

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Advances in Teleophthalmology: Summarising Published Papers on Teleophthalmology Projects

Kambiz Bahaadinbeigy and Kanagasingam Yogesan
*Australian e-Health Research Centre – CSIRO,
Australia*

1. Introduction

Teleophthalmology is a branch of telemedicine that delivers eye care through digital medical equipment and telecommunications technology.¹ It does this through either a store and forward method or real-time communication, and so enables doctors to attend to patients in remote areas.²¹ It has been of increasing interest to researchers in the field of telemedicine over the last decade. This may have been due to the significance and prevalence of eye diseases, as well as a lack of specialists interested in working in remote areas.

A simple search for teleophthalmological research via the Medline database yielded hundreds of results with varying aims and objectives. There had been a significant increase in the research over the past decade, and this made summarising the papers challenging.

Although the studies possessed diverse aims and objectives, most focused on a particular eye problem, such as DR, glaucoma, adnexal disease etc. For instance, some of the projects questioned the feasibility of a particular type of teleophthalmological system for the screening of DR. Others concentrated on issues of cost and patient satisfaction. Whatever their main aims, each article took one or more eye diseases as its central theme.

The question of what eye problems had been of interest to date is important. Regardless of design or conclusions, each paper was proof of the field's increasing relevance. But what were the strengths and weaknesses of the teleophthalmological publications in terms of focusing on different type of eye problems? In other words, having considered the wide variety of eye disease which can be consulted through a telemedicine system, which area have been more of interest for researchers?

There were also other important questions. For example, the type of telemedicine used in teleophthalmological projects (pre-recorded or real-time) would have been of interest to eye care specialists.

Finally, the general conclusions made by the studies were also very significant. Were they positive, thus encouraging others to pursue the study, research and development of teleophthalmology?

This short report discusses the findings of a systematic literature review of published papers that have documented teleophthalmological projects and been indexed by major bibliographic databases. It will also attempt to classify them in order to answer the following questions:

1. What types of eye problems have been focused on?

2. Which type of telemedicine has been used, store and forward or real-time?
3. What proportion of papers has been conducted using a control group?
4. Are the papers' conclusions positive or negative?

2. Method

A comprehensive literature review was conducted.

2.1 Databases

Three bibliographic databases were searched: Medline, EMBASE and CINAHL. Medline was searched via Pubmed, while CINAHL (Ebsco) and EMBASE (Ovid) were searched through the library of University of Western Australia.

2.2 Dates

All published papers through the end of 2009.

2.3 Keywords

The databases were searched for the following keywords: telemedicine, e-health, telehealth, telemetry, tele ophthalmology, teleophthalmology, teleretiology, telediagnosis, teleconsultation, telemonitoring, tele screening, web-based, internet, remote or virtual. These keywords had to occur in conjunction with one of the following: ophthalmology, teleophthalmology, tele ophthalmology, eye, eye care, retina, retinal or tele ophthalmology. All three databases were asked to show only papers that had abstracts and were in English. A very broad range of keywords was chosen in order to ensure all relevant papers would be included.

2.4 Criteria for inclusion

Papers had to be about remote eye care delivered via digital devices or telecommunication technology, and had to be published in peer-reviewed journals. They also had to be in English and contain an abstract.

2.5 Criteria for exclusion

The first criterion for exclusion was that the material was presented in the format of a letter, editorial or review. The second criterion was that the paper was not about an actual teleophthalmological project. For example, articles that evaluated the potential of digital photo diagnosis for use in future teleophthalmological services were left out. Studies about research conducted on computerised models or on non-human models such as animal eyes (criterion three), were also eliminated from the review. Finally, double publications, i.e. a single project reported in two different formats (criterion four), were disqualified from this review.

2.6 Selection of papers

Papers retrieved from all three databases were entered in Endnote Reference Manager XI, and duplicates were removed. In total, 2,095 titles were retrieved. All papers were then reviewed and assessed for relevance to the topic at hand. In the second phase of the research, the abstracts of all shortlisted papers were analysed, with the full texts being evaluated when necessary. Paper selection steps are summarised in Table 1 below.

There were significant disparities between the selected papers in terms of their methodology and aims. They assessed the economy, feasibility, reliability and patient satisfaction of teleophthalmological projects on the screening or diagnosis of eye problems. Since the paper’s main aim was to discover what types of eye problems had been explored thus far, this heterogeneity was ignored.

All shortlisted papers were read, and for each paper, a simple questionnaire was filled out. The options for each question were based on the abstracts of the papers.

Question 1: Type of Eye Problem	Diabetic Retinopathy (DR)	<input type="checkbox"/>
	Premature Retinopathy (ROP)	<input type="checkbox"/>
	Glaucoma	<input type="checkbox"/>
	Strabismus	<input type="checkbox"/>
	General	<input type="checkbox"/>
	Other	<input type="checkbox"/>
Question 2: Type of Telemedicine	Store and Forward	<input type="checkbox"/>
	Real-Time	<input type="checkbox"/>
	Both	<input type="checkbox"/>
Question 3: Study Design	With Control Group	<input type="checkbox"/>
	Without Control Group	<input type="checkbox"/>
Question 4: Paper’s Final Conclusion	Positive	<input type="checkbox"/>
	Negative	<input type="checkbox"/>
	Unclear	<input type="checkbox"/>

Table 1. Questionnaire for the Classification of Papers

Number of papers retrieved from Medline	1573
Number of papers retrieved from CINAHL	169
Number of papers retrieved from EMBASE	1133
Final number of original papers	2095
Number of abstracts selected for further exploration after reading	351
Number of papers selected for in-depth reading	168
Number of papers excluded due to Criterion 1 (The paper was presented in the format of a letter, editorial or review)	183
Number of papers excluded due to Criterion 2a (The paper did not conduct an actual teleophthalmological project)	59
Number of papers excluded due to Criterion 2b (The paper conducted a teleophthalmological project using a computerised model)	11
Number of papers excluded due to Criterion 3 (The paper conducted a teleophthalmological project using a non-human model)	1
Number of papers excluded due to Criterion 4 (The teleophthalmological project was covered in more than one publication)	4
Final number of papers selected for the study	107

Table 2. Paper Selection Process

3. Results

3.1 Subspecialty

As Table 3 shows, 37 per cent of the research focused solely on DR and one or two other diseases. Twenty-three per cent concentrated on general ophthalmology (without a focus on a particular eye problem), fifteen per cent on ROP and ten per cent on glaucoma. In addition, two per cent focused on Strabismus.

Disease focused on in each paper	Number of papers(reference number)	Percentage
Diabetic Retinopathy	37(3-39)	34.58
General ophthalmology*	25(40-64)	23.36
(Retinopathy of Prematurity)ROP	16(65-80)	14.95
Glaucoma	11(81-91)	10.28
Strabismus	4(92-95)	3.74
Adnexal and Orbital disease	4(96-99)	3.74
DR and DME	2(100-101)	1.87
DR and AMD	1(102)	0.93
(Acute Macular Degenration) AMD	1(103)	0.93
DME	1(104)	0.93
SDME	1(105)	0.93
HTN (Hypertensive Retinopathy)	1(106)	0.93
Post-operative care	1(107)	0.93
Suspicion of abusive head trauma	1(108)	0.93
Retinoblastoma	1(109)	0.93
TOTAL	107	100

Table 3. Particular disease which each paper had focused on.

More than 37 per cent of all published projects on teleophthalmology studied only DR, while an additional three per cent also targeted macular degeneration.^{100, 101, 102} These studies evaluated either the feasibility of DR screening or diagnosis.

Twenty-five per cent of all papers were on general eye problems. This category covered projects that had been conducted in general practice clinics or that had not addressed any specific eye problem. These projects were merely targeted at confirming whether teleophthalmology had the potential to assist general practitioners in the treatment of patients with eye problems. Some of these projects focused on cost, patient satisfaction and other issues, rather than discussing a particular disease.

At sixteen per cent, ROP was the third main reason for the execution of teleophthalmological projects. The majority of papers on this eye disease aimed to evaluate the utility of teleophthalmology in its screening and diagnosis.

3.2 Type of telemedicine

Eighty-eight papers (83.02 per cent) focused on store and forward projects, eight (7.55 per cent) on real-time projects, and ten (9.43 per cent) used a mixed system.

3.3 Study design

Only two papers possessed a Randomised Controlled Trial (RCT) design,^{61, 98} and only four had used a control group.

3.4 Final conclusions of papers

Ninety-eight papers had a positive view of teleophthalmology. However, five papers did not arrive at a clear conclusion and four expressed a negative view towards teleophthalmology.^{5, 91, 98, 104}

4. Discussion

This chapter has attempted to locate all the teleophthalmological projects that have been published in peer-reviewed journals and indexed by the three popular bibliographic databases for biomedical research, Medline, EMBASE and CINAHL. It demonstrates that:

There is strong evidence that teleophthalmology is suitable for the treatment of retinal diseases, particularly DR and ROP;

Teleophthalmology has been successful when provided via the store and forward method;

Although the majority of studies to date have concluded on a positive note, only a few of these conclusions were based on high quality study designs involving controlled or randomised controlled trials.

The results show that most teleophthalmology projects to date have been focused on the treatment of DR. The health complications caused by diabetes and the importance of DR screening are likely major factors in the evaluation of teleophthalmology.¹¹⁰

However, other eye problems also require more attention. These include strabismus, cataracts and infectious diseases. Trachoma, for example, is a highly prevalent condition in developing countries.

Although the papers in the 'general eye problems' category were very diverse, it appears that the use of teleophthalmology to deliver eye care service to general practice clinics and optometrists has also been reasonably successful.

Teleophthalmology is still largely considered a store and forward application; this can be seen from the fact that less than seven per cent of the papers examined a real-time project. This might be explained by the requirement for high bandwidth. A considerable number of publications indicate that while store and forward teleophthalmology is both feasible and reliable, further evidence of the feasibility and reliability of real-time teleophthalmology is needed.

Approximately 90 per cent of the papers held positive views on teleophthalmology. However, ten per cent took a sceptical or negative view. This favourable statistic shows that teleophthalmology is a reliable method of eye care delivery. It was not possible to compare the feasibility and reliability of teleophthalmology across different subspecialties. Nevertheless, it is important to take into account the significant lack of papers using RCTs or comparable groups. This fact reveals that our evidence is undeniably inadequate and that we are not yet able to draw an informed conclusion.

5. References

- [1] Yogesana K, Kumar S, Goldschmid & Cuadros L, .(2006). *Teleophthalmology*. Springer

- [2] Ngoh LH, Zhao Z, Yao H, Wei Z, Wu Y, Deng RH & Yu S. TeleOph: a secure real-time teleophthalmology system. *IEEE Trans Inf Technol Biomed.* 2010 Sep;14(5):1259-66. Epub 2010 Jul 26.
- [3] Ng M, Nathoo N, Rudnisky CJ, Tennant MT. Improving access to eye care: teleophthalmology in alberta, Canada. *J Diabetes Sci Technol.* 2009 Mar 1;3(2):289-96.
- [4] Liesenfeld B, Kohner E, Piehlmeier W, Kluthe S, Aldington S, Porta M, et al. A telemedical approach to the screening of diabetic retinopathy: digital fundus photography. *Diabetes Care.* 2000;23(3):345-8.
- [5] Evaluation of digital fundus images as a diagnostic method for surveillance of diabetic retinopathy. *Military Medicine.* 2007;172(4):405-10.
- [6] Luzio S, Hatcher S, Zahlmann G, Mazik L, Morgan M, Liensenfeld B, et al. Feasibility of using the TOSCA telescreening procedures for diabetic retinopathy. *Diabetic Medicine.* 2004;21(10):1121-8.
- [7] Taylor CR, Merin LM, Salunga AM, Hepworth JT, Crutcher TD, O'Day DM, et al. Improving diabetic retinopathy screening ratios using telemedicine-based digital retinal imaging technology: the Vine Hill Study. *Diabetes Care.* 2007;30(3):574-8.
- [8] Conlin PR, Fisch BM, Cavallerano AA, Cavallerano JD, Bursell S, Aiello LM. Nonmydriatic teleretinal imaging improves adherence to annual eye examinations in patients with diabetes. *Journal of Rehabilitation Research & Development.* 2006;43(6):733-9.
- [9] Schneider S, Aldington SJ, Kohner EM, Luzio S, Owens DR, Schmidt V, et al. Quality assurance for diabetic retinopathy telescreening. *Diabetic Medicine.* 2005;22(6):794-802.
- [10] Cummings DM, Morrissey S, Barondes MJ, Rogers L, Gustke S. Screening for diabetic retinopathy in rural areas: the potential of telemedicine. *Journal of Rural Health.* 2001 Winter;17(1):25-31.
- [11] Rotvold G, Knarvik U, Johansen MA, Fossen K. Telemedicine screening for diabetic retinopathy: staff and patient satisfaction. *Journal of Telemedicine & Telecare.* 2003;9(2):109-13.
- [12] Stillman JK, Gole GA, Wootton R, Woolfield N, Price D, Williams M, et al. Telepaediatrics and diabetic retinopathy screening of young people with diabetes in Queensland. *Journal of Telemedicine & Telecare.* 2004;10:S1:92-4.
- [13] Gomez-Ulla F, Alonso F, Aibar B, Gonzalez F. A comparative cost analysis of digital fundus imaging and direct fundus examination for assessment of diabetic retinopathy. *Telemed J E Health.* 2008 Nov;14(9):912-8.
- [14] Boucher MC, Desroches G, Garcia-Salinas R, Kherani A, Maberley D, Olivier S, et al. Teleophthalmology screening for diabetic retinopathy through mobile imaging units within Canada. *Can J Ophthalmol.* 2008 Dec;43(6):658-68.
- [15] Massin P, Chabouis A, Erginay A, Viens-Bitker C, Lecleire-Collet A, Meas T, et al. OPHDIAT: a telemedical network screening system for diabetic retinopathy in the Ile-de-France. *Diabetes Metab.* 2008 Jun;34(3):227-34.
- [16] Fonda SJ, Bursell SE, Lewis DG, Garren J, Hock K, Cavallerano J. The relationship of a diabetes telehealth eye care program to standard eye care and change in diabetes health outcomes. *Telemed J E Health.* 2007 Dec;13(6):635-44.
- [17] Raman R, Rani PK, Mahajan S, Paul P, Gnanamoorthy P, Krishna MS, et al. The tele-screening model for diabetic retinopathy: evaluating the influence of mydriasis on

- the gradability of a single-field 45 degrees digital fundus image. *Telemed J E Health*. 2007 Oct;13(5):597-602.
- [18] Zimmer-Galler I, Zeimer R. Results of implementation of the DigiScope for diabetic retinopathy assessment in the primary care environment. *Telemed J E Health*. 2006 Apr;12(2):89-98.
- [19] Wei JC, Valentino DJ, Bell DS, Baker RS. A Web-based telemedicine system for diabetic retinopathy screening using digital fundus photography. *Telemed J E Health*. 2006 Feb;12(1):50-7.
- [20] Whited JD, Datta SK, Aiello LM, Aiello LP, Cavallerano JD, Conlin PR, et al. A modeled economic analysis of a digital tele-ophthalmology system as used by three federal health care agencies for detecting proliferative diabetic retinopathy. *Telemed J E Health*. 2005 Dec;11(6):641-51.
- [21] Boucher MC, Nguyen QT, Angioi K. Mass community screening for diabetic retinopathy using a nonmydriatic camera with telemedicine. *Can J Ophthalmol*. 2005 Dec;40(6):734-42.
- [22] Ruamviboonsuk P, Wongcumchang N, Surawongsin P, Panyawatananukul E, Tiensuwan M. Screening for diabetic retinopathy in rural area using single-field, digital fundus images. *J Med Assoc Thai*. 2005 Feb;88(2):176-80.
- [23] Massin P, Aubert JP, Eschwege E, Erginay A, Bourovitch JC, BenMehidi A, et al. Evaluation of a screening program for diabetic retinopathy in a primary care setting Dodia (Depistage ophtalmologique du diabete) study. *Diabetes Metab*. 2005 Apr;31(2):153-62.
- [24] Murray RB, Metcalf SM, Lewis PM, Mein JK, McAllister IL. Sustaining remote-area programs: retinal camera use by Aboriginal health workers and nurses in a Kimberley partnership. *Med J Aust*. 2005 May 16;182(10):520-3.
- [25] Jin AJ, Martin D, Maberley D, Dawson KG, Secombe DW, Beattie J. Evaluation of a mobile diabetes care telemedicine clinic serving Aboriginal communities in Northern British Columbia, Canada. *Int J Circumpolar Health*. 2004;63 Suppl 2:124-8.
- [26] Baker CF, Rudnisky CJ, Tennant MT, Sanghera P, Hinz BJ, De Leon AR, et al. JPEG compression of stereoscopic digital images for the diagnosis of diabetic retinopathy via teleophthalmology. *Can J Ophthalmol*. 2004 Dec;39(7):746-54.
- [27] Massin P, Aubert JP, Erginay A, Bourovitch JC, Benmehidi A, Audran G, et al. Screening for diabetic retinopathy: the first telemedical approach in a primary care setting in France. *Diabetes Metab*. 2004 Nov;30(5):451-7.
- [28] Choremis J, Chow DR. Use of telemedicine in screening for diabetic retinopathy. *Can J Ophthalmol*. 2003 Dec;38(7):575-9.
- [29] Kawasaki S, Ito S, Satoh S, Mori Y, Saito T, Fukushima H, et al. Use of telemedicine in periodic screening of diabetic retinopathy. *Telemed J E Health*. 2003 Fall;9(3):235-9.
- [30] Gomez-Ulla F, Fernandez MI, Gonzalez F, Rey P, Rodriguez M, Rodriguez-Cid MJ, et al. Digital retinal images and teleophthalmology for detecting and grading diabetic retinopathy. *Diabetes Care*. 2002 Aug;25(8):1384-9.
- [31] Zeimer R, Zou S, Meeder T, Quinn K, Vitale S. A fundus camera dedicated to the screening of diabetic retinopathy in the primary-care physician's office. *Invest Ophthalmol Vis Sci*. 2002 May;43(5):1581-7.

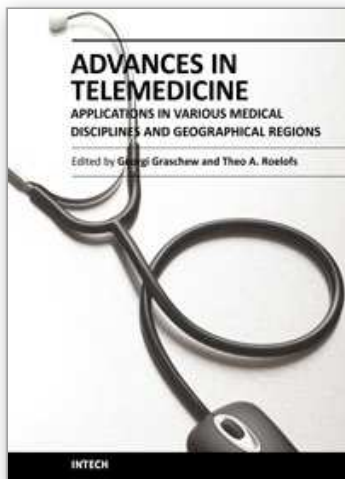
- [32] Bjorvig S, Johansen MA, Fossen K. An economic analysis of screening for diabetic retinopathy. *J Telemed Telecare*. 2002;8(1):32-5.
- [33] Shiba T, Yamamoto T, Seki U, Utsugi N, Fujita K, Sato Y, et al. Screening and follow-up of diabetic retinopathy using a new mosaic 9-field fundus photography system. *Diabetes Res Clin Pract*. 2002 Jan;55(1):49-59.
- [34] Tennant MT, Greve MD, Rudnisky CJ, Hillson TR, Hinz BJ. Identification of diabetic retinopathy by stereoscopic digital imaging via teleophthalmology: a comparison to slide film. *Can J Ophthalmol*. 2001 Jun;36(4):187-96.
- [35] Bursell SE, Cavallerano JD, Cavallerano AA, Clermont AC, Birkmire-Peters D, Aiello LP, et al. Stereo nonmydriatic digital-video color retinal imaging compared with Early Treatment Diabetic Retinopathy Study seven standard field 35-mm stereo color photos for determining level of diabetic retinopathy. *Ophthalmology*. 2001 Mar;108(3):572-85.
- [36] Lawrenson RA. Mobile retinal screening--a Waikato Area Health Board initiative. *N Z Health Hospital*. 1992 Jul-Aug;44(4):4, 6.
- [37] Rudnisky CJ, Tennant MTS, Weis E, Ting A, Hinz BJ, Greve MDJ. Web-Based Grading of Compressed Stereoscopic Digital Photography versus Standard Slide Film Photography for the Diagnosis of Diabetic Retinopathy. *Ophthalmology*. 2007 Sep;114(9):1748-54.
- [38] Abramoff MD, Suttrop-Schulten MSA. Web-based screening for diabetic retinopathy in a primary care population: The EyeCheck Project. *Telemedicine Journal and e-Health*. 2005 Dec;11(6):668-74.
- [39] Stumpf SH, Verma D, Zalunardo R, Aly T, Chen R, Labree L. Online continuous quality improvement for diabetic retinopathy tele-screening. *Telemedicine Journal and e-Health*. 2004;10(SUPPL. 2):S-35-S-9.
- [40] Bar-Sela SM, Glovinsky Y. A feasibility study of an Internet-based telemedicine system for consultation in an ophthalmic emergency room. *Journal of Telemedicine & Telecare*. 2007;13(3):119-24.
- [41] Kennedy C, Bowman R, Fariza N, Ackuaku E, Ntim-Amponsah C, Murdoch I. Audit of Web-based telemedicine in ophthalmology. *Journal of Telemedicine & Telecare*. 2006;12(2):88-91.
- [42] Chen L, Tsai C, Liu T, Tung T, Chiu Y, Chan C, et al. Feasibility of tele-ophthalmology for screening for eye disease in remote communities. *Journal of Telemedicine & Telecare*. 2004;10(6):337-41.
- [43] Kumar S, Tay-Kearney M, Chaves F, Constable IJ, Yogesan K. Remote ophthalmology services: cost comparison of telemedicine and alternative service delivery options. *Journal of Telemedicine & Telecare*. 2006;12(1):19-22.
- [44] Hanson C, Tennant MT, Rudnisky CJ. Optometric referrals to retina specialists: evaluation and triage via teleophthalmology. *Telemed J E Health*. 2008 Jun;14(5):441-5.
- [45] Bai VT, Murali V, Kim R, Srivatsa SK. Teleophthalmology-based rural eye care in India. *Telemed J E Health*. 2007 Jun;13(3):313-21.
- [46] Paul PG, Raman R, Rani PK, Deshmukh H, Sharma T. Patient satisfaction levels during teleophthalmology consultation in rural South India. *Telemed J E Health*. 2006 Oct;12(5):571-8.

- [47] Kumar S, Yogesan K, Hudson B, Tay-Kearney ML, Constable IJ. Emergency eye care in rural Australia: role of internet. *Eye (Lond)*. 2006 Dec;20(12):1342-4.
- [48] Taleb AC, Bohm GM, Avila M, Wen CL. The efficacy of telemedicine for ophthalmology triage by a general practitioner. *J Telemed Telecare*. 2005;11 Suppl 1:83-5.
- [49] Blomdahl S, Calissendorff B, Jacobsson U. Patient-focused urban tele-ophthalmology services. *J Telemed Telecare*. 2002;8 Suppl 2:43-4.
- [50] Gonzalez F, Iglesias R, Suarez A, Gomez-Ulla F, Perez R. Teleophthalmology link between a primary health care centre and a reference hospital. *Med Inform Internet Med*. 2001 Oct-Dec;26(4):251-63.
- [51] Yogesan K, Henderson C, Barry CJ, Constable IJ. Online eye care in prisons in Western Australia. *J Telemed Telecare*. 2001;7 Suppl 2:63-4.
- [52] Blomdahl S, Maren N, Lof R. Tele-ophthalmology for the treatment in primary care of disorders in the anterior part of the eye. *J Telemed Telecare*. 2001;7 Suppl 1:25-6.
- [53] Kennedy C, Van Heerden A, Cook C, Murdoch I. Utilization and practical aspects of tele-ophthalmology between South Africa and the UK. *J Telemed Telecare*. 2001;7 Suppl 1:20-2.
- [54] Lamminen H, Lamminen J, Ruohonen K, Uusitalo H. A cost study of teleconsultation for primary-care ophthalmology and dermatology. *J Telemed Telecare*. 2001;7(3):167-73.
- [55] Cook HL, Heacock GL, Stanford MR, Marshall J. Detection of retinal lesions after telemedicine transmission of digital images. *Eye (Lond)*. 2000 Aug;14 (Pt 4):563-71.
- [56] Lattimore MR, Jr. A store-forward ophthalmic telemedicine case report from deployed U. S. Army forces in Kuwait. *Telemed J*. 1999 Fall;5(3):309-13.
- [57] Lamminen H, Salminen L, Uusitalo H. Teleconsultations between general practitioners and ophthalmologists in Finland. *J Telemed Telecare*. 1999;5(2):118-21.
- [58] Marcus DM, Brooks SE, Ulrich LD, Bassi FH, Laird M, Johnson M, et al. Telemedicine diagnosis of eye disorders by direct ophthalmoscopy. A pilot study. *Ophthalmology*. 1998 Oct;105(10):1907-14.
- [59] Yogesan K, Constable IJ, Eikelboom RH, van Saarloos PP. Tele-ophthalmic screening using digital imaging devices. *Aust N Z J Ophthalmol*. 1998 May;26 Suppl 1:S9-11.
- [60] Rosengren D, Blackwell N, Kelly G, Lenton L, Glastonbury J. The use of telemedicine to treat ophthalmological emergencies in rural Australia. *J Telemed Telecare*. 1998;4 Suppl 1:97-9.
- [61] Shanit D, Lifshitz T, Giladi R, Peterburg Y. A pilot study of tele-ophthalmology outreach services to primary care. *J Telemed Telecare*. 1998;4 Suppl 1:1-2.
- [62] Blackwell NA, Kelly GJ, Lenton LM. Telemedicine ophthalmology consultation in remote Queensland. *Med J Aust*. 1997 Dec 1-15;167(11-12):583-6.
- [63] Bowman RJ, Kennedy C, Kirwan JF, Sze P, Murdoch IE. Reliability of telemedicine for diagnosing and managing eye problems in accident and emergency departments. *Eye*. 2003 Aug;17:743-6.
- [64] Taylor P, Kennedy C, Murdoch I, Johnston K, Cook C, Godoumov R. Assessment of benefit in tele-ophthalmology using a consensus panel. *J Telemed Telecare*. 2003;9:140-5.
- [65] Lorenz B, Elflein H. Preventing blindness in premature infants: a telemedical solution gains acceptance. *Neonatal Intensive Care*. 2002;15(6):42-9.

- [66] Lorenz B, Spasovska K, Elflein H, Schneider N. Wide-field digital imaging based telemedicine for screening for acute retinopathy of prematurity (ROP). Six-year results of a multicentre field study. *Graefes Arch Clin Exp Ophthalmol*. 2009 Sep;247(9):1251-62.
- [67] Richter GM, Sun G, Lee TC, Chan RV, Flynn JT, Starren J, et al. Speed of telemedicine vs ophthalmoscopy for retinopathy of prematurity diagnosis. *Am J Ophthalmol*. 2009 Jul;148(1):136-42 e2.
- [68] Silva RA, Murakami Y, Jain A, Gandhi J, Lad EM, Moshfeghi DM. Stanford University Network for Diagnosis of Retinopathy of Prematurity (SUNDRP): 18-month experience with telemedicine screening. *Graefes Arch Clin Exp Ophthalmol*. 2009 Jan;247(1):129-36.
- [69] Lajoie A, Koreen S, Wang L, Kane SA, Lee TC, Weissgold DJ, et al. Retinopathy of prematurity management using single-image vs multiple-image telemedicine examinations. *Am J Ophthalmol*. 2008 Aug;146(2):298-309.
- [70] Scott KE, Kim DY, Wang L, Kane SA, Coki O, Starren J, et al. Telemedical diagnosis of retinopathy of prematurity intraphysician agreement between ophthalmoscopic examination and image-based interpretation. *Ophthalmology*. 2008 Jul;115(7):1222-8 e3.
- [71] Skalet AH, Quinn GE, Ying GS, Gordillo L, Dodobara L, Cocker K, et al. Telemedicine screening for retinopathy of prematurity in developing countries using digital retinal images: a feasibility project. *J AAPOS*. 2008 Jun;12(3):252-8.
- [72] O'Keefe M, Kirwan C. Screening for retinopathy of prematurity. *Early Hum Dev*. 2008 Feb;84(2):89-94.
- [73] Chiang MF, Wang L, Busuioc M, Du YE, Chan P, Kane SA, et al. Telemedical retinopathy of prematurity diagnosis: accuracy, reliability, and image quality. *Arch Ophthalmol*. 2007 Nov;125(11):1531-8.
- [74] Balasubramanian M, Capone A, Jr., Hartnett ME, Pignatto S, Trese MT. The Photographic Screening for Retinopathy of Prematurity Study (Photo-ROP): study design and baseline characteristics of enrolled patients. *Retina*. 2006 Sep;26(7 Suppl):S4-10.
- [75] Chiang MF, Starren J, Du YE, Keenan JD, Schiff WM, Barile GR, et al. Remote image based retinopathy of prematurity diagnosis: a receiver operating characteristic analysis of accuracy. *Br J Ophthalmol*. 2006 Oct;90(10):1292-6.
- [76] Ells AL, Holmes JM, Astle WF, Williams G, Leske DA, Fielden M, et al. Telemedicine approach to screening for severe retinopathy of prematurity: a pilot study. *Ophthalmology*. 2003 Nov;110(11):2113-7.
- [77] Yen KG, Hess D, Burke B, Johnson RA, Feuer WJ, Flynn JT. The optimum time to employ telephotoscreening to detect retinopathy of prematurity. *Trans Am Ophthalmol Soc*. 2000;98:145-50; discussion 50-1.
- [78] Schwartz SD, Harrison SA, Ferrone PJ, Trese MT. Telemedical evaluation and management of retinopathy of prematurity using a fiberoptic digital fundus camera. *Ophthalmology*. 2000 Jan;107(1):25-8.
- [79] Yen KG, Hess D, Burke B, Johnson RA, Feuer WT, Flynn JT. Telephotoscreening to detect retinopathy of prematurity: Preliminary study of the optimum time to employ digital fundus camera imaging to detect ROP. *Journal of AAPOS*. 2002;6(2):64-70.

- [80] Murakami Y, Jain A, Silva RA, Lad EM, Gandhi J, Moshfeghi DM. Stanford University Network for Diagnosis of Retinopathy of Prematurity (SUNDRP): 12-month experience with telemedicine screening. *Br J Ophthalmol*. 2008 Nov;92:1456-60.
- [81] Lamminen H. Picture archiving and fundus imaging in a glaucoma clinic. *Journal of Telemedicine & Telecare*. 2003;9(2):114-6.
- [82] Labiris G, Fanariotis M, Christoulakis C, Petounis A, Kitsos G, Aspiotis M, et al. Teleophthalmology and conventional ophthalmology using a mobile medical unit in remote Greece. *Journal of Telemedicine & Telecare*. 2003;9(5):296-9.
- [83] Bergua A, Mardin CY, Horn FK. Tele-transmission of stereoscopic images of the optic nerve head in glaucoma via Internet. *Telemed J E Health*. 2009 Jun;15(5):439-44.
- [84] Pasquale LR, Asefzadeh B, Dunphy RW, Fisch BM, Conlin PR. Detection of glaucoma-like optic discs in a diabetes teleretinal program. *Optometry*. 2007 Dec;78(12):657-63.
- [85] de Mul M, de Bont AA, Reus NJ, Lemij HG, Berg M. Improving the quality of eye care with tele-ophthalmology: shared-care glaucoma screening. *J Telemed Telecare*. 2004;10(6):331-6.
- [86] Li HK, Tang RA, Oschner K, Koplos C, Grady J, Crump WJ. Telemedicine screening of glaucoma. *Telemed J*. 1999 Fall;5(3):283-90.
- [87] Yogesani K, Constable IJ, Morgan W, Soebadi DY. International transmission of teleophthalmology images. *J Telemed Telecare*. 2000;6(1):41-4.
- [88] Michelson G, Striebel W, Prihoda W, Schmidt V. Telemedicine in the control of intraocular pressure. *J Telemed Telecare*. 2000;6 Suppl 1:S126-8.
- [89] Yogesani K, Cuypers M, Barry CJ, Constable IJ, Jitskaia L. Tele-ophthalmology screening for retinal and anterior segment diseases. *J Telemed Telecare*. 2000;6 Suppl 1:S96-8.
- [90] Tuulonen A, Ohinmaa T, Alanko HI, Hyytinen P, Juutinen A, Toppinen E. The application of teleophthalmology in examining patients with glaucoma: a pilot study. *J Glaucoma*. 1999 Dec;8(6):367-73.
- [91] de Bont A, Bal R. Telemedicine in interdisciplinary work practices: on an IT system that met the criteria for success set out by its sponsors, yet failed to become part of every-day clinical routines. *BMC Med Inform Decis Mak*. 2008;8:47.
- [92] Helveston EM, Neely DE, Cherwek DH, Smallwood LM. Diagnosis and management of strabismus using telemedicine. *Telemed J E Health*. 2008 Aug;14(6):531-8.
- [93] Dawson E, Kennedy C, Bentley C, Lee J, Murdoch I. The role of telemedicine in the assessment of strabismus. *J Telemed Telecare*. 2002;8(1):52-5.
- [94] Helveston EM, Orge FH, Naranjo R, Hernandez L. Telemedicine: Strabismus e-consultation. *J AAPOS*. 2001 Oct;5(5):291-6.
- [95] Cheung JC, Dick PT, Kraft SP, Yamada J, Macarthur C. Strabismus examination by telemedicine. *Ophthalmology*. 2000 Nov;107(11):1999-2005.
- [96] Verma M, Raman R, Mohan RE. Application of tele-ophthalmology in remote diagnosis and management of adnexal and orbital diseases. *Indian J Ophthalmol*. 2009 Sep-Oct;57(5):381-4.
- [97] Rayner S, Beaconsfield M, Kennedy C, Collin R, Taylor P, Murdoch I. Subspecialty adnexal ophthalmological examination using telemedicine. *J Telemed Telecare*. 2001;7 Suppl 1:29-31.
- [98] Threlkeld AB, Fahd T, Camp M, Johnson MH. Telemedical evaluation of ocular adnexa and anterior segment. *Am J Ophthalmol*. 1999 Apr;127(4):464-6.

- [99] Shimmura S, Shinozaki N, Fukagawa K, Shimazaki J, Tsubota K. Real-time telemedicine in the clinical assessment of the ocular surface. *Am J Ophthalmol*. 1998 Mar;125(3):388-90.
- [100] Cavallerano AA, Cavallerano JD, Katalinic P, Blake B, Rynne M, Conlin PR, et al. A telemedicine program for diabetic retinopathy in a Veterans Affairs Medical Center--the Joslin Vision Network Eye Health Care Model. *Am J Ophthalmol*. 2005 Apr;139(4):597-604.
- [101] Tennant MT, Rudnisky CJ, Hinz BJ, MacDonald IM, Greve MD. Tele-ophthalmology via stereoscopic digital imaging: a pilot project. *Diabetes Technol Ther*. 2000 Winter;2(4):583-7.
- [102] Ulrich JN, Poudyal G, Marks SJ, Vrabec TR, Marks B, Thapa AB, et al. Ocular telemedicine between Nepal and the USA: prevalence of vitreoretinal disease in rural Nepal. *Br J Ophthalmol*. 2009 May;93(5):698-9.
- [103] Zimmer-Galler IE, Zeimer R. Feasibility of screening for high-risk age-related macular degeneration with an Internet-based automated fundus camera. *Ophthalmic Surg Lasers Imaging*. 2005 May-Jun;36(3):228-36.
- [104] Peter J, Piantadosi J, Piantadosi C, Cooper P, Gehling N, Kaufmann C, et al. Use of real-time telemedicine in the detection of diabetic macular oedema: a pilot study. *Clin Experiment Ophthalmol*. 2006 May-Jun;34(4):312-6.
- [105] Rudnisky CJ, Tennant MT, de Leon AR, Hinz BJ, Greve MD. Benefits of stereopsis when identifying clinically significant macular edema via teleophthalmology. *Can J Ophthalmol*. 2006 Dec;41:727-32.
- [106] Castro AF, Silva-Turnes JC, Gonzalez F. Evaluation of retinal digital images by a general practitioner. *Telemed J E Health*. 2007 Jun;13(3):287-92.
- [107] Murdoch I, Bainbridge J, Taylor P, Smith L, Burns J, Rendall J. Postoperative evaluation of patients following ophthalmic surgery. *J Telemed Telecare*. 2000;6 Suppl 1:S84-6.
- [108] Saleh M, Schoenlaub S, Desprez P, Bourcier T, Gaucher D, Astruc D, et al. Use of digital camera imaging of eye fundus for telemedicine in children suspected of abusive head injury. *Br J Ophthalmol*. 2009 Apr;93(4):424-8.
- [109] Qaddoumi I, Nawaiseh I, Mehyar M, Razzouk B, Haik BG, Kharma S, et al. Team management, twinning, and telemedicine in retinoblastoma: a 3-tier approach implemented in the first eye salvage program in Jordan. *Pediatric Blood & Cancer*. 2008;51(2):241-4.



Advances in Telemedicine: Applications in Various Medical Disciplines and Geographical Regions

Edited by Prof. Georgi Graschew

ISBN 978-953-307-161-9

Hard cover, 296 pages

Publisher InTech

Published online 22, March, 2011

Published in print edition March, 2011

Innovative developments in information and communication technologies (ICT) irrevocably change our lives and enable new possibilities for society. Telemedicine, which can be defined as novel ICT-enabled medical services that help to overcome classical barriers in space and time, definitely profits from this trend. Through Telemedicine patients can access medical expertise that may not be available at the patient's site. Telemedicine services can range from simply sending a fax message to a colleague to the use of broadband networks with multimodal video- and data streaming for second opinioning as well as medical telepresence. Telemedicine is more and more evolving into a multidisciplinary approach. This book project "Advances in Telemedicine" has been conceived to reflect this broad view and therefore has been split into two volumes, each covering specific themes: Volume 1: Technologies, Enabling Factors and Scenarios; Volume 2: Applications in Various Medical Disciplines and Geographical Regions. The current Volume 2 is structured into the following thematic sections: Cardiovascular Applications; Applications for Diabetes, Pregnancy and Prenatal Medicine; Further Selected Medical Applications; Regional Applications.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Kambiz Bahaadinbeigy and Kanagasingam Yogesan (2011). Advances in Teleophthalmology: Summarising Published Papers on Teleophthalmology Projects, Advances in Telemedicine: Applications in Various Medical Disciplines and Geographical Regions, Prof. Georgi Graschew (Ed.), ISBN: 978-953-307-161-9, InTech, Available from: <http://www.intechopen.com/books/advances-in-telemedicine-applications-in-various-medical-disciplines-and-geographical-regions/advances-in-teleophthalmology-summarising-published-papers-on-teleophthalmology-projects>

INTECH
open science | open minds

InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2011 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike-3.0 License](https://creativecommons.org/licenses/by-nc-sa/3.0/), which permits use, distribution and reproduction for non-commercial purposes, provided the original is properly cited and derivative works building on this content are distributed under the same license.

IntechOpen

IntechOpen