IL NUOVO CIMENTO **46 C** (2023) 163
DOI 10.1393/ncc/i2023-23163-1

COMMUNICATIONS: SIF Congress 2022

Teleoptometry: State of the art and future perspectives

L. BOCCARDO(1)(3), P. A. GRASSO(1)(2) and M. GURIOLI(1)(2)

(1) *Università di Firenze, Corso di Laurea in Ottica e Optometria - Firenze, Italy*
(2) *Dipartimento di Fisica e Astronomia, Università di Firenze - Via G. Sansone 1, 50019 Sesto Fiorentino, Italy*
(3) *IRSOO Istituto Ricerca e Studi in Ottica e Optometria - Piazza della Libertà 18, 50059 Vinci, Italy*

received 1 February 2023

Summary. — Teleoptometry is a branch of telehealth that makes it possible to provide optometric assistance even when the operator and patient cannot meet in person. It became dramatically popular throughout the Covid-19 pandemic. In the last years, several online platforms have been proposed, expanding what optometrists can do remotely. Important areas of future developing of teleoptometry are capture and archive images to be shared with other eye care practitioners for further reference and follow-up via virtual meetings or dedicated apps. Teleoptometry is likely to continue to expand its role not only for the management of ocular diseases in rural areas, but also for comprehensive eye examinations. We feel that teleoptometry can be a valuable support of customary in-person services, still we definitely expect that it cannot replace them.

1. – Introduction

Telehealth is "the use of electronic information and telecommunication technologies to support and promote long-distance clinical health care, patient and professional health-related education, public health and health administration" [1]. The World Health Organization defines eHealth as "the use of information and communication technologies (ICT) for health" [2].

Teleoptometry is a branch of telehealth that deals with visual quality and permits to provide optometric assistance at distance. By exploiting digital technologies and internet networks, teleoptometry allows lowering the barriers to access assistance, making it possible to provide timely and adequate interventions. This is particularly relevant during emergency conditions such as the Covid-19 pandemic.

Teleoptometry includes the development of techniques exploiting advanced digital technology, such as monitoring via smartphone applications, assessments via video consultations, or the use of validated online psychometric questionnaires [3].

Teleoptometry has a great potential as it allows clinicians to provide advice and remote treatment for non-emergency conditions, while also identifying those conditions needing urgent in-person examination.

The first scientific interest in the field of teleoptometry dates back to the beginning of the new millennium [4, 5] but in recent years we are assisting to a steep growth of

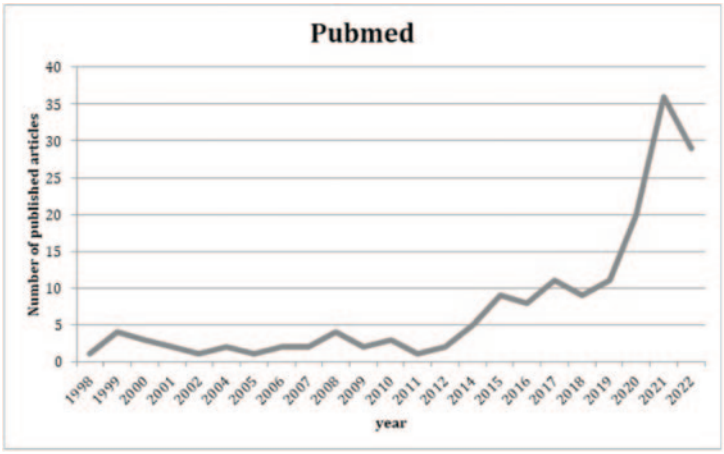

Fig. 1. – Publication trend in the field of teleoptometry spanning from 1998 to 2022. Raw data resulting from the following search query: ((telehealth) AND (optometry)) OR (teleoptometry) OR (tele-optometry).

interest in teleoptometry applications in a large variety of scenarios, even if the efficiency of remote eye exams is still debated [6].

Within this context, our paper aims to analyse the literature concerning teleoptometry to determine the areas of greatest applicability and highlight its advantages and limitations.

2. – Methods

A literature review was conducted on Pubmed and Google Scholar databases. "Teleoptometry" or "telehealth" and "optometry" were used as keywords for the search engine. The titles and abstracts of all the resulting papers were evaluated for statistical analysis, while only a subset of topics was selected to be discussed in the present review.

3. – Results

A total of 146 articles emerged from the PubMed search. The plot in fig. 1 clearly depicts a growth of publications from 2010 with a peak in the last two years when the Covid-19 pandemic emerged. Seven of these articles are reviews or systematic reviews.

The search on Google Scholar identified 51 articles with "teleoptometry" as a keyword, and over 2700 with "telehealth" and "optometry" as keywords.

4. – Discussion

The literature reveals that optometrists are often involved in ophthalmology-led telehealth collaborations [7]. Furthermore, several studies reported that optometrists independently deliver primary eye care via telehealth and that teleoptometry can be effectively used to triage, as well as to provide follow-up care for specific eye conditions [8]. Teleoptometry research reaches around 25% of the broader field of remote eye care. Importantly, eye care delivered by telehealth is generally well accepted by most of the patients [9].

4˙1. *Teleoptometry and psychometric questionnaires.* – It is well known that psychometric questionnaires are very useful in optometric practice as they allow measuring subjective symptomatology, which can help optometrists to better understand the patient's quality of life. Online administration of psychometric questionnaires is simple and effective, therefore it represents a valid method of carrying out remote surveys on various aspects of the optometric practice, such as quality of vision, dry eye, or contact lens discomfort.

4˙2. *Teleoptometry and visual acuity testing.* – The possibility to measure visual acuity and refractive error by means of handheld electronic devices is growing rapidly, and several researches have reported good evidence for unassisted visual acuity testing and subjective refraction [10-13].

Many web-based visual acuity tests have been developed in the last few years, although their use is still limited by technical aspects mainly related to the calibration and the resolution of the screen on which the test is performed. Furthermore, most web-based tests are validated to be used by professionals and not for self-assessment at home [3].

Vision assessment is an area of eHealth that may have particularly benefited from advancements in technology, including screens of larger sizes and higher resolutions, more processing power and lower hardware costs. Numerous tools for vision assessment have been already developed but it has become difficult for clinicians and the public to determine their effectiveness [14].

4˙3. *Teleoptometry and contact lenses.* – Contact lens care is another area which can widely benefit from telehealth applications. Several topics, such as providing instructions, reassurances and reminders for periodical contact lenses replacements, can be efficiently provided online to improve the patient's compliance. In fact, various lens replacement reminder apps for patients and web-based tools to support practitioner prescribing already exist, still the feasibility of lens fitting apps is limited by difficulties in visualising lenses, particularly the soft ones [3]. Compliance could be enhanced by sending information and/or lens replacement reminders via WhatsApp, providing written or verbal information (*e.g.*, videos or patient information sheets) or making patients aware of lens care smartphone apps.

4˙4. *Teleoptometry and patient satisfaction and acceptance.* – In order to increase the diffusion of teleoptometry and expand its use in daily practice, it is necessary to achieve general satisfaction and acceptance. Despite the initial concerns about the feasibility of adequate diagnosis and treatment through virtual exams, the majority of patients have reported positive impressions and felt satisfied with the examination performed and the assistance received [9]. The main exception is for people in the elderly, who usually experience difficulties with teleoptometry either due to inexperience with technologies or due to disabilities in hearing or communication, thus making this practice much more difficult to be applied and not very fruitful. Although some elderly subjects appear to be willing and able to learn about teleoptometry, for many subjects an in-person visit will always be necessary [15].

4˙5. *Teleoptometry and privacy.* – The patients' privacy is one of the major limiting factors for the development and use of teleoptometry. Poor management in the collection, use and sharing of personal data can adversely affect the level of trust and willingness of both professionals and patients to use teleoptometry systems. Upgrading the regulations

related to the management of sensitive personal data is therefore necessary to guarantee the patients' privacy.

5. – Conclusions

Feasibility of remote eye exams is still debated. "Proponents say remote vision testing reminds the public of the importance of good vision and expands access to screenings. Detractors worry they diminish the value of in-person eye exams and the importance of eye health." [6].

It is likely that after the Covid-19 emergency, teleoptometry will expand its role not only for the management of ocular diseases in rural areas, but also for comprehensive eye examinations. Following the report of Patel *et al.*, [9] it turns out that patients' initial experiences were positive or comparable to those of in-person gold standard comprehensive eye examination. Certainly, several telehealth techniques can be implemented in daily practice to make in-person exams more efficient: an initial telephone interview to outline the patient's condition with a detailed triage as well as the use of online questionnaires to evaluate subjective aspects such as discomfort, impact on the quality of life and vision. Other important areas of future developing of teleoptometry are capturing and storing images to be shared with other eye care practitioners for further reference and follow-up via virtual meetings or dedicated apps. Nevertheless, although we feel that teleoptometry can be a valuable support of customary in-person services, we definitely expect that it cannot replace them, mainly due to the essential role of empathy and understanding experienced in face-to-face examinations.

REFERENCES

[1] Health Resources and Services Administration, `https://tinyurl.com/2yd4uju4`.
[2] World Health Organization *et al.*, `https://tinyurl.com/ncnn7jkp`.
[3] Nagra M., Vianya-Estopa M. and Wolffsohn J. S., *Contact Lens Anterior Eye*, **43** (2020) 204.
[4] Smythe J. L., `https://tinyurl.com/2um5ysdr`.
[5] Smythe J., Yolton R. L., LeRoy A., Achong R., Caroline P., Van Nurden M. and Yolton D., *Optometry*, **72** (2001) 13.
[6] Conlin L., `https://tinyurl.com/h8yuvp3z`.
[7] Massie J., Block S. S. and Morjaria P., *Telemed. J. E-Health*, **28** (2022) 1753.
[8] Pidgeon J. H., Bhardwaj M. K., Titterington P., Latulippe K., Roh S. and Ramsey D. J., *Ther. Adv. Ophthalmol.*, **29** (2015) 888.
[9] Patel J., Morettin C., McLeod H., Wyles E., Sanghera N., Kattouf V., Randhawa H., Chaglasian M. and Messner L., *Investig. Ophthalmol. Vis. Sci.*, **61** (2020) 1596.
[10] Bastawrous A., Rono H., Livingstone I. A. T., Helen A., Jordan S., Kuper H. and Burton M. J., *JAMA Ophthalmol.*, **133** (2015) 930.
[11] Han X., Scheetz J., Keel S., Liao C., Liu C., Jiang Y., Müller, A., Meng W. and He M., *Transl. Vis. Sci. Technol.*, **8** (2019) 22.
[12] Perera C., Chakrabarti R., Islam F. M. A. and Crowston J., *Eye*, **29** (2015) 888.
[13] Tofigh S., Shortridge E., Elkeeb A. and Godley B. F., *Eye (London)*, **29** (2015) 1464.
[14] Yeung W. K., Dawes P., Pye A., Neil M., Aslam T., Dickinson C. and Leroi I., *npj Digit. Med.*, **2** (2019) 1.
[15] Lam K., Lu A. D., Shi Y. and Covinsky K. E., *JAMA Int. Med.*, **180** (2020) 1389.