Videoconferencing for Clinical Management of Diabetes

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MD, MSc

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The University of Queensland in 2014
School of Medicine, Centre for Online Health
Abstract
Successful management of diabetes requires frequent appointments with healthcare professionals, many of which take place in hospital outpatient departments. Trips to hospital can be both burdensome and expensive for patients. Several studies have investigated the feasibility and effectiveness of videoconferencing for remote provision of diabetes care, but most have focused on behavioural therapy interventions such as diabetes education, self-management training, and nutrition consultations which are commonly provided by non-physician health professionals. A few clinical trials have reported the clinical outcome of videoconferencing for diabetes care, but no study has been reported on the reliability of video consultation for diabetes specialised care.

The aim of this research was to evaluate the reliability of videoconferencing for clinical management of diabetes. Three preliminary studies were conducted to inform the design of a randomised controlled trial. In the first study, the process of care, delivered by endocrinologists during conventional consultations in a diabetes outpatient clinic was analysed. This study showed that physical examination was not performed in 34% of in-person consultations. The endocrinologists reported that in 86% of the cases, it would be possible to safely provide the same consultation remotely via videoconferencing if the patient was accompanied by a general practitioner at the remote site. This could save the patients cost and inconvenience of long trips.

In the second study, the process of consultations provided remotely by endocrinologists via videoconference was analysed. This study was conducted in the tele-endocrinology clinic of a tertiary teaching hospital in Brisbane, which provides specialty consultations remotely to the patients living up to 1800 km away. Fifty six video consultations during a 5-month period were analysed. A nurse accompanied the patients at the remote site in 66% of the consultations, and in 18% of these cases, the endocrinologists requested the nurse to perform a physical examination. The most frequent recommendations were requesting lab tests (75%), adjustment of insulin dose (39%) and referring to an allied health professional (13%). Of these 56 consultations, the endocrinologists requested an in-person visit for three patients.

In the third study in the same tele-endocrinology clinic, a questionnaire for assessing the level of patient satisfaction with video consultation was developed. It comprised 15 multiple choice items exploring four dimensions: equipment/technical issues, communication and rapport, clinical assessment, and program evaluation. This questionnaire was then used to assess the satisfaction of the patients living in rural areas of Queensland who had been
remotely consulted by two endocrinologists via videoconferencing. In Autumn 2013 the questionnaire was sent by mail to 62 patients and 39% were completed and returned. The 'communications and rapport' dimension received the highest satisfaction rate and the 'clinical assessment' the lowest. The item with highest satisfaction rate was 'video quality' and the least satisfaction rate was reported for 'physical contact'.

Based on the findings of the three preliminary studies, a pilot randomised controlled trial was designed to evaluate the reliability of videoconferencing for remote consultation of people with diabetes who needed to see an endocrinologist in an outpatient clinic. This trial was conducted in the outpatient diabetes clinic of a tertiary teaching hospital in Brisbane. 75 participants were recruited from October 2012 to July 2013. The participants were randomly allocated into a telemedicine group or reference group. Each participant in the telemedicine group received two consultations: one in-person consultation and one video consultation. In the reference group the participants had two in-person (face-to-face) consultations. The paired consultations for each participant were provided by two different endocrinologists. To evaluate the reliability of the video consultation, the level of agreement between endocrinologists in the telemedicine group was calculated by comparing their recommendations on medication changes. In order to be able to assess the impact of videoconferencing on the level of agreement between endocrinologists, similar measures were also calculated in the reference group where two endocrinologists consulted the participants in-person. The findings of this study showed that the level of agreement between two endocrinologists on changing anti-diabetes drugs was 64% in telemedicine group and 78% in the reference group. Although the level of agreement was lower when one of the consultations was via videoconference, the difference was neither statistically, nor clinically significant. The level of agreement on changing cardiovascular drugs was 78% in the telemedicine group and 76% in the reference group, again not significantly different. This first rigorous trial of the reliability of videoconferencing for diabetes remote consultation produced evidence that the technique is acceptable for the patients who need specialist consultation with an endocrinologist.
Declaration by author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

I have clearly stated the contribution of others to my thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, and any other original research work used or reported in my thesis. The content of my thesis is the result of work I have carried out since the commencement of my research higher degree candidature and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution. I have clearly stated which parts of my thesis, if any, have been submitted to qualify for another award.

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Conference papers:


Publications included in this thesis

This thesis includes seven papers published in international peer-reviewed journals.


This paper which is appeared as Chapter 2, 'Review of literature: Telemedicine, telehealth, or eHealth? A bibliometric analysis' was a joint contribution of two authors as outlined below:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Farhad Fatehi (Candidate)</td>
<td>85% Conceiving, designing and conducting the study, writing and editing the manuscript</td>
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<td>Richard Wootton</td>
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This paper which is appeared as Chapter 3, 'Review of literature: PubMed searching on telemedicine for diabetes' was a joint contribution of three authors as outlined below:

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<td>Dominique Bird</td>
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<tr>
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This paper which is appeared as Chapter 4, 'Review of the literature: Clinical applications of videoconferencing' was a joint contribution of three authors as outlined below:

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<td>Nigel R Armfield</td>
<td>15% Designing of the study, data analysis, and editing the manuscript</td>
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<tr>
<td>Mila Dimitrijevic</td>
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<td>Leonard C Gray (Principal Supervisor)</td>
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This paper which is appeared as Chapter 6, 'Process analysis of conventional diabetes consultations' was a joint contribution of three authors as outlined below:

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This paper which is appeared as Chapter 7, 'Process analysis of tele-endocrinology' was a joint contribution of three authors as outlined below:

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<td>Farhad Fatehi (Candidate)</td>
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<tr>
<td>Leonard C Gray (Principal Supervisor)</td>
<td>10% Supervisory role and editing the manuscript</td>
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<tr>
<td>Anthony W Russell (Associate Supervisor)</td>
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Fatehi F, Martin-Khan M, Smith AC, Russell AW, Gray LC: **Patient Satisfaction with Video Teleconsultation in a Virtual Diabetes Outreach Clinic.** *Diabetes Technology and Therapeutics* 2015, 17(1) [Epub ahead of print]

This paper which is appeared as Chapter 8, 'Patient satisfaction with Video Consultation for Diabetes' was a joint contribution of three authors as outlined below:

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<tr>
<td>Farhad Fatehi (Candidate)</td>
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<tr>
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This paper which is appeared as Chapter 9, 'Methodology of the RCT for evaluating reliability of VC for diabetes' was a joint contribution of four authors as outlined below:

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<td>Melinda Martin-Khan</td>
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<td>Leonard C Gray (Principal Supervisor)</td>
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**Contributions by others to the thesis**

Professor Leonard Gray supervised the candidate throughout the Doctoral study and is recognised for: (i) providing the intellectual support in the planning, conducting and reporting the research studies.

Associate Professor Anthony Russell co-supervised the candidate throughout the Doctoral study and is recognised for: (i) intellectual support in the planning, conducting and reporting the research studies, as well as the logistic support for the conduct of the randomised clinical trial in the Princess Alexandra Hospital diabetes outpatient clinic.

Dr. Melinda Martin-Khan is recognised for: (i) intellectual support in the planning of the pilot study (chapter 10), and (ii) perusal and editing the drafts.

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Professor Sanjoy Paul is recognised for providing the statistical support for the analyses of the results of the main study that are shown in Table 10-2.

Editing and proof-reading of this thesis was performed by Prof. Leonard Gray and A/Prof. Anthony Russell.

**Statement of parts of the thesis submitted to qualify for the award of another degree**

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FoR code: 0899, Other Information and Computing Sciences, 40%
FoR code: 1005, Communications Technologies, 30%
FoR code: 1103, Clinical Sciences, 30%
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<thead>
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<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>DM</td>
<td>Diabetes Mellitus</td>
</tr>
<tr>
<td>FTF</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>HbA1c</td>
<td>Haemoglobin A1c (glycolisated haemoglobin)</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
</tr>
<tr>
<td>PAH</td>
<td>Princess Alexandra Hospital</td>
</tr>
<tr>
<td>PAH-TC</td>
<td>Princess Alexandra Hospital Telehealth Centre</td>
</tr>
<tr>
<td>T2DM</td>
<td>Type 2 Diabetes Mellitus</td>
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<tr>
<td>VC</td>
<td>Videoconference, Videoconferencing</td>
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</table>
1. **INTRODUCTION**

1.1. **Diabetes Mellitus**

Diabetes Mellitus is a chronic disease which affects more than 220 million people worldwide. It is a life-long health condition that requires self-management and ongoing health care. High cost of the management of diabetes and its complications, along with the increasing prevalence of this disease have made it a challenge for the health care system in many countries including Australia.

Patients with diabetes are at increased risk of various life threatening conditions. It is well-documented that intensive glycaemic control reduces the risk of development of diabetes related complications.\(^1\)\(^,\) \(^2\) However, a large proportion of people with Type 2 diabetes (T2DM) do not receive basic minimum standard care that is recommended by international guidelines.\(^3\) An alarmingly large proportion of patients with poor glycaemic control do not receive intensified treatment for hyperglycaemia for a long period of time \(^4\), and continue to remain with poor glycaemic control even after the initiation of intensified treatment.\(^5\)\(^,\) \(^6\) Improving access to timely and quality care is the fundamental requirement for effective management of this chronic disease.

1.2. **Access to specialist expertise**

There is inequality in access to specialty care between the residents of rural areas (urban centre population between 10,000 – 100,000), and metropolitan areas (urban centre population over 100,000).\(^7\) Many people living in rural and remote areas do not have the same access to health care compared with their metropolitan counterparts mainly because of the tendency of care facilities and providers, more specifically the specialists, to be centralised in urban areas. People with diabetes who live in rural areas are less likely to have access to adequate diabetes care.\(^8\)

Several strategies have been put in place to improve access to specialty care for the residents of underserved areas. In many cases, the governments provide financial support for travel to a nearby city where the needed specialist expertise is available for the patients. This, however, does not often compensate the time off work of the patient (and the carer if needed to escort the patient). Nevertheless, the stress of the journey cannot be compensated easily. Another strategy is establishing outreach clinics by the governments to bring the most needed specialists to the underserved areas on a pre-scheduled program. Although this approach is helpful for managing people with chronic diseases, it usually ends up with long waiting lists.
for the patients and thus lack of timeliness in access to care. It is also important to know that the concept of accessibility to health care has changed over the past decade and expands beyond just geographic distance. Social and cultural barriers limit access to appropriate care for many people around the world, more specifically for the diseases which are associated with stigma. Telemedicine has been recognised as an alternative to patient travel when specialist care is not available locally.

1.3. The role of telemedicine

Telemedicine, which is defined as the provision of medical opinion, evaluation or management services at a distance using information and communication technologies, holds the promise of improving access to specialist care by bridging the geographical gap between health care providers and consumers and lowering the costs. Telemedicine is generally delivered in two main formats: Store-and-forward (asynchronous) and real time (synchronous). In store-and-forward telemedicine, the health care providers and consumers do not necessarily interact with each other in real time. The patients' information is recorded, stored, and sent to a health care professional and he/she will attend to it in a convenient time. Typical examples of this format of telemedicine are teleradiology and teledermatology in which the digital images along with some information about the patient is sent electronically to a specialist and the specialist provides a report or comments on the diagnosis or management of the patient at a later time.

In real-time (synchronous) telemedicine, two or more parties interact with each other in the real time. This format of telemedicine has been practiced traditionally for decades using telephone calls. Videoconferencing is a more advanced format of real time telemedicine that has the advantage of communicating non-verbal clues between the parties. Although the use of videoconferencing was initially limited due to high cost of equipment and connectivity solutions, recent advancements in information and communications technology has made videoconferencing more accessible to the general public and patients alike.

However telemedicine has its own limitation that should be considered, most notably inability of the health care provider to perform a physical examination on patient remotely. Telemedicine services have been successfully introduced in psychiatry, dermatology and radiology, but application of telemedicine for management of chronic disease is still controversial. Although a variety of telemedicine applications have been used for diabetes care, no published report was found on the reliability of videoconferencing as a medium of delivery of specialised care for people with diabetes. Realising the increasing popularity of
video consultation, the research project designed for this thesis used videoconferencing as the medium of health care delivery.

1.4. Aims and scopes
The aim of this research was to investigate the reliability of remote consultation via videoconferencing for people with diabetes. As it is possible that a specialty consultation provided via videoconference yields an inferior outcome to a face-to-face consultation, it is important to know how inferior, if at all, would be the outcome of video consultations compared to face-to-face consultations, and what clinical implications such a potential difference would have.

1.5. Overview of the study
The body of this thesis is divided into three sections:

- Section 1: Review of the Literature
- Section 2: Preliminary studies
- Section 3: The Main Research Study

Section 1 (Chapters 2-5) provides an overview of the literature on telemedicine and clinical applications of using videoconferencing for clinical purposes. Chapter 2 explores research output in the general field of ICT in healthcare and highlights the lack of clarity in the terminology of this emerging field of study through a bibliometric analysis of the literature. Chapter 3 addresses one common insufficiency in the development of a search strategy for using Medical Subject Headings (MeSH) when searching PubMed for randomised controlled trials. Chapter 4 describes a review of the published papers on using videoconferencing for clinical purposes. Using the results of this literature review, Chapter 5 describes the technical characteristics, including the equipment and networking solutions, of the papers that have studied videoconferencing interventions in health care.

Section 2 (Chapters 6-7) describes three preliminary studies that were carried out to inform the design of the main research study. Chapter 6 explains the study on the process analysis of conventional (in-person) consultations for people with diabetes. Through a similar approach,
Chapter 7 presents the study on the process analysis of diabetes remote consultation in a tele-endocrinology clinic. Chapter 8 describes a study on the patient satisfaction with video consultation. In this study a questionnaire was developed and used for assessing patient satisfaction with videoconferencing in a Tele-endocrinology clinic.

Section 3 (Chapters 9-11) describes the main study of this thesis. Chapter 9 explains the methodology of a novel research design for assessing the reliability of videoconferencing for remote consultation of diabetes. Chapter 10 reports the conduct of this study and the results. Finally, Chapter 11 summarises the aims, scopes, and findings of the whole research program and discusses the practical implications of the results.
Section 1: Review of the Literature
2. **TELEMEDICINE, TELEHEALTH, OR EHEALTH? A BIBLIOMETRIC ANALYSIS**

2.1. **Paper Information**

Telemedicine, which is traditionally defined as the provision of medical services at a distance, emerged as a new concept more than a century ago. At that time telecommunication systems were used for communicating clinical information. However, over time, the applications of telemedicine expanded to other health related purposes such as education and administration. With emergence of new technologies and employing them in health and clinical services, other terms such as eHealth and mHealth were also introduced to the literature, adding more ambiguity to the terminology of this field of science.

Having a clear understanding of the main key terms in each scientific field of study is essential to the successful exploration of the specialised literature. This study aimed to discover how consistent the main three key terms of this field (i.e. telemedicine, telehealth, and ehealth) have been used in the literature and identify any difference in their usage between the countries around the world. This exploratory study informed the development and optimisation of search strategy in the field of telemedicine for various purposes including identifying the research gap.

The following paper has been published in the Journal of Telemedicine and Telecare (2012), Volume 18, Issue 8, pages 460-464. The candidate, Farhad Fatehi, was primarily responsible for conducting the research and writing the manuscript. The paper's co-author, Richard Wootton, contributed to this paper in various aspects as listed in the preliminary pages of this thesis.
Telemedicine, telehealth or e-health?
A bibliometric analysis of the trends in the use of these terms

Farhad Fatehi*† and Richard Wootton‡§

*Centre for Online Health, University of Queensland, Brisbane, Australia; †School of Advanced Medical Technologies, Tehran University of Medical Sciences, Tehran, Iran; ‡Norwegian Centre for Integrated Care and Telemedicine, University Hospital of North Norway, Tromsø, Norway; §Faculty of Health Sciences, University of Tromsø, Norway

Summary
The terms ‘telemedicine’, ‘telehealth’ and ‘e-health’ are often used interchangeably. We examined the occurrence of these terms in the Scopus database. A total of 11,644 documents contained one of the three terms in the title or abstract. Telemedicine was the most common term, with 8028 documents referring to it, followed by e-health (n = 2573) and then telehealth (n = 1679). Telemedicine was referred to in documents from 126 countries; the terms telehealth and e-health were found in publications from 55 and 99 countries, respectively. Documents with telemedicine in their title or abstract first appeared in 1972, and continued to appear at a low rate until 1994 when they started to increase rapidly; telehealth showed a similar pattern, but with the growth beginning about five years later. Although articles containing the term e-health appeared later than the other two terms, the rate of increase was higher. Articles (journal papers) were the most common type for the three key terms, followed by conference papers and review articles. Publication rates for telemedicine or telehealth or e-health were compared with two other relatively new fields of study: Minimally Invasive Surgery (MIS) and Highly Active Antiretroviral Therapy (HAART). Publications concerning HAART seem to have reached a peak and are now declining, but those with the three key terms and those concerning MIS are both growing. The variation in the level of adoption for the three terms suggests ambiguity in their definition and a lack of clarity in the concepts they refer to.

Introduction
Telemedicine has been researched for more than a century. However, the terminology in this field of study suffers from a lack of clarity and an absence of agreement about the definitions of the concepts. The term ‘telemedicine’ was originally used to denote the provision of medical services across distance (this is the literal meaning of the word). As the application of telemedicine widened, the term ‘telehealth’ was introduced to reflect a broader scope of health-related functions such as education and administration. More recently, terms like e-health, m-health and connected health have emerged. The term e-health, for example, was coined to cover a broad range of data processing and computer networking applications (including use of the Internet) in health care.
Chronological observation of the usage of these terms in the literature suggests that the newer themes of telehealth and e-health can be considered as an expansion of the original term telemedicine. However, the terms ‘telemedicine’, ‘telehealth’ and ‘e-health’ are often used interchangeably by both health care providers and consumers.1–3 The aim of the present study was to discover how consistently the key terms in this field have been used in the literature, to determine their trends over the past few years and to identify any differences in their usage between different countries.

Methods
The Scopus electronic database was searched to retrieve all publications referring to the terms ‘telemedicine’, ‘telehealth’ or ‘e-health’. The Scopus database covers a wider range of sources than PubMed and Web of Science, and offers advanced search facilities which allow the searching of various fields, including Title and Abstract.4 It also provides an analysis of results feature.

The search was conducted in September 2012 via the Scopus website. The terms telemedicine, telehealth and
e-health were used to search the title, abstract and title/abstract of articles indexed by Scopus. Since these terms may be written with or without a hyphen or space between the prefix and the stem (e.g. ‘e-health’, ‘e health’ or ‘ehealth’), three spelling variants were used for searching each key term using the OR operator. The following queries were used in the Advanced Search page on the Scopus website to retrieve articles for ‘telemedicine’:

1. **TITLE(**telemedicine** OR tele medicine** OR **tele-medicine**)
2. **ABS(**telemedicine** OR tele medicine** OR **tele-medicine**)
3. **(TITLE(**telemedicine** OR tele medicine** OR **tele-medicine**)) OR (ABS(**telemedicine** OR **tele medicine** OR **tele-medicine**))

Similar queries were used for telehealth and e-health. No limitation was applied to the date of publication, the journal category in the database or the language of the documents.

Documents published in 2012 were excluded to avoid incomplete statistics. The built-in analysis capability of Scopus was used to analyse the distribution of papers over time, by document type and by country. Unlike PubMed, Scopus indexes the affiliations (including the country) of all authors, i.e. a document may have more than one country associated with it if the authors are from different countries.

To compare the rate of publication in the domain of interest with other scholarly domains, the total number of documents concerning the three terms ‘telemedicine’, ‘telehealth’ and ‘e-health’ (referred to collectively as ‘ICT health’) was examined. Two other relatively new fields of study were selected for comparison: Minimally Invasive Surgery (MIS) and Highly Active Antiretroviral Therapy (HAART). These techniques are also technology intensive and were developed in the 1980s and 1990s, i.e. at approximately the same time as telemedicine began to be used widely. To compare these three domains, the basic document search in Scopus was used to search the title, abstract or keywords of the documents (this search procedure yields a slightly higher number of results compared to the exact phrase search described above).

### Results

A total of 11,644 documents contained the term telemedicine or telehealth or e-health in the title or abstract. Telemedicine was the most common term, with 8028 documents referring to it, followed by e-health ($n = 2573$) and then telehealth ($n = 1679$). The number of documents referring to each term as well as their combinations in title, abstract and title/abstract are shown in Table 1. The majority of these articles (93%) were in English, see Table 2.

### Table 1  Number of documents with telemedicine, telehealth, e-health and their combinations in title or abstract (see text) for the period 1972–2011

<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Abstract</th>
<th>Title or Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td>telemedicine</td>
<td>4697</td>
<td>6167</td>
<td>8028</td>
</tr>
<tr>
<td>telehealth</td>
<td>1057</td>
<td>1270</td>
<td>1679</td>
</tr>
<tr>
<td>e-health</td>
<td>1438</td>
<td>1988</td>
<td>2573</td>
</tr>
<tr>
<td>telemedicine OR telehealth</td>
<td>5704</td>
<td>7211</td>
<td>9401</td>
</tr>
<tr>
<td>telemedicine OR e-health</td>
<td>6063</td>
<td>7930</td>
<td>10,313</td>
</tr>
<tr>
<td>telehealth OR e-health</td>
<td>2487</td>
<td>3198</td>
<td>4182</td>
</tr>
<tr>
<td>telemedicine OR telehealth OR e-health</td>
<td>7064</td>
<td>8937</td>
<td>11,644</td>
</tr>
</tbody>
</table>

### Table 2  Language of the articles retrieved using the three search terms telemedicine, telehealth and e-health in the title or abstract

<table>
<thead>
<tr>
<th>Language</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>10,789 (93)</td>
</tr>
<tr>
<td>German</td>
<td>263 (2)</td>
</tr>
<tr>
<td>French</td>
<td>124 (1)</td>
</tr>
<tr>
<td>Spanish</td>
<td>91 (0.8)</td>
</tr>
<tr>
<td>Italian</td>
<td>78 (0.7)</td>
</tr>
<tr>
<td>Japanese</td>
<td>53 (0.5)</td>
</tr>
<tr>
<td>Chinese</td>
<td>48 (0.4)</td>
</tr>
<tr>
<td>Russian</td>
<td>39 (0.3)</td>
</tr>
<tr>
<td>Portuguese</td>
<td>25 (0.2)</td>
</tr>
<tr>
<td>Other</td>
<td>134 (1)</td>
</tr>
<tr>
<td>Total</td>
<td>11,644 (100)</td>
</tr>
</tbody>
</table>

### Year

Documents with telemedicine in their title or abstract appeared in 1972 with four instances, and continued at about the same rate until 1994 when they started to increase rapidly. There was a brief decline in the number of telemedicine documents starting in the year 2000.

Documents containing the term telehealth appeared in 1978 and continued with less than four documents per year until 1996 when a steady growth started. Although articles containing the term e-health appeared later than the other two terms, the rate of increase was higher. The number of e-health publications showed a dip starting in 2000, but it was less pronounced than for telemedicine, see Figure 1.
Country

Telemedicine was referred to in documents from 126 countries (i.e. about half of the countries in the world). The terms telehealth and e-health were found in publications from 55 and 99 countries, respectively. The top ten countries for documents concerning telemedicine are shown in Figure 2. The occurrence of the other two terms is also shown.

The term telehealth was more popular among countries in which English was the official language (e.g. the UK, USA, Canada and Australia). Canada had the highest proportion of documents with the term telehealth (30%) and the lowest for telemedicine (37%).

The trend of publications was similar among the top five countries with the highest number of publications in the past 20 years. The dip in 2002 in the number of documents with the three terms occurred in all countries except Canada (Figure 3).

Document type

Articles (journal papers) were the most common type for the three key terms, followed by conference papers and review articles. However, the proportion of conference papers for e-health (38%) was higher than for telemedicine (23%) or telehealth (16%), see Table 3. The number of conference papers referring to each key term is shown in Figure 4. E-health and telemedicine were substantially more popular than telehealth in conference papers (Figure 4).

Other scholarly domains

In 2011 there were 1960 articles with the terms telemedicine, telehealth or e-health appearing in their title or abstract, or being assigned as the keyword (either by the authors or by Scopus). In the same year there were 2507 articles concerning HAART and 3854 concerning MIS.

Publications concerning HAART seem to have reached a peak and are now declining, but ICT health and MIS are both growing (Figure 5).

The trends of publications for MIS and HAART were similar among the countries with the highest number of documents. Similar to ICT health, the trends of MIS publications showed a slight reduction in these countries in 2000/2001, with more effect in countries with fewer publications.

Discussion

The number of publications on telemedicine, telehealth and e-health shows an overall growth in the past two
decades. With some fluctuations for all three terms, the number of documents containing ‘telemedicine’ and ‘e-health’ have been increasing faster than that of ‘telehealth’. Based on the trends for the last ten years there will be more documents referring to ‘e-health’ than ‘telemedicine’ by 2022 (Figure 6). If the trend for the last five years is considered instead, it will happen by 2016.

The rapid growth in popularity of e-health in conferences during the past six years suggests that similar growth will happen in the number of e-health journal papers in future.

The majority of publications (85%) were from high income countries (according to the World Bank’s classification), whereas less than 1% (n = 42) of all the documents were from low income countries (Figure 7). While ICT health has been claimed to improve access to health care and reduce the costs, low-middle income countries in which these two issues are more challenging, have had less contribution in scientific production in this field.

There was a pronounced fall in the number of publications containing the term telemedicine starting in the year 2000. We do not know the reason for this. A search for documents containing the terms telemedicine, telehealth and e-health in other databases shows the same phenomenon: a growth in the number of articles beginning in the early 1990s, with a dip in 2000. Figure 8 shows the results for the Scopus database, for PubMed and for Web of Science, i.e. the fall is not specific to the Scopus database, but occurs in all of them. This suggests a common factor, such as a sudden, temporary reduction in the number of papers being published, or a sudden reduction in the number of journals being indexed by the databases. Neither seems a particularly likely explanation.
Limitations

The present study had certain limitations. A proportion of incomplete entries, duplicate records or erroneous data has to be expected in any electronic database. Such errors have been reported in electronic literature databases, including Scopus.4 Therefore in the present study, the search results might have included some non-relevant records. Although the search query was developed according to the recommendations of Scopus Help for finding an exact phrase, a few of the publications retrieved were found to be non-relevant (e.g. a paper with an abstract which reads ‘... all members of the A and E health care team’ published in 1993). Where identified, corrections were made by hand to eliminate these false positive results. In addition, the Scopus statistics output was not complete for country analysis, which might have introduced an underestimation for some countries with variations for the three key terms. The missing country data was seen in documents referring to telemedicine (30%), telehealth (31%) and e-health (7%), but may have been evenly distributed among countries.

Conclusion

The variation in the level of adoption for the three terms suggests ambiguity in their definition and a lack of clarity in the concepts they refer to. Telemedicine is a more popular term than telehealth or e-health, based on the number of publications in the Scopus database. The term e-health is more popular than telehealth in non-English speaking countries. The increasing number of publications suggests that this field of study is still growing. It appears that the term e-health will be more popular than telemedicine or telehealth within the next ten years.

Acknowledgement: We thank Mr Saeed Mohammadi, School of Business, Queensland University of Technology, for helpful discussions.

References

2 Vandenbos G, Williams S. The Internet versus the telephone: what is telehealth anyway? Professional Psychology: Research and Practice 2000;31:490
7 Charles B. Telemedicine can lower costs and improve access. Healthc Financ Manag 2000;54:66–9
3. USING MeSH TERMS FOR SEARCHING PubMed ON Telemedicine for Diabetes

3.1. Paper information

Development of electronic bibliographic databases has provided researchers with unprecedented capabilities in searching for and retrieving scientific information. However, the huge volume of ever increasing digital information and the complexity of search algorithms deployed in many electronic databases have made the task of conducting an efficient and successful electronic search a challenge for the users.

The aim of this paper was to highlight the importance of correct development of a search strategy for searching PubMed, and the consequences of using a suboptimal search query in a case of systematic review on telemedicine for diabetes, which is the main topic of this thesis.

The following paper has been published in the Journal of Telemedicine and Telecare (2013), Volume 19, Issue 3, pages 175-176. The candidate, Farhad Fatehi, was primarily responsible for conducting the research and writing the manuscript. The paper's co-authors, Dominique Bird and Leonard C Gray, contributed to this paper in various aspects as listed in the preliminary pages of this thesis.
PubMed searching using MeSH terms to identify randomized controlled trials on telemedicine for diabetes

The identification of all potentially relevant papers is crucial to the systematic review process. This requires the literature search to be as sensitive as possible, rather than specific. However, developing an optimal search strategy for retrieving relevant information from electronic databases is a challenge.1 The rapid growth in the quantity and complexity of the scientific literature has necessitated the use of keywords and subject headings to search, refine the results and retrieve the information.

The US National Library of Medicine (NLM) developed the Medical Subject Heading (MeSH) indexing system for cataloguing and categorizing the biomedical scientific documents stored in MEDLINE. Although MeSH has been shown to facilitate information retrieval from MEDLINE via the PubMed interface, there are certain limitations associated with using MeSH for searching the literature. These limitations include insufficiency and inconsistency in tagging the papers by NLM indexers, and modification of index terms over time. These limitations, and various types of inaccuracy in the bibliographic indexing of documents, make searching electronic databases, including MEDLINE/PubMed, an imprecise task especially for systematic reviews.

PubMed users should therefore use MeSH terms with caution for the purpose of a comprehensive literature review. A search query based solely on MeSH terms will fail to retrieve papers that NLM indexers have indexed insufficiently. A recent cross sectional study showed that 572 randomised controlled studies entered into MEDLINE in 2005 were not tagged with the appropriate MeSH term.3 Although the NLM immensely aided the identification of randomized controlled trials (RCTs) by introducing the “Randomized Controlled Trial” [Publication Type] in 1991, its similarity to “Randomized Controlled Trials as Topic” [Mesh] is still confusing for users (see below).4

We read with interest the review of telemedicine interventions in diabetes care by Siriwardena et al.5 but noticed that a highly cited relevant RCT6 was missing from the results. This led us to examine the paper’s methods to understand whether the search strategy failed to retrieve this study, or whether it had been intentionally excluded from the review. We conducted a PubMed search using the terms “Diabetes Mellitus”[Mesh] AND “Telemedicine” [Mesh] AND “Randomized Controlled Trial”[Publication Type]. This yielded 81 papers meeting the inclusion criteria (with the cutoff date limited to June 2011 as indicated in the original paper). This is nearly twice the number of papers identified as potentially relevant in Siriwardena et al.’s review (47 papers). A substantial number of missing papers may affect the comprehensiveness of the review, both in terms of the number of studies included and the summarising of the results.

“Randomized Controlled Trials” [MeSH] as indicated in the paper’s search strategy cannot identify all randomised controlled trials (RCT) because this MeSH term is used for indexing papers whose topic is an RCT. Instead, PubMed users must use “Randomized Controlled Trial” [Publication Type] for identifying studies that report the conduct or results of randomised controlled trials.

Our own PubMed search for RCTs on telemedicine for diabetes found several additional relevant papers that appeared to be telemedicine related6–10, diabetes related11–13 or randomised controlled trials.14–17 These papers had not been tagged properly with the relevant MeSH terms. Furthermore, Telemedicine was introduced in the MeSH database in 1993, a PubMed search for related papers using “Telemedicine” [MeSH] will not retrieve relevant studies which were indexed prior to that year unless they were updated afterwards.

Including all the relevant papers returned by a better search could improve Siriwardena et al.’s review. For example, it could add another group of papers reporting the results of RCTs using web-based or online interventions (without any telephone or video call)18–21 to the currently summarised three groups (Videoconference, Mobile phone and Telephone calls). Nevertheless, it would probably not change the overall conclusion of the review, that “telemedicine is a promising alternative to conventional therapy” and that “behavioural therapy enhanced by telemonitoring appears to be the most suitable mode of intervention”.

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DOI: 10.1177/1357633X13479708

References


3 Wieland LS, Robinson KA, Dickerin K. Understanding why evidence from randomised clinical trials may not be retrieved from Medline: comparison of indexed and non-indexed records. BMJ 2012;344:d7501
Optimal search strategies for retrieving scientifically strong studies of treatment from Medline: analytical survey. 

B.M. 2005;330:1179


Impact of automated calls with nurse follow-up on diabetes treatment outcomes in a Department of Veterans Affairs Health Care System: a randomized controlled trial. Diabetes Care 2001;24:202–8


Improving diabetes care among patients overdue for recommended testing: a randomized controlled trial of automated telephone outreach. Diabetes Care 2010;33:1452–3

The cost effectiveness of a telephone-based pharmacy advisory service to improve adherence to newly prescribed medicines. Pharm World Sci 2008;30:17–23


Evaluation of a diabetes patient education program consisting of a three-day hospitalization and a six-month follow-up by telephone counseling for mild type 2 diabetes and IGT. Environ Health Prev Med 1999;4:122–9


What we can really expect from telemedicine in intensive diabetes treatment: results from 3-year study on type 1 pregnant diabetic women. Diabetes Technol Ther 2001;3:581–9

Individualized electronic decision support and reminders to improve diabetes care in the community: COMPETE II randomized trial. CMAJ 2009;181:37–44


A web-based program to improve self-management in adolescents with type 1 diabetes. Diabetes Care 2010;33:602–4

4. CLINICAL APPLICATIONS OF VIDEOCONFERRING: A SCOPING REVIEW

4.1. Paper information

Telemedicine solutions are generally classified into two main categories: synchronous (real-time) and asynchronous (store-and-forward). Videoconferencing (VC) is a synchronous mode of telemedicine that allows two or more parties to interact with each other by simultaneous exchange of video and audio. Although VC was initially possible by using relatively high-cost dedicated equipment and telecommunication infrastructure, recent advancements in ICT have made it more accessible to the general public by various software solutions running on desktop computer systems or more recently via portable devices such as notebooks, tablets, or smart phones.

Videoconferencing has been the subject of increasing number of peer-reviewed publications over the past decade, but no published report was found on the clinical applications of VC in general. Most of the systematic reviews limit their scopes to randomised controlled trials and a very specific application of videoconferencing, ending up with a relatively small number of papers. None of those review studies can give a general picture of the use of videoconferencing for clinical purposes. The aim of this review was to summarise the original studies that have scientifically evaluated various aspects of implementing videoconference technology for clinical purposes.

The following paper has been published in the Journal of Telemedicine and Telecare (2014), Volume 20, Issue 7, pages 377–383. The candidate, Farhad Fatehi, was primarily responsible for design of the study, conducting the research and writing the manuscript. The paper's co-authors, Nigel R Armfield, Mila Dimitrijevic and Leonard C Gray contributed to this paper in various aspects as listed in the preliminary pages of this thesis.
Clinical applications of videoconferencing: a scoping review of the literature for the period 2002–2012

Farhad Fatehi1,2, Nigel R Armfield1,3, Mila Dimitrijevic1 and Leonard C Gray1,4

Summary
We conducted a scoping review of the literature on the clinical applications of videoconferencing. Electronic searches were performed using the PubMed, Embase and CINAHL databases to retrieve papers published from 2002 to 2012 that described clinical applications of videoconferencing. The initial search yielded 4923 records and after removing the duplicates and screening at title/abstract level, 505 articles met the inclusion criteria and were reviewed at full-text level. The countries with the highest number of papers were the US, Australia and Canada. Most studies were non-randomised controlled trials. The discipline with highest number of published studies (39%) was mental health, followed by surgery (7%) and general medicine (6%). The type of care delivered via video comprised acute, sub-acute and chronic care, but in 44% of the papers, the intervention was used for a combination of these purposes. Videoconferencing was used for all age groups but more frequently for adults (20%). Most of the papers (91%) reported using videoconferencing for several clinical purposes including management, diagnosis, counselling and monitoring. The review showed that videoconferencing has been used in a wide range of disciplines and settings for different clinical purposes. The practical value of published papers would be improved by following standard guidelines for reporting research projects and clinical trials.

Accepted: 9 August 2014

Introduction
Videoconferencing, which is the primary modality for synchronous telemedicine, has been used for real-time delivery of a range of clinical and health care services at a distance. Advances in information and communication technologies (ICT) have made videoconferencing more affordable for health care providers and the public. It is now possible to carry out video-based remote consultations using free software applications on a desktop computer or on a mobile phone.1 Bibliometric studies have shown a substantial increase in the number of published papers on telemedicine during the past five decades,2–6 but it is not clear what proportion of these papers have used videoconferencing. Therefore the overall picture of the usage of videoconferencing for clinical purposes remains unclear. Most of the systematic reviews have limited their scope to randomised controlled trials (RCT) in a specific medical discipline, resulting in a relatively small number of papers being considered. This means that a considerable proportion of papers, which have been published in peer-reviewed journals, have been excluded from review studies.

Much experience has been gained over the past decade on different aspects of conducting systematic reviews, such as literature searching, critical appraisal of eligible papers and methods for summarising the results, including meta-analysis of RCTs. However, systematic reviews of non-RCT studies are rather limited.7 A scoping review can be used in a complex and broad field of study in which a meta-analysis of the findings is not feasible. A scoping review can map the related literature and examine the extent, range and nature of research activities. Unlike systematic reviews, scoping reviews do not attempt to synthesize evidence by aggregating findings from studies, but instead collate and summarise the key characteristics of the literature.

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We conducted a scoping review of the literature on the clinical applications of videoconferencing. The aim of the study was to map the global research output and to identify the breadth of literature related to this mode of telemedicine.

Methods

A modified version of Arksey and O’Malley’s framework was adopted. This framework, which was one of the first attempts to clarify the methods for scoping reviews, suggests five stages for conducting a scoping study:

1. identifying the research question;
2. identifying relevant studies;
3. selecting the studies;
4. charting the data;
5. collating, summarising and reporting the results.

It also includes an optional sixth stage, which is a consultation exercise. We developed a search strategy, screened the search results according to eligibility criteria, designed a data extraction form and summarised the papers that reported on telemedicine services based on videoconferencing in clinical settings.

Search strategy and data sources

Online literature searches were performed using the PubMed, Embase and CINAHL databases. The search strategy for PubMed is shown in Table 1. A combination of relevant MeSH terms and keywords were used to ensure that the search was highly sensitive. Similar strategies were developed for searching Embase and CINAHL according to their user interfaces. We reviewed the articles published between January 2002 and December 2012. Because computers and related products become obsolete relatively quickly, articles published earlier than 2002 were not included. Reference management software (EndNote version X6) was used to record the identified articles and check for duplicates. We considered all interventions that used videoconferencing for clinical purposes, regardless of the type of devices and communication technology used. There was no limitation on the participants of the studies, so health care professionals, patients and patients’ carers or family members could be participants in the studies.

Eligibility criteria, screening and selection of studies

The focus of the review was on the use of videoconferencing for patient care, and so we included original research papers in which videoconferencing was the main or one of the main topics of research and in which videoconferencing had been used for clinical purposes, not primarily for administration or education. Review papers, conference proceedings, case studies, letters and comments were excluded. We also excluded papers that solely explored technical or economic aspects of videoconferencing.

The articles retrieved from the literature search were initially screened at title and abstract level by two reviewers. Publications lacking an abstract in the English language were excluded. Disagreements were resolved by consensus, or by consulting a third reviewer. The full text of potentially relevant studies was obtained for final eligibility assessment. If the information provided by the title/abstract of a paper was not sufficient for deciding on inclusion or exclusion, the article was regarded as potentially relevant and the full text retrieved. In the case of duplicate publications and companion papers of a primary study, the paper with most comprehensive information was included.

Data extraction

Information was extracted from the selected papers using a data extraction form that was developed for the study. Two reviewers independently checked the full-text of ten
included papers and extracted the information using this form. The results were then compared with each other and disagreements were resolved by discussion, after which the form was revised where necessary. Then the information from the rest of the papers was extracted by one reviewer. Because of the heterogeneity of the studies, a meta-analysis of the results was not feasible. Instead a qualitative approach was adopted. The findings are reported below in a narrative format.

Information was extracted regarding year of publication, country where the telemedicine project was conducted, medical discipline, type of care, age group, type of patients (new or review), type of trial (efficacy study conducted in a controlled way for the purposes of research, or effectiveness study conducted in routine clinical care in ‘real-world’ conditions), demographics of health care providers and patients, host of the videoconferencing session and the setting of videoconferencing. The age group (paediatric, adult, geriatric) was that defined in the papers. The purpose (primary, as well as secondary purpose if applicable) of videoconferencing was also extracted and categorised. The level of evidence of the papers was assessed based on the design of the study.11 No attempt was made to assess the methodological and reporting quality of the included papers or to acquire missing data from the authors of the included papers.

Results

The electronic search of the three databases resulted in 4923 articles, of which 2411 articles were screened at title/abstract level after excluding the duplicates. The full text of 963 articles were retrieved and assessed for eligibility assessment and finally 505 articles were included in the study. A PRISMA flow chart of the process is shown in Figure 1.

Year

The rate of publication from 2002 to 2011 fluctuated between 41 and 47 papers per year, except for the year 2004 which exhibited the lowest number of papers (35 papers). However, the rate of publication increased substantially to 68 papers per year in 2012 (Figure 2).

Country

There were 481 papers describing studies conducted in single countries. The remaining 24 papers reported international studies in which the country of the clinical service provider was different from that of the recipient. Papers concerning single-country studies came from 29 countries, with the US, Australia, Canada and the UK having the greatest number of papers (Table 2). Nine countries (Albania, Colombia, Jordan, Mexico, Pakistan, Romania, Serbia, Northern Mariana Islands and São Tomé and Príncipe) were solely part of multi-national studies.

Figure 1. The process of identifying, screening and including articles for the review.

Figure 2. Number of papers related to videoconferencing for clinical purposes.
Level of evidence

Non-randomised clinical trials represented the highest proportion of the papers (57%), followed by RCTs, comparative studies and case series/case studies. There were 53 papers reporting other study designs, or not mentioning the study design (Table 3).

Medical disciplines

Some papers focused on a single health condition or disease, whereas others included multiple diseases or did not limit their study to particular diseases or health conditions. In 217 papers, videoconferencing was used for a single medical discipline. The most common single medical discipline was mental health with 85 (39%) papers, followed by surgery with 15 (7%) papers. The most frequently researched single medical disciplines are shown in Table 4. In 288 papers, the application of videoconferencing was extended to more than one disease. In these papers, mental health was the medical discipline under study in the greatest number of papers (147; 13%), followed by general medicine with 101 (9%) papers.

Type of care delivered

Videoconferencing was used for the delivery of different types of patient care. In 286 papers the study design focused on a single type of care, either acute, sub-acute or chronic care. In the remaining papers, the intervention comprised a combination of care types (Table 5).

Age group

In 225 (45%) papers, the intervention was targeted at a specific age group. In the remaining 196 papers, more than one age group was investigated. In 84 (16%) papers the age group of the participants was not recorded. The distribution of the papers based on the age group of the subjects is shown in Table 6.

Purpose

A total of 46 papers reported the use of videoconferencing for a single purpose (diagnosis 38, screening 2,
monitoring 2, counselling 2, management 1, follow-up 1). In the remaining papers (459 of 505, 91%) the videoconferencing was used for several purposes (Table 7). In addition to the primary purposes mentioned above, in 314 papers videoconferencing was used for other non-clinical purposes such as patient education (172), training other health staff (49) and administration (48 papers).

### New consultation or patient review

Videoconferencing was used for new patients in 180 (36%) papers, for review patients in 40 (8%), or for both new and review patients in 249 (49%) papers. In 35 (7%) papers, it was not clear whether the patients were new or review cases.

### Health care providers and recipients

The majority of papers (314) reported a specialist doctor as the health care provider via videoconferencing. There were also nurses (100), psychologists (53) and GPs or registrars (34). In 12 papers the qualification of the health care provider was not clear. The recipients of videoconferencing were the patients in 466 papers. In addition to patients, patient family or carers, specialist doctors, nurses and GPs were the other recipients of service.

### Efficacy and effectiveness

In 423 papers (84%) the trial was categorised as an efficacy study, i.e. the videoconferencing intervention was investigated under controlled circumstances. The remaining 82 papers (16%) represented effectiveness studies, i.e. the intervention was investigated under ‘real-world’ conditions.

#### Attendance at videoconference

Patients were alone when participating in videoconferences in 103 (20%) papers. In other cases, the patient was accompanied by a nurse (96, 19%), family member or carer (28, 6%) or others (154, 30%). In 124 (25%) papers it was not clear whether the patient was alone or accompanied by others.

### Setting

The setting of the care provider was mainly hospital (273, 54%) or standalone clinics (140, 28%). In six studies (1%), the healthcare provider was based at home and in 65 (13%) papers this setting was not mentioned. The recipients of the videoconferencing were situated at hospital (225, 45%), clinic (177, 35%), home (131, 26%), nursing home (27, 5%) or other locations (22, 4%). In 20 (4%) papers, the setting of the recipient was not specified.

### Discussion

Peer-reviewed papers about the clinical applications of videoconferencing were published continuously over the study period. The trend in publication rate was similar to that of telemedicine related papers in general. The dip in the year 2004 and the steep increase in the year 2012 matches the pattern of publication rate in telemedicine papers generally. However, the reason for these changes is not known. The striking increase in the number of papers in the year 2012 may reflect the improved availability of videoconferencing for a broader range of people, including patients.

In the present review, more than one third of the papers were from the US, followed by Australia, Canada and the UK. These four countries contributed more than 70% of the papers reviewed. In a previous study, these four countries were also found to have published the most papers on telemedicine generally.4 Sweden, Norway and China appear in the top ten countries with papers on videoconferencing, but not among those with general telemedicine, telehealth or e-health related papers, Table 8. This supports the general belief that the countries which have populations isolated by harsh climate or long distances are more interested in videoconferencing for clinical purposes, compared to the non-clinical applications of telehealth or e-health.

Only 80 of the 505 papers reviewed (16%) reported randomised controlled trials. This reinforces the conclusion of previous systematic reviews that have emphasized the need for high quality studies in telemedicine.12–15 Mental health has been by far the most commonly researched discipline with respect to the clinical use of...
videoconferencing. However, disciplines such as surgery, cardiology and neurology that may perhaps rely more on physical examination appeared among the top five single disciplines in the papers reviewed. This supports previous findings that the inability of doctors to perform physical examinations by videoconferencing, which may be perceived as a drawback for telemedicine, is not a barrier for providing clinical care at a distance.16

Adult patients were the most frequent age group of participants in the papers reviewed, followed by pediatrics and geriatrics. Since video-based telemedicine services are often established between two health care facilities, and primarily operated by experienced staff rather than the patient, concerns about technology acceptance and ease of use for the patients are of lesser importance.17

Videoconferencing was mainly used for the management of diseases rather than diagnosis, counselling or monitoring of the patients. This mirrors the need for frequent clinical appointments for people with chronic diseases and supports the idea that a proportion of clinical follow-up consultations can be delivered via videoconference.18

In the majority of the papers reviewed, patients were accompanied by nurses, family members or others. However, in 20% of the papers, the patients were alone when participating in the video consultation. Since videoconferencing can be performed using mobile devices such as smartphones, remote clinical encounters in future are more likely to happen outside health care facilities. Research is required on the use of mobile devices for clinical videoconferencing, from both a provider and consumer point of view.16

The majority of the studies were conducted in controlled conditions and few studies were conducted in routine clinical care settings. Thus, the evidence of effectiveness is somewhat limited and may not be generalizable to other patients groups or settings. To be of most practical value for clinicians and policy makers, studies should have a pragmatic nature and consider external validity (i.e. applicability beyond the immediate study conditions) at the design stage.

In general terms, if the results of the studies are to have practical implication for other researchers and clinicians, the intervention must be thoroughly described, and the logistic and technical features of their interventions explained in sufficient detail. Unfortunately, not all studies in the present review reported these details. Following the CONSORT-EHEALTH guideline, though not specifically designed for videoconferencing, could improve the reporting quality of the telemedicine papers and the generalisability of their results.20

Conclusion

Videoconferencing has been used for various clinical purposes in a wide range of disciplines and settings. The present review shows that disease management applications were more common than diagnostic, counselling or patient monitoring applications. All age groups were represented, although most studies focussed on adults. Mental health was the most commonly reported clinical area, confirming that many evidence-based mental health interventions may be provided effectively by video. Procedural disciplines, and those requiring more direct physical examination, were less common in the literature reviewed.

From a methodological perspective, there have been shortcomings and inconsistencies in the reporting of findings of research projects, which limit their replication. The practical value of published papers would be improved by following standard guidelines for reporting research projects and clinical trials. Future research could complement the findings of the present study by thematic mapping of the literature to identify and/or visualize the key concepts of telemedicine.

Acknowledgements

We thank Dr Susanne Pearce for her assistance in developing the protocol of this study.

References


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### Table 8. Countries with the highest number of general telemedicine related papers versus videoconferencing papers.

<table>
<thead>
<tr>
<th>Rank</th>
<th>General telemedicine related papers</th>
<th>Videoconferencing papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USA</td>
<td>USA</td>
</tr>
<tr>
<td>2</td>
<td>UK</td>
<td>Australia</td>
</tr>
<tr>
<td>3</td>
<td>Canada</td>
<td>Canada</td>
</tr>
<tr>
<td>4</td>
<td>Australia</td>
<td>UK</td>
</tr>
<tr>
<td>5</td>
<td>Germany</td>
<td>Sweden</td>
</tr>
<tr>
<td>6</td>
<td>Italy</td>
<td>Italy</td>
</tr>
<tr>
<td>7</td>
<td>Spain</td>
<td>Germany</td>
</tr>
<tr>
<td>8</td>
<td>France</td>
<td>Norway</td>
</tr>
<tr>
<td>9</td>
<td>India</td>
<td>China</td>
</tr>
<tr>
<td>10</td>
<td>Japan</td>
<td>Spain</td>
</tr>
</tbody>
</table>

*data from Fatehi & Wootton.*
Fatehi et al. 383

5. Technical Aspects of Videoconferencing for Clinical Purposes: A Review of the Literature

5.1. Introduction

Audio-visual quality of a VC session is a major determinant of usability and satisfaction; both for recipients and providers. From a technical perspective, parameters such as bandwidth, frame rate, image size, resolution, and levels on camera control are determinants of the quality of a VC session. Quality of video and audio could be of different importance based on the medical specialty for which videoconferencing is used. Disciplines such as dermatology and radiology require much higher quality of image comparing to psychiatry, for example. Although it is difficult to rate the quality of videoconferencing encounters simply by describing the type of device and connectivity, these characteristics still do provide an indication of the quality of voice and image. For the purpose of this study, we categorise the VC solutions into two main groups: High quality VC using dedicated equipment (Codec) and high speed connections such as ISDN or broadband network, and Low-medium quality using other solutions including PC- or Web- based VC, video phone, or mobile phone, via various connectivity solutions such as DSL, dial-up and mobile cellular network.

Videoconferencing has been the subject of increasing number of peer-reviewed publications over the past decade, but we found no review on the technical aspects of VC and the trend of changes in equipment used for clinical VC over time. The aim of this study was to review and summarise the equipment used for VC for clinical purposes and reveal the trend of changes, if any, during the past decade.

5.2. Methods

Based on the findings of the previous review study (Chapter 4), papers which mentioned technical information regarding videoconferencing were explored to identify the hardware, software, networking, and the bandwidth used for videoconferencing.

In order to illustrate the trend of changes in the bandwidth used for VC, we categorised the bandwidth into three categories:

- Low-speed: less than 384 kbit/s
- Medium: between 384 kbit/s – 1 Mbit/s
- High-speed: more than 1 Mbit/s
384 kbit/s is regarded as the lowest recommended bandwidth for videoconferencing of an acceptable quality, and bandwidth of more than 1 Mbit/s is regarded as high-speed connection in many papers.

5.3. Results

The search in the three online databases resulted in 1822 unique records. Two authors screened the records at Title/Abstract level and selected 906 articles for assessing the full-text for eligibility. Finally 505 articles were included in this review.

5.3.1. Trend of publication with technical information

78 papers out of 505 did not provide any information on the equipment used for videoconferencing. Six papers mentioned the equipment info for just one party, (one for provider side and five for recipient side), and 422 (84%) papers mentioned the type of equipment used in their research. The trend of papers with adequate technical information varied between 74% in 2002 and 95% in 2009, but did not show any specific pattern over the years under review (Figure 5-1).
5.3.2. Equipment

The equipment used for videoconferencing was not mentioned in 85 papers (17%) articles. Dedicated VC codec was the most frequently used equipment both at provider end (224) and recipient end (227), followed by computer/laptop/notebook. The frequency distribution of the equipment used by the providers and the recipients are summarised in Table 1 and Figure 2. The number of papers reporting the equipment used for videoconferencing does not show any trend over time except for a slight increase in the years 2011 and 2012 for mobile/smart phone both for providers and recipients (Figure 5-2).

![Provider equipment %](image1)

![Recipient equipment %](image2)

5.3.3. Bandwidth

The bandwidth of videoconferencing was not mentioned in 233 (46%) of the studies. The trend of bandwidth used for VC over time is shown in Figure 5-3. The number of articles
that have not mentioned the bandwidth used for the study has increased from 32% in 2002 to 68% in 2012.

Figure 5-3 Number of papers reporting the bandwidth used for videoconferencing over time

5.4. Discussion

A large proportion of peer reviewed papers on using videoconferencing for clinical purposes have not provided the technical information of their intervention. There was a significant increase in the number of papers in the year 2012. The most widely used hardware for videoconferencing are dedicated VC codecs and personal computers (desktop, laptop, or notebook). Starting in 2005, research studies have used mobile/smart phones to establish videoconferencing for clinical purposes. A range of bandwidth has been used in the studies, but over time the use of low bandwidth connectivity has declined and a greater proportion of the papers have reported using medium bandwidth (384 Kb/s – 1 Mb/s) for videoconferencing. Nevertheless, during the past eleven years, a lower proportion of papers are providing information on the bandwidth. Reliability and the quality of service are other concepts related to the connection speed, which are highly dependent on the technology used for establishing the link between health care providers and recipients. These concepts are often beyond the technical expertise of clinical researchers. Considering the rapid change in the ICT technology in the past decade that affects the technical availability and quality of
videoconferencing, there is a need for more stable indicators, apart from hardware and software, when reporting the results of research studies for clinical purposes.

Research shows that the quality of video and audio in video consultations is significantly correlated with the content of communications exchanged between health care professionals. Image freezing and transmission delays are among the technical challenges that require solution in synchronous telemedicine, in particular in applications that heavily rely on visual information such as tele-sonography. When image quality is a critical factor, high definition video transmitted over super-fast networks should be considered. Uncompressed High Definition technologies, though not yet ready for broad deployment, can be used in disciplines such as teledermatology in which standard definition video is not satisfactory. Results of this review showed that a very low proportion of papers have mentioned frame rate and image quality of their videoconferencing solutions. Although the overall quality of videoconferencing depends on many factors, reporting a few basic settings of videoconferencing (such as frame rate) under study can roughly indicate the quality of video and audio experienced by the clinicians and/or patients during a clinical video visit.
Section 2: Preliminary Studies
6. PROCESS ANALYSIS OF CONVENTIONAL DIABETES CONSULTATIONS

6.1. Paper Information

The review of the literature showed that there is no previously published report on the feasibility of videoconferencing for clinical consultation dealing with patients who have diabetes.

By understanding the characteristics of the diabetic patients who are referred to an endocrinologist for specialty consultation, as well as the procedures and components of such consultations, it would be possible to identify the consultations that, either entirely or in part, can be performed remotely via videoconferencing.

This study was designed to provide the basic information needed for a clinical trial on the reliability of video consultation for diabetes. The aim of this study was to quantitatively analyse the process of care which is provided by endocrinologists in an outpatient clinic.

The following paper has been published in the Diabetes and Technology and Therapeutics journal (2013), Volume 16, Issue 1, pages 8-14. The candidate, Farhad Fatehi, was primarily responsible for conducting the research and writing the manuscript. The paper's co-author, Leonard C Gray and Anthony W Russell, contributed to this paper in various aspects as listed in the preliminary pages of this thesis.
A Clinimetric Study of Outpatient Diabetes Consultations: The Potential for Telemedicine Substitution

Farhad Fatehi, MD, MSC1,2, Leonard C. Gray, MD, PhD1,3, and Anthony W. Russell, MD, PhD4,5

Abstract

Background: The purpose of this study was to identify the clinimetric characteristics of specialist outpatient consultations for people with diabetes and to evaluate the possibility of providing such consultations remotely using telemedicine.

Materials and Methods: The process of care was analyzed during the specialist consultations provided by five endocrinologists in a tertiary hospital diabetes outpatient clinic. The specialists' opinion of the possibility of providing each consultation remotely was also sought.

Results: In total, 50 consultations were analyzed. The patients had type 1 and type 2 diabetes in 28% and 64% of the cases, respectively; 68% had at least one diabetes complication. Diabetic neuropathy was the most prevalent (42%) complication. Physical examination was not performed by the specialists in 34% of cases. General foot inspection, the most frequent examination, was performed in 54% of the consultations. After "general advice," ordering laboratory tests was the most frequent recommendation (80%), followed by adjustment of an insulin regimen (52%). In 86% of consultations, the specialists believed that it would have been possible to provide that consultation remotely via videoconferencing to a patient with the general practitioner present. In their opinion, communicating with the patients through e-mail was the least possible alternative means of providing the consultations.

Conclusions: Endocrinologists with little telemedicine experience believe that a considerable proportion of outpatient specialty consultations for people with diabetes can be provided remotely via videoconferencing. The clinimetric analysis of 50 consultations supports this opinion.

Introduction

With the increasing rate of obesity and the relative shortage and cost of healthcare providers, the provision of appropriate care for diabetes patients has become a major challenge for many countries.1–5 Tight control of blood glucose has been shown to prevent or delay development of diabetes complications6–8; however, the majority of patients do not receive standard health checks,7 and more than 30% of people with diabetes fail to achieve their target level of glycemic control in general practice.5,9

Several strategies have been suggested for improving the outcome of managing people with chronic illness—ready access to necessary expertise is one of them.10 However, access to specialty care is not possible for all patients all of the time. Geographical, financial, social, and cultural barriers limit access to specialists for patients.11,12 Limiting factors could be enforced from the provider side as well. A proportion of subspecialists, including endocrinologists, cannot accommodate patients with physical mobility impairment, thus imposing more limitations to access to specialty care.13 New methods are needed for improving timely and appropriate access of patients to specialist advice for managing chronic diseases.14 Similarly, primary care providers also benefit from access to specialists for education and up-skilling.15

In response to growing demand for care with decreasing availability of personnel, information and communications technology has the potential for improving access to healthcare services and lowering costs. Telemedicine services have been successfully introduced in medical disciplines such as pathology16 and radiology,17 where in-person interaction between the patient and the specialist is not essential. However, scientific evidence on the application of telemedicine solutions for the clinical management of chronic disease, including diabetes, is weak and contradictory.18 Although there are reports that telemedicine case management of diabetes effectively improves glycemic control, levels of blood lipids, and blood pressure,19 most of the publications to date on telemedicine for improving diabetes care describe various interventions for monitoring the blood glucose level.

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2School of Advanced Technologies in Medicine, Tehran University of Medical Sciences, Tehran, Iran.

3Princess Alexandra Hospital, Brisbane, Australia.
adherence to the treatment plan, patient education, and motivational support of the persons with diabetes, but not the process of consultation with diabetes specialists. Thus it is not possible, based on the current literature, to comment on the feasibility, acceptability, safety, and accuracy of telemedicine for diabetes specialty consultation.

To evaluate the possibility of providing remote consultation for people with diabetes, it is necessary to clearly identify how a traditional consultation is performed. By understanding the nature of referrals, the profiles of the patients and their clinical conditions, the content of the interview, the procedures, and the outcomes, it may be possible to identify those consultations that, entirely or in part, might be substituted with a telemedicine modality, should the patient live in a community with limited access to specialists. The American Diabetes Association considers four components for a comprehensive diabetes evaluation: medical history, physical examination, laboratory evaluation, and referrals. Of these components, physical examination appears to be the only one that is challenging to perform remotely via telemedicine. However, the limitations associated with telemedicine highly depend on the mode of interaction and the equipment used for remote provision of care and exchange of information.

In asynchronous telemedicine (or store-and-forward telemedicine such as e-mail) the provider and the consumer do not interact in real time, so there is always a delay between sending a request and receiving the response. This time lag logically opts out this mode of telemedicine for emergency consultations. Moreover, basic e-mails are traditionally used to convey messages in text format, although there is an increasing capability with most of the e-mail service providers for attaching audio, image, or video files to the e-mails in order to enrich the content of the messages. In contrast, in synchronous (or real-time) telemedicine the provider and the consumer interact with each other in real time, so theoretically there is no time lag in communication between the local and remote parties. Synchronous solutions are categorized based on the modality used for communication, ranging from online text chat, to telephone call, and then to interactive video call (videoconference). Although a telephone call is the most available means of telecommunication worldwide, videoconferencing has the superiority of incorporating video over voice, thus capable of communicating visual information and nonverbal cues. Considering the four techniques used in a classic physical examination (i.e., inspection, palpation, percussion, and auscultation), videoconferencing can provide the users with the possibility to inspect and auscultate (to some extent), but a telephone call can be used only for auscultation at the best, and online chat can help with none of them.

Clinimetrics is a methodological discipline concerned with measurement issues in clinical medicine. From the clinical point of view, different medical disciplines rely differently on findings from physical examinations. For instance, decision making in general surgery disciplines mostly depends on palpation and percussion, in cardiology on auscultation, and in ophthalmology on inspection. Thus the impact of findings through physical examinations on decisions made by clinicians needs to be assessed based on the discipline under question. Nevertheless, physical examination can be safely performed by other healthcare professionals such as a general practitioner (GP) or a nurse on behalf of the specialist. It has been shown that collaborative management of diabetes by a multidisciplinary team is effective in achieving and maintaining glycemic control.

This study was designed to assess the possibility of providing outpatient referral specialty consultations remotely. We adopted two approaches: (1) conceptualization and analysis of the process of care during an outpatient specialist visit for diabetes management and (2) seeking the specialists’ opinion on the suitability of each consultation to be conducted remotely via telemedicine for several in-person diabetes consultations. The specialists’ opinion informs us of an estimate of the percentage of the referral diabetes patients who could be consulted on remotely using a range of telemedicine solutions in different settings (i.e., where a GP is available, a nurse is hosting the remote consultation, or the patient is alone). Moreover, the process analysis of diabetes specialty consultations in an outpatient referral clinic enables us to identify various elements of such consultations. These elements can then be evaluated, where required, for the possibility of being conducted remotely by a GP, nurse, or trained health professional under supervision of the specialist.

The objectives of this study were:

- To systematically conceptualize the traditional in-person diabetes consultation provided by endocrinologists in an outpatient setting
- To provide a profile of patients referred to a specialist outpatient diabetes clinic
- To identify the frequency of various components of typical specialty consultations for diabetes care and recommendations made for each patient that might present challenges if substituted with telemedicine
- To assess the endocrinologist’s opinion on the possibility of using telemedicine instead of in-person consultation for each case of diabetes consulted

Materials and Methods

This observational study was conducted in the outpatient diabetes clinic of the Princess Alexandra Hospital, Brisbane, Australia. This is a tertiary referral hospital in the south metropolitan area of Brisbane. This hospital serves both its local population (over 1 million people) and the patients referred by regional hospitals and doctors. Around 75% of the patients seen in the diabetes outpatient clinic are referred by GPs, and the other 25% are internal referrals from other specialists within the hospital. All the consultant endocrinologists in the clinic were approached and asked to participate. They were requested to complete a questionnaire for each of the consultations for adult patients with diabetes in two clinic sessions. Consultations for patients younger than 18 years of age or patients with severe audio/visual disability were excluded.

The instrument used in this study was a questionnaire that was developed by a panel of endocrinologists who attended at the Princess Alexandra Hospital outpatient diabetes clinic, which reviews patients with diabetes referred from their GP. They were familiar with telemedicine solutions to various extents. The questionnaire comprised five sections: (1) patient’s characteristics, (2) reason for referral, (3) procedures and findings, (4) detailed management plan, and (5) specialist’s opinion on the possibility of providing the consultation remotely (Supplementary Fig. S1; Supplementary Data are available online at www.liebertpub.com/dia). Another
questionnaire was administered to assess the extent to which the specialists were familiar with and used information technology in their routine work.

The specialists’ opinion was sought on the possibility of providing each consultation remotely in five different scenarios: the patient alone; the patient with a GP; a GP without the patient present; a practice nurse with the patient; and a diabetes nurse educator with the patient. In each scenario, four modalities of telemedicine were proposed: telephone, e-mail, Internet video chat such as Skype™ (Microsoft®, Redmond, WA), and high-definition videoconferencing (i.e., using dedicated videoconferencing equipment).

Data were entered into Microsoft Excel for producing the descriptive statistics and then exported to R statistical software for analysis. Absolute numbers and percentages were used for presenting the demographic and baseline data. Logistic regression analyses were used to examine the predictive power of patients’ age, type of diabetes, performance of physical examination, and existence of any diabetes complication on the specialists’ opinion of the possibility of providing the consultation via telemedicine. No honorarium was offered to the participating specialists. The Human Research Ethics Committee of Queensland Health approved the study (protocol number HREC/11/QPAH/583–15/11/2011).

Results

Fifty consultations performed by five consultant endocrinologists in the Princess Alexandra Hospital outpatient diabetes clinic were analyzed. Each consultant completed between eight to 12 questionnaires in two clinical sessions.

Specialists’ profile

Five endocrinologists (three male and two female) participated in this study. The average experience of medical practice was 21.8 years (range, 12–31 years; SD, 8.7 years). They all used e-mail regularly in daily life, for discussing clinical problems with professional colleagues, and for interacting with their patients. Although just one of them was using videoconferencing for the purpose of medical practice, they all reported part of their practice could be conducted via video consultation.

Demographics

The age of the patients ranged from 21 to 87 years (mean ± SD, 54 ± 17 years), and 54% were male. More than half of the patients lived within 20 km of the clinic, and only two patients (4%) traveled more than 100 km to attend their appointment. Of 50 patients consulted on, 14 (28%) had type 1 diabetes, 32 (64%) patients had type 2, and the remainder (8%) had other types of diabetes. Patients’ demographic characteristics (i.e., age, gender, type, and duration of diabetes) were statistically similar among the specialists.

Reason for referral

The majority of patients (n=46; 92%) had previously been seen in the clinic and were scheduled for review appointments (review patients), and only four patients (8%) were referred for the first time (new patients). The new patients were referred to the clinic for management of (1) poor glycemic control, (2) diabetes complications, or (3) macrovascular risk factors. Prior to the consultation, 38 (76%) patients were taking insulin, and 26 (52%) were taking oral hypoglycemic agents. Thirty four (68%) patients presented with at least one diabetes complication. Neuropathy (42%) was the most prevalent complication. Nephropathy, retinopathy, ischemic heart disease, and diabetic foot ulcer were identified in 38%, 36%, 20%, and 8% of the patients, respectively.

Procedures and findings

The length of consultations varied from 15 to 60 min (mean ± SD, 28 ± 11 min). The specialists performed no physical examination in 17 (34%) cases. All new cases had a physical examination. Of the 33 cases in which a physical examination was performed, no important signs that would alter management were detected in 16 cases. Feet and

<table>
<thead>
<tr>
<th>Examination</th>
<th>Each examination performed (%)</th>
<th>Important sign detected in physical examination (% of those examined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feet</td>
<td>27 (54%)</td>
<td>7 (25.9%)</td>
</tr>
<tr>
<td>Assessment of pulses</td>
<td>26 (52%)</td>
<td>4 (15.4%)</td>
</tr>
<tr>
<td>Neurological exam</td>
<td>23 (46%)</td>
<td>7 (30.4%)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>19 (38%)</td>
<td>3 (15.7%)</td>
</tr>
<tr>
<td>Abdominal</td>
<td>19 (38%)</td>
<td>1 (5.2%)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>17 (34%)</td>
<td>0</td>
</tr>
<tr>
<td>Injection sites</td>
<td>14 (28%)</td>
<td>6 (42.8%)</td>
</tr>
<tr>
<td>Neurological</td>
<td>11 (22%)</td>
<td>1 (9.1%)</td>
</tr>
<tr>
<td>Eyes</td>
<td>3 (6%)</td>
<td>1 (33.3%)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (4%)</td>
<td>1 (50%)</td>
</tr>
</tbody>
</table>

**Table 1. Type of Examinations Performed and Frequency of Important Signs Detected by the Specialists (n=50)**

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Number of patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory</td>
<td>40 (80%)</td>
</tr>
<tr>
<td>Order lab test(s)</td>
<td>8 (16%)</td>
</tr>
<tr>
<td>Order other diagnostics (e.g., imaging)</td>
<td></td>
</tr>
<tr>
<td>Medication*</td>
<td></td>
</tr>
<tr>
<td>Initiate insulin</td>
<td>0</td>
</tr>
<tr>
<td>Initiate or titrate hypoglycemic agents apart from insulin</td>
<td>8 (16%)</td>
</tr>
<tr>
<td>Initiate or titrate a drug for cardiovascular risk factor reduction</td>
<td>14 (28%)</td>
</tr>
<tr>
<td>Adjustment of insulin regimen</td>
<td>26 (52%)</td>
</tr>
<tr>
<td>No change in medication</td>
<td>16 (32%)</td>
</tr>
<tr>
<td>Referral</td>
<td>9 (18%)</td>
</tr>
<tr>
<td>Refer to another specialist</td>
<td></td>
</tr>
<tr>
<td>Refer to allied health</td>
<td>15 (30%)</td>
</tr>
<tr>
<td>Arrange hospital admission</td>
<td>2 (4%)</td>
</tr>
<tr>
<td>General advice</td>
<td>46 (92%)</td>
</tr>
</tbody>
</table>

*The percentages do not add up to 100% because of cases with more than one medication change.
injection sites had the highest number of important signs detected during the physical examination. The specific physical examinations performed on the patients as well as the frequency of important signs detected by the specialists are summarized in Table 1. The performance rate of physical examination among the specialists was significantly different (Pearson’s $\chi^2$ test, $P < 0.01$). One specialist physically examined all the patients consulted, whereas other specialists performed physical examination just for a proportion of their patients (Fig. 1).

**Management plan**

In 16 cases (32%) no medication change was advised. After “general advice,” ordering laboratory tests and adjustment of an insulin regimen were the most frequent recommendations given in the consultations (Table 2). A follow-up visit was arranged for 47 (94%) patients, ranging from 1 to 52 weeks later (mean ± SD, 19 ± 13 weeks).

**Specialists’ opinion on the possibility of providing the consultation remotely**

The specialists reported that a GP or a trained nurse could perform the physical examination and report to them in 47 (94%) or 29 (58%) of the cases, respectively. From the specialists’ point of view, it was possible to provide the same consultation via high-definition videoconferencing in 86% of the cases if the patient was accompanied by a GP. The specialist considered that e-mail was the least favored means to provide a remote consultation (Table 3). Logistic regression analyses did not show any significant association between the potential explanatory effects of the patients’ age, gender, type of diabetes, presence of diabetes complication, or performance of physical examination with the specialists’ opinion on the possibility of remote consultation via videoconferencing. Generalized linear mixed-effects modeling with the specialist as a random effect did not improve the models fitted in logistic regression analyses (data not shown).

**Discussion**

Physician–patient communication and its impact on the patient’s health outcome have been researched in several studies, both in conventional in-person consultations as well as telemedicine encounters, but no studies were identified in the literature on clinimetric analysis of specialty consultation for chronic diseases and in particular diabetes. Although communication skills of the physicians and psychological factors have been shown to influence the outcome of medical consultations, little is documented about the various components of outpatient specialty consultations and hence the possibility of provision of such services remotely via telemedicine modalities. To our best knowledge, this is the first report on the clinimetric characteristics of specialty outpatient consultations for diabetes management.

The contribution of history taking and physical examination in diagnosis and management of health conditions has been traditionally highlighted by several studies. However,
physicians’ estimate of the most important components of clinical encounters varies significantly by the disease. For example, in a survey of 313 U.S. physicians, 95% estimated laboratory tests as the most important component in clinical encounters for the management of diabetes, followed by patient history (19%) and physical examination (9%). But for management of rheumatoid arthritis, patient history and physical examination received the highest estimation by 74% and 65% of the physicians, followed by 19% for laboratory tests.

The results of this study show that it is possible, from the specialists’ point of view, to substitute video teleconsultation for a significant proportion of in-person specialist diabetes consultations. A well-known limitation of telemedicine— inability to perform a complete physical examination—did not appear to be a barrier with many diabetes review patients. Evidence regarding the impact of physical examination on the outcome of a specialty consultation for diabetes is scant. It has been shown that the contribution of physical examination to the diagnosis of conditions like dementia is not significant if the results of laboratory examinations and imaging investigations are accessible. Also, it is feasible to conduct physical examination remotely through videoconferencing by a trained health worker under supervision of a specialist. Depending on the modality used for telemedicine, there will be various degrees of limitations on performing physical examination remotely. Videoconferencing has been shown to be more effective and more acceptable compared with a telephone call for clinical purposes. Thirty-four percent (n = 50) of the consultations in this study were provided without any physical examination by the specialists. This indicates that the history and clinical data seemed to be sufficient for the specialist to make a final recommendation in a considerable proportion of outpatient visits. This observation suggests that it could be possible to predict which patient needs physical examination during a diabetes specialty consultation. In fact, most of the comprehensive physical examinations for the management of diabetes have been recommended to be performed on an annual basis. Our finding supports the anecdotal evidence that the specialists do not need in all consultations to physically examine the patient to give advice on the patient’s management plan. Moreover, the significant difference between the practice styles of the specialists in terms of performing physical examination for their patients suggests the effect of personality or habits of individual physicians on their clinical practice. It is also noteworthy to mention that the percentage of consultations in which physical examination is not performed could have been even higher than what we are reporting. It has been evident that physicians may temporarily alter the quality of care when their practice is being surveyed by a researcher (the Hawthorne effect).

In 32% of the specialist consultations, there was no adjustment made to the current treatment regimen. The most common change in therapy was adjustment of insulin dose. All changes in management could theoretically be conveyed and acted upon remotely. In Australia, Medicare Benefits Schedule item numbers are available for reimbursement for remote consultations rendered by specialists via videoconferencing for patients in remote, regional, or outer metropolitan areas. Similar item numbers were also introduced for the patient-end services provided by GPs, nurse practitioners, midwives, or other eligible practitioners during the video consultation with the specialist. However, video consultation is potentially a more expensive solution than conventional consultation at present, not only for the needed equipment and technical requirements, but also for administration and coordination. Because of the financial burden of video consultation, especially in the countries where remote consultations are not reimbursed, deciding on this option needs to be informed by proper economic evaluations. A systematic review of real-time videoconferencing for telehealth services showed mixed economic results for rural service delivery.

Unsurprisingly, asynchronous telemedicine and consulting the patient directly with no healthcare provider present were less desirable as a substitution for in-person consultations from the specialists’ point of view. Using e-mail for interacting with the patient without any GP or nurse involved was the least favored configuration for the provision of the consultations remotely (8%). Provision of the consultation via high-definition videoconferencing where the patient was accompanied by a GP received the highest rate of acceptability (86%) to replace traditional in-person consultations, according to the specialists’ opinion. There was some reluctance to do the video consultation with the patient alone. Although just one of the study specialists had ever used videoconferencing for clinical practice, all reported that part of their medical practice could be done remotely via video. No statistically significant relationship was seen between the level of specialists’ information technology skills and experiences and their opinion on the possibility of using videoconferencing for remote consultation. All the recommendations that specialists made for the patients are capable to be made remotely should the legal and administrative measures allow for such interactions.

Our study raised several questions for future research. First, which factors have the highest predicting power on the suitability of a clinical consultation to be provided remotely? Second, acknowledging that a remarkable proportion of specialty consultations for diabetes patients are thought to be able to be provided from a distance, what would be the optimal model of care for exploiting telemedicine for managing diabetes? Would it be safe and reliable to conduct an

### Table 3. Possibility of Providing the Consultation Remotely from the Specialists’ Point of View (n = 50)

<table>
<thead>
<tr>
<th>Setting</th>
<th>Telephone</th>
<th>E-mail</th>
<th>Internet video chat</th>
<th>HD VC</th>
</tr>
</thead>
<tbody>
<tr>
<td>The patient alone at the remote site</td>
<td>17 (34%)</td>
<td>3 (6%)</td>
<td>20 (40%)</td>
<td>24 (48%)</td>
</tr>
<tr>
<td>Case presented by a GP without the patient present</td>
<td>23 (46%)</td>
<td>4 (8%)</td>
<td>23 (46%)</td>
<td>26 (52%)</td>
</tr>
<tr>
<td>A GP with the patient present</td>
<td>29 (59%)</td>
<td>5 (10%)</td>
<td>30 (60%)</td>
<td>43 (86%)</td>
</tr>
<tr>
<td>A practice nurse with the patient present</td>
<td>21 (42%)</td>
<td>5 (10%)</td>
<td>22 (44%)</td>
<td>34 (68%)</td>
</tr>
<tr>
<td>A diabetes nurse educator with the patient present</td>
<td>23 (46%)</td>
<td>5 (10%)</td>
<td>24 (48%)</td>
<td>37 (74%)</td>
</tr>
</tbody>
</table>

GP, general practitioner; HD VC, high-definition videoconferencing.
in-person consultation once a year and perform the intervening review consultations remotely?

This study has several limitations that make it difficult to generalize the results. The number of consultations studied is relatively low. Also, the setting used for this study was an outpatient diabetes clinic in a tertiary teaching hospital. This setting may not be representative of all diabetes specialty consultations, especially in countries that have not implemented a referral system for the patients to receive a specialty opinion. Another limitation of the study is that we acquired specialists’ opinion on the possibility of using telemedicine for each case after they had consulted on the patient. In reality, the decision on suitability of each case for remote consultation needs to be made prior to the consultation. It is not clear to what extent these opinions would match those acquired without patient contact and just relying on the patient records and GP referral note.

Conclusions

Physical examination was not performed for almost one-third of patients during their specialist consultation. All types of recommendations made in the consultations (i.e., laboratory orders, changes in medication, and referrals) can be enacted remotely. Specialists with little telemedicine experience report that a considerable proportion of outpatient specialty consultations for people with diabetes can be provided remotely via videoconferencing. Telemedicine should be a viable and safe option to deliver specialist diabetes services to rural and remote areas.

Author Disclosure Statement

No competing financial interests exist.

F.F. contributed to the design of the study, collected and researched data, and wrote the manuscript. L.C.G. and A.W.R. designed the study and reviewed and revised the manuscript. F.F. is the sole guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of data analysis.

References


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7. Process Analysis of Video Consultations in a Tele-Endocrinology Clinic

7.1. Paper Information

Telemedicine can improve access to care, especially for people who are living in remote and rural areas. It is a feasible mode of health care delivery for people with chronic conditions, who need ongoing care often for a long time. Despite the growing number of real-time telemedicine services using videoconferencing in many countries, little has been published on the processes and procedures of video consultations. Most of the research to date on video consultation is focused on the verbal contents of the interviews, or behaviours of each party. Nothing has been published on the clinical nature of video consultations.

The aim of this study was to examine the practice of video consultation in a tele-endocrinology clinic where endocrinologists consult diabetic patients remotely, and analyse the consultations provided videoconferencing.

The following paper has been published in the Journal of Telemedicine and Telecare (2013), Volume 19, Issue 7, pages 379-382. The candidate, Farhad Fatehi, was primarily responsible for conducting the research and writing the manuscript. The paper's co-author, Leonard C Gray and Anthony W Russell, contributed to this paper in various aspects as listed in the preliminary pages of this thesis.
Telemedicine for clinical management of diabetes – a process analysis of video consultations

Farhad Fatehi1,2, Leonard C Gray1,3 and Anthony W Russell4,5

Summary
We analysed 56 video consultations provided in a 5-month period by two endocrinologists from the tele-endocrinology clinic of a tertiary teaching hospital in Brisbane. The patients were suffering from type 1 or type 2 diabetes, and 41% of them had at least one diabetic complication. Their mean age was 51 years and 45% were female. The consultations were provided to ten cities located 210–1800 km from Brisbane. A questionnaire was developed for analysing the video visits. It comprised 26 questions, arranged in six sections: (1) Patient characteristics, (2) Reason for referral, (3) Procedures and findings, (4) Recommendations, (5) Telehealth logistics, (6) Consultant’s opinion. In 66% of consultations a nurse accompanied the patient. The specialist requested the nurse to perform a physical examination in 18% of these cases. No change in medications was made in 36% of the consultations. The most frequent recommendations were requesting laboratory tests (75%), insulin dose adjustments (39%) and referrals to an allied health professional (13%). Out of 56 consultations, the specialists indicated the need to perform a physical examination for 12 patients that was not possible remotely. However, they requested an in-person (face-to-face) visit for three patients. Nevertheless they believed that in 34% of the cases they could have made a better decision if the consultation had been in-person. Video consultation can substitute for a large proportion of in-person specialist consultations for people with diabetes who are referred to endocrinology specialists.

Accepted: 1 September 2013

Introduction
Managing diabetes is complex and costly, and remains a challenge in many countries. Adequate access to high quality care is required to improve the outcome of this disease, but there is marked disparity in access to care between urban and rural residents.1 Residents of rural and remote areas suffer from lower quality of diabetes care.2

Telemedicine can improve access to health care services, especially for people living in remote and rural areas. Despite the growing popularity of telemedicine for improving access to care, little has been published on the nature of consultations provided remotely via videoconferencing. Several studies have analysed physician-patient interactions, but they have all focused on the content of verbal interactions3,4 or the behaviours of each party.5,6 We are not aware of studies on the process and elements of teleconsultation from a clinical point of view.

The aim of the present study was to examine the practice of using videoconferencing for remote consultation of people with diabetes who were referred to an endocrinology specialist by their general practitioner (GP), and analyse the process of care provided for them.
2000 km from Brisbane (Figure 1). The telehealth studio in the diabetes clinic is equipped with a videoconferencing unit (990MXP, Tandberg) and an 81-cm flat-screen display. The unit provides a wide-angle view of the room, and the camera can be controlled locally by the provider and remotely by the recipient (Figure 2). Remote sites are equipped with similar devices.

**Administration and coordination**

The patients were normally referred to the diabetes telehealth clinic by their GP. A diabetes nurse educator checked the patients’ records and contacted the patients one week before the telehealth appointment to remind them of the forthcoming video consultation and the necessity for some blood tests. At the remote site, a nurse often accompanied the patient. She provided the patient’s latest clinical data, if not communicated beforehand, and performed any physical examinations under the direction of the specialist if required.

The patients’ data were accumulated and maintained partly in hardcopy at the provider site and partly electronically through an electronic patient record which is accessible through the Queensland Health IT network. After a series of specialist consultations, when satisfactory blood glucose level achieved, the patient was referred back to the GP for regular follow-up. Ethics permission was not required for the study.

**Questionnaire**

A questionnaire was developed for analysing the video consultations. It comprised 26 questions, arranged in six sections: (1) Patient characteristics, (2) Reason for referral, (3) Procedures and findings, (4) Recommendations, (5) Telehealth logistics, and (6) Consultant’s opinion. The questions were developed by observing conventional diabetes consultations and seeking advice from a panel of experts in telemedicine, each with more than five years of experience with clinical videoconferencing. The questionnaire was pilot tested in four video consultations and modifications were made to the questions as suggested by the specialists and the researchers.

**Analysis**

To examine any associations between the characteristics of the patients and the specialists’ perceived suitability for videoconferencing, we carried out a cross-tabulation using a standard package (SPSS, version 21). The chi-squared test was used to test for significance.

**Results**

A total of 56 video consultations were analysed. The patients were aged 14–81 years (mean 51). The characteristics of the patients are summarised in Table 1. Of the 56 video consultations, 46 (82%) were review consultations and 10 (18%) were new consultations. In 37 (66%) cases, the patient was accompanied by a nurse whereas in 16 (29%) cases the patient was alone or with a family member at the remote site. In three cases, the patient was not present at the consultation and the case was discussed with a nurse or a family member.

**Physical examination**

In 49 consultations (88%) no physical examination was performed. In seven cases, the nurse physically examined...
injection sites, patients' feet and cardiovascular system as requested by the specialist and reported back to him. In three out of seven patients for whom the specialist asked for a physical examination, a new important sign was detected that it was believed would influence the management plan.

**Management of the patients**

The patients' management plan was confirmed by the specialists in 21 (37%) of the consultations with no change needed. In the remaining 35 consultations, the medications of the patient were changed in terms of initiation, dose adjustment, change regimen or cessation of one or more medicines (Table 2). Apart from medications, the specialists made several recommendations for the patients as shown in Table 3.

### Follow-up

The specialists arranged for a follow-up visit through video consultations for 48 (86%) patients. The follow-up consultations were requested for the following 2–52 weeks (mean 11). For three patients (5%), the specialists needed to arrange an in-person consultation for optimum management of their condition.

### Technical performance

During the 56 consultations, one video problem occurred (loss of video during the consultation). No audio, connectivity or other type of technical problem occurred.

### Access to clinical data

The specialists had access to the patients' clinical data in various forms such as hard copy (25; 45%), electronic patient records (14; 25%), asking the patient verbally (11; 20%), forms sent by fax (6; 11%), visually through the screen (5; 9%) or received via email (2; 3%). For 22 patients (39%), the specialists did not have access to all the clinical data they needed, and in 12 cases (21%) they needed to perform a physical examination that was not possible via video consultation.

### Specialists' opinions

The specialists believed that the necessary physical examination could be performed adequately by a GP or a trained nurse in 100% and 96% of the cases, respectively. Nevertheless, they stated that they could have made a

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**Table 1.** Patient characteristics.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>31 (55)</td>
</tr>
<tr>
<td>Female</td>
<td>25 (45)</td>
</tr>
<tr>
<td><strong>Distance to the state’s capital city (km)</strong></td>
<td></td>
</tr>
<tr>
<td>200–1000</td>
<td>16 (29)</td>
</tr>
<tr>
<td>More than 1000</td>
<td>40 (71)</td>
</tr>
<tr>
<td><strong>Type of diabetes</strong></td>
<td></td>
</tr>
<tr>
<td>Type 1</td>
<td>18 (32)</td>
</tr>
<tr>
<td>Type 2</td>
<td>37 (66)</td>
</tr>
<tr>
<td>Other type</td>
<td>1 (2)</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
</tr>
<tr>
<td>Insulin</td>
<td>44 (79)</td>
</tr>
<tr>
<td>Other hypoglycaemic agents</td>
<td>12 (21)</td>
</tr>
<tr>
<td><strong>Complications</strong></td>
<td></td>
</tr>
<tr>
<td>Neuropathy</td>
<td>7 (12)</td>
</tr>
<tr>
<td>Nephropathy</td>
<td>15 (27)</td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>6 (11)</td>
</tr>
<tr>
<td>Retinopathy</td>
<td>4 (7)</td>
</tr>
<tr>
<td>Diabetic foot</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Other complications</td>
<td>2 (4)</td>
</tr>
<tr>
<td>None</td>
<td>27 (48)</td>
</tr>
</tbody>
</table>

*the percentages do not add up to 100% because of cases with more than one complication.

**Table 2.** Changes in management of the patients' medications (changes made in 35 of the 56 consultations). Values shown are numbers (%).

<table>
<thead>
<tr>
<th>Medication Type</th>
<th>Initiation of a medication</th>
<th>Adjustment of dose</th>
<th>Change of regimen</th>
<th>Cessation of a medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin</td>
<td>2 (4)</td>
<td>22 (39)</td>
<td>1 (2)</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Oral hypoglycaemic agents</td>
<td>2 (4)</td>
<td>6 (11)</td>
<td>1 (2)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Hypotensive agents</td>
<td>1 (2)</td>
<td>0</td>
<td>1 (2)</td>
<td>0</td>
</tr>
<tr>
<td>Anti-lipid agents</td>
<td>2 (4)</td>
<td>1 (2)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other medications</td>
<td>1 (2)</td>
<td>2 (4)</td>
<td>1 (2)</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 3.** Recommendations apart from medication change.

<table>
<thead>
<tr>
<th>Recommendation Type</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order laboratory tests</td>
<td>42 (75)</td>
</tr>
<tr>
<td>Refer to an allied health professional</td>
<td>7 (12)</td>
</tr>
<tr>
<td>Refer to another specialist</td>
<td>4 (7)</td>
</tr>
<tr>
<td>Order other diagnostic tests</td>
<td>2 (4)</td>
</tr>
<tr>
<td>Arrange hospital admission</td>
<td>1 (2)</td>
</tr>
<tr>
<td>General advice</td>
<td>7 (12)</td>
</tr>
<tr>
<td>Other recommendations</td>
<td>7 (12)</td>
</tr>
</tbody>
</table>

*the percentages do not add up to 100% because of cases with multiple recommendations.
better decision in 19 consultations (34%) if it had been an in-person encounter. No significant difference was found between the specialists’ opinion on the possibility of making better decision and the baseline characteristics of the patients (i.e. age, gender, type of diabetes, treatment plan or having diabetes complications).

Discussion

The present study showed that in a high proportion of cases the specialist endocrinologists were confident with their recommendations for patients with diabetes made via videoconferencing. The inability to perform a physical examination was not a limiting factor. The specialists thought that the discussion with the patient, in addition to access to clinical data, was adequate for conducting a consultation remotely. Also, the specialists believed that GPs and nurses could safely perform any required physical examination on behalf of the specialists.

All of the recommendations made for the management of diabetes could be enacted remotely. Although the specialists thought that in 34% of the consultations they could make a better decision if the consultation was in-person, they actually needed to see the patient in-person only in 5% of the cases. This decision could be regarded as a trade-off between the quality of care, and the cost or inconvenience of taking a long trip by the patients to attend a conventional specialist clinic. Long distances between patients and major hospitals can make telemedicine the only choice for patients who otherwise would not have access to specialist care. The present findings complement those from a previous study which analysed the process of conventional diabetes consultation.7 The process analysis of in-person diabetes consultations showed no change in medication of the patients in 32% of the cases, which is similar to the value in the present study (37%).

It appears that no single patient characteristic is a significant predictor of the suitability of telemedicine for outpatient diabetes consultations. The results of the present study support the alternative model suggested by Toledo et al.5 to increase access to specialist care for people with diabetes who are living in remote and rural areas. An initial video consultation is an acceptable alternative to an in-person interaction. If a physical examination is considered necessary, the specialist can either arrange a follow-up consultation in person, or arrange for a local practitioner to perform the requisite examination. Although videoconferencing is often used in the clinical management of diabetes, there are few published reports of such activities. Most publications on telemedicine for diabetes report patient education, remote monitoring and improving self-management.

The present study had certain limitations that might reduce the generalizability of the results. The data network used was highly reliable but similar networks may not be available in all countries. Also the study design did not allow us to identify any potential cases in which the management of patients was suboptimum. Studies with more rigorous design, such as reliability studies or clinical trials comparing telediabetes with in-person consultations, are needed to assess the safety of clinical management of diabetes via telemedicine.

Conclusion

Process analysis of video consultations of people with diabetes showed that most of the elements of specialty consultation could be performed remotely. The inability to examine the patient physically does not seem to be a limiting factor. Video consultation can substitute for a large proportion of in-person specialist consultations for people with diabetes who are referred to endocrinology specialists.

Acknowledgements

We thank Dr Grant Cracknell and Ms Christine Sheehan for their kind cooperation with this study.

References


8. PATIENT SATISFACTION WITH VIDEO CONSULTATION FOR DIABETES

8.1. Paper Information

Patient satisfaction is important in successful implementation of telemedicine services. Most of published papers on satisfaction with telemedicine were part of exploratory, demonstration, or feasibility studies, and very few studies have reported the satisfaction for patients with a routine telemedicine service. Nevertheless, no instrument was found in the literature specifically designed for assessing the patient satisfaction with videoconferencing. The aim of this study was to develop a questionnaire for assessing patient satisfaction with video tele-consultations and preliminarily evaluate it in a routine tele-endocrinology clinic.

The following paper has been published in Diabetes Technology & Therapeutics (2015), Volume 17, Issue 1, [Epub ahead of print]. The candidate, Farhad Fatehi, was primarily responsible for conducting the research and writing the manuscript. The paper's co-author, Melinda Martin-Khan, Anthony C Smith, Anthony W. Russell and Leonard C Gray, contributed to this paper in various aspects as listed in the preliminary pages of this thesis.
Patient Satisfaction with Video Teleconsultation in a Virtual Diabetes Outreach Clinic

Farhad Fatehi, MD, MSc; Melinda Martin-Khan, PhD; Anthony C. Smith, PhD; Anthony W. Russell, MD, PhD; and Leonard C. Gray, MD, PhD

Abstract

Objective: This study assessed the level of patient satisfaction with diabetes remote consultations via videoconferencing in a virtual outreach clinic. Materials and Methods: A cross-sectional observational survey was conducted of people with diabetes who were living in regional cities of Queensland, Australia, and remotely consulted by endocrinologists at the Princess Alexandra Hospital tele-endocrinology clinic in Brisbane during autumn 2013. A questionnaire with 15 multiple-choice questions and one open-ended question was developed for assessing patient satisfaction with videoconferencing for specialty consultation. The questionnaire items showed strong internal consistency (Cronbach’s α = 0.90). Patient satisfaction was assessed by this 16-item questionnaire exploring four dimensions: equipment/technical issues; communication and rapport; clinical assessment; and program evaluation. Results: In total, 62 questionnaires were mailed to the patients, with 24 (39%) surveys completed and returned. The quality of video had the highest satisfaction rate (100%). The lowest satisfaction scores were reported in the “Clinical Assessment” dimension, in which 21% of respondents (five of 24) were concerned that the lack of physical contact could be a problem for managing their diabetes. The patients did not report any problem with building rapport with their consultant over the videoconference. Conclusions: The patients with diabetes who were seen remotely by endocrinologists via videoconferencing were generally satisfied with remote consultation. The questionnaire developed specifically for diabetes video teleconsultation in this study is useful for the measurement of patient satisfaction, and a modified version may be used in other clinical specialties.

Introduction

Satisfaction is an important quality indicator of healthcare services. It is a complex concept and multidimensional construct that is affected by many parameters. Several definitions have been proposed for satisfaction, but no consensus has been reached. Although some authors have provided complex psychological models and relate it to human cognition, in most studies satisfaction is regarded as a match between a patient’s expectations and the services that he or she receives. Thus, dissatisfaction occurs when patients do not receive the healthcare service they were expecting (i.e., a marked mismatch between expectations and experience). Although the importance of qualitative methods such as observation, in-depth interviews, and focus group discussion has been increasingly acknowledged, most satisfaction studies still use quantitative methods that rely on administering a questionnaire. Patient satisfaction questionnaires traditionally use measures such as Likert scales, Guttman scales, or semantic differential scales. In the field of telemedicine, researchers have emphasized that successful implementation and adoption of telemedicine services depend on acceptance and satisfaction of both healthcare consumers and service providers. Despite numerous publications on patient satisfaction with telemedicine, it has been identified that this aspect of telemedicine needs further investigation. The published works on telemedicine satisfaction tend to rely on a general assumption that both patient and provider levels of satisfaction with telemedicine are high. Thus further research on patient satisfaction has been a lower
priority compared with other domains of telemedicine research such as effectiveness, reliability, or economic benefit. However, there are several insufficiencies associated with satisfaction studies that limit the generalizability of the findings. In addition to general shortcomings of satisfaction studies such as inability to identify the concept and ambiguity in the definition of outcome measures, most of the telemedicine satisfaction studies have been part of exploratory, demonstration, or feasibility studies, rather than surveying a well-established and operational telemedicine service. Furthermore, the patient selection criteria and refusal rate have not been clearly stated in most studies. This suggests the possibility of selection bias in favor of higher levels of satisfaction.

In a systematic review of literature, Mair and Whitten analyzed the quality of the satisfaction studies of real-time telemedicine services and more specifically video consultation for publications from 1989 to 1998. They highlighted several limitations with the published work. Only a few studies defined satisfaction, and of those that did, all used different definitions. Therefore it was not possible to discern from the studies which satisfaction parameters they have evaluated. The settings of the studies were also quite heterogeneous. For instance, one of the largest U.S. studies in this field was conducted in a prison setting, which is quite different from the usual clinical environment.

Because telemedicine research involves the use of a range of modalities and communication technologies, it is challenging to find a universal set of questions that apply to all telemedicine solutions. For example, a questionnaire developed for a store-and-forward telemedicine project is not suitable for interactive video consultations, and vice versa. As videoconferencing is gaining more popularity for both patient education and remote consultation, there is a need for the development of a reliable and validated instrument for assessing the level of satisfaction with the services that are delivered remotely via videoconference. The aim of this study was to evaluate patient satisfaction with interactive video teleconsultation in a virtual diabetes outreach clinic.

Materials and Methods

Settings of the virtual outreach clinic

The Princess Alexandra Hospital (PAH) is a tertiary teaching hospital in Brisbane, QLD, Australia. It operates a wide range of conventional outpatient clinics, including diabetes and endocrinology. Recently, the PAH Telehealth Centre was established to enhance the capacity of several traditional outreach clinics serving rural areas of Queensland by means of interactive videoconferencing. Specialist doctors from several clinical disciplines, including diabetes and endocrinology, as well as cardiology, orthopedics, geriatrics, and dermatology, provide teleconsultations via videoconferencing to those patients referred by their general practitioner (GP) for specialty consultation. The details of the telemedicine service for diabetes patients and analysis of the process of care provided remotely to them have been published elsewhere. The service delivery conforms to the hub-and-spoke model, in which all the administration and coordination tasks are carried out centrally from the PAH (the hub). The distance of remote sites (the spokes) from the hub varies from 220 km to 1,700 km (Fig. 1).

FIG. 1. The locations of cities where the diabetes remote consultation was delivered, with their distance to Brisbane, the capital city of Queensland. Color images available online at www.liebertpub.com/dia

The patients who are living elsewhere need to travel to the nearest health center (spoke) to access a videoconferencing system for their teleconsultation with a specialist based in Brisbane. The videoconferencing is achieved using the Queensland Health Wide Area Network, which is a high-speed network that connects to all Queensland Health end points across the state. Both local and remote sites are equipped with dedicated videoconferencing units, including TV screen, commercial grade codec, pan-tilt-zoom camera, and microphone. The general connection speed (technically referred to as bandwidth) ranges from 512 kbits/s to 2.3 Mbits/s, depending on the site-specific connections. The video consultation is hosted by a local clinician (doctor, nurse, or allied health professional) when available. In some cases, the patient may be accompanied by a friend or family member during the videoconference.

Development of the questionnaire

No validated questionnaire was found in the published literature for assessing satisfaction of patients with video teleconsultation. The main domains of satisfaction with real-time telemedicine were identified through review of the literature, and a set of questions was accumulated from three relevant studies. After duplicate and similar items were
removed, 16 questions were selected by a panel of experts. The panel comprised two specialist doctors (one endocrinologist and one geriatrician) with at least 5 years of video teleconsultation experience and two senior researchers with more than 9 years of research in the field of telemedicine.

A questionnaire with 15 multiple-choice questions and one open-ended question was developed to assess satisfaction of diabetes patients who have had an appointment with their endocrinologist via videoconference. The multiple-choice questions scored on a 5-point Likert-type scale (from 1 for strongly disagree to 5 for strongly agree). These questions covered four domains of satisfaction with the video consultation: equipment and technical issues (three questions); communication and rapport (three questions); clinical assessment (four questions); and overall evaluation of the program (five questions). The open-ended free-text question enabled the participants to comment on their experience with the video consultation and express their opinion in this regard (Table 1).

The questionnaire had a scoring range of 15–75. A score of 15 indicates all responses as “strongly disagree,” and a score of 75 means all responses were “strongly agree.” Higher scores favor video consultation, and lower scores favor conventional face-to-face consultations. The overall internal consistency (Cronbach’s $\alpha$) of the questions was 0.90, which indicates a strong correlation between the 15 items of the questionnaire. It was 0.80 for the equipment/technical issues, 0.64 for the communication/rapport, 0.82 for medical concerns, and 0.85 for the program evaluation (Table 2). For new questionnaires, an internal consistency of more than 0.7 is regarded as acceptable.20

**Participants**

Those people with diabetes who had a video consultation with specialists at the PAH Telehealth Centre between March and May 2013 were included in the study. The questionnaire was mailed to the patients’ postal address along with a prepaid self-addressed envelope for returning the completed questionnaire. The questionnaire was anonymous. It was decided that the completed questionnaire would be returned to the research team (not the healthcare providers), to minimize the potential for biased responses. The study protocol was approved by the appropriate institutional ethics committee (reference number HREC/12/QPAH/479). Participation in the study was voluntary, and completing the survey implied a participant’s consent.

**Statistical analyses**

Reliability of the instrument was measured by internal consistency among all questions as well as within each of the four subgroups. Internal consistency was evaluated by Cronbach’s $\alpha$. No attempt was made to assess the repeatability of the instrument. As the survey was completed anonymously, it was not possible to report demographic information or compare information between respondents and nonrespondents.

**Results**

**Patients’ satisfaction with video teleconsultation**

In total, 62 questionnaires were sent via mail to patients who had video consultations with a specialist at the PAH Telehealth Centre, and 24 completed questionnaires were returned. We were not able to check what proportion of questionnaires was delivered to the intended persons and how many were sent back to the researchers. There are anecdotes on instances of failure of postal delivery services in rural areas in which the subjects of this survey resided.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Item number</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment/technical issues</td>
<td>1</td>
<td>I was satisfied with the quality of the picture (video) during the videoconference.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>I was satisfied with the quality of the sound (audio) during the videoconference.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>I experienced NO technical difficulties during the videoconference (e.g. unexpected disconnections, loss of sound or picture, etc.).</td>
</tr>
<tr>
<td>Communication and rapport</td>
<td>4</td>
<td>The videoconference did not make me feel nervous and uncomfortable.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>I could easily explain my medical problems to the doctor in the video visit.</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>I took my doctor’s advice given by video seriously.</td>
</tr>
<tr>
<td>Clinical assessment</td>
<td>7</td>
<td>I was confident that the clinician could assess my condition via videoconferencing as if I was there.</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>I believe the doctor understood my blood sugar situation during the video visit.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>I was confident that the doctor could evaluate my medication requirements (insulin or tablets) via video visit.</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>The lack of physical contact in a video visit is NOT a problem for managing diabetes.</td>
</tr>
<tr>
<td>Program evaluation</td>
<td>11</td>
<td>Telehealth enables me to save money and time.</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Telehealth improves my access to specialist care.</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>I would like to use telehealth again in the future.</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>I believe that a video visit is good for achieving good control of my diabetes.</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>I prefer to have my next consultation via video visit.</td>
</tr>
<tr>
<td>Comments</td>
<td>16</td>
<td>If you have any comments or suggestions about the telehealth service please note here.</td>
</tr>
</tbody>
</table>
Patients’ responses to the questionnaire on satisfaction with videoconferencing are summarized in Table 3. On average, more than 22 of the 24 respondents were satisfied/highly satisfied with the equipment and technical features of the videoconference appointment. Also, almost all (23 of 24) of the patients were satisfied with their communication with the specialist via videoconference. The primary focus of dissatisfaction for patients was the perception of the clinical assessment through video consultation. Five respondents reported that the lack of physical contact could be a problem for managing diabetes. Almost all the participants (23 of 24) reported that telemedicine had improved their access to specialist care and would like to use the service again.

### Table 2. Analysis of the Questionnaire Items for Cronbach’s $\alpha$

<table>
<thead>
<tr>
<th>Item number</th>
<th>Mean of total score if deleted</th>
<th>Variance of total score if deleted</th>
<th>Corrected item-total correlation</th>
<th>Cronbach’s $\alpha$ if deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60.4</td>
<td>49.6</td>
<td>0.30</td>
<td>0.90</td>
</tr>
<tr>
<td>2</td>
<td>60.6</td>
<td>44.8</td>
<td>0.62</td>
<td>0.89</td>
</tr>
<tr>
<td>3</td>
<td>60.6</td>
<td>47.7</td>
<td>0.41</td>
<td>0.90</td>
</tr>
<tr>
<td>4</td>
<td>60.6</td>
<td>48.6</td>
<td>0.41</td>
<td>0.90</td>
</tr>
<tr>
<td>5</td>
<td>60.7</td>
<td>46.7</td>
<td>0.62</td>
<td>0.90</td>
</tr>
<tr>
<td>6</td>
<td>60.5</td>
<td>48.0</td>
<td>0.49</td>
<td>0.90</td>
</tr>
<tr>
<td>7</td>
<td>61.0</td>
<td>43.4</td>
<td>0.68</td>
<td>0.89</td>
</tr>
<tr>
<td>8</td>
<td>60.8</td>
<td>45.2</td>
<td>0.61</td>
<td>0.89</td>
</tr>
<tr>
<td>9</td>
<td>60.8</td>
<td>42.8</td>
<td>0.76</td>
<td>0.89</td>
</tr>
<tr>
<td>10</td>
<td>61.4</td>
<td>40.8</td>
<td>0.60</td>
<td>0.90</td>
</tr>
<tr>
<td>11</td>
<td>60.5</td>
<td>46.0</td>
<td>0.49</td>
<td>0.90</td>
</tr>
<tr>
<td>12</td>
<td>60.6</td>
<td>45.4</td>
<td>0.77</td>
<td>0.89</td>
</tr>
<tr>
<td>13</td>
<td>60.6</td>
<td>45.1</td>
<td>0.80</td>
<td>0.89</td>
</tr>
<tr>
<td>14</td>
<td>60.1</td>
<td>43.6</td>
<td>0.73</td>
<td>0.89</td>
</tr>
<tr>
<td>15</td>
<td>61.0</td>
<td>44.2</td>
<td>0.66</td>
<td>0.89</td>
</tr>
</tbody>
</table>

### Table 3. Survey Results

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment/technical issues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I was satisfied with the quality of the picture (video) during the videoconference.</td>
<td>8</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I was satisfied with the quality of the sound (audio) during the videoconference.</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>I experienced NO technical difficulties during the videoconference (e.g., unexpected disconnections, loss of sound or picture, etc.).</td>
<td>2</td>
<td>8</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication and rapport</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The videoconference did not make me feel nervous and uncomfortable.</td>
<td>12</td>
<td></td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I could easily explain my medical problems to the doctor in the video visit.</td>
<td>1</td>
<td>14</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I took my doctor’s advice given by video seriously.</td>
<td>11</td>
<td></td>
<td>13</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Clinical assessment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I was confident that the clinician could assess my condition via videoconferencing as if I was there.</td>
<td>2</td>
<td>1</td>
<td>13</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>I believe the doctor understood my blood sugar situation during the video visit.</td>
<td>1</td>
<td>1</td>
<td>13</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>I was confident that the doctor could evaluate my medication requirements (insulin or tablets) via video visit.</td>
<td>2</td>
<td></td>
<td>13</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>The lack of physical contact in a video visit is NOT a problem for managing diabetes.</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Program evaluation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telehealth enables me to save money and time.</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Telehealth improves my access to specialist care.</td>
<td>1</td>
<td>11</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would like to use telehealth again in the future.</td>
<td>1</td>
<td>10</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I believe that a video visit is good for achieving good control of my diabetes.</td>
<td>1</td>
<td>3</td>
<td>12</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>I prefer to have my next consultation via video visit.</td>
<td>1</td>
<td>3</td>
<td>12</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Data are the number of responses in each category.
Patients' comments on the remote consultation service

One-third (eight of 24) of the respondents provided comments in the open-ended question regarding their opinion and experience of remote consultation via videoconferencing. Five patients expressed their appreciation and satisfaction with the service, mostly because of avoidance of travel and saving money. One respondent was concerned that the strict scheduling of telehealth appointments could introduce the feeling of being rushed in order to keep to schedule. One respondent expressed unhappiness with the nurse who hosted the remote consultation, and finally one respondent expressed his or her preference for in-person consultation rather than video teleconsultation.

Discussion

Telemedicine differs from conventional face-to-face encounters in several ways that may adversely affect the doctor–patient relationship. Inability to perform a physical examination and decreased nonverbal communication are among the most important concerns in remote consultations.21 These characteristics may contribute to patient dissatisfaction. However, a recent comprehensive literature review shows that videoconferencing has been used for remote consultation of patients in a range of medical disciplines, including the ones that may rely more on physical examination, such as neurology.22 Previous studies have evaluated the level of satisfaction with telemedicine services from various perspectives, but no validated questionnaire was found in the literature specifically designed for video teleconsultation. In this study, we developed a patient satisfaction questionnaire and evaluated the level of diabetes patient satisfaction with remote video consultations.

Our survey showed that some patients were concerned with the lack of physical contact in remote consultation via videoconferencing. This may reflect concern about the long-term complications of diabetes such as foot ulcers or diabetic retinopathy. In circumstances when this is an issue, the endocrinologist would work in partnership with the patient’s GP or nurse practitioner, to observe the physical examination being completed if the GP or nurse was in attendance with the patient for the videoconference or to ask for a physical examination to be completed by the GP at the patient’s next clinical visit. Previous research shows, from an endocrinologist’s perspective, that a GP or a trained nurse can perform the physical examination needed for a diabetes specialist consultation.23 Despite this issue, the overall proportion of patients with such concerns (five of 24) was relatively low. This supports the findings of other studies on patient satisfaction with telemedicine.17 Most of the patients (22 of 24) reported their confidence with the clinical assessment of the doctor of their health condition and medication requirement.

All of the respondents in this survey were satisfied with the quality of video during the consultation. One respondent reported dissatisfaction with the audio transmission. None of the respondents indicated any technical difficulty with the videoconferencing. This level of satisfaction with technical aspects of telemedicine is mainly due to highly reliable infrastructure and networking available in the Queensland public hospitals, clinics, and health centers throughout the state. Similar reliable networks and telehealth infrastructure may not be available in other countries.

The comment from one of the respondents on the attitude of the nurse who hosted the remote consultation at the remote side and the responses to the questionnaire shows that he or she has differentiated the level of satisfaction with the vehicle of healthcare delivery from the people who are providing the service, but it could be not true for some people. In order to isolate these two determinants of the healthcare quality (personnel and modality), future studies on development of satisfaction assessment instrument may consider inclusion of a separate set of questions to evaluate the performance of the personnel while asking for the satisfaction with the modality (e.g. videoconferencing).

All the administrative tasks and coordination functions of telemedicine sessions were conducted centrally by the personnel of the PAH Telehealth Centre, which eliminated the burden of those issues from the people on the patient’s side. Also, as the patients were attending their local clinic or health center for the videoconference, they did not have to know how to operate the telemedicine equipment; this issue should be specifically considered when evaluating home telecare services in which the remote device needs to be operated by the patients themselves, caregivers, and/or family members.

This study has several limitations. The number of subjects participating in this study and the response rate were not high, and diabetes was the only health condition investigated. Provision of remote consultations for other diseases may need different requirements in terms of physical examination (e.g., for orthopedics) or audio/video quality (e.g., for dermatology) that should be considered in developing a comprehensive instrument. Also, the setting of our study (videoconferencing between a hospital and a rural clinic) limits the generalizability of the results, so that for other situations such as home telecare in which the patients need to operate the telemedicine device by themselves, additional sets of questions should be added to the questionnaire. The questionnaire introduced in this study may be regarded as a preliminary version of an instrument for assessing the satisfaction of patients with remote consultation using videoconferencing. Although the questions have been formulated in the context of diabetes, the specific scripting could be modified to suit other health conditions. Further research is required to confirm the validity of the questionnaire introduced in this article.

Conclusions

The survey demonstrated that patients who had an appointment with their specialist via videoconferencing were generally satisfied with the service provided. This preliminary evidence shows that the questionnaire developed in this study is useful for the measurement of diabetes patients’ satisfaction with interactive video teleconsultation and could be modified for use in other clinical specialties.

Acknowledgments

We are grateful for the support of the PAH Telehealth Centre and the Department of Diabetes and Endocrinology at the Princess Alexandra Hospital in Brisbane, Australia. We also thank the patients for their participation in this study. Funding support was provided by the Australian Commonwealth Government, the Queensland Government, and the Centre for Online Health. We also thank Queensland Gas...
Company Pty. Ltd. for funding research into telehealth in the Western Downs.

Author Disclosure Statement

No competing financial interests exist. F.F. designed the study, collected and researched data, and wrote the manuscript. M.M.-K. and A.C.S. designed the study and edited the manuscript. L.C.G. and A.W.R. designed the study and reviewed and revised the manuscript. F.F. is the sole guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of data analysis.

References


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Section 3: The Main Research Study
9. METHODOLOGY OF A CLINICAL TRIAL FOR EVALUATING THE RELIABILITY OF VIDEOCONFERENCING FOR REMOTE CONSULTATION OF DIABETES

9.1. Paper information

Telemedicine applications are increasingly implemented by service providers to link patients with doctors, or doctors to specialists. The reduction in equipment costs makes video consultation a viable alternative to travel. The escalating adoption of video consultation as a vehicle for medical service makes it challenging for research on the reliability of the use of video conferencing to keep pace.

The aim of this paper was to describe the design of a randomised controlled trial to identify the reliability of videoconferencing for specialty consultation for people with diabetes. This protocol follows the methodology of non-inferiority trials that is recommended for assessing new health care interventions.

This research design involves paired consultations in two study groups. One group compares the level of agreement between outcomes of consultations provided via videoconference with those of face-to-face. As this is a challenging group, with no previous indication of agreement between endocrinologists on the outcome of diabetes consultation in usual practice, an additional group (standard clinical practice) includes paired face-to-face consultations. The level of agreement in the videoconference group can then be considered by comparing agreement in the standard clinical practice group.

The following paper has been published (online ahead of print) in the BMC Medical Informatics and Decision Making journal (2014; doi: 10.1186/1472-6947-14-11). The candidate, Farhad Fatehi was primarily responsible for conducting the research and writing the manuscript. The paper's co-authors, Melinda Martin-Khan, Leonard C Gray, and Anthony W Russell contributed to this paper in various aspects as listed in the preliminary pages of this thesis.
Design of a randomized, non-inferiority trial to evaluate the reliability of videoconferencing for remote consultation of diabetes

Farhad Fatehi¹,²*, Melinda Martin-Khan¹,³, Leonard C Gray¹,³ and Anthony W Russell⁴,⁵

Abstract

Background: An estimated 366 million people are living with diabetes worldwide and it is predicted that its prevalence will increase to 552 million by 2030. Management of this disease and its complications is a challenge for many countries. Optimal glycaemic control is necessary to minimize complications, but less than 70% of diabetic patients achieve target levels of blood glucose, partly due to poor access to qualified health care providers. Telemedicine has the potential to improve access to health care, especially for rural and remote residents. Video teleconsultation, a real-time (or synchronous) mode of telemedicine, is gaining more popularity around the world through recent improvements in digital telecommunications. If video consultation is to be offered as an alternative to face-to-face consultation in diabetes assessment and management, then it is important to demonstrate that this can be achieved without loss of clinical fidelity. This paper describes the protocol of a randomised controlled trial for assessing the reliability of remote video consultation for people with diabetes.

Methods/Design: A total of 160 people with diabetes will be randomised into either a Telemedicine or a Reference group. Participants in the Reference group will receive two sequential face-to-face consultations whereas in the Telemedicine group one consultation will be conducted face-to-face and the other via videoconference. The primary outcome measure will be a change in the patient’s medication. Secondary outcome measures will be findings in physical examination, detecting complications, and patient satisfaction. A difference of less than 20% in the aggregated level of agreement between the two study groups will be used to identify if videoconference is non-inferior to traditional mode of clinical care (face-to-face).

Discussion: Despite rapid growth in application of telemedicine in a variety of medical specialities, little is known about the reliability of videoconferencing for remote consultation of people with diabetes. Results of this proposed study will provide evidence of the reliability of specialist consultation offered by videoconference for people with diabetes.

Trial registration number: Australian New Zealand Clinical Trials Registry ACTRN12612000315819.

Keywords: Diabetes, Telemedicine, Remote consultation, Videoconferencing, Video teleconsultation, Video consultation, Video visit

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Background
Diabetes Mellitus (DM) is a common disease with increasing prevalence in many countries. More than 366 million people are estimated to have diabetes worldwide and it is projected to increase to 552 million by 2030, affecting 9.9% of the global adult population [1]. Managing diabetes and its complications is very costly, and creates a substantial burden on the health care economy. There is no cure; instead optimal glycaemic control is required to minimize complications [2]. However, less than 70% of people with diabetes are achieving target glycaemic control, demonstrating that effective disease management for people with diabetes remains a challenge [3,4]. For some patients, particularly in rural areas, not achieving target glycaemic control is at least in part due to poor access to qualified health care providers [5,6]. In response to the growing demand for health care and a decreasing availability of health care providers, information and communications technology (ICT) has shown potential to improve the accessibility of health care services and to reduce costs of health care delivery [7].

Telemedicine is the provision of medical and health services remotely using information and communication technology [8]. The telemedicine interactions are generally divided into two categories: synchronous (occurring in real time such as videoconferencing) and asynchronous (store-and-forward solutions such as transmission of a blood glucose level from a glucometer to a health centre).

Asynchronous (store-and-forward) telemedicine has been successfully implemented in the medical specialties such as pathology [9], radiology [10] and dermatology [11] where real time exchange of information between health care providers and consumers is not essential. In contrast, synchronous telemedicine requires both parties to interact with each other in real time using communication technology. Among the synchronous telemedicine solutions, videoconferencing – real time exchange of voice and image - is becoming popular through rapid achievements in digital communication technology. Video teleconsultation has been used in a wide range of disciplines from emergency medicine [12] to mental health [13], but it has been emphasized that most existing discipline-specific studies cannot be generalized to other tele-medical contexts [14].

In a systematic review on synchronous and asynchronous teleconsultation for diabetes care, Verhoeven et al. suggested that both teleconsultation solutions are feasible, cost-effective and reliable for delivering diabetes care. However they identified a lack of high quality studies and diversity in the included studies [15]. Several studies have reported results of using videoconferencing for diabetes care. However, almost all used videoconferencing for behavioural therapy including diabetes education, self-management training, nutrition counselling, and collaborative goal setting [16]. The accuracy of videoconferencing for specialist telediagnosis and assessment of selected diseases has been studied (e.g., Alzheimer’s disease) [17], but there is no published study on the reliability and accuracy of videoconferencing for clinical consultation with regard to medical specialist evaluation and management of diabetic patients.

If a doctor is able to assess and manage a diabetic patient via videoconference with a similar level of reliability as a face-to-face consultation, the medical profession could have confidence in including video consultation as a regular aspect of their clinical care. A clinician who regularly sees patients for evaluation of their diabetic management may choose to substitute some of the regular face-to-face consultations with a video consultation. This has important implications for patients isolated by either their physical location (e.g., rural communities) or their function (e.g., disabled older people in aged care facilities) and paves the way for at least some specialist consultation for people living in rural or remote areas to avoid the expense and inconvenience of long distance travel. It may also increase the opportunities for some people to receive advice in situations where they previously may have not, due to an inability to travel. This protocol describes a research project that will evaluate the reliability of clinical decisions made during a diabetic patient consultation via videoconference.

Typically the aim of a Randomized Controlled Trial (RCT) is to identify if superiority exists between two or more parallel groups to guide decision making, for example whether to replace a current medication or procedure with a new one. However, an alternative analytical approach is required when the aim is to identify if an innovation is suitable to replace an existing process at the same level of efficacy [18]. Such methodology is referred to as non-inferiority trial. A priori defined level of clinically acceptable variation between the two modes of delivery is used to determine the outcome. This study is a non-inferiority trial comparing the clinical outcomes of video consultations against those of conventional face-to-face consultations.

Aims and objectives
In this study we are seeking to identify if telemedicine is a reliable vehicle for providing specialty consultation for people with diabetes using videoconferencing, with the implication that it would be useful to utilise when usual care is either not available or difficult to deliver. The aim of the study is to test the level of clinical agreement achieved using specialist to patient videoconferencing (VC) compared with face-to-face (FTF) consultation. To place this level of agreement in context, it will also establish the level of agreement among specialists using face-to-face consultation. This approach enables the variation in clinical decision making among clinicians to be identified, and thus to be differentiated from the effect of the VC mode of service delivery.
This study will test the hypothesis that the clinical assessment and recommendations as determined by an alteration in medication type or dose made by endocrinologists for people with diabetes via videoconference are significantly different from those made through face-to-face consultation (null hypothesis). Secondary hypotheses will apply the same analytic techniques to the other aspects of diabetes consultation: (i) ordering lab tests or other diagnostic intervention; (ii) initiation of new medication(s) or dose adjustment of the previously prescribed drugs for dyslipidaemia and/or hypertension; (iii) detection or management of diabetes related complications; and (iv) referring to other specialists or arranging hospital admission.

Methods/design
This study is a repeated-measure non-inferiority randomized controlled trial. All patients participating in the study will receive two consultations (one original consultation and one additional consultation; called paired-consultation in this paper) by two different endocrinologists. Level of agreement between the recommendations made via VC versus FTF for the same patient by two endocrinologists will be calculated. This constitutes VC-FTF paired-consultations. Since there is likely to be a certain level of clinical variability between clinicians, the level of agreement in VC-FTF paired-consultations will then be compared against the level of agreement between two endocrinologists when they consult a patient in standard clinical practice (FTF-FTF). This arrangement will determine whether any lack of agreement is likely to be a result of the videoconference modality, or just normal variation between doctors.

Study setting and participants
This study will be conducted in the outpatient diabetes clinic of the Princess Alexandra Hospital (PAH) which is a tertiary teaching hospital in Brisbane, Australia. People with diabetes who have an appointment with an endocrinologist as a new or review case for the purpose of improving management of their diabetic condition will be approached and invited for participation. Six endocrinologists who attend the clinic routinely will visit the patients as scheduled (these are referred to as ‘routine endocrinologists’ in this paper). Another endocrinologist (referred to as the ‘research endocrinologist’ in this paper) will be employed for the purpose of this research to undertake the additional consultation for each patient who consents to participate in the trial. The additional consultation will be conducted by the research endocrinologist prior to the original consultation for each patient. However, the participant patients will receive both their consultations on the same day in the same clinic session. The routine and research endocrinologists are all specialist doctors with the same qualifications and credentials (i.e. accredited by the Royal Australian College of Physicians).

Inclusion and exclusion criteria
Eligible participants include patients (i) with a confirmed diagnosis of diabetes, (ii) who are 18 years of age or older. Patients will be excluded if (i) they are severely ill, (ii) unable to communicate effectively (blind, deaf, mute, etc.), or (iii) speak in a language other than English if an interpreter is not available.

Randomisation
Participants will be randomly allocated in a 1:1 ratio into one of two study groups (Telemedicine or Reference group). In the Telemedicine group the participants will receive a paired-consultation in which one of the consultations is via video (FTF-VC or VC-FTF), but in the Reference group both consultations will be face-to-face (FTF-FTF). Figure 1 outlines the randomisation and allocation process. The first consultation in each paired-consultation will be provided by the research endocrinologist, whereas the second consultation will be provided by one of the routine endocrinologists of the clinic. Since the order of VC vs. FTF consultations are also randomised, there will be three potential configurations for the paired consultations of each participant (Table 1). With such design, half of the video consultations will be conducted by the research endocrinologist, and the other half by the routine endocrinologists of the clinic.

A block randomisation with the block size of eight will be used to ensure balanced representation of the participants in each group. The randomised configuration will be provided by an independent biostatistician using SAS software. Opaque sealed envelopes with sequential numbers will be used for allocating the participants into the groups.

Informed consent and recruitment
Eligible patients will be contacted by phone prior to their appointment to explain the project and seek verbal consent. Once check-in to the clinic for their appointment, patients who have verbally consented will be given the participant information sheet, and written consent will be obtained. Each participant will be offered two movie vouchers (valued roughly US$ 30.00) as a compensation and appreciation for participating in this study. Non-consenting or excluded patients will receive their routine service at the clinic.

Usual care
Princess Alexandra Hospital operates three diabetes clinics a week in the outpatient clinic building. New patients are allocated a 45-minute, and review patients usually a 30-minute time slot for consultation. Wherever possible, review patients are scheduled to see the same endocrinologist they saw for their previous appointment to ensure continuity of care.
Following arrival at the clinic, the patient is received by a diabetes nurse practitioner and initial assessments such as measuring weight and blood pressure are performed. The nurse also downloads the blood glucose readings from the patient’s glucometer and updates the patient charts with the latest lab results. The patient then visits the endocrinologist. At the conclusion of the consultation, the doctor writes the progress notes and any pharmacy scripts that are required, requests pathology test(s), refers the patient to another specialist or other health professional where indicated, or arranges for hospital admission if needed. The patient is then scheduled for another follow up outpatient appointment, or care is transferred back to the referring GP with a management plan.

### Intervention

All participants, both in the Telemedicine and Reference groups, will receive an additional consultation (consultation 1) by the research endocrinologist who is employed for this study. This endocrinologist is officially qualified and credentialled to visit and manage patients at the clinic. The additional consultation will always occur prior to the original consultation (consultation 2). For the participants in the Reference group, both consultations will be face-to-face: consultation 1 by the research endocrinologist and consultation 2 by one of the routine endocrinologists of the clinic. For the participants in Telemedicine group, one consultation will be face-to-face and the other one via video-conferencing. The format of the first and second consultations (FTF-VC, or VC-FTF) for the participants in this group will be determined in the randomisation process. The final recommendation for patient management will be provided by the routine endocrinologists at the end of second consultation.

To ensure that the integrity of usual patient care is maintained for the participants in the Telemedicine group who will have their second consultation via video-conferencing (Table 1: configuration 2.2), they will be able to meet the endocrinologist face-to-face immediately after video-consultation, if required by either the endocrinologist or the patient.
Access to patient information in video consultations

To be able to isolate the effect of videoconferencing from other factors on the outcome of each consultation, we assume that doctors would have access to the same patient information as in a face-to-face consultation. Since the endocrinologist and the patients will be in the same building for both face-to-face and video consultations, it will be possible to provide the endocrinologists with the full records of the patients in hard copy during the videoconferencing as well as access to the electronic patient record via the Queensland Health network. Similar to original consultations, the latest blood glucose readings will be downloaded from each patient’s glucometer and entered in the patient record by a practice nurse upon check-in of each patient to the clinic. That will ensure that the endocrinologists will have equivalent access to the latest blood glucose measures, in each of the paired consultations.

Equipment and connectivity

Remote video consultation will be simulated using one video-enabled laptop dialling into the diabetes clinic telehealth studio. The telehealth studio is currently functioning and located in the same building of the clinic. For video consultations, the patient will be accompanied by a diabetes nurse educator, who will “host” the consultation and assist with aspects of clinical examination, if needed, under the direction of the endocrinologist. This arrangement closely emulates the typical situation for diabetes remote consultation by videoconference, where patients are accompanied either by a nurse or their GP.

The telehealth studio in the diabetes clinic, where the patient will sit, is equipped with a Tandberg codec 990MXP + camera unit, Sony Bravia 32” television, and an Audio-Technica microphone. This codec provides pan, tilt, zoom functions for the camera by both the local and remote parties. The endocrinologists will use a laptop with 13” screen and Cisco Telepresence Movi software ver. 4.2 (Cisco systems, San Jose, California, USA) to connect to the telehealth studio for conducting the video consultations. Both Tandberg codec and Cisco Movi are H.264 compliant and capable of high definition video (up to 1080p 30 fps) encoding and decoding. The laptop has been tested to be compatible with the Tandberg codec. This is the configuration that clinicians use when they provide remote consultations on a trip or in the facilities that dedicated VC equipment is not available. The connection will be through the existing Local Area Network (LAN) and Wireless LAN (WLAN) within the clinic building. Although the LAN bandwidth is 100 Mbps, the codec and software will be set on 384 Kbps. This bandwidth is generally regarded as the minimum connection speed for producing acceptable full screen, full motion video. Although the general connection speeds between the Queensland Health telehealth centres range from 512 kbit/s to 2.3 Mbit/s depending on site specific connections, selection of minimum required bandwidth will ensure the results of this research to be more generalizable to the countries that high speed networks are not readily available.

Outcome measures

The outcome measure of this study is the difference in level of agreement between the two groups. Agreement will be calculated for each group (Reference group: FTF-FTF; Telemedicine group: FTF-VC or VC-FTF) and compared. For the comparison between two consultations to be accurate, it is necessary that the endocrinologists be blinded to each other’s assessment and recommendations. Part of this information can be communicated by the patient, which is inevitable, however the research endocrinologist has been requested to refrain from giving information about the assessment and treatment plan to the patient during the first consultation. Since the research endocrinologist adds nothing to the patient chart (either in hard copy or electronic records), it will ensure that the endocrinologists will be blinded to each other’s opinion on each patient.

The primary outcome measure is the level of change in patient’s medications during the consultation. Based on its impact, medication change is divided into three categories: Major, Minor, and No change (Table 2). When more than one category is applicable to a participant, the highest impact will be regarded as the overall impact of the medication change.

Secondary outcomes focus on performing the physical examination, detection of diabetes complications and patient satisfaction. For each video consultation, the endocrinologist will be asked about any technical problem or

<table>
<thead>
<tr>
<th>Medication</th>
<th>Change</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin</td>
<td>Initiation of insulin</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td>Cessation of Insulin</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td>Change in regimen (type, injection frequency)</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td>Dose adjustment</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>No change</td>
<td>No change</td>
</tr>
<tr>
<td>Other hypoglycaemic agents</td>
<td>Initiation of new drugs</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td>Cessation of drugs</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td>Dose adjustment</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>No change</td>
<td>No change</td>
</tr>
<tr>
<td>Other medications (hypertension, lipids, etc.)</td>
<td>Initiation of new drugs</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td>Cessation of drugs</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td>Dose adjustment</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>No change</td>
<td>No change</td>
</tr>
</tbody>
</table>
Data collection
The endocrinologists will complete a questionnaire for each patient they consult [see Additional file 1]. The questionnaire will capture various elements of each consultation and comprises 16 questions in three sections: (1) Patient characteristics, (2) Procedures and findings, and (3) Recommendations. The questions have been developed based on the results of two previous studies: observing conventional face-to-face diabetes consultations, [19] and process analysis of video teleconsultation for diabetes [20]. The questionnaire has been pilot tested in four consultations and modifications are made to the questions as suggested by the endocrinologists and the researchers. The participants in the telemedicine group will also be asked to complete a patient questionnaire after their video consultation. This satisfaction questionnaire comprised 17 questions in five-point Likert-type scale asking for various aspects of videoconference session.

Statistical methods
Demographic and baseline data will be reported as absolute numbers, percentage, and/or mean +/- SD. Percentage agreement and the weighted kappa statistic (Kw) will be used to assess inter-rater reliability between the two groups on the agreement on assessments and recommendations made by the endocrinologists [21].

Sample size
This study will evaluate if agreement on the recommendations for the Telemedicine group is not inferior to agreement in the Reference group by more than an acceptable amount. This clinically acceptable amount of variation for diabetes consultation was set as 20% by a group of expert specialist consultants who had more than five years of telemedicine experience. The sample size is calculated based on the incidence rates of 25, 50, 25% for major change, minor change, and no change respectively in the patient medication made by the endocrinologists (significance level 5%, power 80%). It will be possible with a total of 160 participants (80 per each group) to detect any statistically significant difference for the true kappa of 0.7 and the null kappa of 0.5.

Ethics and trial registration
Ethics approval for this study has been obtained from the Human Research Ethics Committee of Queensland Health (HREC/11/QPAH/645 – 12/03/2012) as well as The University of Queensland School of Medicine (2011-SOMILRE-0022 – 4/05/2012). This study is also registered by Australian New Zealand Clinical Trials Registry (ANZCTR) as a randomized controlled trial (ACTRN12612000315819, 20/03/2012).

Discussion
Results of the proposed study will provide an important and novel insight into provision of clinical consultation remotely to patients with diabetes by endocrinologists. It will investigate whether videoconferencing is as reliable and safe as face-to-face encounter for management of diabetes. To our best knowledge, this is the first RCT looking at safety of videoconferencing for specialty consultation of diabetes.

Global prevalence of diabetes has been estimated to increase from 8.3% in 2011 to 9.9% in 2030 among the adult population [1]. During this period, developing countries will have a 69% increase in prevalence of diabetes whereas this increase will be 20% for developed countries [22]. Although this study has been designed and will be conducted in Australia which is categorized as a high-income country, the proposed intervention has potential to be adopted in all countries that meet the minimum technical requirements for a videoconferencing with quality accepted for clinical purposes. The World Health Organization (WHO) has recommended the incorporation of newer technologies, such as telecommunications, into the health care system to improve access to health services in resource limited countries [23]. Many health centres in low-middle income countries already have Internet connection that is a prerequisite in most of telemedicine interventions including video teleconsultation, which has been proposed here.

Consultants’ style of clinical practice might be different from their regular practice while they know they are involved in a research study (Hawthorne effect). However, this potential effect will equally affect both Reference and Telemedicine groups. Consultants are also required to fill in a questionnaire for each consultation in this study. Items included in the questionnaire that are derived from observing routine consultations in the outpatient clinic of a teaching hospital, can act as a checklist and serve as a decision support system that possibly improve the process of the consultation, but again this effect will be equally distributed among the two groups.

Many hospitals and clinics are currently utilizing electronic patient records, either as a substitution to the traditional paper-based patient's records or as a complement to them. In this study the endocrinologists will have access to the patient’s complete medical records equally in both face-to-face and video consultations. This is not the case in the real world, except for the settings in which the patient records are fully electronic and accessible via network, and if there is some additional information on hard copy, that information would be sent to the tele-consultant before or during the consultation.
A limitation of the study is the inability to randomise the order of the endocrinologists that the patient will see and which endocrinologist would provide the final treatment recommendation. This is not able to be performed due to practical issues involved around ensuring the smooth running of a busy outpatient clinic as there is not time for both endocrinologists to discuss each patient and provide a collaborative management plan.

Despite the rapid growth in telemedicine services in Australia and official adoption of videoconferencing as a mode of delivery for clinical consultations in Australian health system and worldwide, little has been published on safety and reliability of videoconferencing for remote consultation of people with diabetes. This study will fill in the gap of research in the field of telemedicine for diabetes, and may serve to guide the application of telemedicine to the management of other chronic diseases.

Additional file

Additional file 1: Analysis of endocrinology consultation.

Abbreviations
ICT: Information and communications technology; VC: Videoconference; videoconferencing: FTFT: Face-to-face.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
FF contributed to the study design and drafted the manuscript. MMK and LG conceived the original study design. FF, LG and AR participated in the development of the protocol and revised the manuscript. MMK and LG contributed to the study design and drafted the manuscript. MMK and LG participated in the management of other chronic diseases.

Acknowledgement
FF is funded by PhD scholarship from Tehran University of Medical Sciences and may serve to guide the application of telemedicine to the management of other chronic diseases.

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References
10. **RELIABILITY OF VIDEOCONFERENCING FOR REMOTE CONSULTATION OF DIABETES: A PILOT RANDOMISED CONTROLLED TRIAL**

Based on the findings of the three preliminary studies (Chapters 6-8), a pilot randomised controlled trial was designed to evaluate the reliability of videoconferencing for remote consultation of people with diabetes who needed to see an endocrinologist in an outpatient clinic. This trial was conducted in the outpatient diabetes clinic of a tertiary teaching hospital in Brisbane. 75 participants were recruited from October 2012 to July 2013. The participants were randomly allocated into the telemedicine group or reference group. Each participant in telemedicine group received two consultations: one in-person consultation and one video consultation. In the reference group the participants had two in-person (face-to-face) consultation. The paired consultations for each participant were provided by two different endocrinologists. To evaluate the reliability of the video consultation, the level of agreement between endocrinologists in the telemedicine group were calculated by comparing their recommendation on the medication changes. In order to be able to assess the impact of videoconferencing on the level of agreement between endocrinologists, similar measures were also calculated in the reference group where two endocrinologists consulted the participants in-person. The findings of this study showed that the level of agreement between two endocrinologists on changing anti-diabetes drugs was 64% in the telemedicine group and 78% in the reference group. Although the level of agreement was lower when one of the consultations was via videoconference, the difference was neither statistically, nor clinically significant. The level of agreement on changing cardiovascular drugs was 78% in the telemedicine group and 76% in the reference group, again not significantly different.
10.1. Introduction
Remote consultations of diabetic patients via videoconferencing could be inferior to the conventional face-to-face encounters due to the potential limitations in physical examination or access to the patient's data. This pilot randomised controlled study was designed to evaluate the reliability of videoconferencing for clinical management of diabetes by endocrinologists. We sought to identify the impact of the modality of consultation (i.e. videoconferencing versus face-to-face) on the level of agreement between endocrinologists when consulting people with diabetes. As doctors do not always agree with each other on the management of diseases, we needed to establish the level of agreement between endocrinologists when consulting patients in conventional face-to-face encounters, and then compare it with that of video consultations. The details of the design of this study were described in Chapter 9.

10.2. Methods

10.2.1. Participants and setting
Participants were people with diabetes who had an appointment with an endocrinologist at the outpatient diabetes clinic of the Princess Alexandra Hospital in Brisbane, Australia. Inclusion criteria were having a confirmed diagnosis of diabetes and age of 18 years or more. Exclusion criteria were being severely ill, unable to communicate effectively (e.g. blind, deaf, or mute), or speaking in a language other than English when an interpreter was not available.

10.2.2. Recruitment and ethics
Eligible people were invited to participate in the study upon registering at the clinic. Written consent was obtained from those who were willing to enrol in the study. Two movie vouchers were offered as an honorarium to each participant. Patients who opted not to participate in the study received the routine service of the clinic. The protocol of the study was approved by the Human Research Ethics Committees of both Queensland Health and The University of Queensland. This study is registered on the Australian New Zealand Clinical Trials Registry (ACTRN12612000315819).

10.2.3. Randomisation
Participants were randomly allocated into two groups: face-to-face (FTF) consultation plus video consultation (telemedicine group) or two FTF consultations (reference group). The randomisation process also determined the order of consultations for the participants in the
telemedicine group: FTF followed by video consultation (FTF-VC) and video consultation followed by FTF (VC-FTF). A block randomisation with the block size of eight was used to ensure balanced representation of participants in each group.

10.2.4. Intervention

All the participants received two consultations by two different endocrinologists during the same session of the clinic. Participants in the reference group were seen by the first doctor and then the second doctor, both face-to-face. Similarly each participant in the telemedicine group received two consultations, but one consultation was via videoconference. The order of consultations was randomly allocated to either the first doctor or the second one. The same doctor, who was employed specifically for this study, undertook all of the first consultations for both groups, but did not provide any recommendation to the patients. The second consultation for each participant was carried out by one of the routine doctors of the clinic. Assignment of the participants to the doctors for the second consultation was according to the clinic routines: normally each patient was assigned to the doctor who consulted the patient in the previous appointment. Final recommendations for each patient were made at the end of the second consultation. The video consultations for 50% of the individuals in the telemedicine group were carried out by the first doctor, and the rest by the second doctor. All the doctors participated in this study were endocrinologists with similar qualifications. However, their experience with telemedicine was not similar. This is one of the limitations of the design of this study. In fact, it was not possible to find endocrinologist with similar telemedicine experience to participate in this study. The remote consultations performed by doctors who are more experienced with teleconsultation, might be more similar to face-to-face consultations.

10.2.5. Equipment and connectivity

Videoconference, for the telemedicine group, was established between two rooms in the same building of the clinic. The telehealth studio of the clinic, where patients sat for teleconsultation, is equipped with a Tandberg codec 990MXP + camera unit, Sony Bravia 32” television, and an Audio-Technica microphone. The camera featured pan, tilt, and zoom functions. The endocrinologists used a laptop with 13” screen and Cisco Telepresence Movi software ver. 4.2 (Cisco systems, San Jose, California, USA) to connect to the telehealth studio. Both Tandberg codec and Cisco Movi are H.264 compliant and capable of high definition video (up to 1080p 30 fps) encoding and decoding. The connection was via IP at 384 kbit/s. This bandwidth is generally regarded as the minimum connection speed for
producing an acceptable clinical videoconference. The minimum required bandwidth was selected to improve the generalizability of the results of this study to the locations where high speed networks are not readily available.

10.2.6. **Outcome measures**

Typical diabetes consultations have several variables, in addition to an interview with the patient, which have the potential to be considered as an outcomes measure in a health services research. These variables can be categorised as 1) Procedures and findings, and 2) Recommendations. Procedures and findings include the components of a consultation the help the physician to assess the condition of the patient. For diabetes consultation these components are review of home blood glucose readings and lab test results, as well as physical examination. Recommendations are the actual outcome of a consultation which could be advice to the patient, ordering investigations, changing and/or adjusting the patient's drugs, referring the patient to other health care professionals, arranging follow-up visits or hospital admission, or a combination of these items.

Based on the results of two previous studies, requesting laboratory tests and changing medications of the patients, followed by referring to other health care providers, were the most frequent recommendations made by the endocrinologists for managing diabetes. Of these items, changing the medications is the most important recommendation in terms of the impact on the management of the diabetes, and can be easily recorded as dichotomised values in a single consultation and can then be statistically analysed. Other outcomes of diabetes consultations including performance of physical examination, detection of a new sign, and general assessment of the patient are not good candidates of the primary outcome measure of a research project with limited number of participants because of very high or very low frequency of occurrence.

The outcome measures were changes in prescribing of anti-diabetes, anti-hypertensive and lipid lowering drugs. The primary aim of the study was to compare the level of agreement between endocrinologists in terms of changes in anti-diabetes drugs in the telemedicine and reference groups. The secondary aim was to compare the levels of agreement between endocrinologists for changes in anti-hypertensive and lipid lowering drugs.

Four categories of drug were included in the questionnaire: Insulin, other anti-diabetic drugs (oral and injectable non-insulin drugs), anti-hypertensive drugs, and lipid lowering drugs. For each category four possible types of change were considered: Initiation, Dose adjustment,
Change in regimen (type, frequency), and Cessation. If any of these four changes had been indicated by the endocrinologist for a drug as the recommendation of the consultation, that drug was marked as 'Changed'. For statistical analysis of drug change, Insulin and other anti-diabetic drugs were consolidated into a group called “anti-diabetic drug”. Similarly, anti-hypertensive and lipid lowering drugs were also grouped to form “cardiovascular drugs”. The status of each group was regarded as 'Changed' if at least one drug in that group had been marked as changed, otherwise it was regarded as 'Not changed'. Nevertheless, other important aspects of diabetes consultations such as performance of physical examination and detection of new signs and diabetes related complications were recorded in this study.

### 10.2.7. Data collection and statistical analyses

A data collection form was developed based on findings of previous studies which analysed the process of specialty consultations in the same diabetes outpatient clinic. Doctors were asked to complete the form for each consultation they provided.

Basic statistics on patients’ characteristics were presented by number (%), mean (SD) or median (IQR). The differences in the distributions of individual characteristics between the telemedicine and reference group were tested using appropriate parametric or non-parametric statistical tests. The raw agreement between two endocrinologists was presented by percentage separately for telemedicine and reference group. The kappa statistics and the areas under the receiver operator characteristic (AROC) estimates were obtained along with their 95% confidence intervals (CI). The interpretation of the level of raw agreements was based on Kappa value (≤0.20 poor; 0.21 – 0.40 fair; 0.41 – 0.60 moderate; 0.61 – 0.80 good; and 0.81 – 0.99 very good; 1.00 perfect agreement). For AROC estimation, bootstrapped estimates of CI were obtained.

### 10.3. Results

#### 10.3.1. Participants

A total of 75 participants were recruited from October 2012 to July 2013. Two patients were seen by a registrar (specialty trainee) instead of the intended endocrinologists because of administrative failure and thus were excluded from the study. Data analysis was performed on 146 consultations provided for 73 participants. Based on the randomisation process, 37 participants were allocated to the reference group, and 36 participants to the telemedicine group (Figure 10-1). The mean age of the participants was 57 years (SD=14; range: 24–83)
and 34% were female. The two groups were similar on key baseline characteristics (Table 10-1).

Figure 10-1 Participant recruitment diagram
Table 10-1 Baseline characteristics of the participants by study group (n=73). Variables are summarised as count (%) unless otherwise indicated.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Reference group</th>
<th>Telemedicine group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=37</td>
<td>n=36</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>14 (38%)</td>
<td>11 (31%)</td>
</tr>
<tr>
<td>Male</td>
<td>23 (62%)</td>
<td>25 (69%)</td>
</tr>
<tr>
<td>Age (years)*</td>
<td>59 ± 14</td>
<td>55 ± 14</td>
</tr>
<tr>
<td>Distance to the clinic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20 km</td>
<td>9 (24%)</td>
<td>15 (42%)</td>
</tr>
<tr>
<td>20-100 km</td>
<td>23 (62%)</td>
<td>16 (44%)</td>
</tr>
<tr>
<td>&gt;100 km</td>
<td>3 (8%)</td>
<td>3 (8%)</td>
</tr>
<tr>
<td>missing data</td>
<td>2 (6%)</td>
<td>2 (6%)</td>
</tr>
<tr>
<td>Diabetes Treatment plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet only</td>
<td>3 (8%)</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>OAD\textsuperscript{d} only</td>
<td>3 (8%)</td>
<td>2 (6%)</td>
</tr>
<tr>
<td>Insulin only</td>
<td>19 (51%)</td>
<td>23 (64%)</td>
</tr>
<tr>
<td>Insulin + OAD\textsuperscript{d}</td>
<td>9 (24%)</td>
<td>8 (22%)</td>
</tr>
<tr>
<td>Data Missing</td>
<td>3 (8%)</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>HbA1c (%)\textsuperscript{*}</td>
<td>8.3 ± 1.4</td>
<td>8.4 ± 1.7</td>
</tr>
<tr>
<td>Diabetes complication\textsuperscript{**}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retinopathy</td>
<td>13 (35%)</td>
<td>16 (44%)</td>
</tr>
<tr>
<td>Nephropathy</td>
<td>13 (35%)</td>
<td>12 (33%)</td>
</tr>
<tr>
<td>Neuropathy</td>
<td>13 (35%)</td>
<td>12 (33%)</td>
</tr>
<tr>
<td>Ischemic Heart Disease</td>
<td>11 (30%)</td>
<td>8 (22%)</td>
</tr>
<tr>
<td>Foot ulcer</td>
<td>1 (3%)</td>
<td>3 (8%)</td>
</tr>
<tr>
<td>Nil</td>
<td>13 (35%)</td>
<td>9 (25%)</td>
</tr>
</tbody>
</table>

\* Data are means ± SD

\** The percentages do not add up to 100 because of cases with both plans

OAD: Oral Anti-diabetes Drugs
10.3.2. Level of agreement between doctors in changing diabetes drugs

The observed agreement between the endocrinologists for changing anti-diabetes drugs was 78% (29/37) in the Reference group, and 64% (23/36) in the telemedicine group. Cohen's Kappa test showed moderate agreement (0.42, 95% CI: 0.27 – 0.55) in the Reference group and fair agreement (0.31, 95% CI: 0.09 – 0.52) in the telemedicine group. However, the difference between the two groups was not statistically significant. The area under ROC curve for the reference group and the telemedicine group was 0.76 and 0.69 respectively (Table 10-2).

10.3.3. Level of agreement between doctors in changing cardiovascular drugs

The level of observed agreement between the endocrinologists for changing cardiovascular drugs was 76% (32/37) in the reference group, and 78% (28/36) in the telemedicine group. Cohen's Kappa test showed fair agreement in the reference group (0.27; 95% CI 0.11 – 0.39) and the telemedicine group (0.37; 0.15 – 0.75). The levels of agreement between doctors are summarised in Table 10-2.
Table 10-2 The measures of agreement between the endocrinologists in Reference group vs. telemedicine group

<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Reference group</th>
<th></th>
<th>Telemedicine group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Raw agreement</td>
<td>Kappa (95% CI)</td>
<td>AROC (95%CI)</td>
</tr>
<tr>
<td></td>
<td>% (proportion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes drugs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin</td>
<td>78% (29/37)</td>
<td>0.42** (0.27, 0.55)</td>
<td>0.76* (0.54, 0.92)</td>
</tr>
<tr>
<td>Non-insulin drugs</td>
<td>78% (29/37)</td>
<td>0.50** (0.27, 0.63)</td>
<td>0.82* (0.63, 0.92)</td>
</tr>
<tr>
<td>Cardiovascular drugs</td>
<td>92% (34/37)</td>
<td>0.37* (0.00, 0.90)</td>
<td>0.96 (0.88, 1.00)</td>
</tr>
<tr>
<td>Anti-hypertension drugs</td>
<td>76% (28/37)</td>
<td>0.27* (0.11, 0.39)</td>
<td>0.61 (0.48, 0.80)</td>
</tr>
<tr>
<td>Lipid lowering drugs</td>
<td>86% (32/37)</td>
<td>0.38** (-0.04, 0.49)</td>
<td>0.65 (0.48, 0.88)</td>
</tr>
<tr>
<td>Lipid lowering drugs</td>
<td>89% (33/37)</td>
<td>0.28* (-0.05, 0.36)</td>
<td>0.61 (0.46, 0.88)</td>
</tr>
</tbody>
</table>

* P ≤ 0.05
** P ≤ 0.01
10.3.4. Impact of the mode of consultation on recommendations made by the endocrinologists

Almost half of the participants (36 out of 73) were in telemedicine group and thus received one consultation via videoconference and the other via face-to-face. For these participants, the endocrinologists changed anti-diabetes drugs in 61% when consulted FTF, and 47% when consulted via videoconference. Changes in cardiovascular drugs were recommended in 31% for FTF consultations, and 14% in video consultations. Overall changes recommended for the participants in telemedicine group was 72% when consulted FTF, and 58% when consulted via videoconference (Table 10-3).

<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Face-to-face</th>
<th>Videoconference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in anti-diabetes drugs</td>
<td>22/36 (61%)</td>
<td>17/36 (47%)</td>
</tr>
<tr>
<td>Changes in cardiovascular drugs</td>
<td>11/36 (31%)</td>
<td>5/36 (14%)</td>
</tr>
<tr>
<td>Overall changes in all drugs</td>
<td>26/36 (72%)</td>
<td>21/36 (58%)</td>
</tr>
</tbody>
</table>

10.3.5. Level of agreement between doctors in referring the patients

The raw agreement between doctors in referring the patients to other health care professionals was similar between the two groups (Table 10-4).

<table>
<thead>
<tr>
<th>Study group</th>
<th>Doctor 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not referred</td>
<td>Back to GP</td>
</tr>
<tr>
<td>Reference</td>
<td>Doctor 1</td>
<td></td>
</tr>
<tr>
<td>Not referred</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Back to GP</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>To another specialist</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>To allied health</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>Telemedicine</td>
<td>Doctor 1</td>
<td></td>
</tr>
<tr>
<td>Not referred</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Back to GP</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>To another specialist</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>To allied health</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>3</td>
</tr>
</tbody>
</table>
10.4. Discussion

In this pilot randomised controlled trial we demonstrated that the outcome of consultations provided by endocrinologists via videoconferencing is not inferior to those of in-person encounters in terms of prescribing medications. The level of agreement in changing anti-diabetes drugs between endocrinologists in the telemedicine group (64%) was lower than that of the reference group (78%), but this difference was not statistically significant. Furthermore, this difference was not more than 20%, which was set by a panel of experts as the highest clinically accepted inferiority due to the medium of delivery. The between-group difference in the level of agreement in changing cardiovascular drugs was also neither statistically nor clinically significant.

The most obvious limiting factor of using telemedicine for clinical consultation of the patients is the inability to perform a physical examination. The assessment of a diabetic patient, compared with a cardiovascular or respiratory patient, relies more on the results of laboratory tests (i.e. blood glucose levels and Haemoglobin A1c) rather than the findings from physical examination. However, it is possible in many disciplines to request a GP or a nurse practitioner who accompanies the patient at the remote site to perform the required physical examination and report the findings back to the specialist (e.g. examination of feet for evidence of neuropathy and peripheral vascular disease, and injection sites for lipohyperthrophy). Logically, it seems that the more a consultation is dependent on a specialised physical examination, the less it will be suitable for telemedicine.

Any inferiority in the clinical outcome of tele-consultations, either via store-and-forward applications such as email or synchronous applications such as videoconferencing, should be considered in the context of the condition of the patient and the health care system. In Australia, like many other countries, diabetes patients are primarily managed by General Practitioners (GP) and the patient is referred to an endocrinologist when there is a need for a specialist opinion. In such case, the patient visits an endocrinologist and the process of care is returned to the referring GP with the management plan. In this arrangement it can be assured that the patient has access to a local GP in case of any potentially dangerous condition due to any flaw in remote consultation of the patient.

Our findings showed that the endocrinologists were more conservative in altering the patients' drugs for patients when consulting via videoconference, compared to face-face consultation (Table 10-3). This conservative approach might be due to feeling that the patient is far away and not readily accessible, as would be a local patient, in case of an adverse effect
or unforeseen circumstances. The other possible explanation could be lower confidence of doctors on their assessment of the patient's condition when consulting the patient remotely. Nevertheless, in this study we just considered one single consultation for each patient. It is also noteworthy that the doctors in clinic were not routinely performing video consultation and essentially it was a new skill for them and this might have contributed to the conservative approach. Doctors with more experience in telemedicine might have had a different approach. It is probable that reluctance to change patient medications in one consultation might be rectified in the following consultations based on the results of laboratory tests. The design of this study did not allow us to test this hypothesis. Nevertheless, there is anecdotal evidence that the style of clinical practice varies between doctors of the same qualifications in the same discipline; some are more aggressive in changing medications than the others.

The actual raw agreement for change in cardiovascular drugs was higher than that of diabetes drugs. This may suggest that altering cardiovascular drugs, on the basis of a blood pressure measurement or lipid profile results, was easier than the diabetes medications. There might have been fewer adjustments of these medications purely because a lot of patients were actually to target BP or lipids. The lower agreement in changing diabetes drugs could be explained by the need of doctors to take more parameters into account: not only HbA1c but also diet, activity, home blood glucose level (BGL) measurements, and compliance that are more subjective when one adjusts diabetes drugs.

There is a trade-off between improved access to health care using ICT–based solutions, and the fidelity of the recommendations provided through such encounters. In many situations telemedicine provides the patients with access to care that would not otherwise be possible. For some other situations, it will be the question of timely access to a lower-quality care versus a delayed access to conventional services. Considering the cost and inconvenience of long trips to the cities where specialised care is available, several studies have reported that the patients would not have attended their specialised care appointment if there was no telemedicine application in place. It is also noteworthy that for a proportion of people who live in extremely isolated areas, telemedicine is not an alternative to conventional care, but the only option.

This study has several limitations that should be considered for both interpreting the results and generalizing to other settings and disciplines. First, the doctors in both groups had equal access to the whole patient information, both in electronic and hard copy format. This is not the case in the real world except for the settings in which patients' information are stored and
retrieved electronically and fully accessible from a distance. Second, the research endocrinologist, who conducted the first consultation for all the patients neither managed the patient nor was responsible for the consequences of the recommendations that she made for the purpose of this research. A more robust design would constitute a situation in which both doctors would take the case of any patient equally seriously. We assume this condition equally affected both groups, thus had no effect on the ultimate comparison between the telemedicine and reference groups. Another limitation of the study is that it does not assess the possible importance of face-to-face counselling and motivational interview techniques to alter patient's self-management. Nor does the study assess longer term clinical outcomes such as HbA1c and we have assumed the change in medications is an important outcome that will affect patient outcomes. In an ideal situation, clinical outcomes should be assessed in long term (i.e. a RCT comparing a group over 12 months who are managed via face-to-face vs telemedicine).

In this research we studied the intervention in a single consultation for each participant, whereas the process of care for the people with diabetes is ongoing and often lifelong. Consultation with a specialist often requires several consecutive consultations. It is expected that even if the fidelity of care delivered via videoconference is suboptimal in the first encounter compared to face-to-face, it will be addressed in the follow-up consultations in the light of laboratory test results. Future studies should consider the whole process of care by the specialist, comprising several consultations over a longer period of time, similar to what patients receive in the real world.

Appropriately powered clinical trials are needed to confirm the findings of this study on the reliability of videoconferencing for specialty remote consultation of diabetes. There is a need for developing reliable indicators for assessing the impact of the medium of communication on the outcome of office visits to adequately inform the design of health services research, especially for evaluating telemedicine interventions.

10.5. Conclusion

This study presents the preliminary evidence on the reliability of videoconferencing for specialty consultation for people with diabetes. Endocrinologists who provided a consultation to the patients remotely using videoconferencing were more conservative in changing the anti-diabetes drugs, but not for cardiovascular drugs. Further studies are needed to confirm these findings, and assess the clinical outcomes of video consultation in long term.
11. CONCLUSIONS AND RECOMMENDATIONS

11.1. Research purpose

Access to timely and quality specialised care prevents or delays the development of diabetes related complications. However, there are limitations in access to care, especially for people living in remote and rural areas. Geographic distance and poor weather as well as social and cultural barriers limit access to care for many people worldwide. Telemedicine has the potential to address these issues and provide timely access to care for a proportion of underserved populations.

11.2. Study outcomes

The findings of this thesis shows that telemedicine or similar interventions which are referred to as telehealth or ehealth have been researched in almost half of the countries in the world, though different countries may use different terms for the same concepts. The number of publications in this field of study is rising. This suggests that the field of telemedicine is emerging.

Telemedicine interventions for improving diabetes have used four technologies as the medium of communication: telephone, mobile phone, videoconferencing, and online solutions.

The use of videoconferencing for clinical purposes shows a striking increase in 2012 compared with the previous ten years. If this increase continues, videoconferencing will be the main medium of remote consultations in future. This is in parallel with the everyday observation of popularity of videoconferencing which is facilitated and readily available by smart phones and other portable devices such as tablets.

The increasing popularity of applications such as Skype, Face Time, and Google Hangout in everyday life of people makes videoconferencing more acceptable as a medium of communication between health care professionals and patients for health care purposes. Smart phones have been used for making videoconferencing for clinical purposes in the past few years and the trend of their use seem to be on the rise.

The process analysis of specialised care in an outpatient diabetes clinic showed that a considerable proportion of patients were not physically examined by the endocrinologists. All the recommendations could be enacted remotely and in almost all of the cases it was possible for a GP to physically examine the patient on behalf of the endocrinologist. For a
considerable proportion of the consultations, the endocrinologists reported that it was possible to provide the same consultation remotely via videoconferencing if the patient was accompanied by a GP.

The analysis of the process of care delivered via videoconferencing in a tele-endocrinology clinic to patients located 210-1800 Km away revealed that the recommendations made by the endocrinologists were quite similar to those of the conventional face-to-face clinics. Although the endocrinologists believed that it could be possible to make a better decision of the consultation was face-to-face, they arranged a face-to-face consultation for less than 6% of the patients. For a large proportion of the people with diabetes who are referred to a specialist by GP, video consultation can substitute the conventional face-to-face consultation and thus eliminate the cost and inconvenience of long distance travel for the patients (and/or their carers).

An instrument for assessing the patient satisfaction with video consultation was developed and tested in the tele-endocrinology clinic of a tertiary hospital. Sixteen questions covering four dimensions of satisfaction with video consultation were included. The patients who were consulted remotely by an endocrinologist via videoconferencing reported the highest satisfaction with the 'Communication and rapport' dimension, and with the 'Clinical assessment' the lowest. The patients were generally satisfied with the service they received.

To scientifically assess the reliability of videoconferencing for remote consultation of diabetes, there was a need for a rigorously designed research study. Typically a non-inferiority trial is needed to show that a new treatment or mode of health care delivery is within an acceptable range of fidelity to the current solution or the gold standard. Informed by the findings of the preliminary studies, a novel non-inferior randomised controlled trial was designed to compare the outcome of video consultations with face-to-face consultations. To evaluate the impact of the medium of health care delivery (i.e. videoconferencing) on the outcome of the consultation, the change in patient's medications was chosen as the outcome measure. Since doctors do not always agree with each other on the management of patients, it was necessary to establish the level of agreement between endocrinologists when consulting patients face-to-face, and use it as a reference.

The findings of the pilot randomised controlled trial showed that the level of agreement between endocrinologists in changing anti-diabetes drugs is lower when one of them consults the patient via video, compared with the conventional situation when both endocrinologists consult the patient face-to-face.
11.3. Implications for the use of videoconferencing

The need for an assessment of videoconferencing as a medium of clinical care delivery is highlighted in the review of the literature (Section one). The findings of this research show that video consultation is not inferior to face-to-face consultation for specialty consultation of people with diabetes. Specifically, this research has shown that for specialty consultation of people with diabetes:

- The use of videoconferencing has no significant impact on the adjustment of anti-diabetes drugs
- The use of videoconferencing has no impact on the adjustment of cardiovascular drugs
- Patient satisfaction with video consultation is generally high for the residents of remote and rural areas
- Overall, videoconferencing is a reliable medium for provision of diabetes specialty consultation by an endocrinologist to a patient

These results are applicable to the settings in which the endocrinologist has access to the patient's records and there is a technically reliable videoconferencing system in place to connect the endocrinologist to the patient. The results of this research can be generalised to the diseases which are managed through a similar model of care.

11.4. Future research

Further research is needed to confirm the findings of the pilot trial in this study. Also there is a need for the development of a suitable indicator for assessing the immediate outcome of a consultation to be used in the future Health Services Research.

Recent changes in the videoconferencing solutions needs to be monitored and the best hardware or software solutions selected for future studies. It looks like the videoconferencing solutions are moving from dedicated hardware solutions such as VC codecs to cloud-based solutions such as Skype. This transition will have various medico-legal implications that need to be addressed.

There is no standard and validated instrument for evaluating the satisfaction of patients (and providers) with video consultation. The instrument which was developed in this research was
preliminarily tested, but may need further developments through proper psychometric analyses such as Principal Component Analysis or Varimax Rotation.29

Nevertheless, the health systems in many countries including Australia and the UK are already using videoconferencing for clinical purposes, despite the scarcity or lack of evidence that supports the reliability of this mode of health care delivery.

11.5. Policy implications

The results of this research provide health care managers and health policy makers with the preliminary evidence of the reliability of videoconferencing for specialist diabetes consultations. Based on the findings of this research, the current model of care for the management of diabetes can be redesigned to allow safe integration of videoconferencing as a mode of consultation in to the practice of diabetes clinics. Such redesign may consider conducting the first visit of a newly referred patient in face-to-face mode, and the following visits via videoconferencing for a period of up to one year, or when the patient is discharged to the referring GP. This arrangement mimics current attitude of many endocrinologists in preforming a comprehensive physical examination at the first visit and then every year, if the patient still requires visiting the specialist on a regular basis.

Although the context of this research was diabetes, the results can be generalised to other endocrinology diseases and chronic conditions which have similar models of care. Unsurprisingly, the introduction of a new technology such as videoconferencing, tele-monitoring systems, and web-based solutions may necessitate a redesign in the models of health care delivery. Utilising ICT solutions and products, including video consultation, in a health care system raises several ethical concerns such as privacy, consent, and confinement. Moreover, shifting towards a technology-centred health care may adversely limit the access to care for a group of people on the grounds of poverty and/or digital divide.

In addition to clinical, technical and ethical issues, several regulatory and managerial issues need to be addressed for a successful integration of telemedicine into a health care system. Perhaps one of the most important issues is the economic implication of telemedicine. Although generally the cost of equipment and connectivity is decreasing, still building up and running a telemedicine centre in a hospital or clinic is costly. Apart from the capital investment for the physical space, equipment and technical infrastructure, the cost of staff training and implementing change in the work place practice is quite considerable.
Furthermore, the ongoing cost of running a telemedicine centre such as technical support, maintenance, and administration should not be overlooked.

Achieving equity in access to care is one of the strategic goals for many health care systems. Telemedicine can play an important role in achieving this goal. It has the potential to bridge the geographical gap for the residents of remote and rural areas. Telemedicine can also overcome the barriers such as restricted mobility and frailty that may limit the access to care for urban populations. Other people who may benefit from telemedicine are the patient who are culturally isolated or the people with diseases that are associated with stigma such as psychiatric disorders or HIV/AIDS.31

The Australian Government Department of Health and Ageing (DoHA) established the reimbursement of the service for video consultations in remote, regional and out metropolitan areas in 2011.32 Similar financial supports have been provided, though very limited, in other countries such as the USA, but it is still a major issue to be addressed by many nations around the world.

People living in cities can also benefit from video consultation. The observation of the routine work flow of a diabetes clinic in Brisbane with more than two million population revealed that it takes about four to five hours for a patient to attend a 20-minutes appointment with an endocrinologist. This usually costs the patient one day off work if he/she is working. The time required for a round trip to the clinic and waiting for the appointment can easily be saved in case of video consultation. In addition to the travel cost, there are also other costs such as cost of child care or parking fee associated with having an in-person consultation for many patients. Nevertheless, a proportion of patients, especially those with disabling complications or frailty, have more limitation in access to care because they need to be accompanied by a family member, friend, or carer. Telemedicine can play an important role in eliminating this limitation, too.
11.6. Conclusions

The findings of this research demonstrated that videoconferencing is a reliable means of communication between endocrinologists and patients. Video consultation can substitute a considerable proportion of conventional outpatient specialty consultations for people with diabetes. Known limitations of videoconferencing for clinical purposes did not have remarkable impact on the outcome of consultation in terms of adjustment of patient's medications. The results of this research should be confirmed by further studies with appropriate power.

In addition to conventional clinical knowledge, the doctors who are going to use telemedicine as a routine part of their practice may need additional skills such as communication and fostering relationship with the patient at a distance. Moreover, access to the latest patient's information and coordination of remote consultation sessions are pre-requisite to the proposed telemedicine application.
References


Appendices
Appendix 1: Supplementary Materials to Chapter 6

Dr Farhad Fatemi
Centre for Online Health
The University of Queensland
Level 3 Foundation Building
Royal Children's Hospital
Herston
QLD 4029

Dear Dr Fatemi

HREC Reference number: HREC/11/QPAH/325
Project title: Analysis of traditional endocrinology consultation for people with diabetes

Thank you for submitting the above research protocol to the Metro South Health Human Research Ethics Committee for ethical and scientific review. This protocol was first considered by the Human Research Ethics Committee (HREC) at the meeting held on 12 July 2011.

I am pleased to advise that the HREC has granted approval of this research protocol.

You are reminded that this letter constitutes ethical approval only. You must not commence this research protocol at a site until separate authorisation from the District CEO or Delegate of that site has been obtained.

A copy of this approval must be submitted to the District Research Governance Office(s)/Delegate of the relevant institution with a completed Site Specific Assessment (SSA) Form for authorisation from the CEO or Delegate to conduct this research at the Princess Alexandra Hospital.

The documents reviewed and approved include:

<table>
<thead>
<tr>
<th>Document</th>
<th>Version</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Low Risk</td>
<td></td>
<td>03 June 2011</td>
</tr>
<tr>
<td>Letter to Doctor - Introducing Research project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Questionnaire: Analysis of traditional endocrinology consultation</td>
<td>Endocrinologist questionnaire</td>
<td>03 June 2011</td>
</tr>
</tbody>
</table>

Please note the following conditions of approval:
1. The Coordinating Principal Investigator will immediately report anything which might warrant review of ethical approval of the protocol in the specified format, including unforeseen events that might affect continued ethical acceptability of the protocol. Serious Adverse Events must be notified to the HREC as soon as possible. In addition the Investigator must provide a summary of the adverse events, in the specified format, including a comment as to suspected causality and whether changes are required to the...
specified format, including a comment as to suspected causality and whether changes are required to the Patient Information and Consent Form. In the case of Serious Adverse Events occurring at the local site, a full report is required from the Coordinating Principal Investigator, including duration of treatment and outcome of the event.

2. Amendments to the research protocol which may affect the ongoing ethical acceptability of a protocol must be submitted to the HREC for review. Major amendments should be reflected in a revised online NEAF (accompanied by all relevant updated documentation and a cover letter from the principal investigator, providing a brief description of the changes, the rationale for the changes, and their implications for the ongoing conduct of the study). Hard copies of the revised NEAF, the cover letter and all relevant updated documents, with tracked changes, must also be submitted to the HREC office as per standard HREC SOP. (Further advice on submitting amendments is available at http://www.health.qld.gov.au/ohrm/documents/researcher_userguide.pdf http://www.health.qld.gov.au/pahospital/research/amendments.asp)

3. Amendments to the research protocol which only affect the ongoing site acceptability of the protocol are not required to be submitted to the HREC for review. These amendment requests should be submitted directly to the Research Governance Office.

4. Proposed amendments to the research protocol which may affect both the ethical acceptability and site suitability of the protocol must be submitted firstly to the HREC for review and, once HREC approval has been granted, then submitted to the Research Governance Office.

5. Amendments which do not affect either the ethical acceptability or site acceptability of the protocol (e.g. typographical errors) should be submitted electronically (track changes) and in hard copy (final clean copy) to the Research Ethics Manager. These should include a cover letter from the Coordinating Principal Investigator or Study Co-ordinator providing a brief description of the changes and the rationale for the changes, and accompanied by all relevant updated documents with tracked changes.

6. The HREC will be notified, giving reasons, if the protocol is discontinued at a site before the expected date of completion.

7. The Coordinating Principal Investigator will provide an annual report to the HREC and at completion of the study in the specified format.

This HREC approval is valid for 3 years from the date of this letter.

8. If you require an extension for your study, please submit a request for an extension in writing outlining the reasons. Note: One of the criteria for granting an extension is the compliance with the approval’s conditions including submission of progress reports.

Should you have any queries about the HREC’s consideration of your protocol please contact the Ethics Secretariat on 07 3176 7672.

Please note that the Metro South HREC is constituted and operates in accordance with the National Health and Medical Research Council’s (NHMRC) National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007) and the GMP/ICH Note for Guidance on Good Clinical Practice. Attached is the HREC Composition with specialty and affiliation with the Hospital (Attachment 1).

The HREC Terms of Reference, Standard Operating Procedures, membership and standard forms are available from the following websites:

2011-325 Chair Approval Letter
Once authorisation to conduct the research has been granted, please complete the Commencement Form (Attached) and return to the Metro South Human Research Ethics Committee.

The Metro South HREC wishes you every success in your research.

Yours sincerely,

[Signature]
Dr [Name]
Manager Research Ethics
Metro South

Approved by and on behalf of

A/Prof Maher Gandhi
Chair
Metro South Health Service District
Human Research Ethics Committee (EC00167)
Centres for Health Research
Princess Alexandra Hospital

C.c.  A/Prof Tony Russell - Department of Diabetes and Endocrinology, Princess Alexandra Hospital
      Prof Len Gray - Centre for Research in Geriatric Medicine and the Centre for Online Health
SSA Approval – PRINCESS ALEXANDRA HOSPITAL

Dear Dr Fatehi

HREC reference number: HREC/11/QPAH/325
SSA reference number: SSA/11/QPAH/365
Project title: Analysis of traditional endocrinology consultation for people with diabetes

Thank you for submitting an application for authorisation of this project. I am pleased to inform you that authorisation has been granted for this study to take place at the following site:

- Princess Alexandra Hospital

The following conditions apply to this research proposal. These are additional to those conditions imposed by the Human Research Ethics Committee that granted ethical approval.

1. Problems and SAEs: The Research Governance Office must be informed of any problems that arise during the course of the study which may have ethical implications. Where serious adverse events (SAEs) are encountered, the events must be notified as soon as possible. http://www.health.qld.gov.au/pano/patient/sa_e.html
2. Proposed amendments to the research protocol or conduct of the research which may affect the ethical acceptability of the project are to be submitted to the HREC for review. A copy of the HREC approval/rejection letter must be submitted to the RGO;
3. Proposed amendments to the research protocol or conduct of the research which only affects the ongoing site acceptability of the project, are to be submitted to the research governance officer;
4. Proposed amendments to the research protocol or conduct of the research which may affect both the going ethical acceptability of the project and the site acceptability of the project are to be submitted firstly to the HREC for review and then to the research governance officer after a HREC decision is made.
If this research involves the recruitment of patients from the Metro South Health Service District (MSHSD), it is my responsibility to remind you of your ongoing duty of care for all people recruited into projects or clinical trials whilst public patients. All conditions and requirements regarding confidentiality of public information and patient privacy apply. You are required to comply at all times with any application requirements of Australian and Queensland Laws including the Health Services Act, the Privacy Act, Public Health Act (2005) and other relevant legislation, ethics obligations and guidelines which may be applicable to the MSHSD from time to time including, without limitation, any requirement in respect of the maintenance, preservation or destruction of patient records.

When the study involves patient contact, it is your responsibility as the principal investigator to notify the relevant consultant and request their approval.

We wish you every success in undertaking this research.

Yours sincerely,

Dr David E. Theile Smr
DISTRICT CHIEF EXECUTIVE OFFICER
METRO SOUTH
19/11/11
School of Medicine Approval Form for Research Involving Humans Including Behavioural Research for Honours, MPhil & PhD Students in the School of Medicine

<table>
<thead>
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<th>Farhad Fatehi</th>
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<tr>
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<td>Analysis of traditional endocrinology consultation</td>
</tr>
<tr>
<td>Supervisor(s)</td>
<td>Prof Len Gray, Dr Anthony Russell</td>
</tr>
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<td>Co-Investigator(s)</td>
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Comments: Holds prior approval from the QH Low Risk Review

UQ School of Medicine Low Risk Ethical Review Committee

The project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research (complies with the regulations governing research involving humans) and UQ ethical paragraphs concerning low risk research.

UQ School of Medicine Low Risk Ethical Review Committee Representative

Associate Professor Dany Eley

Signed Date 21/11/2011

SOMILRE: School of Medicine Internal Low Risk Ethics
Analysis of traditional endocrinology consultation
Endocrinologist questionnaire

Clinician Name: ..................  Consultation start time: ...........  Consultation finish time: ...........  Date: ..................

I. Patient characteristics:
1. Year of birth: ...........
2. Type of diabetes:
   1) Type I  2) Type II  3) GDM  4) Other
3. Gender:
   1) Female  2) Male
4. How far from the clinic is the patient living?
   1) <20 KM  2) 20-100 KM  3) >100 KM

II. Reason for referral:
5. Was it a review consultation? (Select one option only)
   1) Yes (if yes, go to question No. 7)
   2) No, it was a new patient
   3) No, it was a new referral of a previously seen patient
6. What was the health professional’s primary reason for referral? (Select more than one, if appropriate)
   1) Suspected diagnosis of diabetes
   2) Initiating a management plan in a newly diagnosed patient
   3) Poor blood sugar control
   4) Whilst already on insulin
   5) Requiring initiation of insulin
   6) Requiring alteration in agents other than insulin
   7) Managing diabetes complications
      a) Nephropathy
      b) Retinopathy
      c) Neuropathy
      d) Diabetic foot ulcer
      e) Other ..........................................................
   8) Management of macrovascular risk factors such as blood pressure and lipids
   9) Other (please specify)
      a) ..........................................................

III. Procedures and findings:
7. How was the physical examination performed?
   1) By the endocrinologist
   2) By endocrinologist, with nursing assistance
   3) Not performed (if not performed, go to question 10)
8. Which examination(s) was performed?
   a) Feet – general inspection  1) No  2) Yes
   b) Feet – assessment of pulses  1) No  2) Yes
   c) Feet – neuropathy examination  1) No  2) Yes
   d) Eyes  1) No  2) Yes
   e) Injection sites  1) No  2) Yes
   f) Cardiovascular  1) No  2) Yes
   g) Respiratory  1) No  2) Yes
   h) Abdominal  1) No  2) Yes
   i) Neurological  1) No  2) Yes
   j) Other ..........................................................
9. Was any new important sign detected in patient’s physical examination which in your opinion would influence management?
   a) Feet – general inspection  1) No  2) Yes
   b) Feet – assessment of pulses  1) No  2) Yes
   c) Feet – neuropathy examination  1) No  2) Yes
   d) Eyes  1) No  2) Yes
   e) Injection sites  1) No  2) Yes
   f) Cardiovascular  1) No  2) Yes
   g) Respiratory  1) No  2) Yes
   h) Abdominal  1) No  2) Yes
   i) Neurological  1) No  2) Yes
   j) Other ..........................................................
10. Prior to this consultation, which of the following treatments were prescribed?
    a) Diet  1) No  2) Yes
    b) Exercise  1) No  2) Yes
    c) Oral diabetic medication  1) No  2) Yes
    d) Insulin  1) No  2) Yes
11. Does the patient have any of the following diabetes complications?
    a) Retinopathy  1) No  2) Yes
    b) Nephropathy  1) No  2) Yes
    c) Neuropathy  1) No  2) Yes
    d) Diabetic foot ulcer  1) No  2) Yes
    e) Ischemic Heart Disease  1) No  2) Yes
    f) Other ..........................................................

Denotes mutually inclusive options - Denotes potentially inclusive options
IV. Recommendations:

12. What recommendations did you make?
   a. Order lab test(s) ☐Ono  ☑Yes
   b. Order other diagnostics (e.g. imaging, echo, ...) ☐Ono  ☑Yes
   c. Initiate or titrate a drug for glucose lowering apart from insulin ☐Ono  ☑Yes
   d. Initiate or titrate a drug for cardiovascular risk factor reduction ☐Ono  ☑Yes
   e. Adjustment of insulin regimen ☐Ono  ☑Yes
   f. Confirm current treatment plan ☐Ono  ☑Yes
   g. Refer to another specialist ☐Ono  ☑Yes
   h. Refer to allied health ☐Ono  ☑Yes
   i. Arrange hospital admission ☐Ono  ☑Yes
   j. General advice ☐Ono  ☑Yes
   k. Other ........................................................................................................

13. Did you arrange a follow-up appointment at this clinic? ☐Ono  ☑Yes
   a. If yes, when will be the patient's next appointment? In ______ weeks

V. In your opinion...

14. Could a trained GP perform the physical exam and report to you? ☐Ono  ☑Yes

15. Could a trained nurse perform the physical exam and report to you? ☐Ono  ☑Yes

16. Was it necessary to see the patient in person? ☐Ono  ☑Yes
   a. If yes, why? ..............................................................................................

17. Would it be possible to provide this consultation remotely with the patient alone, provided you had access to the clinical data and lab results? ☐Ono  ☑Yes

17.1. If Yes, via:
   a. Telephone ☐Ono  ☑Yes
   b. Email ☐Ono  ☑Yes
   c. Internet video chat (e.g. Skype) ☐Ono  ☑Yes
   d. HD videoconferencing ☐Ono  ☑Yes

18. Would it be possible to provide this consultation remotely if the case was presented to you by a GP without the patient present and assuming that you had access to the clinical data and lab results? ☐Ono  ☑Yes

18.1. If Yes, via:
   a. Telephone ☐Ono  ☑Yes
   b. Email ☐Ono  ☑Yes
   c. Internet video chat (e.g. Skype) ☐Ono  ☑Yes
   d. HD videoconferencing ☐Ono  ☑Yes

/umd

Denotes mutually exclusive options. ☐Denotes potentially inclusive options.

*High-definition videoconferencing is provided by means of special equipment with capability of zooming, panning, tilting of camera and high quality video and audio.
## Analysis of traditional diabetes consultation

### IT Profile of Endocrinologists

1. Gender:  O Male  O Female
2. How many years have you been practicing medicine?  ...... years
3. Do you routinely do a complete cardiovascular, respiratory and abdominal examination on all new referrals?  O Yes  O No
4. Do you regularly use e-mail?  O Yes  O No
5. Do you use e-mail to discuss clinical problems with professional colleagues?  O Yes  O No
6. Do you interact with your patients using e-mail?  O Yes  O No
7. Do you use an electronic health record to print pathology request forms or write scripts?  O Yes  O No
8. Do you use videoconferencing in your medical practice?  O Yes  O No
9. Do you think part of your practice could be done via videoconference?  O Yes  O No

Thank you!
Appendix 2: Supplementary Materials to Chapter 10

Thank you for submitting the above research protocol to the Metro South Human Research Ethics Committee for ethical and scientific review, on behalf of the following Principal Investigators (see appendix). This protocol was first considered by the Human Research Ethics Committee (HREC) at the meeting held on 06 December 2011.

I am pleased to advise that the HREC has granted approval of this research protocol.

You are reminded that this letter constitutes ethical approval only. You must commence this research protocol at a site until separate authorisation from the District CEO or Delegate of that site has been obtained. A copy of this approval must be submitted to the District Research Governance Officer/Delegate of the relevant institution with a completed Site Specific Assessment (SSA) Form for authorisation from the CEO or Delegate to conduct this research at the Princess Alexandra Hospital.

The documents reviewed and approved include:

<table>
<thead>
<tr>
<th>Document</th>
<th>Version</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response to: Request for Further Information</td>
<td></td>
<td>03 February 2012</td>
</tr>
<tr>
<td>Patient Information and Consent Form</td>
<td>2</td>
<td>12 January 2012</td>
</tr>
</tbody>
</table>

Please note the following conditions of approval:

1. The Coordinating Principal Investigator will immediately report any matter which might warrant review of ethical approval of the protocol in the specified format, including unforeseen events which might affect continued ethical acceptability of the protocol. Serious Adverse Events must be notified to the HREC as soon as possible. In addition, the investigator must provide a summary of the adverse events, in the specified format, including a comment as to the suspected causality and whether changes are required to the Patient Information and Consent Form. In the case of Serious Adverse Events occurring at the local site, a full report is required from the Coordinating Principal Investigator, including duration of treatment and outcome of the event.

2. Amendments to the research protocol which may affect the ongoing ethical acceptability of a protocol must be submitted to the HREC for review. Major amendments should be reflected in a revised online NEAF (accompanied by all relevant updated documentation and a cover letter from the principal investigator, providing a brief description of the changes, the rationale for the changes, and their implications for the ongoing conduct of the study). Hard copies of the revised NEAF, the cover letter and all relevant updated documents, with tracked changes, must also be submitted to the HREC office as per standard HREC SOP. Further advice on submitting amendments is available at http://www.health.qld.gov.au/ohrm/documents/research_userguide.pdf and http://www.health.qld.gov.au/pahospital/research/amendments.asp.

3. Amendments to the research protocol which only affect the ongoing site acceptability of the protocol are not required to be submitted to the HREC for review. These amendment requests should be submitted directly to the Research Governance Officer.
4. Proposed amendments to the research protocol which may affect both the ethical acceptability and site suitability of the protocol must be submitted firstly to the HREC for review and, once HREC approval has been granted, then submitted to the Research Governance Office.

5. Amendments which do not affect either the ethical acceptability or site acceptability of the protocol (e.g., typographical errors) should be submitted electronically (track changes) and in hard copy (final clean copy) to the Research Ethics Manager. These should include a cover letter from the Coordinating Principal Investigator or Study Coordinator providing a brief description of the changes and the rationale for the changes, and accompanied by all relevant updated documents with tracked changes.

6. The HREC will be notified, giving reasons, if the protocol is discontinued at a site before the expected date of completion.

7. The Coordinating Principal Investigator will provide an annual report to the HREC and at completion of the study in the specified format.

This HREC approval is valid for 3 years from the date of this letter.

8. If you require an extension for your study, please submit a request for an extension in writing outlining the reasons. Note: One of the criteria for granting an extension is the completion of the study's inception, i.e., prospectively.


Should you have any queries about the HREC's consideration of your protocol please contact the Ethics Secretariat on 07 3176 7672.

Please note that the Metro South HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007) and the CMIPCH Note for Guidance on Good Clinical Practice. Attached is the HREC Composition with specialties and affiliations with the Hospital (Attachment I).

The HREC Terms of Reference, Standard Operating Procedures, membership and standard forms are available from the following websites:

Once authorization to conduct the research has been granted, please complete the Commencement Form (Attached) and return to the Metro South Human Research Ethics Committee.

The Metro South HREC wishes you every success in your research.

Yours sincerely,

[Signature]

Associate Professor Maher Gandhi
Chair
Metro South Health Service District
Human Research Ethics Committee (EC00167)
Centres for Health Research
Princess Alexandra Hospital

---

Office: Centres for Health Research
Princess Alexandra Hospital
Metro South Health Service District

Postal: Pinjarra Road
Wooloongabba 4102

Phone: 07 3176 7672
Fax: 07 3176 7667

2011-646 Ethics Clearance Letter  Page 2 of 2
Your ACTRN (registration number): ACTRN12612000315819

To: @faradhi@gmail.com

Dear Farhad,

Re: Evaluation of accuracy of video tele-consultation for people with type II diabetes by comparing the recommendations made through videoconferencing with those of in-person consultation

Thank you for submitting the above trial for inclusion in the Australian New Zealand Clinical Trials Registry (ANZCTR).

Your trial has now been successfully registered and allocated the ACTRN: ACTRN12612000315819

Date submitted: 16/03/2012 10:13:02 AM
Date registered: 20/03/2012 12:35:25 PM
Registered by: Farhad Fatehi

If you have already obtained Ethics approval for your trial, could you please send the ANZCTR a copy of at least one Ethics Committee approval letter? A copy of the letter can be sent to info@actr.org.au (by email) OR (61 2) 9565 1863, attention to ANZCTR (by fax).

Please be reminded that the quality and accuracy of the trial information submitted for registration is the responsibility of the trial’s Primary Sponsor or their representative (the Registrant). The ANZCTR allows you to update trial data, but please note that the original data lodged at the time of trial registration and the tracked history of any changes made will remain publicly available.

The ANZCTR is recognised as an ICMJE acceptable registry (http://www.icmje.org/faq.pdf) and a Primary Registry in the WHO registry network (http://www.who.int/ictrp/network/primary/en/index.html).

If you have any queries please send a message to info@actr.org.au or telephone +61 2 9562 5333.

Kind regards,

ANZCTR Staff
T: +61 2 9562 5333
F: +61 2 9565 1863
E: info@actr.org.au
W: www.ANZCTR.org.au
School of Medicine Approval Form for Research Involving Humans Including Behavioural Research for Honours, MPhil & PhD Students in the School of Medicine

<table>
<thead>
<tr>
<th>Chief Investigator (student)</th>
<th>Farhad Fatehi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title</td>
<td>Evaluation of accuracy and safety of video teleconsultation for diabetes – A pilot study</td>
</tr>
<tr>
<td>Supervisor(s)</td>
<td>Prof. Len Gray</td>
</tr>
<tr>
<td>Co-Investigator(s)</td>
<td>A/Prof. Anthony Russell</td>
</tr>
<tr>
<td>Research Centre/Institute/School</td>
<td>Centre for Online Health, School of Medicine</td>
</tr>
<tr>
<td>SOM Clearance Number</td>
<td>2011-SOMILRE-0022</td>
</tr>
<tr>
<td>Date of Issue</td>
<td>05 April 2012</td>
</tr>
<tr>
<td>Date of Expiry</td>
<td>31 December 2013</td>
</tr>
</tbody>
</table>

Comments:

Also holds clearance from Metro South Health Service District Human Research Ethics Committee (EC00167)

UQ School of Medicine Low Risk Ethical Review Committee

This project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research (complies with the regulations governing research involving humans) and UQ ethical paragraphs concerning low risk research.

UQ School of Medicine Low Risk Ethical Review Committee Representative

Associate Professor Diann Eley

Signed: 05 April 2012

Date: 05 April 2012
Dear Dr Fatehi,

HREC Reference number: HREC/11/QPAH/645
SSA reference number: SSA/11/QPAH/692
Project title: Evaluation Of Accuracy And Safety Of Video Tele-Consultation For Diabetes – A Pilot Study

Thank you for submitting an application for authorisation of this project. I am pleased to inform you that authorisation has been granted for this study to take place at the Princess Alexandra Hospital.

The following conditions apply to this research proposal. These are additional to those conditions imposed by the Human Research Ethics Committee that granted ethical approval.

1. Problems and SAEs: The Research Governance Office must be informed of any problems that arise during the course of the study which may have ethical implications. Where serious adverse events (SAEs) are encountered, the events must be notified as soon as possible.
   

2. Proposed amendments to the research protocol or conduct of the research which may affect the ethical acceptability of the project are to be submitted to the HREC for review. A copy of the HREC approval/rejection letter must be submitted to the RGO;

3. Proposed amendments to the research protocol or conduct of the research which only affects the ongoing site acceptability of the project, are to be submitted to the research governance officer;

4. Proposed amendments to the research protocol or conduct of the research which may affect both the ongoing ethical acceptability of the project and the site acceptability of the project are to be submitted firstly to the HREC for review and then to the research governance officer after a HREC decision is made.
If this research involves the recruitment of patients from the Metro South Health Service District (MSHSD), it is my responsibility to remind you of your ongoing duty of care for all people recruited into projects or clinical trials whilst public patients. All conditions and requirements regarding confidentiality of public information and patient privacy apply. You are required to comply at all times with any application requirements of Australian and Queensland Laws including the Health Services Act, the Privacy Act, Public Health Act (2005) and other relevant legislation, ethics obligations and guidelines which may be applicable to the MSHSD from time to time including, without limitation, any requirement in respect of the maintenance, preservation or destruction of patient records.

When the study involves patient contact, it is your responsibility as the principal investigator to notify the relevant consultant and request their approval.

We wish you every success in undertaking this research.

Yours sincerely,

[Signature]

Dr David Thiele Snr
DISTRICT CHIEF EXECUTIVE OFFICER
METRO SOUTH

7/6/12

C.C. Professor Anthony Russell
Diabetes and Endocrinology Department
Princess Alexandra Hospital
196 Ipswich Road Woolloongabba

Office
Centres for Health Research
Princess Alexandra Hospital
Metro South Health Service District

Postal
Ipswich Road
Woolloongabba Q 4102

Phone
61 7 3176 7722

Fax
61 7 3176 7867
Analysis of endocrinology consultation

Clinician Name: ................. Patient ID: ................. Consultation Date: ................. Mode: 0n-person / 0VC
Times: Case preparation ........ minutes; Consultation: from ........ to ........; writing report: ........ minutes

I. Patient characteristics:
1. Year of birth: .................
2. Gender: 0Female 1Male
3. How far from the clinic is the patient living?
   0<20 KM 020-100 KM 0>100 KM
4. Prior to this consultation, which of the following treatments were prescribed?
   a. 0Diet
   b. 0Exercise
   c. 0Oral diabetic medication
   d. 0Byetta
   e. 0Insulin

II. Procedures and findings:
5. Latest HbA1c: .................
6. How was the physical examination performed?
   0Not performed (go to Question 9)
   0By the endocrinologist
   0By the endocrinologist, with nursing assistance
7. Which examination(s) was performed?
   a. 0Feet – general inspection
   b. 0Feet – assessment of pulses
   c. 0Feet – neuropathy exam
   d. 0Eyes
   e. 0Injection sites
   f. 0Cardiovascular
   g. 0Respiratory
   h. 0Abdominal
   i. 0Neurological
   j. 0Other
8. Was any new important sign detected
   in patient's physical examination which in your opinion would influence management?
   a. 0Feet – general inspection
   b. 0Feet – assessment of pulses
   c. 0Feet – neuropathy exam
   d. 0Eyes
   e. 0Injection sites
   f. 0Cardiovascular
   g. 0Respiratory
   h. 0Abdominal
   i. 0Neurological
   j. 0Other (Please specify) .................

II. Recommendations:
9. Does the patient have any of these complications?
   a. 0Retinopathy
   b. 0Nephropathy
   c. 0Neuropathy
   d. 0Diabetic foot ulcer
   e. 0Ischemic Heart Disease
   f. 0Other

10. What is your assessment of the patient's condition?
    0The patient's condition is satisfactory
    0More investigations are needed
    0There is a need for change in management plan

IV. Recommendations:
11. Did you advise any life style change?
    a. 0Healthy diet
    b. 0Physical activity
    c. 0Sport
    d. 0Other

12. Did you order any of the following investigations?
    a. 0Lab test(s)
    b. 0Imaging(s)
    c. 0Other

13. Did you change the patient medication?
    a. 0No; current treatment plan confirmed
    b. 0Yes, Insulin
    c. 0Other hypoglycaemic agents
    d. 0Anti-hypertensive drugs
    e. 0Lipid drugs
    f. 0Other

14. What is your advice on the future management?
    a. 0Inpatient hospitalisation
    b. 0Outpatient consultation
    c. 0Follow-up

15. What is your opinion on the patient's current treatment plan?
    a. 0Effective
    b. 0Ineffective
    c. 0Other

16. What is your opinion on the patient's current medications?
    a. 0Effective
    b. 0Ineffective
    c. 0Other

17. What is your opinion on the patient's current lifestyle?
    a. 0Healthy
    b. 0Unhealthy
    c. 0Other

Videoconference for diabetes – Endocrinologist’s questionnaire – Ver. 2.20130405
14. Did you refer the patient?
   a. □ No
   b. □ Yes; the patient was referred
      1. □ back to the GP
      2. □ to another specialist
      3. □ to an allied health professional
      4. □ for hospital admission
      5. □ other ........................................

15. Did you arrange any follow-up?
   a. □ Yes, at this clinic, in ............ weeks
   b. □ Yes, at another clinic
   c. □ No; Follow-up was not needed
   d. □ No; Follow-up was not possible
   e. ........................................

16. Please indicate any problem you might have with videoconferencing (if the consultation was via video).

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Thank you!

□ Denotes mutually inclusive options - □ Denotes potentially inclusive options

*High Definition Videoconferencing is provided by means of special equipment with capability of zooming, panning, tilting of camera and high quality video and audio.