilitation sessions at home.

What are the main results of the review?
We found two ongoing studies but not any completed study that directly addressed the research question.

How up-to-date is this review?
The search was last run on 24 June 2019.

BACKGROUND

Description of the condition

Low vision is defined as "a visual impairment, not corrected by standard eyeglasses, contact lenses, medication, or surgery, that interferes with the ability to perform everyday activities" (NEI glossary). Visual impairment can result from a variety of ocular and systemic disorders and may present as reduced central vision, reduced peripheral vision, blind spots, loss of contrast sensitivity, or a combination of these symptoms. It is estimated that about 300 million people currently have low vision worldwide (Foster 2008). It was estimated that in 2017 nearly 4 million older adult Americans had low vision (best-corrected visual acuity worse than 20/40) (Chan 2018). With the increase in life span and age-related diseases such as diabetic retinopathy or age-related macular degeneration, the number of people with low vision is expected to double by 2050 (Chan 2018).

Without effective interventions, reading, mobility, and functional independence decrease with low vision, and the risk of falls and fractures increases (Lamoureux 2008); these changes are associated with withdrawal from society and depression, resulting in a devastating impact on quality of life (Goldstein 2012). The US National Institutes of Health National Eye Institute's strategic plan, the Low Vision and Blindness Rehabilitation—National Plan for Eye and Vision Research, recommends developing rehabilitation programs and determining the most effective interventions for people with visual impairments (www.nei.nih.gov/about/strategic-planning).

Description of the intervention

Low-vision rehabilitation is the primary intervention for people with chronic, disabling visual impairment (Markowitz 2006). The goal is to improve activities of daily living by helping people with reduced visual function optimize the use of their remaining sight through the provision of appropriate refractive correction as well as training in the use of vision assistive equipment (VAE) and compensatory strategies (Binns 2012). Individuals are taught to cope with their disability by initiating lifestyle and habitat modifications.

Successful use of VAE is highly dependent on skill reinforcement with a rehabilitation specialist. The Low Vision Intervention Trial (LOVIT) demonstrated a positive effect of inpatient low vision rehabilitation on self-reported visual function (Stelmack 2008); however, the current outpatient-based approach for delivering low-vision rehabilitation presents significant challenges due to transportation barriers and insufficient compliance with VAE device training.

Patients may be provided with limited instructions or training in the use of newly prescribed VAE. VAE require specific working distances, which may be unnatural for the patient and require training, education, practice, and skill reinforcement. Patients may become frustrated and not return for follow-up visits when they continue to experience difficulty using VAE at home or if their vision or general health decline.

Furthermore, the majority of the population seeking outpatient low-vision rehabilitation services are elderly, with 73% of individuals aged 65 and older (Goldstein 2012). In addition to their vision impairment, there are age-associated physical, psychological, and cognitive issues, including memory deficits.

This group relies heavily on others for support and transportation. One study found that about two-thirds of the low-vision population do not drive (Goldstein 2012). Transportation issues and comorbidities limit peoples' ability to return for the necessary follow-up sessions, which commonly focus on training with VAE.

Given all these challenges, VAE have variable effectiveness and high rates of abandonment (Watson 1997). The potential efficacy of low-vision rehabilitation may not be fully achieved without additional training. The strategy of inpatient rehabilitation employed in the LOVIT study incorporated multiple rehabilitation sessions and found effect sizes that far outweighed typical outpatient low-vision rehabilitation (Stelmack 2008), which often may involve only one visit to a low-vision clinic.

Telerehabilitation refers to the delivery of rehabilitation services via information and communication technologies (Brennan 2011). Clinically, this term encompasses a range of rehabilitation services that include assessment, monitoring, prevention, intervention, supervision, education, consultation, and counseling. Telerehabilitation is commonly used for individuals with stroke, brain injury, joint replacement, or spinal cord injury (Rogante 2010), and usually involves audio and video technology.

How the intervention might work

Telerehabilitation may offer several important advantages over traditional in-office care and has the potential to lead to improvement in vision- and health-related outcomes (Rogante 2010). Firstly, it can potentially overcome transportation difficulties. Furthermore, health professionals can evaluate patients in their home environment rather than in a clinical setting, thereby providing more personalized care. In addition, telerehabilitation has the potential to expand rehabilitation modalities through the use of secure, Internet-based communication technology (e.g. computers, tablets, smartphones), and may also increase efficiency by optimizing the use of time and other resources.

Why it is important to do this review

In ophthalmology, most studies of telemedicine have involved transfer of patients' ocular images among providers for interpretation, diagnosis, and management of ocular disease, while fewer studies appear to have used telemedicine to communicate directly with patients or to provide low-vision rehabilitation (Tang 2005). The goal of low-vision rehabilitation services, whether in person or remotely via telemedicine, is to help people with vision loss maintain visual functioning and activities of daily living, as well as social and psychological well-being. While telemedicine may overcome some barriers, such as transportation, it may present other technological challenges in interactions with elderly visually impaired patients. We wanted to determine whether studies on telerehabilitation have achieved success with the low-vision population.

OBJECTIVES

To compare the effects of telerehabilitation with face-to-face (e.g. in-office or inpatient) vision rehabilitation services for improving vision-related quality of life and near reading ability

in people with visual function loss due to any ocular condition. Secondary objectives were to evaluate compliance with scheduled rehabilitation sessions, abandonment rates for visual assistive equipment devices, and patient satisfaction ratings.

METHODS

Criteria for considering studies for this review

Types of studies

We planned to include randomized controlled trials (RCTs) and controlled clinical trials (CCTs). We summarized non-randomized studies, such as cohort studies and case series.

Types of participants

We planned to include studies in which participants were diagnosed with low vision, that is visual function loss due to any ocular condition, as defined in the individual studies. According to the World Health Organization (WHO), low vision is diagnosed when the best-corrected visual acuity in the better eye is between 20/400 and 20/60 (WHO low vision definition); however, as this definition is not universally accepted, we decided to accept the definitions specified in the included studies.

Types of interventions

The main intervention of interest was the use of web-based technology to provide real-time, remote rehabilitation services to the low-vision population. The comparison intervention was any face-to-face communication, such as traditional office-based approaches for providing low-vision rehabilitation. Low-vision rehabilitation includes assessing visual status, prescribing VAE (e.g. magnifiers, telescopes, optical or electronic devices), training, education, and counseling. We planned to document whether each telerehabilitation intervention was combined with any initial or subsequent in-office visits, also noting the frequency of each type of encounter (i.e. number and proportion of in-person visits).

Types of outcome measures

Primary outcomes

The primary outcome of the review was vision-related quality of life, measured by any validated visual function questionnaire instrument used in the trial at 3 to 12 months after starting the intervention. We planned to analyze both absolute values at a follow-up time point and change from baseline when data were available. We also planned that when data from multiple time points were available (e.g. when a trial reported 3-, 6-, and/or 12-month data), we would use the data from the longest follow-up time point.

Secondary outcomes

The secondary outcomes included:

1. short-term (less than six months) vision-related quality of life measured by any validated instrument to assess patient-reported visual function;
2. clinical measures, such as reading speed or reading acuity, at all documented postintervention time points;
3. patient satisfaction with the intervention, as assessed in an included trial, at the end of the intervention phase; and
4. compliance at the end of the intervention phase, as judged in the included trial.

We planned to use standardized and validated measurement methods when they were available (e.g. reading speed in words per minute or critical print size in M decimal notation using validated texts such as the MNREAD acuity charts) or validated questionnaire data (e.g. the Activity Inventory or Veteran Affairs Low-Vision Visual Functioning Questionnaire).

We planned to report any adverse events related to the interventions.

Search methods for identification of studies

Electronic searches

The Cochrane Eyes and Vision Information Specialist searched the following electronic databases for RCTs and CCTs. We did not use any language restriction or study design filter in the electronic searches; however, we restricted the searches from 1980 onwards because the Internet was not introduced to the public until 1982. The electronic databases were last searched on 24 June 2019.

- Cochrane Central Register of Controlled Trials (CENTRAL; 2019, Issue 6) (which contains the Cochrane Eyes and Vision Trials Register) in the Cochrane Library (searched 24 June 2019) (Appendix 1).
- MEDLINE Ovid (1946 to 24 June 2019) (Appendix 2).
- Embase.com (1947 to 24 June 2019) (Appendix 3).
- PubMed (1948 to 24 June 2019) (Appendix 4).
- US National Institutes of Health Ongoing Trials Register ClinicalTrials.gov (www.clinicaltrials.gov; searched 24 June 2019) (Appendix 5).
- World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP) (www.who.int/ictrp; searched 24 June 2019) (Appendix 6).

Searching other resources

We planned to search reference lists of included studies to identify additional studies for inclusion.

Data collection and analysis

Selection of studies

Two review authors independently screened the titles and abstracts against the eligibility criteria and labeled each record as 'definitely relevant', 'possibly relevant', or 'definitely not relevant'. We retrieved the full-text reports for each record labeled as 'definitely relevant' or 'possibly relevant' by both review authors. Two review authors independently assessed the full-text reports for eligibility, documenting the reasons for exclusion of excluded studies and resolving discrepancies through discussion.

We did not include any studies in this review. If eligible studies are identified in the future, we will use the following methods for data abstraction and analysis.

Data extraction and management

Two review authors will independently extract data from the included studies onto a web-based, electronic data collection form in Covidence (Covidence). We will extract information on study

design (e.g. study setting, countries in which the participants were recruited, sample size, study duration, types of design and analysis, funding source for the study and any potential conflicts of interest), participant characteristics (e.g. inclusion and exclusion criteria of the individual study, underlying disease, diagnosis, vision, and medical history), interventions and comparators (e.g. treatment modality, duration, timing), and outcomes (e.g. outcome domain, specific measurement tool, metric, method of aggregation, and time frame). One review author will enter data into Cochrane's statistical software Review Manager 5 (Review Manager 2014), and a second review author will verify the data entered. We will present summary data in the 'Characteristics of included studies' table and resolve any discrepancies between data extractors through discussion. We will contact study investigators for any missing or unclear information; if we receive no response within two weeks, we will proceed with the available information.

Assessment of risk of bias in included studies

Two review authors will independently assess risk of bias in the included RCTs and CCTs according to the guidance in Chapters 8 and 13 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2019; Reeves 2019). Specifically, we will assess random sequence generation, allocation concealment, masking (blinding) of outcome assessors, and completeness of outcome data. Masking of providers and participants is unlikely to be feasible due to the nature of the intervention. We will assign each domain as at 'low', 'high', or 'unclear' risk of bias following the criteria outlined in the *Handbook* and document reasons and rationales for our assessment.

Measures of treatment effect

We will treat ordinal outcomes and measurement scales, such as level of satisfaction and vision-related quality of life, as continuous data or dichotomous data as appropriate, depending on the length of the scale used and the manner in which the outcomes are reported.

Continuous outcomes

For continuous outcomes (e.g. reading speed rates or critical print size), we will use difference in means to measure the treatment effect and determine 95% confidence intervals.

Dichotomous outcomes

For dichotomous outcomes, such as compliance with follow-up (defined as the attendance rate of scheduled follow-up visits within a specified window of time, and based on a predefined threshold for compliance), we will use risk ratios to estimate treatment effects.

Unit of analysis issues

Due to the nature of the intervention, we expect that individual participants will be randomized in the included studies.

Dealing with missing data

We will contact trial authors for missing or unclear information, such as information required to assess risk of bias or for unclear or underreported outcomes. We will allow two weeks for the authors to respond, otherwise moving forward with best available information. We will estimate missing outcome data based on multiple imputation or other imputation approaches that account for the uncertainty in imputing the missing outcome data. When no such estimates are possible, we will use estimates reported by the authors and discuss the potential bias that could be introduced by missing data.

Assessment of heterogeneity

We will assess clinical and methodological heterogeneity by carefully evaluating the design and participant characteristics of the included studies for factors that could affect the reliability of estimates of the magnitude and direction of treatment effects. Clinical and methodological heterogeneity may manifest as statistical heterogeneity. We will quantify statistical heterogeneity using the I^2 statistic, the Q statistic and the Chi^2 test for heterogeneity, and the Tau^2 value when a sufficient number of studies are available (Turner 2012). We will consider an I^2 value of 75% or greater as indicative of considerable heterogeneity (Higgins 2019).

Assessment of reporting biases

When study protocols are available, we will compare the study protocol with study publications to identify any discrepancies in the reporting of outcomes. When a sufficient number of studies (10 or more) are included, we will use a funnel plot to visualize small-study effects and the potential for publication bias.

Data synthesis

We will combine results quantitatively using random-effects meta-analysis when three or more studies reporting the same outcome are included and when the studies are clinically, methodologically, and statistically homogeneous. We will not combine studies in a meta-analysis when there is considerable statistical heterogeneity (i.e. I^2 value of 75% or greater). We will not include observational studies, cohort studies, or case series in meta-analysis.

Subgroup analysis and investigation of heterogeneity

We will consider the following subgroups: underlying disease (e.g. age-related macular degeneration versus glaucoma), severity of visual impairment (e.g. early versus advanced stage of vision loss; legal blindness or not), and type of impairment (e.g. central versus peripheral visual impairment). Based on our clinical knowledge, we expect that the treatment effect may vary according to these factors.

Sensitivity analysis

We will conduct a sensitivity analysis by excluding studies graded at high risk of bias for allocation concealment before randomization in order to assess the robustness of our findings.

Summary of findings

We will summarize the main findings, including the strengths and limitations of evidence for each main outcome. We will provide a summary of our perception of how the intervention may work, for whom, and under what circumstances. We will provide a general interpretation of the evidence we find in the context of other evidence and discuss implications for practice and future research. We will use a 'Summary of findings' table when appropriate, and two review authors will independently grade the overall certainty of the evidence for each outcome using the GRADE classification (GRADEpro GDT).

RESULTS

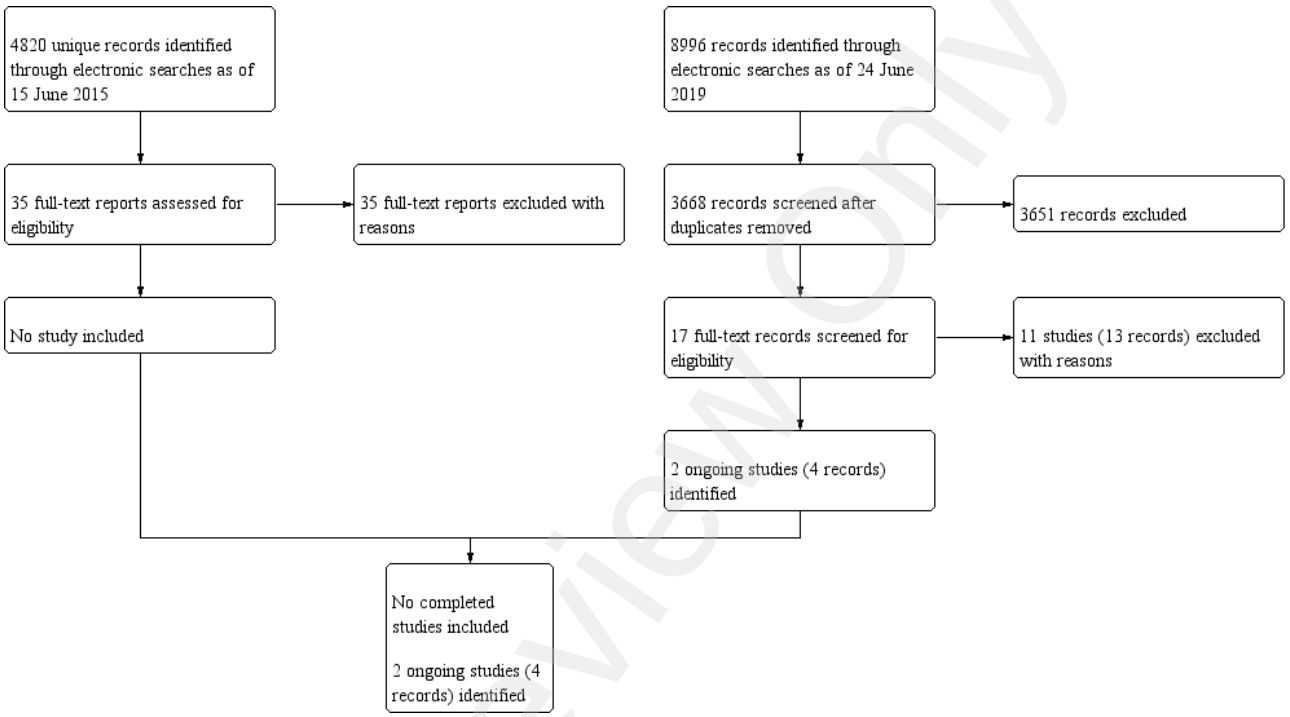
Description of studies

Results of the search

We previously published the detailed results of the 2015 version of this review (Bittner 2015). In brief, we excluded 35 studies based on full-text review and identified no eligible studies out of 4820 records.

We conducted the updated electronic database searches on 24 June 2019, which yielded 3668 unique records. We screened the titles and abstracts of the 3668 records and retrieved 17 full-text copies for further review. After full-text review, we excluded 13 records of 11 studies with reasons, and identified four records of two ongoing studies (NCT03957980; van der Aa 2017). We did not find any completed RCTs or CCTs. A flow diagram describing the search and screening is shown in Figure 1.

Figure 1. Study flow diagram.



Included studies

We did not find any relevant completed RCTs and CCTs. The two ongoing studies are described briefly below.

In a randomized cross-over trial, NCT03957980 compares in-home telehealth-based intervention to standard care in 21 children with cortical visual impairment to assess the feasibility and acceptability of the telerehabilitation. van der Aa 2017 compares an e-mental health intervention offered via the Internet with digital and telephone guidance of a social worker to usual care. This study randomized 174 participants with retinal exudative diseases who receive anti-vascular endothelial growth factor treatment; based on the trial registration information, it is unclear how many of these participants are 'low vision'. We will reclassify this study when the results become available.

Excluded studies

We excluded 46 studies after full-text assessment (see reasons for exclusion in the Characteristics of excluded studies table).

Risk of bias in included studies

There were no included studies for which we could assess the risk of bias.

Effects of interventions

There were no included studies to be used for evidence synthesis.

DISCUSSION

Summary of main results

We did not find any RCTs or CCTs that met our inclusion criteria. We found a few review articles that cited studies that are relevant to our topic; these are summarized in Agreements and disagreements with other studies or reviews.

Overall completeness and applicability of evidence

Delivering low-vision rehabilitation services remotely via telemedicine has the potential to help people with vision loss maintain function and activities of daily living as well as social and psychological well-being. Although we did not find any controlled trials that specifically addressed telerehabilitation for people with low vision, we found case series, cohort studies, and review articles that cited projects that had assessed the needs and feasibility of telemedicine for ophthalmologic or other medical conditions. These findings are supportive and highlight the need for more specific research on telerehabilitation for people with low vision.

Quality of the evidence

We found no evidence for benefit or harm of telerehabilitation for people with low vision. The quality of the evidence is thus moot.

Potential biases in the review process

We followed the *Cochrane Handbook for Systematic Reviews of Interventions,* Higgins 2011, and Methodological Expectations of Cochrane Intervention Reviews (MECIR) Standards for the reporting of new Cochrane Intervention Reviews (editorial-unit.cochrane.org/mecir) in conducting this review. A trained information specialist designed and conducted the electronic search. Two review authors independently screened the search results. None of the review authors has any financial conflicts of interest.

Agreements and disagreements with other studies or reviews

Need for telemedicine: A literature review of eye health in rural Australia highlighted the need for services capable of reaching individuals living in rural areas, who had poor access to eye care providers, reduced utilization of services, and increased prevalence of blinding eye diseases (e.g. glaucoma). However, that review was conducted 15 years ago and did not contemplate the use of telehealth for low-vision rehabilitation (Madden 2002).

Feasibility of telerehabilitation: An overview of telemedicine for eye care suggested that low-vision consultation through tele-ophthalmology could improve access to specialized care that was otherwise unavailable in underserved areas. The authors of this report described a low-vision population who received consultation using a tele-ophthalmology approach without traveling to the low-vision center at the University of Texas at Houston. The tele-ophthalmology services were discontinued after the grant funding ended; no further details are available (Tang 2005). In more recently published case series (Bittner 2018), 10 low-vision elderly patients with macular pathology received VAE (i.e. a handheld magnification device) for reading and one-hour telerehabilitation sessions in their homes from the office of low-vision providers. Participants and providers both gave positive evaluations with respect to feasibility and acceptability of the telerehabilitation sessions. One retrospective cohort study investigated the travel cost and time saved by telerehabilitation in veterans with low vision (Ihrig 2019), reporting that the median saving of travel cost and time between fiscal year 2013 and 2017 was approximately USD 65 and two hours per veteran, respectively.

Two review articles of tele-ophthalmology in India described real-time interactions using a videoconferencing system between the remotely located ophthalmologists and patients undergoing screening for ocular diseases (Murthy 2012; Prathiba 2011). Also in India, the Aravind Tele-ophthalmology Network and Madras Diabetes Research Foundation have provided a videoconferencing system for the retinal specialist at a base hospital to communicate directly with patients in a mobile screening van (Murthy 2012). However, there was no indication that low-vision rehabilitation services were delivered to these patients via tele-ophthalmology in these projects. One review specifically stated that low-vision consultation could be one potential tele-ophthalmology service (Prathiba 2011).

A systematic review of telemedicine for elderly patients with any health condition found that some telemedicine studies had excluded people with visual impairment. These studies did not provide data with regard to the impact of vision loss on patients' ability to participate in the videoconferencing sessions (Van den Berg 2012). Most studies of telemedicine in elderly patients found benefits for behavioral outcomes, such as adherence, self-efficacy, quality of life, and economic outcomes. These findings are encouraging since most low-vision populations are elderly; however, the potential for vision loss to limit access to or use of a videoconferencing portal for telemedicine has not been formally evaluated in an older population.

We identified a recent study on usage of relevant technologies by individuals with low vision, which potentially could be used to deliver telerehabilitation services. In 2014, use of a tablet device was reported by nearly half (48%) of 132 people with low vision or no vision (Crossland 2014). Most respondents (81%) indicated that they used a smartphone and about half (51%) used their camera and screen as a magnifier. While this study did not specify the proportion who used video chat on their device, it did suggest that devices with video functionality were being used by the survey respondents.

AUTHORS' CONCLUSIONS

Implications for practice

There is currently no evidence available from controlled trials to support the use of telerehabilitation for people with low vision. Several observational studies and projects have indicated the potential benefit and feasibility of delivering ophthalmologic care via the Internet. However, previous studies and projects have not demonstrated the efficacy of telerehabilitation for low vision and utility for practice.

Implications for research

Given the disease burden and the growing interest in telemedicine, there is a need for future studies to explore the potential for telerehabilitation as a platform for providing remote services to people with low vision. As a logical first step, it would be helpful for research to explore patients' preferences for receiving telerehabilitation versus in-office rehabilitation, considering both ex ante and post hoc elicitation of preferences, as well as individuals' ability to access the Internet for telerehabilitation services. If there is sufficient support for telerehabilitation, a pilot feasibility study could initially evaluate whether people with low vision can successfully use and satisfactorily communicate with a provider using a secure videoconferencing portal after an initial in-person consultation. Such a study would be followed by a randomized clinical trial to compare the outcomes following low-vision rehabilitation delivered in-office versus remotely via the Internet. Quality monitoring is necessary for such a study to ensure that the low-vision participants are using the system correctly. Despite the growing interest in telerehabilitation, the absence of any controlled studies with data for people with low vision may reflect concerns about long-term feasibility and sustainability given limited payment reimbursement mechanisms for this type of service. However, supportive evidence from a randomized controlled trial of telerehabilitation for low vision could be used to help drive policy changes and implement

programs that help provide payment to cover remotely delivered services via a telehealth platform.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Aimola 2014	Not the intervention of interest
Arnold 2002	Not an RCT or CCT
Bai 2007	Not an RCT or CCT; not the intervention of interest
Beumer 2000	Not the intervention of interest
Bittner 2018	Not an RCT or CCT
Chee 2018	Not an RCT or CCT
CITT 2008	Not the participants of interest
CITT 2009	Not the participants of interest
Gall 2012	Not an RCT or CCT
Gell 2013	Not an RCT or CCT; not the intervention of interest
George 2011	Not the intervention of interest
Girdler 2010	Not the intervention of interest
Herzer 2016	Not an RCT or CCT
Ihrig 2019	Not an RCT or CCT
Jacobson 2005	Not an RCT or CCT; not the intervention of interest; not the population of interest
Jeon 2012	Not the intervention of interest
Jiang 2005	Not an RCT or CCT
Kasten 1995	Not the intervention of interest
Kasten 2000	Not the intervention of interest
Kasten 2001	Not the intervention of interest
Kerkhoff 1998	Not the intervention of interest
Komm 2009	Not the intervention of interest
Kämpf 2001	Not the intervention of interest
Kämpf 2008	Not the intervention of interest
Larizza 2014	Not an RCT or CCT
Lynch 2016	Not the intervention of interest
Mines 2011	Not an RCT or CCT; not the intervention of interest
NCT01083147	Not an RCT or CCT

Study	Reason for exclusion
NCT01581606	Not an RCT or CCT
NCT03560765	Not the intervention of interest
Patty 2018	Not an RCT or CCT
Powers 2009	Not an RCT or CCT
Puig de la Bellacasa 1980	Not an RCT or CCT
Ross 1992	Not the intervention of interest
Schenk 2013	Not the intervention of interest
Schiefer 2006	Not an RCT or CCT; not the intervention of interest
Schinzel 2011	Not the intervention of interest
Silvestri 2017	Not the intervention of interest
Srinivasan 2012	Not the intervention of interest
Tan 2013	Not an RCT or CCT
Tatarinov 1993	Not an RCT or CCT
Tennant 2001	Not the intervention of interest
Tsitsiashvili 2007	Not the intervention of interest
Ulrich 2009	Not an RCT or CCT
Widdig 2006	Not an RCT or CCT
Zhang 2013	Not the intervention of interest

CCT: controlled clinical trial
RCT: randomized controlled trial

Characteristics of ongoing studies *[ordered by study ID]*

NCT03957980

Trial name or title	Remote access: cortical visual impairment
Methods	Randomized cross-over trial
Participants	**Inclusion criteria:** • children aged 12 months to 6 years 11 months with suspected or previously diagnosed cortical visual impairment. For children who had been previously diagnosed with cortical visual impairment and were under regular ongoing therapy related to vision, they should not be receiving more than 1 time/session a week at the time of recruitment. • caregivers are cognitively able to provide meaningful consent and/or parent permission

NCT03957980 *(Continued)*

	• home address must be in either Ohio, Kentucky, West Virginia, or Indiana (due to occupational therapy licensure laws and telehealth) • English speaking **Exclusion criteria:** • children who were not referred for an evaluation for cortical visual impairment • children not living in Ohio, Kentucky, Indiana, or West Virginia • children who are already receiving more than 1 therapy session related to vision a week
Interventions	**Intervention:** occupational therapy via telehealth for 12 weeks, then cross-over to receiving no intervention for 12 weeks **Comparison intervention:** no intervention in the first 12 weeks, then cross-over to receiving occupational therapy via telehealth for 12 weeks
Outcomes	**Primary outcome(s)**: functional vision **Secondary outcome(s):** individualized and function goals **Other outcome(s):** caregiver and therapist telehealth qualitative data; caregiver and therapist intervention questionnaire **Maximum follow-up:** 12 months
Starting date	May 2017 **Estimated study completion:** November 2018
Contact information	clinicaltrials.gov/ct2/show/NCT03957980
Notes	

van der Aa 2017

Trial name or title	Economic evaluation of an e-mental health intervention for patients with retinal exudative diseases who receive intraocular anti-VEGF injections (E-PsEYE)
Methods	Randomized parallel-group trial
Participants	**Inclusion criteria:** • 50 years or older • diagnosed with a retinal exudative disease (i.e. macular degeneration, diabetic retinopathy, and/or macula edema caused by retinal vein occlusion) • treated with anti-VEGF injections • at least mild symptoms of depression or anxiety, or both: a score of 5 or higher on the Patient Health Questionnaire-9 and/or a score of 3 or higher on the Hospital Anxiety and Depression Scale-Anxiety • able to speak the Dutch language adequately • have access to the Internet **Exclusion criteria:** • cognitively impaired, which is assessed by telephone with a score < 3 on the 6-item Mini-Mental State Examination • have a score of 20 or higher on the Patient Health Questionnaire-9, indicating severe symptoms of depression, because the E-PsEYE intervention would then not be suitable

van der Aa 2017 *(Continued)*	• indicated to be suicidal (i.e. patients respond positively on the Patient Health Questionnaire-9 suicide item) • heavy drinkers (score of 8 or higher on the Alcohol Use Disorders Identification Test)
Interventions	**Intervention:** E-PsEYE, which is a patient-centered, cognitive behavioral therapy-based e-mental health intervention, offered via the Internet with digital and telephone guidance of a social worker **Comparison intervention:** usual care
Outcomes	**Primary outcome(s):** symptoms of depression and anxiety; health-related quality of life **Secondary outcome(s):** adaptation to vision loss; illness cognitions (related to helplessness, acceptation and disease benefits); vision-related quality of life; mastery; cognitive therapy skills **Other outcome(s):** cost evaluation; process evaluation **Maximum follow-up:** 12 months
Starting date	June 2017 **Estimated study completion:** not reported
Contact information	apps.who.int/trialsearch/Trial2.aspx?TrialID=NTR6337
Notes	

anti-VEGF: anti-vascular endothelial growth factor

APPENDICES

Appendix 1. CENTRAL search strategy

#1 MeSH descriptor: [Vision, Low] explode all trees
#2 MeSH descriptor: [Vision Disorders] explode all trees
#3 MeSH descriptor: [Visually Impaired Persons] explode all trees
#4 ((low* or handicap* or subnormal* or impair* or partial* or disab* or reduce* or diminish* or decrease*) near/3 (vision or visual* or sight*))
#5 ((Vision or visual) near/2 loss)
#6 #1 or #2 or #3 or #4 or #5
#7 MeSH descriptor: [Telecommunications] this term only
#8 MeSH descriptor: [Telemedicine] explode all trees
#9 MeSH descriptor: [Telemetry] explode all trees
#10 MeSH descriptor: [Videoconferencing] explode all trees
#11 MeSH descriptor: [Wireless Technology] explode all trees
#12 MeSH descriptor: [Computer Communication Networks] explode all trees
#13 MeSH descriptor: [Decision Making, Computer-Assisted] explode all trees
#14 MeSH descriptor: [Computer-Assisted Instruction] explode all trees
#15 MeSH descriptor: [Computers] explode all trees
#16 MeSH descriptor: [User-Computer Interface] explode all trees
#17 (Telecommunication* or telemed* or tele-med* or telemetry or telerehab* or tele-rehab* or Telehealth* or tele-health* or Teleconsult* or tele-consult* or Teleconference* or tele-conference* or tele-home* or telehome* or tele-coach or telecoach* or tele-care* or telecare* or tele-ophthalm* or teleophthalm* or tele-screen* or telescreen* or tele-therap* or teletherap* or tele-diagnosis or telediagnosis or tele-mentor* or telementor*)
#18 (eHealth or e-health or eMedicine or e-medicine or eRehab* or e-rehab*)
#19 (Mobile health or mHealth)
#20 (information technolog* or information communication technolog* or ICT)
#21 ((web* or internet* or virtual* or remote* or wireless* or mobile or video* or computer* or online or on-line) near/5 (rehab* or therap* or treatment or communication* or consult* or care or specialist* or monitor* or educat* or counsel* or train* or asses*))
#22 #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21

#23 #6 and #22 from 1980

Appendix 2. MEDLINE (Ovid) search strategy

1. exp vision, low/
2. exp vision disorders/
3. exp visually impaired persons/
4. ((low* or handicap* or subnormal* or impair* or partial* or disab* or reduce* or diminish* or decrease*) adj3 (vision or visual* or sight*)).tw.
5. ((Vision or visual) adj2 loss).tw.
6. or/1-5
7. Telecommunications/
8. exp telemedicine/
9. exp telemetry/
10. exp Videoconferencing/
11. exp Wireless Technology/
12. exp Computer Communication Networks/
13. exp Decision Making, Computer-Assisted/
14. exp Computer-Assisted Instruction/
15. exp computers/
16. exp User-Computer Interface/
17. (Telecommunication* or telemed* or tele-med* or telemetry or telerehab* or tele-rehab* or Telehealth* or tele-health* or Teleconsult* or tele-consult* or Teleconference* or tele-conference* or tele-home* or telehome* or tele-coach or telecoach* or tele-care* or telecare* or tele-ophthalm* or teleophthalm* or tele-screen* or telescreen* or tele-therap* or teletherap* or tele-diagnosis or telediagnosis or tele-mentor* or telementor*).tw.
18. (eHealth or e-health or eMedicine or e-medicine or eRehab* or e-rehab*).tw.
19. (Mobile health or mHealth).tw.
20. (information technolog* or information communication technolog* or ICT).tw.
21. ((web* or internet* or virtual* or remote* or wireless* or mobile or video* or computer* or online or on-line) adj5 (rehab* or therap* or treatment or communication* or consult* or care or specialist* or monitor* or educat* or counsel* or train* or asses*)).tw.
22. or/7-21
23. 6 and 22
24. limit 23 to yr="1980 -Current"

Appendix 3. Embase.com search strategy

#1 'visual impairment'/exp
#2 'low vision'/exp
#3 'visual disorder'/exp
#4 ((low* OR handicap* OR subnormal* OR impair* OR partial* OR disab* OR reduce* OR diminish* OR decrease*) NEAR/3 (vision OR visual* OR sight*)):ab,ti
#5 ((vision OR visual) NEAR/2 loss):ab,ti
#6 #1 OR #2 OR #3 OR #4 OR #5
#7 'telehealth'/exp
#8 'telemetry'/exp
#9 'telecommunication'/de
#10 'teleconference'/exp
#11 'mass communication'/de
#12 'internet'/exp
#13 'videoconferencing'/exp
#14 'webcast'/exp
#15 'wireless communication'/exp
#16 'computer network'/exp
#17 'decision support system'/exp
#18 'computer'/exp
#19 'computer interface'/exp
#20 'human computer interaction'/exp
#21 telecommunication*:ab,ti OR telemed*:ab,ti OR telemetry:ab,ti OR telerehab*:ab,ti OR telehealth*:ab,ti OR teleconsult*:ab,ti OR teleconference*:ab,ti OR telehome*:ab,ti OR telecoach*:ab,ti OR telecare*:ab,ti OR teleophthalm*:ab,ti OR telescreen*:ab,ti OR teletherap*:ab,ti OR telediagnosis:ab,ti OR telementor*:ab,ti
#22 (tele NEXT/1 (med* OR rehab* OR health* OR consult* OR conference* OR home* OR coach* OR care* OR ophthalm* OR screen* OR therap* OR diagnosis OR mentor*)):ab,ti
#23 ehealth:ab,ti OR 'e health':ab,ti OR emedicine:ab,ti OR 'e medicine':ab,ti

#24 (e NEXT/1 rehab*):ab,ti
#25 'mobile health':ab,ti OR mhealth:ab,ti
#26 'information technology':ab,ti OR 'information technologies':ab,ti OR 'information communication technology':ab,ti OR 'information communication technologies':ab,ti OR ict:ab,ti
#27 ((web* OR internet* OR virtual* OR remote* OR wireless* OR mobile OR video* OR computer* OR online OR 'on line') NEAR/5 (rehab* OR therap* OR treatment OR communication* OR consult* OR care OR specialist* OR monitor* OR educat* OR counsel* OR train* OR asses*)):ab,ti
#28 #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27
#29 #6 AND #28
#30 #6 AND #28 AND [1980-2015]/py

Appendix 4. PubMed search strategy

#1 ((low*[tiab] OR handicap*[tiab] OR subnormal*[tiab] OR impair*[tiab] OR partial*[tiab] OR disab*[tiab] OR reduce*[tiab] OR diminish*[tiab] OR decrease*[tiab]) AND (vision[tiab] OR visual*[tiab] OR sight*[tiab])) NOT Medline[sb]
#2 ((Vision[tiab] OR visual[tiab]) AND loss[tiab]) NOT Medline[sb]
#3 #1 OR #2
#4 (Telecommunication*[tiab] OR telemed*[tiab] OR tele-med*[tiab] OR telemetry[tiab] OR telerehab*[tiab] OR tele-rehab*[tiab] OR Telehealth*[tiab] OR tele-health*[tiab] OR Teleconsult*[tiab] OR tele-consult*[tiab] OR Teleconference*[tiab] OR tele-conference*[tiab] OR tele-home*[tiab] OR telehome*[tiab] OR tele-coach[tiab] OR telecoach*[tiab] OR tele-care*[tiab] OR telecare*[tiab] OR tele-ophthalm*[tiab] OR teleophthalm*[tiab] OR tele-screen*[tiab] OR telescreen*[tiab] OR tele-therap*[tiab] OR teletherap*[tiab] OR tele-diagnosis[tiab] OR telediagnosis[tiab] OR tele-mentor*[tiab] OR telementor*[tiab]) NOT Medline[sb]
#5 (eHealth[tiab] OR e-health[tiab] OR eMedicine[tiab] OR e-medicine[tiab] OR eRehab*[tiab] OR e-rehab*[tiab]) NOT Medline[sb]
#6 (Mobile health[tiab] OR mHealth[tiab]) NOT Medline[sb]
#7 (information technolog*[tiab] OR information communication technolog*[tiab] OR ICT[tiab]) NOT Medline[sb]
#8 ((web*[tiab] OR internet*[tiab] OR virtual*[tiab] OR remote*[tiab] OR wireless*[tiab] OR mobile[tiab] OR video*[tiab] OR computer*[tiab] OR online[tiab] OR on-line[tiab]) AND (rehab*[tiab] OR therap*[tiab] OR treatment[tiab] OR communication*[tiab] OR consult*[tiab] OR care[tiab] OR specialist*[tiab] OR monitor*[tiab] OR educat*[tiab] OR counsel*[tiab] OR train*[tiab] OR asses*[tiab])) NOT Medline[sb]
#9 #4 OR #5 OR #6 OR #7 OR #8
#10 #3 AND #9

Appendix 5. ClinicalTrials.gov search strategy

low vision AND (telemedicine OR internet OR website OR remote)

Appendix 6. WHO ICTRP search strategy

vision AND telemedicine OR vision AND internet OR vision AND website OR vision AND remote

WHAT'S NEW

Date	Event	Description
21 November 2019	New search has been performed	Electronic searches updated.
21 November 2019	New citation required but conclusions have not changed	Two ongoing studies identified; no eligible completed studies included.

CONTRIBUTIONS OF AUTHORS

Conceived the review: AKB, PDY, TL
Designed the review: AKB, TL
Co-ordinated the review: AKB, TL
Screened search results: AKB, SLW, PDY, TL
Organized retrieval of papers: AKB, SLW, PDY, TL
Screened retrieved papers against the inclusion criteria: AKB, SLW, PDY, TL
Wrote the review: AKB, SLW, PDY, TL
Performed previous work that was the foundation of the current study: AKB, TL

Guarantor of the review: AKB

DECLARATIONS OF INTEREST

One reason for conducting this systematic review was to establish the knowledge base for designing a randomized controlled trial to evaluate the efficacy of telerehabilitation for a primarily elderly, visually impaired population. Along with this systematic review, Dr Tianjing Li has received funding to collect pilot data to demonstrate the feasibility of using telerehabilitation as a platform for delivering low-vision rehabilitation services. The systematic review and the pilot data collected will lay the foundation for preparing a randomized controlled trial application.

AKB, PDY and SLW have no conflicts of interest to declare.

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  The views expressed in this publication are those of the authors and not necessarily those of the NIHR, NHS, or the Department of Health.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

We did not follow all methods set forth in the protocol for the review as there were no included studies and thus no meta-analysis. We revised methods for future updates of this review to include, when possible, GRADE assessment and a 'Summary of findings' table.