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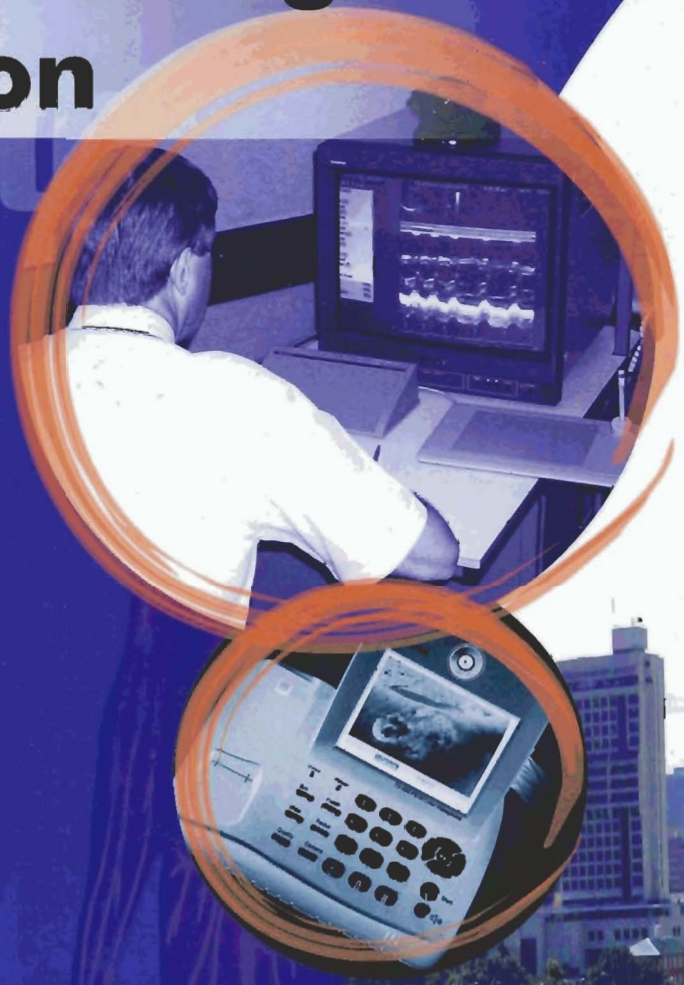

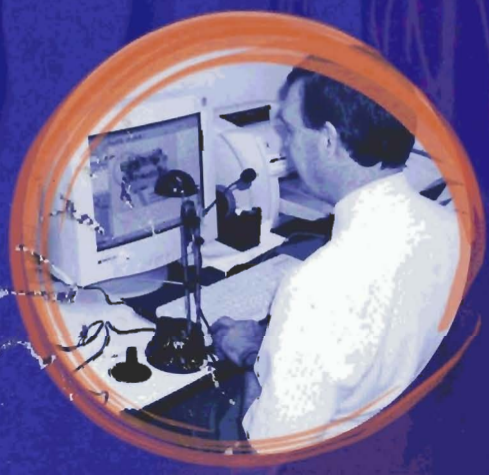

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CONTENTS

FOREWORD

Welcome to the second conference entitled "Successes and Failures in Telehealth" sponsored by the Centre for Online Health of the University of Queensland at the Royal Children's Hospital in Brisbane. The first conference in 2001 was a resounding success and I have similar expectations for this meeting.

The title " Successes and Failures in Telehealth" is in itself challenging and provocative. Most of us are happy to share our successes. Rarely are we as open about our failures, be they small scale or grand scale failures! Yet, as with any other new technique, if telehealth is to live up to its promise, then it will be essential that we share our experiences, both positive and negative.

For some people, new health technologies have an intrinsic appeal and most new technologies have their enthusiastic supporters who are not always completely objective in their assessments. Telehealth is no exception in this regard. The enthusiastic supporters of telehealth see unlimited potential for its application. On the other hand, those of us responsible for health service administration and management require a more rigorous analysis of both the clinical- and cost-effectiveness of telehealth. In some circumstances, of course, clinical effectiveness may be more important than cost effectiveness.

One of the difficulties in evaluating telehealth as a new health technology is that there is no universal model for health service delivery or funding. The funding models, health service delivery systems and geographical imperatives vary from state to state and country to country, and it is difficult therefore for the lessons learned in one telehealth environment to be applied to another.

In many respects, Queensland is an ideal test-bed for telehealth. It is a geographically large state with its north-south dimension being equivalent to the distance from London to Moscow. Much of its population is concentrated in the south-east corner and along the coastline in regional cities. A relatively small number of people live in widely scattered rural and remote areas, making the equitable provision of routine medical services difficult and the provision of specialist and sub-specialist services an even greater challenge. However, public health services are provided by a single agency, Queensland Health, and travel expenses for patients in rural, remote and regional Queensland for access to specialist services is government funded. In this environment, if telehealth services obviate the need for patient travel, there are "bankable" savings for the health system. This is not often the case in other countries.

As evinced by the program for this conference, there is an increasing diversity of specialty services being provided by telehealth. At the Royal Children's Hospital in Brisbane, for example, we have a growing experience in the delivery of diabetes and endocrinology services by telehealth.

I support telehealth as a method for delivery of health services in Queensland but I am also a critical observer. As has been observed elsewhere, telehealth appears to work best when there are "champions" at both the home and remote site.[1] As you will learn during the course of the conference, the Centre for Online Health and the Royal Children's Hospital have been engaged in a pilot research project on delivery of paediatric sub-specialty services by telehealth to two test sites. There are measurable differences in the uptake of the services and subsequent changes in referrals between the two sites, and I suspect that one of the major

differences is the influence of the clinical "champion".[2] This illustrates one of the greatest challenges for telehealth, which is converting the potential demonstrated by pilot trials involving "champions" of telehealth into the wider medical community with the same level of success.

I am sure that this year's programme will surpass the success of last year's inaugural conference.[3] I hope you find the programme stimulating and challenging and I look forward to your contribution.

Professor Alan Isles
District Manager
Royal Children's Hospital
Herston 4029
Australia
(Fax: +61 7 3636 7215; Email: IslesA@health.qld.gov.au)

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PAPERS

Videoconferenced continuing medical education in Nova Scotia

Michael Allen, Joan Sargeant and Eileen MacDougall

Office of Continuing Medical Education, Dalhousie University, Canada

Correspondence to
Michael Allen MD
Dalhousie University Continuing Medical Education
5849 University Avenue
Halifax
Nova Scotia B3H 4H7
CANADA
(Fax: + 1 902 494 1479; Email: michael.allen@dal.ca)

Summary
Videoconferencing has been used for continuing medical education (CME) in Nova Scotia since a pilot project to four communities in 1995. The Nova Scotia TeleHealth Network (NSTHN) was developed after the pilot project. Using the network, the videoconferenced CME program expanded over the next several years until in 2000-2001, 66 programs were broadcast to 38 sites. Throughout expansion of the program, we have improved video quality, and developed efficient methods of: 1) scheduling and planning the content of the videoconferences; 2) training faculty in videoconferencing techniques; and 3) evaluation. We consider this program represents a success. However, several factors could be improved. Faculty still need encouragement to make visual aids legible by videoconference and to provide handouts. Also, there has been little upgrading of equipment over the past four years with some compromise of reliable connectivity.

Introduction
Like many areas, the province of Nova Scotia faces challenges providing health services to rural communities. In 1995, through an initiative of the Nova Scotia Department of Health, a group of rural physicians identified concerns that affect physician recruitment and retention: practice coverage; personal lifestyle; and access to specialist services and continuing medical education (CME). In response, in 1995-1996 a telehealth pilot project was implemented linking four rural communities with the tertiary care centre in Halifax. Telehealth services provided were teleradiology, teledermatology and videoconferenced CME. The success of, and lessons learned from that pilot project[1] led to the development of the Nova Scotia Telehealth Network (NSTHN) which now links 40 health care facilities. Videoconferenced CME is a major component of the NSTHN and this paper describes its development, its successes, and its challenges.

Pilot project
In the pilot project, Dalhousie CME broadcast 24 one-hour videoconferences to four communities. Videoconferences were broadcast over two Centrex lines at 112 kbit/s to two sites simultaneously. From the pilot project we learned that:

video quality was inadequate
it was feasible to broadcast to more than two sites simultaneously
it was essential to involve receiving-site physicians in planning
it was essential to obtain faculty support and provide training in videoconferencing techniques
it was essential to have coordinated technical support at the presenting site, the receiving sites, and the bridge.

Development of province-wide videoconferencing program
Following the success of the pilot project, the NSTHN and videoconferenced CME program developed in stages (Table 1).

Table 1. Videoconferencing activity from 1995 to 2001

Year	Number of sites	Number of Videoconferences	Attendance
1995-96	4	24	332
1997-98	14	30	479
1998-99	20	30	665
1999-00	37	64	1059
2000-01	38	66	1058

Technology and video quality
To improve video quality, videoconferencing was conducted using three ISDN lines at 384 kbit/s. However, the equipment at the presenting and receiving sites changed little between the pilot and provincial programs. Presenting sites used a room-based videoconferencing system (Polycom or PictureTel) with one or two monitors ranging in size from 69 to 91 cm. Receiving sites in larger communities used room-based PictureTel units while smaller communities used PC-based units with a 53 cm monitor. An eight-port bridge, operated by the local telecommunications company, distributed the videoconferences.

Planning and scheduling with receiving-site physicians
We involved receiving-site physicians in many aspects of planning. Before videoconferencing equipment was installed in receiving sites, we visited physicians there to describe the videoconferencing program and conduct an initial needs assessment. Each community selected their preferred time to receive videoconferences, and a contact physician to help with further planning and coordination. We then formed groups each containing four to six sites that wished to receive the videoconferences at the same time.

Contact physicians conducted a detailed needs assessment and then participated in a telephone audioconference with other contact physicians from communities in the same group. Together, they selected videoconferencing topics for the following year. Generally, each group received one videoconference per month (nine per academic year).

Faculty support and training
To involve faculty members, we attended departmental meetings to describe the videoconferencing program, ask for their support, and solicit topics that they were willing to

present by videoconference. This topic list was sent to receiving-site contact physicians to help them select the year's videoconferences as described above.

All faculty members presenting by videoconference received an information package describing: 1) the videoconferencing equipment; 2) preparation of visual aids; 3) methods of encouraging interaction; and 4) presenting a professional appearance. They were also offered a one-hour training session.

Technical support
At each presenting site, a technician operated the videoconferencing equipment allowing faculty members to concentrate on teaching. At receiving sites, a member of the hospital staff (e.g. a nurse, X-ray technician or laboratory technician) was trained to dial in to the bridge. Because of other hospital duties, this staff member was not always present throughout the videoconference. However, in several sites, physicians learned to operate the equipment. All sites could obtain technical support through a toll-free help line.

Evaluation
For evaluation, both the receiving-site participants and faculty members completed one-page evaluation forms consisting of open-ended questions for comments and five-point Likert scale questions (1 = strongly disagree, 3 = neutral, 5 = strongly agree). Also, at the end of each year's series of videoconferences, we visited physicians at all new receiving sites and many older ones to gather qualitative data.

Results
Tables 2 and 3 show data from the evaluation forms from receiving-site participants and faculty during the pilot project and from 2000-2001, the most recent year for which we complete data are available.

Table 3. Ratings[1] of the faculty members' evaluation of videoconferencing technology

Variable	Pilot 1995-1996				Provincial program 2000-2001			
	N	Rating[a]	SD		N	Rating[a]	SD	P
Picture quality was satisfactory	24	3.7	0.99		22	4.1	0.8	0.14
Audio quality was satisfactory	24	3.7	0.84		22	4.0	0.8	0.22
Videoconferencing equipment enabled interaction between sites	24	3.9	1.00		22	3.7	0.6	>0.3
Videoconferencing equipment enabled effective use of teaching aids	24	4.1	0.81		22	4.3	0.7	>0.3
Videoconferencing works as well as a live presentation	24	3.3	1.03		22	3.3	1.3	>0.3

[a]Ratings were on a Likert scale where 1 = strongly disagree; 3 = neutral; 5 = strongly agree

Generally, participants were well satisfied with the content and presentation in the pilot and the provincial program. They were less satisfied with pre-course materials in the provincial program, possibly because these materials were not provided for all videoconferences. With regard to videoconferencing technology, participants in the provincial program were more satisfied than those in the pilot with video quality and ability of videoconferencing equipment to enable effective use of teaching aids. Faculty ratings of videoconferencing technology did not change statistically, though there was a trend toward higher scores for picture and audio quality in the provincial program.

Qualitative data from receiving sites provided valuable suggestions for improvement. Physicians asked that the videoconferences start at the scheduled time rather than wait for latecomers. Follow-up revealed that physicians appreciated the definite start and stop time that enabled them to schedule their workday. Another suggestion was to change the method of interaction in videoconferences. In the early years of the program, we encouraged faculty to direct questions to each site in turn. Several physicians complained that this slowed the videoconference, and some physicians at sites where they were the only person attending found this intimidating. Faculty members now tend to direct questions to all sites at once. Although this does lead to some confusion if two sites speak simultaneously, it does not usually create problems.

Discussion

Lessons learned from the pilot project have helped us to develop a long-term province-wide program. Using three ISDN lines has provided better video quality with higher ratings by receiving-site physicians. Broadcasting to more than two sites simultaneously has not affected their ratings for opportunity for discussion (pilot = 4.4; provincial program = 4.5) or ability of videoconferencing equipment to enable interaction between sites (pilot = 4.1; provincial program = 4.1). These findings are relevant because Davis et al have shown that discussion in CME programs is important in changing physician practice[2].

One difficulty in moving to a large-scale program is having faculty members consistently provide pre-program handouts. In a small pilot project with few faculty members making presentations, encouraging them is relatively easy. With approximately eight videoconferences per month extending over a full academic year, it is not always possible for busy faculty members to prepare handouts.

We consider that this program represents a success. However, we have encountered some difficulties during the past year (2001-2002). Faculty members still need to be encouraged to make their visual aids legible by videoconference. There have also been problems with reliable connectivity. It is possible that these problems have led to the decreased attendance observed in 2001-2002. Although we do not have complete information, preliminary data indicate that attendance will be lower this year at approximately 950 participants. For several videoconferences, there have been no participants at some receiving sites. This has led to some dissatisfaction from faculty members who have taken time to prepare for and present the videoconference.

Through contact physicians in receiving sites, we are now working to identify the reasons for low attendance. Some communities have enough face-to-face CME so that videoconferences are unnecessary. Some have lost physicians and those remaining find that clinical duties take precedence over the videoconferences. We expect that our program will continue with fewer receiving sites and fewer videoconferences. We will broadcast to more sites simultaneously so that if attendance is low at some sites, faculty members will still consider that teaching by videoconference is a valuable use of their time. And this may be the most important lesson – to be aware of and respond to the changing needs and circumstances of all those involved in our videoconferencing program.

Acknowledgements

We thank the Medical Society of Nova Scotia for funding the videoconferenced CME program, Ms Trudi Evans for coordinating the program, and the Nova Scotia Department of Health for funding the Nova Scotia Telehealth Network.

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Table 2. Ratings of remote-site participants of content and presentation and videoconferencing technology

Variable	Pilot 1995-1996				Provincial Program 2000-2001			
	N	Rating[a]	SD		N	Rating[a]	SD	P
Content was applicable to my practice	194	4.3	0.75		441	4.2	0.75	0.12
Instructor presented material clearly[b]					451	4.4	0.65	
Instructor used appropriate teaching methods	195	4.3	0.74		449	4.6	0.60	<0.001
Instructor allowed adequate opportunity for discussion	195	4.4	0.73		433	4.5	0.66	>0.3
Pre-course materials were useful	188	4.2	0.92		240[c]	3.9	1.09	<0.001
Picture quality was satisfactory	191	3.6	0.91		431	4.0	0.96	<0.001
Audio quality was satisfactory	192	4.2	0.63		435	4.2	0.74	>0.3
Videoconferencing equipment enabled interaction between sites	192	4.1	0.74		421	4.1	0.85	>0.3
Videoconferencing equipment enabled effective use of teaching aids	189	3.7	1.03		417	4.0	0.93	<0.001
Videoconferencing works as well as a live presentation	188	3.9	0.86		421	3.9	1.02	>0.3

[a]Ratings were on a Likert scale where 1 = strongly disagree; 3 = neutral; 5 = strongly agree
[b] Question not asked in pilot project
[c] Not provided for every videoconference

Website discussion forums: results of an Australian project to promote telecommunication in dermatology

Keng Chen[1], Adrian See[2] and Stephen Shumack[1]

1 St George Hospital, Kogarah, NSW, Australia
2 Royal Haslar Infirmary, Gosport, UK

Correspondence:
Keng Chen
St George Dermatology and Skin Cancer Centre
Level 3, 22 Belgrave St
Kogarah
NSW 2217
AUSTRALIA
(Fax no: +61 2 9553 8133; Email:kengchen74@hotmail.com)

Summary
Discussion forums on the Internet allow doctors to discuss issues of interest in a rapid, convenient and educational manner. In March 2002, the Department of Dermatology at the St George Hospital, Sydney, Australia, launched a national website with an online discussion forum for dermatologists. Features of the website forum include the ability to moderate the discussion boards, to produce public or private discussions, and receiving automatic email notifications. Over a period of three months, 3 dermatologists posted a total of 13 messages in 3 topics. The low rate of participation by dermatologists may be due to lack of time or familiarity with the technology. Increased promotion and/or education of dermatologists who are most likely to utilise the discussion forum may improve utilisation of this means of communication.

Introduction
The Internet has revolutionised communication. It is a simple, cheap, rapid and reliable method of communication and has allowed access to information on an unprecedented scale. Usage of the Internet among the medical profession is high, particularly for email purposes. Discussion forums such as Physicians Online and Surginet allow doctors to discuss medical cases, current issues or research through the Internet.

In March 2002 our department launched a national website capable of linking every dermatology department in Australia. Primary aims of the website include formation of a national archive of clinical cases for educational purposes, and production of an Internet discussion forum to promote communication of ideas and opinions among dermatologists nationally.

Methods

The website was developed over a period of approximately six months in collaboration with the New South Wales Open Training and Education Network (OTEN). Funding for the program was obtained from three pharmaceutical companies. The website was officially launched in March 2002 at the Royal Newcastle Hospital Department of Dermatology Annual Meeting. Promotion of the forum was done by regular presentations at major clinical meetings of dermatologists, both before and after the website was launched.

Access to the discussion board required passwords that could only be obtained from the website administrator. The discussion board had a simple layout with intuitive command options such as 'Read message', 'Post message' and 'Reply to message'. A range of topics relating to dermatology was chosen to act as a focus for discussion, including:

acne
melanoma
cosmetic dermatology
Mohs surgery
general
non-melanoma skin cancers
HIV and dermatology
psoriasis
lasers in dermatology.

A separate dermatologist with specific expertise in that area moderated each of these topics. Messages could be posted on each of the topics, as well as replies to specific messages. Users were able to tailor their account to receive automatic email notifications whenever new messages were posted on any topic of interest. A 'Help' function detailing how to use the discussion board was available online. Users were also encouraged to contact the web administrator regarding any difficulties in accessing or using the discussion board.

Results

34 dermatologists, 12 registrars and eight research fellows in dermatology requested and obtained access to the website and discussion forums. Over a period of three months, 3 dermatologists posted a total of 13 messages in 3 topics, see Table 1.

Table 1. Discussion topic and number of messages posted over 3 months

Topic	**Number of messages**
General	2
Melanoma	1
Non-melanoma skin cancers	10

The highest number of times an individual message was read was 40. This figure includes the possibility of an individual reading a message several times. Four messages were posted in reply to this original message.

No requests for assistance in using the discussion board were received.

Discussion

Use of the discussion boards was less than anticipated. Possible causes of this include lack of time, lack of familiarity with the use of discussion boards and lack of interest among the dermatologists. We felt that the last of these was least likely as overall feedback and requests for access were high among dermatologists attending the meetings, which indirectly indicated interest. Previous surveys of Internet usage by doctors have reported time constraints as a factor limiting use of the Internet.[1, 2]

Doctors who use Internet discussion forums are more likely to be less than 55 years of age, in an urban private solo or group practice, and have infrequent consultations with colleagues.[3] Our promotion of the website among dermatologists attending meetings may therefore not attract the doctors most likely to use the discussion forum. Those doctors attending meetings are more likely to have frequent consultations with colleagues through departmental affiliations.

One message was read 40 times but only received four replies. This suggests that 'passive' users, i.e. members who read but do not post messages or replies, are common. Technical limitations did not allow us to assess the number of passive users accurately, and it is possible that the message in question was read many times by the same individual, although we feel this is unlikely. Previous studies suggest the proportion of 'passive' users may be as high as 60%.[4]

It has been suggested that discussion forums offer a different method for the dissemination of medical information compared to the traditional medical literature and clinical meetings, and that forums may be valuable.[4] We therefore intend to carry out wider promotion of the discussion forum, particularly to those dermatologists who are most likely to use it. Educating dermatologists in the use of the new technology may also be required.

Acknowledgements

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Sustainability - the Holy Grail of telehealth?

TD Cradduck

The Keston Group, Edmonton, Canada

Correspondence:
Dr TD Cradduck
The Keston Group
11350 - 104th Ave, Unit 331
Edmonton
Alberta T5K 2W1
CANADA
(Fax: +1 780 450 1771; Email: cradduck@keston.com)

Summary
The sustainability of a telehealth programme is one measure of its success. However, the term "sustainable telehealth" has almost become an oxymoron. Many telehealth programmes are initiated in good faith based upon well-founded principles. Unfortunately, the initial funding cycle is rarely long enough to enable the programme to reach maturity and become integrated into the healthcare delivery system. Telehealth is not about technology; it is about change management and it takes time for personnel to adopt new modes of practice. In addition, a telehealth programme needs a threshold number of installations before it can be deemed fully operational. In many instances an evaluation carried out at the conclusion of the pilot phase will fail to recognize the initial goals. As a consequence, the criteria used to justify further financial support are often at odds with the original goals and aspirations of the project initiators and this leads to dissatisfaction by all parties concerned.

Introduction
The term "sustainable telehealth" has almost become an oxymoron. This is especially true in Canada where a number of funding sources have been used to initiate different telehealth projects. Unfortunately, the nature of this funding has not usually provided sufficient time for the project to reach a level of maturity so that it can be sustained. Furthermore, the justification for continuing financial support has, in many instances, been made dependent on criteria that bear little relationship to the original objectives of the project.

Sustainability
Sustainability can best be described as that situation when telehealth is no longer regarded as a "special" case, but has been absorbed into routine healthcare delivery. Other indicators of sustainability in telehealth are:

the number of telehealth systems
continued use of those systems with increasing demand for services
commitment by healthcare providers to invest
acceptance of telehealth as part of the core budget of healthcare providers

commitment by government to support core services.

When health authorities are prepared to commit recurrent funding to telehealth projects it may be assumed that telehealth has achieved a level of maturity such that it will be sustained in the long term. The savings associated with telehealth accrue primarily to the patient rather than the provider. The result is that telehealth tends to add extra cost to the healthcare system and any direct savings are difficult to identify. As a consequence there needs to be a commitment by government to support the core services that contribute to the success of a programme.

The Alberta experience

Alberta has a relatively large telehealth system. The number of installed units was originally projected to be 160 by the end of the fiscal year 2002/03. It is now expected to be closer to 200 systems by the end of March, 2002. This represents a 25% increase, occurring twelve months early.

In terms of use there has been an increasing demand for services. One metric that can serve as an indicator of network activity is the use of the multipoint bridge. This has grown from about 200 port-hours per month in February, 2000 to 640 port-hours per month in November, 2001. There was a total of 5400 port-hours of bridge use in 2001.

The question remains, however, whether these systems are being used effectively. Only in some instances is this the case. In February, 2001, one health authority reported that all seven of their installations were booked for 90% of the month of April, 2001. That heavy schedule has been continued throughout 2001. Most of the use has been for continuing education and administrative activities. With the notable exception of mental health, there has been a relatively low volume of clinical traffic. This would suggest a lack of interest by clinicians.

The willingness of health authorities to invest has been varied and depends to a very great extent on the geographical and demographic pressures on that health authority to provide remote services. Some of the health authorities were slow to submit business plans for their telehealth programmes; others were extremely slow to implement them, once approval had been given. On the other hand the willingness of some health authorities to invest significant funds above those offered by the provincial programme suggests commitment. In addition, despite the fact that Alberta has demonstrated that the existence of core services is important to the success of a province-wide network, government funding for future support of core services has not been forthcoming.

The Nova Scotia experience

Nova Scotia has a telehealth network of similar size to Alberta. Nova Scotia is a smaller province and has had about 50 sites operational for the last four years. These systems were installed under a programme initiated by the provincial government, not, as is the case in Alberta, by the individual health regions. The Nova Scotia network has been used quite heavily for continuing education and a substantial number of radiological images are transmitted for remote interpretation. Other clinical applications have been slow to develop.

Experience in Nova Scotia and Alberta suggests that it takes 3-4 years before telehealth becomes integrated into routine healthcare delivery. This is probably a consequence of several factors. The time taken by health authorities to implement telehealth programmes has been grossly underestimated. It takes up to as much as a full year before health authorities are able to select, purchase and install equipment after being given permission to proceed. Telehealth coordinators have been, for the most part, new to the task. They have had a lot to learn, which has presented another major challenge. In addition, there has been slow clinician buy-in, largely because some health authorities have lacked commitment at a senior level.

Conclusion

Success and failure must be judged on the basis of the overall objectives and the goals of the programme. It is unfortunate that very often the original goals are lofty and strike a popular chord. However, when the project has reached the end of initial funding it is often the case that new evaluative measures, which are more financially oriented, are applied. This results in neglect of the original goals of the programme. One primary goal of most telehealth programmes is to improve access to healthcare. Increasing access to healthcare services leads to greater use of those services and, consequently, increased costs. Although this may have the desired effect of providing early diagnosis, or monitoring, and therefore avoidance of the greater costs associated with more serious conditions, the original goal of improved access should not be replaced by asking if the programme is cost-effective in the short term.

The lesson to be learned is that, either the final evaluation of a project and the decision for continuing financial support must be based on the original objectives of the project, or, alternatively, recognition must be given at the outset to the evaluation criteria that will be applied when considering further support at the end of the initial funding period. The latter alternative may well require that the laudatory goals and objectives of the project plan must play a secondary role in terms of project evaluation. Moving the goal posts during the game changes the rules and thus leads to dissatisfaction by all players.

Lessons learned from the Hospital Without Walls project

Michael Dadd[1], Briony Doyle[1], Laurie Wilson[1] and Marcus Gunaratnam[2]

1 CSIRO Division of Telecommunications and Industrial Physics, Marsfield, Australia
2 Ryde Hospital and Community Health Services, Eastwood, Australia

Correspondence:
Michael Dadd
CTIP
PO Box 76
Epping 1710
AUSTRALIA
(Fax: +61 2 9372 4411; Email: Mike.Dadd@csiro.au)

Summary
The Hospital Without Walls is a project in home telecare, incorporating research in physiological monitoring, very low power radio communication, database storage of physiological data and in methods of viewing clinically relevant information from large amounts of stored data. The system records vital signs from patients in their homes using a body-mounted two-way radio system and a base station located in the home, which transmits data records to a central recording facility every day, or in response to pre-defined emergency events. The prototype system has successfully undergone preliminary clinical trials, with an emphasis on monitoring activity using three axis accelerometers. Our experience with the trial suggests that there are significant differences in the technical design required by a long-term, home monitoring system and one where monitoring takes place in an environment staffed by health professionals. These lessons will guide further development of the system in the next round of trials.

Introduction
The aging population, the high cost of managing chronic diseases and the severe disruption to lifestyle brought about by current clinical management methods has stimulated research into technological aids to support the management of long term medical problems in the home. In addition, the high cost and limited supply of hospital beds is resulting in post-operative patients being returned home for convalescence.

The Hospital Without Walls system[1] is designed to record vital signs from people in their homes or in communal settings, such as retirement villages, hostels or nursing homes. It is therefore potentially applicable to the monitoring of both chronic disease and short-term care situations.

Achieving this goal, requires research in different areas, including:

physiological monitoring

low power radio communication
analysis of physiological data
database storage of physiological data
extraction and presentation, on request, of clinically relevant information from a large quantity of stored data.

This has now reached the stage where it has been possible to carry out preliminary clinical trials in both a hospital environment and in the homes of elderly volunteers.

The Hospital Without Walls system

The Hospital Without Walls design allows installation and removal of equipment to be accomplished in minutes without any structural alterations to the home being required. To facilitate development, the design of the research prototype is modular (Fig 1) and, as far as practicable, generic. It is likely that future commercial versions of the system will use alternative versions of both hardware and software, depending on the particular application.

Data from multiple sensors are transmitted via a body-mounted two-way radio system to a base station located in the home. This uploads data records to a central recording facility every day or in response to a pre-defined emergency event. The identification of events requiring an immediate response is determined by software in the home computer.

A 'fixed station' attached to the home computer is provided for periodic measurements which will not make use of the mobile radio link. Oximetry and blood pressure measurements have been implemented in the research system and any device providing a digital output can easily be accommodated.

The database software (essentially a special-purpose electronic record system) has been developed to record raw data transmitted from the sensors as well as generating trend and summary data appropriate to the clinical application. The data can be accessed remotely using a web browser, making use of data mining techniques developed for this application.

Preliminary trials

The first prototype systems are undergoing preliminary trials, both in a controlled hospital environment (Ryde Hospital, Sydney) and in the homes of elderly subjects who are susceptible to falls. In both applications we have concentrated on activity and gait monitoring, although ECG, heart rate, blood pressure and pulse oximetry are included in the demonstration system. The fall and gait monitoring use three accelerometers to record body posture and movement.

The transmitted data can be monitored in real time as shown in Fig 2. In most situations this display is not used, as the incoming information is stored in a database and processed with automatic production of summary data and analysis of trends. The database has been designed with a front end, which allows data mining to be performed when accessed from an authorized computer terminal.

Our clinical study has focused on the analysis of three-axis accelerometer data as a measure of posture, mobility, activity and fall detection. Fig 3 illustrates typical accelerometer data recorded as a volunteer patient from the 'Falls Clinic' at Ryde hospital followed a standardised activity routine.

What have we learnt?

Physiological monitoring

As the sensors required are application specific, only basic sensors have been implemented in the research prototype, to demonstrate the capability. This has allowed us to develop the capability of our radio and software systems to deal with a continuous flow of a variety of physiological data. The inclusion of three-axis accelerometers in all our prototypes has led to development of algorithms to continuously estimate activity and subject orientation. This has proved a rich area for research, particularly in application of this technology to aged care.

Low power radio communication

A decision was made to use the 2.4 GHz ISM band for the mobile radio transmission. This decision was made partly to simplify potential regulatory difficulties with the radio transmission and partly because of the availability of expertise in designing very low power, spread spectrum communication systems of this type. Custom design also allowed up to eight mobiles to be serviced by each base station. This makes the design particularly suitable for settings such as nursing homes, but results in a more complicated radio system than would be required for a single user installation.

A situation that will be encountered with any radio system is the user moving out of range of the receiver or some external conditions which prevent the transmission getting through. This will happen whatever wireless technology is used and must be taken into consideration in the system design. The importance of this limitation depends on the particular application. For example it is critical to define the range of conditions where it may become necessary to raise an alarm and ensure a communications pathway. The allowable number of radio dropouts, for example, is much less in a situation where an urgent response to an alarm is required than where long term data are being collected for later analysis.

The performance of the prototype radios has been adequate in most situations as reflection of the radio waves from walls and ceilings provides many alternative transmission paths. The practical weakness, which is being addressed, is in the relatively high level of absorption by tissue at this frequency. This has proved to be significant in some home trials where dropout has occurred when the user has gone to sleep lying on top of the transmitter, which means that the radio signal has to pass through a substantial depth of tissue.

Analysis of physiological data

Much of the research on analysis of the raw data has been in developing algorithms for analysis of accelerometer data as a means of defining the subject's activity, gait and spatial orientation. While this work has been driven by a particular clinical interest in falls, it has proved to be much more generally applicable.

The areas of performance that we are re-examining in the light of the clinical trials are largely focused on defining where the storage and analysis of the sensor data is performed. At present, only limited temporary data storage occurs in the mobile unit. Processing and storage occur predominantly in the home station computer. Transferring processing functions to the mobile unit would reduce the performance required of the radio communications link at the probable expense of more weight and a shorter battery life for the mobile unit. It would also probably mean that it was more difficult to upgrade the mobile unit.

Database storage of physiological data

In the current version of the software, the raw sensor data is stored in a database. Various forms of summary data and feature extraction can be performed automatically on the raw data and the results also stored in the database for convenient access. Software for accessing and viewing this data in clinically relevant ways has been developed. Web access to data summaries has been provided for authorised medical staff.

Any electronic transmission of medical data presents security issues. In addition the substantial volume of the raw data and the need for clinically relevant displays places severe demands on the design of the remote viewing system. Further development is being undertaken to extend the ability to meaningfully view the clinical data.

Conclusions

The Hospital Without Walls system is a modular research tool which facilitates testing of ideas in a range of potential areas of application. As all aspects of the system were brought together it became clear that different technical priorities applied in different areas of clinical application. In any healthcare and monitoring system it is necessary to understand, and design for, a potential deterioration in performance or a complete failure of equipment. Technology only meets the user's needs when it is integrated into a properly developed health delivery system. For example, there is no advantage in raising an alarm if there is no one available to answer it.

Our experience with home monitoring has emphasised the essential difference in technical design requirements between a long-term, relatively unattended monitoring system and one where monitoring takes place in an environment staffed by health professionals and where technical assistance and/or equipment replacement is readily available. Implementing the Hospital Without Walls system is a formidable challenge.

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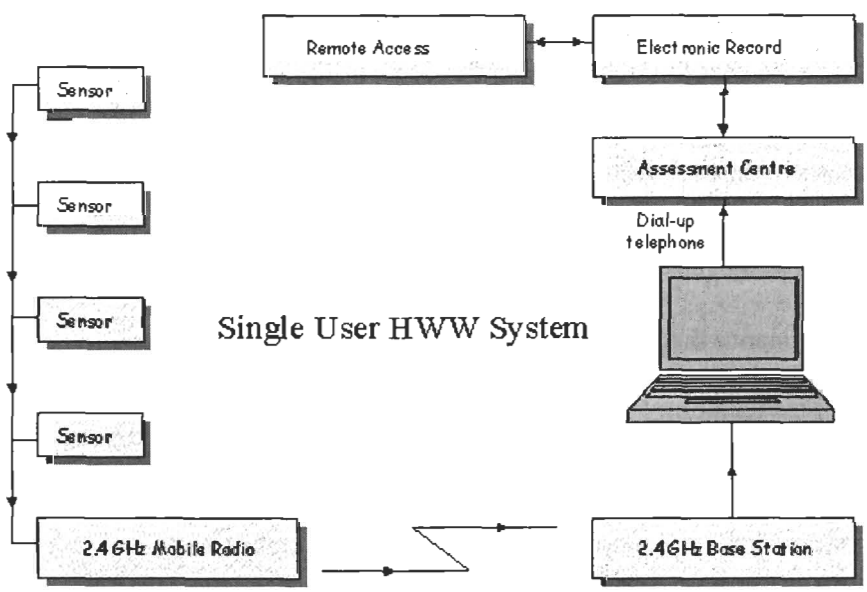

Fig 1. Hospital Without Walls system

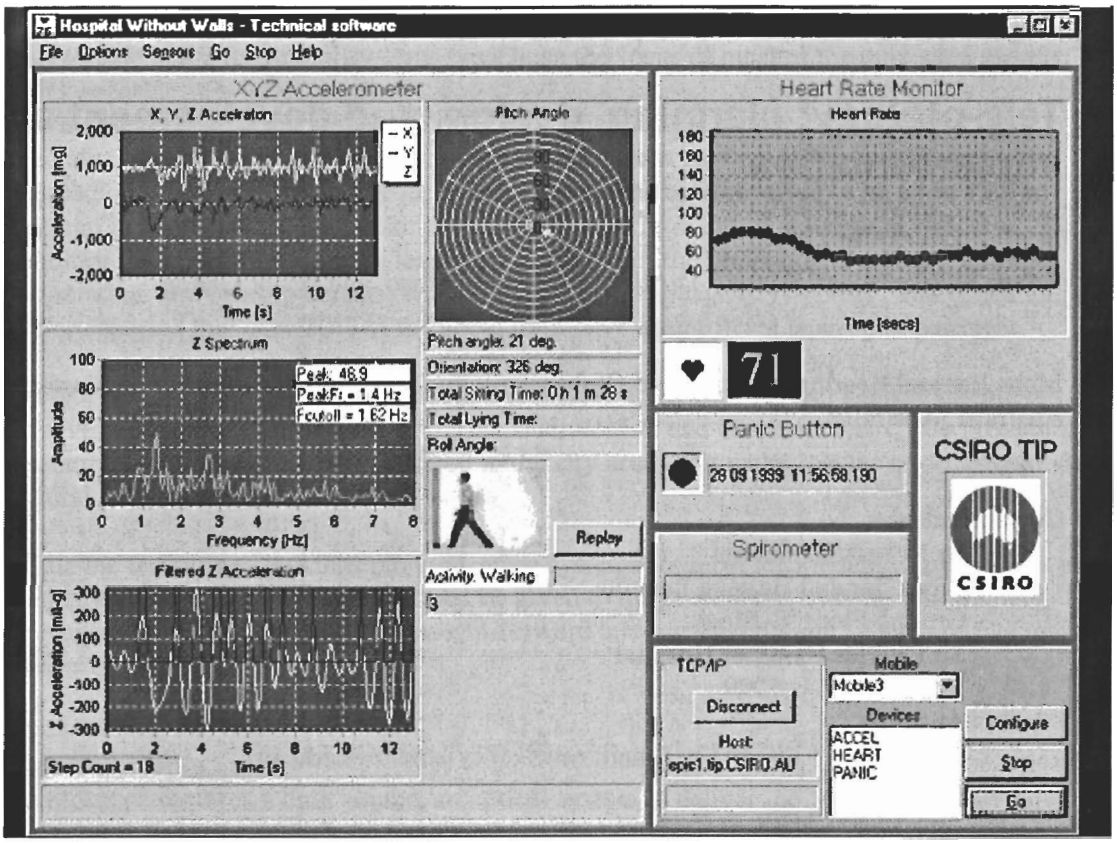

Fig 2. Real-time monitoring display

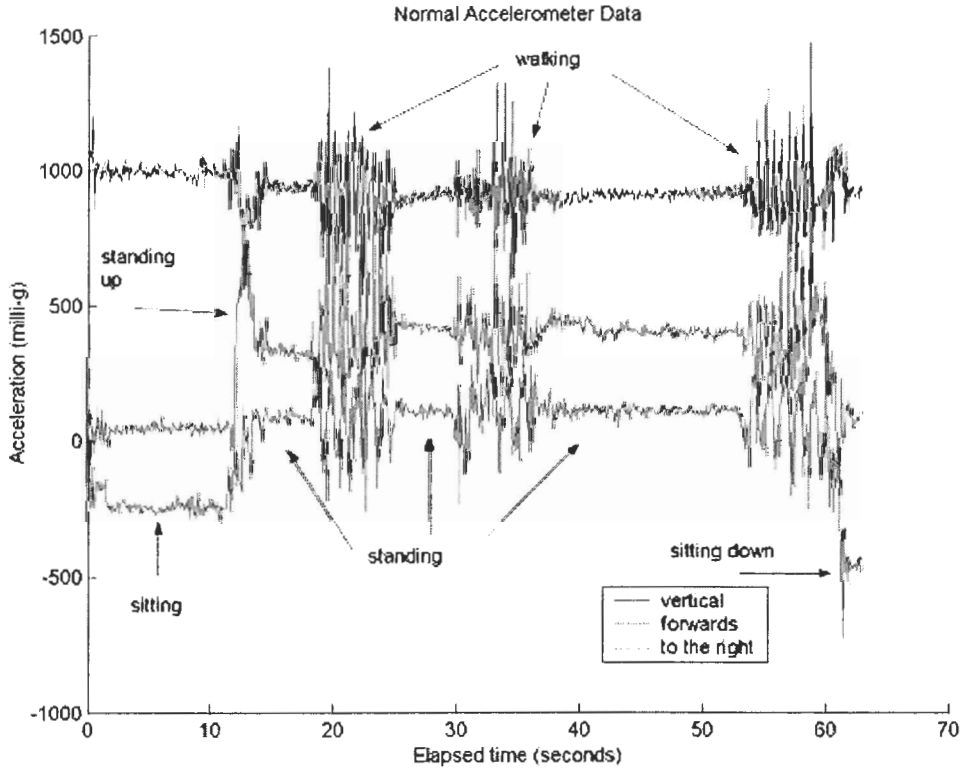

Fig 3. Typical accelerometer recording

Tele-otology: planning, design, and development and implementation

Robert H Eikelboom, Marcus D Atlas, Mathew N Mbao and Mark Gallop

Lions Ear and Hearing Institute, and Otolaryngology Department, University of Western Australia, Australia

Correspondence:
Dr Robert Eikelboom
Lions Ear and Hearing Institute
Ground Floor, E-Block
Sir Charles Gairdner Hospital
Nedlands WA 6009
Australia
(Fax: +61 8 9346 3637; Email: robeik@cyllene.uwa.edu.au)

Summary
The view of the tympanic membrane of the ear provides the specialist with important information for assessing ear disease, making a diagnosis and planning further treatment. Tele-otoscopy has the potential to assist to reduce the effects ear diseases, and to overcome the huge distances that must be catered for in Western Australia. In rural and remote areas the incidence of ear disease is very high, and access to ear specialists is limited. As part of a project to deliver tele-otoscopy services to remote Western Australia, we have investigated and implemented various aspects of a tele-otoscopy system. We found that the MedRX video-otoscope is relatively safe to use and produces very good quality images. Iimage compression of still images to 20kB provided images from which a confident diagnosis could be made, and video sequences could be compressed to a ratio of 1:300. A software package has been developed and we are developing a training course for remote area health care workers.

Introduction
The examination of the ear canal and tympanic membrane (eardrum) is essential for the diagnosis of ear disease and hearing disorders by a medical specialist. Examination is by the use of an otoscope with which the specialist can assess the condition of the ear canal, presence of fluid, perforation or suppuration. These views, with audiometric and tympanometry data, and a clinical history are in most cases sufficient in order for the clinician to make the diagnosis and decide on further treatment.

Much of the clinical assessment, besides otoscopy, is often performed by audiologists, general practitioners or rural-health workers. The examination and assessment of the outer and middle ear remains part of the specialist's role when ear disease is suspected, or in the presence of hearing loss. However, with the increasing availability and utility of imaging equipment, there may be a role for the imaging to be performed by allied health personnel as part of a telemedicine system. To date, little has been reported on the implementation of

telemedicine in the otolaryngology medical specialty, although it has been discussed widely.[1] Large-scale multi-functional systems have been the focus of most of the published reports.[2-6]

The high incidence of ear disease in rural and remote areas, and the lack of access to specialist medical service for people living in these areas encourage the development of a telemedicine system. The incidence of otitis media has been reported to be up to 70% of children in some Aboriginal communities, and is also high in non-aboriginal children.[7] This condition, if left untreated, often leads to perforation of the tympanic membrane, chronic suppuration, and hearing defects, which then affects language development and education.[8] It is also reported that over 20% of the population have a significant hearing impairment.[9]

Current management of patients in rural and remote areas with ear and hearing disorders involves local rural health workers, nurses, audiologists and GPs as primary care providers. Otolaryngologists are almost all located in the city areas, but make regular or occasional visits to rural and remote areas.

While the technology and telecommunication systems for most telemedicine applications are readily available, a lot of attention must be given to the procedures, systems and training elements. We are developing a store-and-forward tele-otology system. There are five main elements.

Video-otoscopes

An otoscope requires a light source, an optical system to deliver the light into the ear canal and project an image of the canal and eardrum, and an imaging device. Video-otoscopes of various configurations, quality and cost are available. Those with a Hopkins-Rod telescope optical system (Storz, Smith and Nephew, Welch Allyn) produce high quality images; however, they require extreme care in use as they can quite easily be inserted too far into the ear canal and perforate the eardrum. Adaptations of the conventional otoscope have been made by placing a video camera at the image plane (Welch Allyn); although an inexpensive option, our experience is that the light source is not bright enough so that poor quality images are produced. Also, its field of view is too small.

To assess the quality of images from various types of video-otoscopes we digitised images of both ears of 24 patients. They were imaged using four video-otoscopes: Storz Hopkins rod-telescope (Fig 1), Smith and Nephew rod-telescope (Fig 2), MedRX (Fig 3), and Welch Allyn Compac Video Otoscope (Fig 4). Each set of 24 subjects consisted of 12 with ear pathology or disease and 12 controls. The subjects were presented to three experienced assessors in a random order, who were asked to make an assessment of image quality, specifically: image clarity, colour and positioning, and the ability to make diagnostic findings.

The grading of image quality was similar for all instruments except those from the Welch Allyn, Fig 5. Over half the images from this instrument were of poor quality. The MedRX and Smith and Nephew instruments produced at least 30% excellent images, and over 70% of images were good or better. The results confirmed that the MedRX produces high quality images, and because it is not based on a rod-telescope, it is safe and well suited to tele-otoscopy.

Software

We have developed a package that presents the live image on a computer screen and captures a series of still images without having to remove the otoscope from the ear canal. Thumbnail views of images are shown to the side, can be reviewed and then stored if required.

Image sequences can also be recorded. These are often useful to the otolaryngologist when assessing the mobility of the tympanic membrane. Patient data, such as tympanometry, audiometry, clinical history, patient demographics, and other observations, can be entered by selection of the appropriate 'tab' at the top of the screen. Also accessible by these 'tabs' are video-digitising parameters, operator details, and telecommunication settings.

The review and assessment software is similar to that at the remote site: all the patient data and a series of image thumbnails are presented to the assessor. The assessor records their assessment and advice, and this then is transmitted back to the remote site.

Image compression

Although telecommunication bandwidth continues to increase, the need for image compression remains. Digitised images stored as uncompressed files are over 1 MByte in size. Transmission of a number of these images using a modem is impractical. JPEG and wavelet image compression has been demonstrated to be an effective solution.[10] We have also reported a study showing that images of the tympanic membrane and ear canal can be compressed by JPEG to about 30 kByte or 2.5% of their original size, while still retaining the detail required for assessment.[11]

We have also sought a suitable video sequence compression algorithm. Just as for the selection of a compression format for still images, it is desirable to choose a non-proprietary and popular format to ensure continued support. We selected a set of 12 image sequences from five patients with pathology and seven normal controls. The raw image sequences were 5-15 s in length, and up to 180 MByte in size. After compression with MPEG, the sequences were presented in a random order to four assessors, to make judgements of image colour, blocking, blurring and overall quality, and make a diagnosis.

Statistical analysis indicated that blocking and blurring was significantly ($P<0.05$) worse when compression was 1:200, and overall quality and colour was significantly worse at 1:300. However, assessors could correctly diagnosis from these compressed sequences. Above this there was a large increase in the rate of unacceptable and poor images. These results suggest that compression of video sequences to 1/300th of original size would be suitable for a tele-otology system.

Training of rural health workers

The most important element of a tele-otology system is the acquisition of excellent images. The images must be in focus, ear wax must not be allowed to obstruct the optics and degrade the image quality, a discharging ear or one with compacted wax must be cleaned before image acquisition, the ear drum must be orientated correctly and must be completely shown, and attention should be given to any unusual pathology. We are developing a course for rural health workers that will teach them how to image the ear canal and tympanic membrane properly. Other topics will include ear anatomy and physiology, diseases of the middle ear and telemedicine. This will complement the instruction about ear toileting and primary ear care that they receive from other sources.

Other aspects

We are investigating whether high quality video-otoscope images, together with audiometry and tympanometry data, and a clinical history will be allow an ear specialist to make a confident assessment and provide advice to the remote area health worker and the patient.

Acknowledgements
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Fig 1: Storz Hopkins-rod based video-otoscope

Fig 2: Smith and Nephew Hopkins-rod based video-otoscope

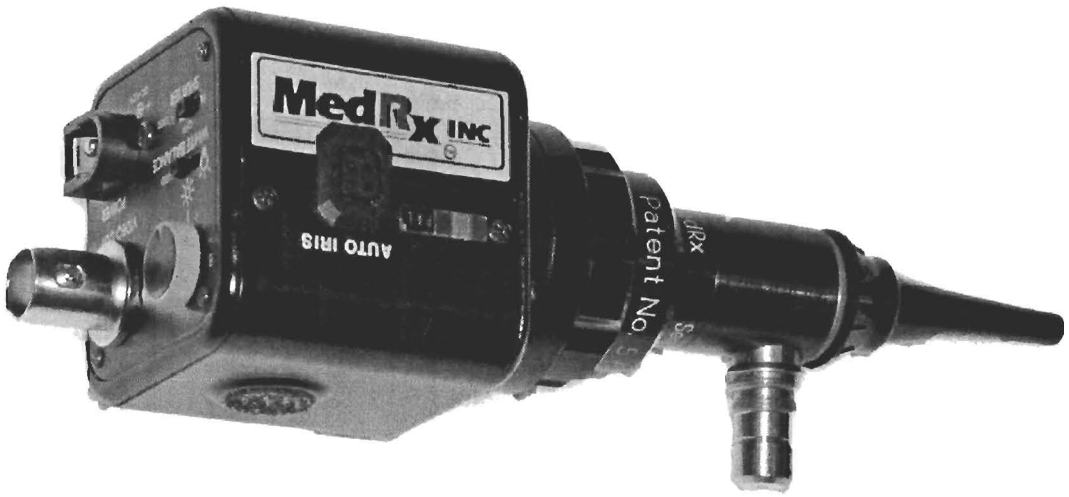

Fig 3: MedRX video-otoscope

Fig 4: Welch Allyn Compac video-otoscope

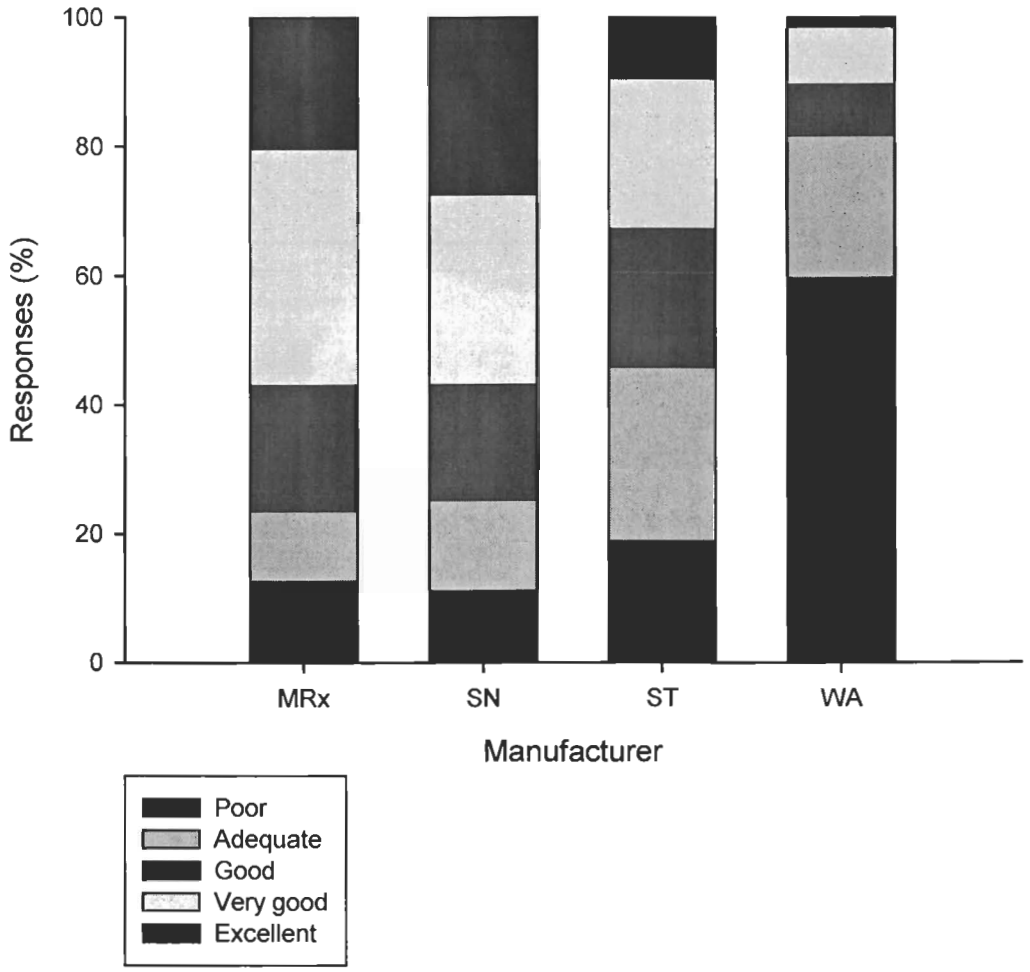

Fig 5: Assessment of image quality for four different video otoscopes by four assessors: MedRX (MedRX), Smith and Nephew (SN), Storz (ST) and Welch Allyn (WA).

The use of telemedicine in primary care for women with cervical cytological abnormalities

Ian J Etherington[1], Anne D Watts[1], Elisabeth Hughes[2] and Helen E Lester[2,3]

1 Department of Obstetrics and Gynaecology, City Hospital, Birmingham, UK
2 Lee Bank Group Practice, Birmingham, UK
3 Department of General Practice, Medical School, University of Birmingham, UK

Correspondence:
Ian J Etherington
Department of Obstetrics and Gynaecology
City Hospital
Birmingham B18 7QH
UK
(Fax: +44 121 507 5467; Email: ian.zoe@virgin.net)

Summary
Telemedicine can be used in two different ways in the context of the National Health Service Cervical Screening Programme. The first method allows primary health-care providers to offer direct on-line booking of clinic appointments according to pre-defined algorithms based on the woman's cytological abnormality. The second method is tele-colposcopy which is designed to be used by nurses in primary care. Preliminary data confirm that such a system can be reliably used to make diagnoses. The technology used is easily adaptable for true real-time teleconsultation.

Introduction
England has had an organised cervical screening programme for 14 years. The programme aims to detect and treat significant pre-malignancy (cervical intraepithelial neoplasia (CIN)), and consequently to reduce mortality from invasive disease. The National Health Service Cervical Screening Programme has defined standards for a number of aspects of the service such as waiting times for first appointments and default rates from clinic. Over 90% of women with a minor smear abnormality should be seen within 8 weeks of referral and the clinic default rate should be under 15%[1]. These targets are ambitious and many units do not reach the required standards[2]. At City Hospital our default rate at the colposcopy clinic is 20-25%. Women with minor smear abnormalities for the largest group of new referrals for colposcopy. In a recent internal audit we found that over half the women in this group were found to have no abnormalities whatsoever when they attended the colposcopy clinic.

We have therefore explored the use of telemedicine and have developed a novel approach that integrates more fully with our partners in primary care the pathway of referring a woman with an abnormal smear for investigation. The telemedicine methods used consist of direct on-line booking of clinic appointments by General Practitioners and true telediagnosis in the form of nurse-lead telecolposcopy.

Online booking

The on-line booking system for colposcopy referrals was developed within the City Hospital Rapid Access Pilot Project for Out-patient Review and Treatment (RAPPORT) system which is linked with the NHS intranet, to which all GPs in Birmingham are connected. Initially we allowed two appointment slots in each clinic to be booked directly by GPs. In order that we meet national standards on waiting times for women with different smear grades, we designed an algorithm that opened appropriate clinic appointment slots. It did not allow well motivated and well meaning GPs to book all of the earliest appointment slots for women who had only minor smear abnormalities. When the booking is completed, an invitation letter and appropriate information regarding colposcopy are printed from the booking home page to give to the woman.

Tele-colposcopy

In order to address the problem of how best to manage the women with a minor smear abnormality who is found to have no colposcopic abnormality, we developed telecolposcopy. The details have been described previously.[3] Images from the telecolposcopy examination are recorded and the files can be transmitted or stored for later transmission at the end of a clinic session.

Methods

We have carried out a pilot study to see if the telecolposcopy system could record images of sufficient quality for diagnosis. Women patients of an inner city general practice in Birmingham who had minor smear abnormalities were invited to take part in the study. A research nurse colposcopist performed the telecolposcopy examinations and then invited the women to attend City Hospital for a formal colposcopy within 2 weeks. In this way each participant acted as an internal control. The transmitted images from primary care were reviewed by one experience colposcopist and the respective diagnoses made by the tele-screener and colposcopist were not revealed until the end of the study.

Following our pilot study we have embarked on a randomised trial using telecolposcopy as a triage for women with minor smear abnormalities. Ethical approval for both the pilot and the randomised trial was given from the Local Research and Ethics Committee at City Hospital NHS Trust.

Results

Our pilot study identified 97 women who were suitable for inclusion. Full data were available from 81 cases. Five defaulted telescreening appointments, six had telecolposcopy images that were unable to be interpreted and five did not attend their colposcopy appointments. Telecolposcopic and colposcopic diagnoses are shown in Table 1. Based on a diagnosis of normal vs abnormal, telecolposcopy had sensitiviy of 89% and specificity of 93% with positive predictive value (PPV) and negative predictive value (NPV) of 91% and 91% respectively. The level of agreement between the telecolposcopy-screener and the colposcopist was good (= 0.70). Furthermore, telecolposcopy screening did not erroneously grade any cases of colposcopic high-grade CIN as normal.

Table 1. Comparison of the reference diagnosis (REF - colposcopy) and telemedicine diagnosis (TM - tele-colposcopy) (n=81)

	REF Normal	**REF Low**	**REF High**
TM Normal	42	4	0
TM Low	3	16	5
TM High	0	3	8

Discussion

Telemedicine can be used in two ways to address the problems encountered by a busy hospital clinical service. Ideally we would like to invite only those women who have a significant chance of harbouring pre-malignancy for colposcopy. In practical terms this means that we investigate many women with no disease or insignificant changes, as well as the few cases that genuinely have pre-malignant disease. This puts pressure on clinic appointments and has led to a greatly expanded need for accredited colposcopists to cope with the workload.

Non-attendance for colposcopy clinic appointments is a major problem and contributes to inefficient clinic management. The reasons for default are multifactorial and relate to poor communication between hospital and patient, inconvenient clinic scheduling (particularly with regards to a woman's menses), and the effect of patient anxiety about the perceived disease and pre-conceptions she may have about the examination. We believe that RAPPORT booking for colposcopy can address some of the reasons highlighted above. Direct bookings using RAPPORT in other areas of gynaecology have shown a significant reduction in patient default. Allowances can be made from the outset regarding inappropriate dates, rather than requiring the woman to pro-actively contact the hospital to reschedule.

Telecolposcopy in primary care may also result in improved patient compliance. We know that having an abnormal smear causes significant psychological morbidity[4,5]. We also know that considerable anxiety is experienced by women when they attend the colposcopy clinic[6]. We believe that by offering nurse-led telecolposcopy in primary care, the investigations will be perceived as less threatening and compliance will improve. Telecolposcopy will only be of use if it is acceptable to the women being screened. We received only positive comments from the study participants.

We have previously described the use of video recording of colposcopic examinations onto video tape and shown this to be acceptable as a means of diagnosis[7]. Telecolposcopy is a development of this work and is the natural extension of cervicography[8,9]. The advantages of our system over traditional cervicography are numerous. Electronic file transmission from a customised database is not only quick, but intimately links patient data to the images. The use of digitised images allows for instant review and rejection of poor quality images and the use of video clips allows dynamic elements of the colposcopic examination to be assessed remotely. The design of the system has been kept as simple as possible and we feel that it could be used by anyone who has the necessary skills to perform a cervical smear examination.

The benefits of using telecolposcopy are not restricted to screening women with minor cytological abnormalities. Following the success of the pilot study we offer a teleconsultation service for general practitioners to refer women who have a persistently inadequate cervical smear or a clinically suspicious looking cervix. Using the system in real time rather than store-and-forward offers the chance of an instant second opinion from an expert centre during a standard colposcopic examination[10]. This will be useful in situations where a woman may have to travel a long distance to the expert centre for examination. Telecolposcopy can be used in the training of colposcopists, so that the trainer can make an objective assessment of the trainees capabilities when the latter first undertakes unsupervised practice.

Although our pilot study demonstrated that it is possible to make a remote diagnosis, we cannot, as yet, infer from the data that telecolposcopy screening will result in fewer women being referred for colposcopy. This hypothesis requires further study.

Acknowledgements
The telecolposcopy pilot study was funded through a grant from the National Health Service Cervical Screening Programme. We thank our partners in primary care for their enthusiasm for these new approaches to healthcare delivery. We also thank the women of South and West Birmingham who agreed to take part in the study.

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Child development services: a multidisciplinary approach to professional education via videoconference

Antoinette Fitzgerald[1], Maggie Bailey[1], Anthony C Smith[2], Kerri Webb[1], Diane Keating[1], Karin Klepper[1] and Eileen Gibney[1]

1 Child Development Unit, Royal Children's Hospital and Health Service District, Brisbane, Queensland, Australia
2 Centre for Online Health, University of Queensland, Australia

Correspondence:
Antoinette Fitzgerald
Child Development Unit
PO Box 277
Everton Park
Queensland 4053
AUSTRALIA
(Fax: +61 7 3355 7548; Email: Antoinette_Fitzgerald@health.qld.gov.au)

Summary
We have piloted a monthly series of multidisciplinary case discussions in the area of child development via videoconference. The project provided a forum for clinical discussion of complex cases, peer review, professional development and networking for allied health professionals and paediatricians. Six Queensland sites participated in the project, with each site presenting at least one case for discussion. The videoconferences ran for 90 min each and were attended by an average of 26 health professionals per session. The response rate for the questionnaires was 71%. The respondents rated the effectiveness of case summaries and the follow-up newsletter very positively. Despite some early difficulties while becoming familiar with the technical aspects of videoconferencing, the evaluation demonstrated the participants' satisfaction with the project and its relevance to their everyday practice.

Introduction
The community-based team of the Child Development Unit (CDU) comprises both allied health professionals and paediatricians. The CDU operates on a 'chronic disorder' based model of service delivery[1], which differs from the traditional practice of short-term interventions for school aged children with complex developmental disorders. The model focuses on a multidisciplinary management approach which is child-, family- and school-centred.

In response to the educational demands, the CDU piloted the use of videoconferencing for the delivery of an education program called the 'Child Development Connection' (CDC). The need for education in child development has been identified elsewhere[2] and it is reported that allied health professional rated children with developmental concerns as their biggest caseload due to large numbers (10-20%) and the long-term nature of their condition.

However, interdisciplinary education for health professionals working in these teams is rare[3]. We evaluated the effectiveness and user satisfaction of using videoconferencing to provide multidisciplinary, problem-based education.

Methods

The CDC sessions were delivered via videoconference, using ISDN at a bandwidth of 128 kbit/s. Transmission quality was relatively poor, but suitable for conversation between sites and the transmission of overhead transparencies and PowerPoint slides. Equipment integrated with the videoconference unit (Sony 5100P) included a video document camera (Sony VID-P110), PC scan converter and video recorder. The videoconference studio facilities were located at the Centre for Online Health, University of Queensland, which is based at the Royal Children's Hospital, Brisbane.

The sessions ran for approximately 90 min each, one per month, over a seven-month period (November to May, excluding January, 2002). Six Queensland sites participated, at Cairns, Mackay, Bundaberg, Hervey Bay, the Gold Coast and the CDU in Brisbane. Prior to each session a case for discussion was nominated by one of the sites and a brief outline of the case was distributed by email to all sites. The sessions generally consisted of (1) an attendance check, (2) a welcome and introduction, (3) a case presentation using a structured proforma and (4) interactive discussion between the sites. Following each session the CDU prepared a newsletter that summarised the case and expanded on issues that emerged from the case discussion.

After the final videoconference all participants were asked to complete a questionnaire that evaluated the project as a whole. A combination of 5 point Likert scale questions (strongly agree=5; strongly disagree=1) and open-ended questions were used. There were 12 Likert questions that focused on six main themes as detailed in the results section. The open-ended questions provided opportunity for the participants to comment on aspects of the videoconference that they found helpful.

Results

Attendance varied between the sessions. The average number of sites attending was 5.5 with an average of 26 participants each session. A total of 25 questionnaires were completed, a response rate of 71%. The average number of sessions attended by each participant was 4.3 (see Table 1).

Organisation

The respondents rated the organisational aspects of the videoconference very positively, with 90% of respondents agreeing or strongly agreeing that it was well organised and the case summaries and follow-up newsletters were effective.

Effectiveness of presentation of cases

86% of the respondents reported that the format of the case discussions was effective and the CDU's facilitation during the videoconference was adequate.

Clinical relevance of cases

Participants were asked to rate whether their professional goals were met and to detail what their goals were. Respondents identified a wide variety of goals ranging from 'to gain an understanding of how other teams work and assess', 'networking' and 'further knowledge in developmental disabilities'. Overall 83% reported that they agreed or strongly agreed that their goals were met.

Generalisation to work practice
There were four questions related to work practice and 79% of respondents reported that they agreed or strongly agreed with these statements. Comments in the open-ended questions related to 'local staffing and service issues' that make it difficult to change practice and access multidisciplinary teams.

Development of professional networks
64% of the respondents agreed or strongly agreed that the project was successful in expanding professional networks.

Effectiveness of videoconference technology
The majority of respondents reported that videoconferencing was an effective medium (96%). However, three sites commented on the poor sound and picture quality received from other remote sites.

Discussion
The primary aim of the project was to evaluate the effectiveness of videoconferencing as a medium for providing multidisciplinary education in the area of child development. Despite recent studies which have highlighted the need for more appropriate multidisciplinary/team education[4,5], this project has been one of the few that addressed this issue. The model of approach to education was that of problem-based learning[6], structured around 'real' case examples. Similar work has been achieved in the area of medical education for health professionals - in the field of paediatrics and child health[7].

Despite the early challenge of becoming familiar with technological aspects of videoconferencing, the results of this aspect of the evaluation were quite encouraging. Some technical difficulties and issues were reported in the evaluation. These comments were directly related to the standard of audio and video transmission from several of the remote videoconference sites which had an effect on the level of discussion possible.

We have identified several factors that contributed to the success of the project. The first was the commitment of the CDU team to provide and coordinate the sessions via videoconference. The second factor was that the CDU had access to a facility that was suitably designed and equipped for videoconferencing. The third factor was that technical support and training was provided to the CDU staff, and guidance provided for the multi-site bridge bookings and administrative responsibilities related to the videoconference organisation.

The project was a valuable learning experience. We realise the value of interaction between all sites for the discussion of case study presentations. We also believe it is important for sites to have access to videoconferencing facilities that are in good working order. Overall the participants strongly valued the CDC and requested that the program continue. Given the success of this project, it will be continued as a core component of the Child Development Unit's state-wide educational role.

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Table 1. Questionnaire results

Statement	**Mean Score**	**Strongly Agree 5**	**Agree 4**	**Uncertain 3**	**Disagree 2**	**Strongly Disagree 1**	**No answer 0**
The 'Child Development Connection' videoconferences were well planned and organised. (n=25)	4.9	17	7	1	0	0	0
Receiving the case summaries prior to the videoconferences facilitated participation in the discussion. (n=24)	4.2	9	11	3	1	0	1
The format used for case presentations allowed cases to be presented in an effective manner. (n=24)	4.2	9	12	2	1	0	1
Discussion during the videoconferences was adequately facilitated by the CDU. (n=25)	4.2	9	12	3	1	0	0
Your professional goals for attending the videoconferences were met. (n=24)	4.2	9	11	4	0	0	1
The cases presented were useful in furthering your understanding of the diagnostic process for children with developmental disorders. (n=25)	4.4	11	13	1	0	0	0
The cases were useful in demonstrating a multidisciplinary management approach of children with developmental disorders. (n=25)	4.3	12	9	3	1	0	0
You will be able to use information from cases discussed in your professional work. (n=24)	4.2	11	7	6	0	0	1
Your management of children with developmental disorders has changed as a result of your participation in the videoconferences. (n=21)	3.6	5	7	7	0	2	4
The videoconference was successful in expanding your professional networks with other professionals working in the area of child development. (n=25)	3.7	6	10	5	4	0	0
The newsletters were an effective means of expanding on topics discussed during the videoconferences. (n=25)	4.6	17	6	2	0	0	0
The videoconferencing technology was effective as a medium for providing professional education. (n=25)	4.4	12	12	0	1	0	0

Videoconferencing in aged care facilities

Clare Guilfoyle[1], Richard Wootton[2], Stacey Hassall[1], Jan Offer[1], Margo Warren[1], Debbie Smith[1] and Michelle Eddie[1]

1 Blue Care, Brisbane, Queensland, Australia
2 Centre for Online Health, University of Queensland, Australia

Correspondence:
Ms C Guilfoyle
Blue Care
PO Box 1539
Milton 4064
AUSTRALIA
(Fax: +61 7 3377 3366; Email: ce.guilfoyle@bluecare.org.au)

Summary
Two projects were conducted to test the feasibility of delivering care services by videoconferencing to facilities providing aged care. Both studies used videoconferencing equipment connected by ISDN lines at 384 kbit/s. During the first study, there were no consultations, care plans or assessments conducted. During the second study, 120 assessments were conducted in just over two weeks, both face-to-face and by videoconference. Why was one project so successful and the other not? A number of issues can be identified. These include: ownership; planning; participants; and location. A comparison of these two projects highlights some of the considerations necessary to ensure the success of any telehealth project.

Introduction
Videoconferencing is a well-recognised method of delivering telemedicine in residential settings. For example, in a study in Hong Kong, a range of healthcare services were provided to residents of an Aged Care Facility from a community geriatric assessment team based in a regional hospital using videoconferencing equipment. The acceptability of the system to clients and staff was assessed and it was found that 89% of services could be carried out via telehealth and only 11% of the services provided by the team required site visits.[1] To date however, there has been little work done in Australia to investigate the feasibility of using telemedicine in aged care facilities.

Methods
Two projects were conducted to test the feasibility of delivering health care services to Aged Care Facilities using videoconferencing. Both studies used videoconferencing equipment connected by ISDN lines at 384 kbit/s.

Study A
The first project linked a residential aged care facility to a busy local general practitioners' centre. The residential aged care facility included a hostel and nursing home with a total of 168 beds. The study took place over three months. The purpose was to determine the feasibility of conducting consultations, assessments, case conferencing and care planning.

Study B
The second project linked a rural 50-bed high care residential facility to an allied health service in the Brisbane metropolitan area. This project looked at the feasibility of conducting assessment, case conference and education via videoconference for five different allied health disciplines: physiotherapy, podiatry, occupational therapy, speech pathology and dietetics.

Results
During the first study, no consultations, care plans or assessments were conducted. Two case conferences were conducted via videoconference at the nursing home during the study period. The numbers were too low to give any real indication of the feasibility of conducting further videoconferencing between the general practitioners and the residential facility.

During the second study, 120 assessments were conducted over a three-week period, both face-to-face and by videoconference.

Factors in success
The two projects were conducted in a similar environment. Why was one project so successful and the other not? A number of issues can be identified. These include:

ownership
planning
participants
location.

Ownership
Study A was planned by staff who for a number of reasons were not available during the trial itself. Implementation was then left to staff who were not in a position to take on the extra workload that the project entailed. They were not part of the initial planning and they were sceptical about the outcome and benefits of the trial. Also the general practitioners were not involved in the planning, and while some of them were enthusiastic about the trial, there was no overall commitment.

In contrast Study B was strongly driven by key staff who had direct involvement in planning and implementing the trial, i.e. they felt a sense of "ownership".

Planning
Extensive planning is essential to the success of any project.[2] Initially a number of planning sessions were conducted for Study A, but due to changes of the staff directly involved in the planning including the project manager, there were some misinterpretations and presumptions made, with the result that the planning was disjointed. Initially this project was to investigate the feasibility of undertaking assessment, case conference and care plans. However, the fact that general practitioners could not be reimbursed for assessment and care planning via telehealth meant that this part of the trial could not be conducted; this has been a problem in other studies.[3] It was initially thought that all twelve general practitioners from this large practice all had clients at the aged care facility. Once the project began it was found that only three doctors had clients and one doctor said that he did not wish to be involved in the project.

Also the hostel supervisor was on leave and had not been replaced. Consequently, the hostel residents were excluded from the project due to staffing problems. This dramatically reduced the number of residents that were eligible for participation. Case conferencing also involved a great deal of planning to ensure that residents and their families, care professionals and general practitioners were all able to attend and this affected the number of case conferences that were conducted. In three months only three case conferences were scheduled, two case conferences were conducted and one was cancelled as the doctor had to deal with an emergency.

In contrast there was extensive planning for Study B involving a steering committee that had direct involvement in all phases of the project. This "grass-roots" approach with well-respected local staff was undoubtedly an important factor in the success of the project.[4] Assessments were carefully scheduled so that allied health staff, staff at the aged care facility and residents could factor the project into their workload. Ample time and information was provided to ensure that the most appropriate assessment was chosen and preparation undertaken. Each therapist conducted an assessment for 12 residents both by videoconference and face-to-face. A total of 120 assessments were conducted in the two formats over a three-week period.

Project participants

The attitudes of participants are a key factor in the adoption of a telemedicine application.[5] The general practitioners invited to participate were not employees of Blue Care. This affected the items for which they could be reimbursed for they were reliant on what was allowable in the public health system. They also had no vested interest in the success of the project as the outcome had no direct benefit to them.

On the other hand, all the health care professionals involved in Study B were Blue Care employees so there were no difficulties with reimbursement. Nurses from the residential facility had an opportunity to access allied health professional expertise in caring for their clients and they reported that this was reassuring, informing and motivating. Because of the limited access to allied health professionals in this rural town, nurses would have normally undertaken basic assessments and developed care plans without specialist support. Similarly the allied health professionals were motivated by the improved access that videoconferencing would have to rural clients and they have all expressed an interest in conducting further, more focused studies. None of the participates from either project had previous experience in telehealth.

Location, location, location

One of the general practitioners stated that he chose not to be involved in Study A as he preferred to see his clients face-to-face. This was certainly a reasonable request, made possible because the medical practice and the aged care facility were only 10 km from each other. On completion of the project, the medical officers were asked, "In which setting would it have been most useful". All respondents stated that rural and remote settings would be most useful.

In contrast, Study B was conducted with a residential facility in a rural area where access to allied health was very limited. The connecting allied health centre was located 300 km away.

Conclusion

Due to the many obstacles and assumptions made for Study A, the measures were too few to be able to establish any real outcomes. Six staff including one general practitioner, two residents and three relatives completed a survey on the use of the videoconferencing equipment. While the results were favourable, and all thought that the general quality of the

videoconferencing equipment was satisfactory to very good, it was clear that no firm recommendations could be developed from this project.

In contrast, the results from Study B yielded eight key findings and three recommendations for further investigations. The study compared 60 face-to-face assessments and 60 assessments conducted via videoconferencing. Quantitative data clearly demonstrated that allied health services could be provided via videoconference. The qualitative data collected will be used to modify and improve the design for further studies. It also highlighted the effect that videoconferencing and an improved access to a wider professional network could have on the morale and confidence of the staff at the residential facility.

The comparison of these two projects highlights many of the considerations that must be made to ensure the success of all telehealth projects. If trials do not yield results that inform further research and practice, telehealth and telemedicine will not move forward.

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The evolution of a successful telemental health service

David Hailey[1], Tim Bulger[2], Sharlene Stayberg[2] and Douglas Urness[2]

1 Department of Public Health Sciences, University of Alberta and Alberta Heritage Foundation for Medical Research, Edmonton, Canada
2 Telemental Health Service, Alberta Mental Health Board, Ponoka, Canada

Correspondence:
Dr David Hailey
22 Sinclair Street
Kambah
ACT 2902
AUSTRALIA
(Fax: +61 2 6231 1090; E mail:.dhailey@ozemail.com.au)

Summary
Development of telemental health services in Alberta, Canada evolved via a pilot project, the delivery of routine services to a small group of centres and subsequent expansion to a province-wide program. Success of the service was linked to support for telehealth by the provincial government and consultation between the Alberta Mental Health Board (AMHB) and local stakeholders. Assessments by the AMHB have shown that telepsychiatry is acceptable and sustainable at a realistic cost. However, there are few measures of clinical effectiveness available and none of cost-effectiveness. Detailed economic evaluation of the telemental health network would now be a major task. The expansion of telemental health services has created further demands to take account of the increased complexity of the network, the expectations of health care decision-makers and the introduction of new initiatives such as use of telepsychology. Management of this successful telehealth program continues to be time-consuming and challenging.

Introduction
Alberta, a province in western Canada, has many rural communities, which have had limited access to mental health services. Historically, provision of such services was associated with substantial travel both by psychiatrists and their patients. Telemedicine was seen by the Alberta Mental Health Board (AMHB) as a means of improving access to mental health services. Over the last six years, telemental health services have expanded in Alberta as a sustainable component of mental health care. Studies of this area of telemedicine beyond the pilot project stage are still uncommon. As with other telehealth applications, few studies have compared the clinical or economic outcomes of telemental health with a non-telemedicine alternative[1].

The AMHB experience with telepsychiatry provides an opportunity to review the development of a telemental health program from the pilot project stage through to a province-wide network providing routine services.

Methods

The Telemental Health Service of the AMHB has routinely collected data from its telemedicine program and conducted assessments over a number of years. Data and descriptions of services provided in earlier publications dealing with assessment of telepsychiatry in Alberta [2,3,4] were reviewed. More recent experience with telemental health was addressed through consideration of information from routine databases and discussion of the status of the AMHB service, including constraints on the type of activities suggested by formal assessment frameworks[5].

Results

The growth of the telemental health services in Alberta took place in in stages, over a number of years. Somewhat different program and evaluation requirements faced the AMHB at each stage, as indicated in Table 1.

Table 1. Evolving requirements for telemental health in Alberta

Stage	Questions
Pilot project	"is this feasible?" "should we exist?"
Initial routine use	"can it be sustainable?"
Expansion	"how should it develop further?"
Mature network	"is the service effective, efficient and equitable?" "what new services should exist?"

As a first stage, a pilot telepsychiatry program was put in place in central Alberta. Seven participating psychiatrists were based at Alberta Hospital Ponoka, a major mental health facility, with video links to clinics at five regional general hospitals in small towns.

The nature of the telemental health service was to a large extent established during the pilot project. An important feature was the consultation process between the AMHB and local stakeholders. The future success of the program followed from acceptance and input from local health care professionals and the four regional health authorities concerned.

The pilot project ran for nine months during which minor difficulties relating to technical quality of the service, were resolved. Initial assessment indicated satisfaction with service by health professionals and their patients and informed the decision by the AMHB and the health authorities to continue the operation as a routine service [2].

The initial phase of a routine telepsychiatry service involved the same five regional hospitals, linked to Alberta Hospital Ponoka. Over a two year period, there was continued satisfaction with the service, which was shown to be sustainable, with 546 consultations [3]. Benefits to patients included decreased waiting times, avoidance of travel and associated costs, perceptions of privacy and improved choice and control [4]. A break-even analysis, taking account of use of the videoconferencing network for administrative meetings, indicated that the costs of the service were acceptable for the AMHB.

Assessment of the routine service provided input to decisions by the AMHB and regional health authorities to expand the telepsychiatry network. A further sixteen sites were added in 2000 and 2001 throughout the province (Table 2).

Table 2: Numbers of AMHB telehealth sites

Fiscal year	Number of telehealth sites linked to Alberta Hospital Ponoka
1996/ 97	5
1997/98	5
1998/99	11
1999/00	16
2000/01	21

The network has continued demonstrate that it is sustainable, with numbers of clinical consultations rising as further sites came on line, and a large increase in tele-education and administrative sessions (Table 3). The tele-education programs have links to over 40 sites, including some in remote locations outside Alberta [6].

Table 3: Numbers of sessions in the telemental health service

	Completed clinical consults	Education sessions	Administrative meetings
1996/97	111*	1	15*
1997/98	263	7	18
1998/99	320	4	78
1999/00	484	45	203
2000/01	702	88	203

*Nine months operation in this year

Indications about the benefit of the service continue to be positive, as judged by periodical monitoring of satisfaction of clients and health professionals. Ongoing data collected on wait time for consultations and on overall costs give assurance that the telemental health service continues to be viable. There has been piloting of new clinical initiatives, such as use of telepsychology, and appraisal of new options for equipment.

There are still some limitations both to available performance measures and to the extent of use of telemental health in Alberta. Data on clinical outcomes from telemental health remain limited. It has been difficult to put in place appropriate studies and tracking of outcomes data. Nor is there yet any measure of the cost effectiveness of the telemental health service. A detailed economic evaluation of what is now a complex network would be a challenge, and need to take account of other types of telehealth services that have now been put in place by regional health authorities. Numbers of services have increased as the network has grown, but the size of the increase is relatively modest, with numbers of clinical consultations per site dropping from the levels seen during initial routine operation (Table 4).

Table 4: Numbers of sessions per telemedicine site

	Clinical sessions per site	Administrative sessions per site
1996/97*	30	4
1997/98	53	4
1998/99	57	14
1999/00	40	16
2000/01	41	12

*Data based on projected 12 months of operation

Development of the telemental health network has undoubtedly improved access to services for many people, but it seems uncertain whether coverage has yet been optimized. Also, there continue to be difficulties with a few centres that have very low rates of utilization [6].

Discussion

Over the last six years, telemental health in Alberta has evolved to become an accepted part of routine mental health services and has now reached become relatively mature. Experience with this service have been positive, though there are still limitations on outcomes and economic data, and perhaps an incomplete picture of the place of telepsychiatry in relation to overall psychiatric services in Alberta.

It has taken a sustained effort from the AMHB to develop and maintain this telemental health network. Questions associated with the first three stages of the service – pilot project, initial routine operation and expansion – have largely been answered. Issues related to the mature stage of the network, including questions of effectiveness, efficiency and equity deserve further attention.

However, obtaining resources for assessment at the local level is a real difficulty. The AMHB has undertaken assessment throughout the life of the telemental health service, but there are limits to evaluations that can realistically be undertaken. Also, there are increasing demands from the health care bureaucracy for information in response to short-term needs of decision makers, some of which may be politically related. Management of this successful telehealth program continues to be challenging.

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Integrated regional services: are working process changes desirable and achievable?

Kari Harno[1], Carola Grönhagen-Riska[1], Hanna Pohjonen[2], Jaakko Kinnunen[2] and Martti Kekomäki[3]

[1] Department of Medicine, [2] Imaging and [3] Administration; Hospital District of Helsinki and Uusimaa, Helsinki University Central Hospital, Helsinki, Finland

Correspondence:
Dr Kari Harno
Department of Medicine, Administration
Helsinki University Central Hospital
POB 340
00029 HUS
FINLAND
(Fax: +38 9 4717 4007; Email: kari.harno@hus.fi)

Summary
In the Hospital District of Helsinki and Uusimaa 32 municipalities with one or more health care centres provide primary care to their residents. Legal and organizational barriers between primary care and hospital care providers impede the continuity of care and cause unwanted consequences when patients are treated in or transferred from primary care to hospital care or vice versa. In one trial, diabetics can send home blood glucose measurements by modem to their centre. Preliminary observations suggest that the diabetics increase their glucose testing largely because they are able to transmit the results to the database and receive teleconsultations. A PACS has been in operation in two clinics of the Helsinki University Central Hospital for over two years and seven hospitals became filmless by the end of 2001. A regional PACS is planned to be completed by the year 2004. Integrating primary and secondary care with the aid of information technology may facilitate a virtual electronic patient record in which viewing of images and other patient data is possible regardless of the organization that produced them.

Introduction
All nations feel the pressure of an increasing demand for health care services. This is mainly due to an aging population and is associated with uncontrollable medical costs. Basic healthcare costs could decline as consumer and purchaser incentives to self-care, prevention and health maintenance emerge. Many attempts have been made to shift the emphasis in health care to health promotion and the prevention of disease.

Type 2 diabetes is probably the best single example of a clinical condition which is often preventable[1]. Despite most preventive efforts, the prevalence of Type 2D is increasing rapidly in most Western societies, as is the economic burden. In Finland, the additional health care costs due to diabetes have been calculated to be roughly 500 million Euros per year, or some 3000 Euros per year for each of the nation's 150,000 citizens with Type 2D[2-3].

Many telemedicine applications in radiology have been proven to result in savings through avoidance of unnecessary patient transfer or patient travel[4-5]. Teleradiology is evolving from a point-to-point application to a service delivered via a universal network closely resembling the Internet. A picture archiving and communication system (PACS) that uses digital data held in a single or distributed database and is accessible through a network, offers new interfaces and gateways to healthcare facilities. This enables hospitals and clinics to offer new, seamless clinical processes both within hospitals and between remote health care institutions.

However, the cultural change necessary to achieve a transformation of health care work by integrating primary and secondary care with information technology may be deeper than it sounds. First of all, the different participants in health care must be actively working together. The care between them must be genuinely seamless so as to allow a global assessment of the clinical condition. In addition, the responsibility to orchestrate the care must be defined clearly. Unnecessary clinic (and hospital) visits must simultaneously be reduced to a minimum.

Methods

Diabetes Management Systems or diabetes registers have been in use in Finland since 1997 and at present more than 18,000 diabetics are registered. This means that 12% of the 150,000 diabetics in Finland are included in these management systems. Nine out of 21 hospital districts operate diabetes registries. The number of diabetics in these registries ranges from 350 to 8000. A regional diabetes data register was installed in the Hospital District of Helsinki and Uusimaa (HUS) in May 2001.

All nine hospital districts use identical software, which is a client/server system. The clients are web-browsers and the server is a web-server running Windows NT. The diabetes care system can be networked throughout regional care units involved in diabetes care. Patient data belongs to the care unit, but joint usage is possible, if agreements are made between the organizations. Since all patient information is gathered in a central regional database this makes the system operable nationally as well. It is XML-based and uses open standards such as HL7. Data transfer protection is handled mainly by means of SSL (secure-socket layer) but also with smart cards.

The design of the PACS is based on local short-term archives and a centralized long-term or back-up archive. There is a regional patient information directory, which facilitates access to patient information (including images, requests and reports).

There are agreed standards of using HL-7 (Health Level 7) and DICOM standards to integrate different modalities, RIS and HIS in sharing patient and study information across the regional network. Hospital Information Systems in all the regional hospitals comply with these standards, but pre-IHE (Integrating the Health Care Enterprise) standards prevent information systems of health centres from communicating with HIS systems. The reference database or patient information directory is therefore needed for images to be delivered between secondary care and primary care, or a web-server may be used for self-ordered images in health centres.

Data security is based on user identification and passwords. The patient's consent is always needed for viewing data or images by means of the patient information directory.

Results

So far 1185 patients in the Hospital District of Helsinki and Uusimaa have been enrolled into the regional diabetes register. Of these, there are 905 who are being treated in tertiary care (536 juvenile Type 1 diabetics and 369 adult Type 1 or Type 2 diabetics). All juvenile diabetics are treated and followed in hospitals until adulthood (16-22 years of age). Because abundant and structured information is available, replacement of high-cost tertiary care with outpatient care is possible.

The rest of the 1185 diabetics, enrolled since October 2001 from secondary and primary care, are participating in a randomized trial to assess the integrated regional diabetes care model. The catchment area for this regional pilot includes approximately 80,000 inhabitants in the municipalities. Thus, the 280 patients included in the diabetes management system represent 12% of the calculated number of diabetics in this area. From these 280 diabetics one third could not be included in the trial because they were either unwilling or unable to participate (e.g. mobile phone owners without an ordinary telephone were unable to use the modem).

The diabetics are randomized into a group performing visits as usual and a group sending home blood glucose measurements by modem to their centre. Unnecessary clinic (and hospital) visits are reduced to a minimum and only annual visits have been planned for the latter group. IT is used to facilitate real-time data transfer from the patient's home to the regional registry. The follow-up time is one year after recruitment/education and will extend until the end of year 2003.

Preliminary observations suggest that the diabetics increase their glucose testing largely because they are able to transmit the results to the database and receive teleconsultations. The same phenomenon was noted in an earlier study[6] with newly-diagnosed Type 1 diabetics and resulted in fewer hypoglycaemic glucose values in these patients. Some problems have also emerged. Data entry has been of a disappointingly low standard in primary care as compared to secondary care. To improve the quality of diabetes care a minimum quantity of data is needed. Clinical software in diabetes care may have to be tailored accordingly and better integration of IT-systems is needed to avoid extra work in data entry.

The PACS has been in operation in two clinics of the Helsinki University Central Hospital for over two years and seven hospitals became filmless by the end of 2001. A regional PACS is planned to be completed by the year 2004.

A coherent and secure framework for managing and distributing patient data across the region has been provided. This produces greater benefits than just making filmless hospitals in the specialty care. It is also a way to facilitate virtual electronic patient records: viewing of images and other patient data is possible regardless of the organization that they have been produced in. This results in fewer duplicate examinations and lower radiation doses.

The aim is to provide the maximum diagnostic information (of which radiology is only a part) for the patients' care irrespective of place or time, wherever the patient is treated. Our strategy is to bring the imaging as near to the patient as possible, but to concentrate the special diagnostic knowledge in hospitals, and make it available anywhere by means of PACS. Clinicians and radiologists will always have the required images, whether at hospital, at home or when travelling. A second opinion may also be obtained when performing a radiological examination or procedure at a remote hospital.

Discussion

Although there is evidence, that telemedicine is as effective as face-to-face consultation[4,7,8] there is less proof about cost-savings to the health system[8,9]. Diabetes Management Systems are designed to enable people with diabetes, their carers and health professionals to improve

individual care decisions and outcomes, as well as to facilitate quality assurance and service development[10].

Four of the hospital districts in Finland have begun to integrate the diabetes management system with their neighbouring municipalities. However, the number of regional municipal partners remains low. Only two or three municipalities are integrated with the hospital district. Yet, they include one-third of the diabetics presently included in the diabetes register.

Installing a large regional PACS de novo in a hospital district with 1.4 million inhabitants has several potential benefits, since the financially inefficient intermediate steps to digital radiography are eliminated. By reducing the need for X-ray film, processing chemicals and archiving X-ray films there should be savings on material costs.

However, the capital costs to achieve this filmless digital environment within the three university hospitals, four regional hospitals and 32 communal health centres of the HUS are enormous. It has been suggested that by re-engineering the X-ray service the number of stages in the overall process can be reduced by at least 25%. This also speeds up the transfer time between processes. The total number of imaging procedures in the HUS is about 1,000,000 per year, which suggests that significant cost savings may be achieved. After the implementation of the PACS the improvement in effectiveness and cost-effectiveness of clinical care must be proven. The first pilot study is planned for September 2002.

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Videoconferencing training for those working with at-risk young people in rural areas of Western Australia

Sarah Haythornthwaite

YouthLink, in collaboration with the West Australian Institute for Psychotherapy Research, Inner City Mental Health Services, Royal Perth Hospital, Perth, Australia

Correspondence:
Sarah Haythornthwaite
YouthLink
223 James Street
Northbridge
WA 6003
AUSTRALIA
(Fax: +61 8 9328 5911; Email: sarah.haythornthwaite@health.wa.gov.au)

Summary
Rural Links is a videoconference training initiative developed for those who work with at-risk youths in remote and rural regions of Western Australia. The training programme was run twice (in parallel) for two groups of participants; 17 workers from the Great Southern and SouthWest regions of Western Australia and 15 workers from the Wheatbelt, Pilbara and Kimberley regions of Western Australia. The programme consisted of seven two-hour sessions presented over a period of 12 weeks. Objectives of the training programme centred on increasing participants' knowledge and confidence in relation to the training topics. The initiative also aimed to enhance consultation between rural youth networks and a metropolitan-based youth mental health service (YouthLink). Analyses of pre- and post-measures indicated that there were improvements in workers' knowledge and confidence in relation to training topics following participation in the programme. Comparisons of the improvements made by rural participants, who accessed training via videoconferencing, and metropolitan participants, who accessed training face-to-face, revealed very few significant differences. Rural participants reported high levels of satisfaction, decreased feelings of professional isolation and an increased likelihood of accessing YouthLink for consultative support, as a result of completing the Rural Links training programme.

Introduction
YouthLink is a specialist mental health service, located in Perth, which provides direct clinical services for at-risk young people and education, training and consultation for those who work with this population. Most non-government workers providing support services to at-risk young people in rural areas of Western Australia complete training for qualifications. However training opportunities are limited for most rural workers compared to those in the metropolitan area. There was a perceived need for training and consultation services, such as those provided by YouthLink, within the rural areas of Western Australia.

Videoconferencing is a communication medium that has become more widely used in mental health in recent years[1]. While the use of videoconferencing for education and training purposes is still a relatively new development, one recent study strongly supported the use of this medium in the training of rural and remote mental health workers[2].

The aim of the present study was to evaluate a training programme for those who work with at-risk young people in rural areas of Western Australia. This initiative involved the delivery of training by videoconferencing over distances up to 3500 km from the training centre in Perth. The training programme was adapted from current YouthLink training resources and the implementation of this programme was guided by the process undertaken by Rees and Gillam in the delivery of videoconferencing training for rural mental health workers[2].

Methods

The training programme was run twice (in parallel) for two groups of participants, from August to December 2001. A standard commercial videoconferencing system (Cruiser, VCON) was used in Perth to conduct the training. Each training session consisted of a multipoint videoconference involving between five and seven simultaneous sites and all sessions were conducted at 256 kbit/s.

Thirty-two workers from a variety of settings enrolled in the programme, with the majority from non-government youth services. There were 17 workers in the Great Southern/South West group, with three participants at the Albany, Bunbury and Busselton sites, and four participants at the Bridgetown and Esperance sites. There were 15 workers in the Wheatbelt/Pilbara/Kimberley group, with three participants at each of the sites of Broome, Geraldton, Kununurra, Moora and Newman.

The Rural Links training programme comprised seven fortnightly training sessions, each lasting 2 hours, accompanied by reading material on topics covered and work books for in-session exercises. Training modules included 'Enhancing skills for working with young people', 'Anger management with young people', 'Working with depressed young people' and 'Worker self-care'. Objectives for these modules centred on increasing participants' knowledge, skills and confidence in relation to the training topics. Training sessions included a mixture of instructive teaching, participant exercises, small group discussions, large group discussions, case studies and role-plays.

The programme was evaluated by administering a questionnaire to the participants before and after the training. The questionnaire, with 28 items in total, consisted of true/false questions examining knowledge in relation to the training topics and questions specific to the objectives of each training module, based on five-point Likert scales. The questionnaire also included items examining participants' views of videoconferencing as a training modality. Evaluation also involved the administration of a satisfaction questionnaire (32 questions based on five-point Likert scales) at the completion of the programme.

Learning outcomes for participants who accessed YouthLink training via videoconferencing were compared to those for participants who accessed this training in face-to-face workshops. This was made possible because YouthLink provides face-to-face workshops to metropolitan Perth workers on the same topics as those provided in the Rural Links programme. Throughout 2001, metropolitan workers, who attended these workshops, completed the relevant sections of the pre- and post-training questionnaire.

Results

Learning outcomes of Rural Links training

Twenty-six of the original 32 participants completed the training programme. Of these, 20 completed both the pre- and post- training questionnaires. There were significant improvements in participants' knowledge for the module 'Enhancing skills for working with young people' and in their confidence that they could recognise an ethical dilemma in their work with young people, following the training (Table 1, items 9 and 10). However, improvements on items that reflected the other objectives of this training module were not significant, probably owing to a ceiling effect, as pre-training means were high (from 3.80 to 4.40 on scale of 1 to 5, Table 1, items 11-14). Similarly, the insignificant improvement in participants' knowledge for the module 'Helping young people keep their cool' was most likely due to a ceiling effect (pre-training mean 8.45 out of a possible score of 10, Table 1, item 15).

There were significant improvements in participants' ratings of their confidence, understanding and skills in relation to training objectives for the 'Helping young people keep their cool' and the 'Helping young people get up when they're feeling down' modules (Table 1, items 16-21 and 23-28). In addition, there was a significant improvement in participants' knowledge for the training module 'Helping young people get up when they're feeling down' (Table 1, item 22).

Comparison with face-to-face training

Compared to metropolitan participants, who received face-to-face training, rural participants showed similar levels of improvement in learning for most areas. That is, there were no significant differences between the improvements made by these two groups in 20 of the 28 items of the questionnaire used pre- and post-training. Differences in improvements between the rural and metropolitan groups were examined using analyses of covariance (ANCOVA) with pre-training scores considered as a covariate. Table 2 illustrates the results of these analyses for the eight items on which significant differences in improvements were indicated.

Satisfaction

Over 70% of the 18 participants who completed the satisfaction questionnaire were satisfied or very satisfied with all aspects of the training (Table 3). Over 80% agreed that it had enhanced their capacity to work with young people and 78% reported that their skills for working with young people had improved at the end of the course. Over 85% agreed that participating in the training had reduced feelings of isolation and 100% agreed that participating had made it more likely that they would contact YouthLink for consultative support.

Approximately 80% of participants, who completed the questionnaire, agreed that the training had been delivered satisfactorily via videoconferencing and that they would recommend a course via videoconferencing to a colleague. One of the videoconferencing sites involved in the study experienced technical difficulties throughout the course of the training; these difficulties may explain reports from a few participants that are counter to the views just reported (Table 3).

Discussion

The findings of the present study confirm that videoconferencing is an effective means of delivering training to remote and rural workers. In addition, the study revealed that participating in videoconferencing training is an effective means of reducing perceived professional isolation. These findings are in keeping with those of Rees and Gillam, which also suggested that videoconferencing is a viable medium for delivering training and reducing perceived isolation[2]. The implementation of the Rural Links project involved non-government workers accessing training delivered by a specialist, metropolitan-based, youth

mental health service via videoconferencing facilities at their local mental health services. In this way, the project brought together non-government and government workers, who provide services to at-risk youth in rural areas, for training and consultation via videoconferencing.

The findings of the present study indicate that workers who participated in the videoconferencing training experienced significant improvements in a number of areas of knowledge, perceived confidence and perceived competence in relation to the training topics. In addition, comparisons of the improvements made by rural participants, who accessed training via videoconferencing, and metropolitan participants, who accessed training face-to-face, revealed very few significant differences. Overall, the comparisons of the improvements of rural and metropolitan participants indicate that training via videoconferencing resulted in similar learning outcomes to those that result from face-to-face training.

The majority of participants reported high levels of satisfaction with all aspects of the Rural Links training course. In addition, participants indicated that participating in the course had positive effects in terms of their capacities and skills as workers and in relation to improving opportunities for consultation and support. A large majority of participants agreed that participating in the course had reduced feelings of professional isolation. The results of the present study provide further evidence that videoconferencing is an effective means for providing training, decreasing professional isolation and increasing consultative support for rural workers.

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Table 1. Comparisons of rural participants' pre- and post-training scores for each item (n=20, t scores calculated from t-tests, z scores calculated from Wilcoxon Signed-Rank tests)

Item	Pre-training mean ‡	Post-training mean ‡	t value	z value
Compared to the following training modes, how would you rate videoconferencing as a training mode: 1. One on one [a]	2.43	2.67	-1.144	
2. Distance learning (tutor contact via phone) [a]	3.67	3.78	-0.416	
3. Group setting with trainer [a]	2.48	2.72	-1.426	
4. Participating in a training course via videoconferencing will reduce feelings of professional isolation [b]	3.86	3.90		0.176
5. Videoconferencing is a suitable mode of delivering education and training to rural and remote workers [b]	3.80	4.05	-1.561	
6. My confidence and capacity for working with at-risk young people will be enhanced through participating in this course [b]	4.20	4.05	1.000	
7. How would you rate your comfort with using videoconferencing equipment [c]	2.85	3.60	-2.595*	
8. How would you rate your ability to use videoconferencing equipment [d]	2.85	3.55	-2.774*	
9. Knowledge score for 'Enhancing skills for working with young people' [e]	7.00	7.95	-3.226*	
10. I am confident that I could recognise an ethical dilemma if it arose in my work with a young person [b]	3.90	4.20	-2.349*	
11. I am confident that I can recognise boundary issues in my work with young people [b]	4.10	4.25	-1.143	
12. I have a clear understanding of a framework for addressing ethical dilemmas [b]	3.80	4.00	-1.073	
13. I am confident that I understand confidentiality and what may affect the limits of confidentiality in my work with young people [b]	4.40	4.25	1.000	
14. I have a clear understanding of what it means to 'act ethically' in my work with young people [b]	4.20	4.20	0.000	
15. Knowledge score for 'Helping young people keep their cool' [f]	8.45	9.00	-1.814	
16. I am confident that I understand the causes of aggression and what it achieves for young people [b]	3.45	4.00	-4.067*	
17. I have a clear understanding of the theory of anger [b]	3.29	4.15		-3.169*
18. I am confident that I can explain to a young person how anger and aggression work (eg using a visual model) [b]	3.62	4.10		-2.324*
19. I feel confident that I can assess anger and aggression in young people [b]	3.67	4.20		-2.840*

20. I have a clear understanding of the different dimensions that contribute to anger and its expression (eg past experiences, communication skills) [b]	3.75	4.05	-2.854*	
21. I have a clear understanding of different interventions that can be used for aggression problems [b]	3.29	3.90		-3.051*
22. Knowledge score for 'Helping young people get up when they're feeling down' [f]	8.24	9.35		-2.799*
23. I have a good knowledge of the 'facts' about depression in young people (eg how common it is) [b]	3.15	4.20	-5.294*	
24. I have an understanding of what makes a young person vulnerable to depression [b]	3.67	4.20		-3.051*
25. I know the indicators of depression in young people (eg, what they will be doing, thinking, saying) [b]	3.52	4.30		-3.066*
26. I know the kinds of things I can ask a young person to find our if he/she is depressed [b]	3.70	4.20	-3.684*	
27. I have a good idea of the ways in which I can assist a depressed young person [b]	3.29	4.10		-3.690*
28. I have a clear idea of when to refer a depressed young person on to a mental health professional [b]	3.57	4.20		-2.521*

* Significance $p<0.025$

‡ Participants' scores were determined according to the following scales/criteria

[a] 1 Far less effective – 5 Far more effective

[b] 1 Strongly disagree – 5 strongly agree

[c] 1 Very uncomfortable – 5 very comfortable

[d] 1 Very incapable – 5 very capable

[e] Number of TRUE/FALSE statements correct out of 9

[f] Number of TRUE/FALSE statements correct out of 10

Table 2. Results of Analyses of Covariance for questionnaire items on which there were significant differences in improvements from pre- to post-training scores between rural and metropolitan groups (with pre-training scores considered as a covariate)

Item	Rural Mean ‡	Metro Mean ‡	Source	F-value
11. I am confident that I can recognise boundary issues in my work with young people.	0.150 (n=20)	0.727 (n=11)	Location	5.218*
			Pre-training score	28.169**
12. I have a clear understanding of a framework for addressing ethical dilemmas.	0.200 (n=20)	0.909 (n=11)	Location	8.953**
			Pre-training score	43.425**
14. I have a clear understanding of what it means to 'act ethically' in my work with young people.	0.000 (n=20)	0.636 (n=11)	Location	4.776*
			Pre-training score	30.641**
16. I am confident that I understand the causes of aggression and what it achieves for young people.	0.550 (n=20)	1.080 (n=26)	Location	8.531**
			Pre-training score	42.364**
18. I am confident that I can explain to a young person how anger and aggression work (eg using a visual model).	0.450 (n=20)	1.520 (n=25)	Location	10.342**
			Pre-training score	111.645**
20. I have a clear understanding of the different dimensions that contribute to anger and its expression (eg past experiences, communication skills)	0.300 (n=20)	0.880 (n=25)	Location	10.077**
			Pre-training score	53.927**
21. I have a clear understanding of different interventions that can be used for aggression problems.	0.550 (n=20)	1.200 (n=25)	Location	11.667**
			Pre-training score	63.640**
22. Knowledge score for 'Helping young people get up when they're feeling down'.	1.050 (n=20)	-0.500 (n=12)	Location	17.705**
			Pre-training score	71.694**

*Significance $p<0.05$; **Significance $p<0.02$; ‡Mean improvement from participants' pre- to post-training scores for each item

Table 3. Results of the satisfaction questionnaire

Question	n_1	n_2	n_3	n_4	n_5	Median	25th – 75th percentile
How many of the young people you work with would benefit from the knowledge and strategies that you have learnt about in the course? [a]			4	9	5	4.0	3.75 – 5.00
Of these, how many do you intend to use this knowledge and these strategies with? [a]		1	2	5	10	5.0	4.00 – 5.00
Did the content of the course meet your expectations? [b]			1	9	8	4.0	4.00 – 5.00
Would you recommend the Rural Links course to a colleague? [b]				4	14	5.0	4.75 – 5.00
Would you recommend a course via videoconferencing to a colleague? [b]	1	1	1	5	10	5.0	4.00 – 5.00
The quality of your service to young people was diminished due to participation in the course [c]	8	8	1	1		2.0	1.00 – 2.00
Your caseload decreased whilst participating in this course [c]	3	13	2			2.0	2.00 – 2.00
Rural Links was delivered satisfactorily using videoconferencing [c]	2		2	9	5	4.0	3.75 – 5.00
Videoconferencing is a suitable mode of delivering education and training to rural and remote workers [c]			3	7	8	4.0	4.00 – 5.00
Participating in the Rural Links course via videoconferencing reduced feelings of professional isolation [c]		1	1	11	5	4.0	4.00 – 5.00
Participating in the Rural Links course made it more likely that I would contact YouthLink for consultation and/or support in relation to working with young people [c]				12	6	4.0	4.00 – 5.00
My capacity as a worker with young people has enhanced since participating in this course [c]			3	12	3	4.0	4.00 – 4.00
At the end of this course my skills for working with young people had improved [c]			4	10	4	4.0	3.75 – 4.25
I enjoyed the Rural Links course			3	7	8	4.0	4.00 – 5.00
I became more comfortable with using videoconferencing equipment as the course progressed [c]		2	5	6	5	4.0	3.00 – 5.00
My ability to use the videoconferencing equipment improved over the duration of the course [c]		3	2	10	3	4.0	3.00 – 4.00
Satisfaction with course content [d]			1	11	6	4.0	4.00 – 5.00
Satisfaction with explanations by trainer [d]			2	2	14	5.0	4.00 – 5.00
Satisfaction with small group discussions [d]		1	2	12	3	4.0	4.00 – 4.00
Satisfaction with small group feedback to			1	1	3	4.0	4.00 – 4.00

larger group [d]				4			
Satisfaction with case studies [d]			1	16	1	4.0	4.00 – 4.00
Satisfaction with role play [d]			5	13		4.0	3.00 – 4.00
Satisfaction with background reading [d]			1	13	4	4.0	4.00 – 4.25
Satisfaction with length of course (7 sessions) [d]			1	16	1	4.0	4.00 – 4.00
Satisfaction with readability of reading material [d]				11	7	4.0	4.00 – 5.00
Satisfaction with content of reading material [d]			1	11	6	4.0	4.00 – 5.00
Satisfaction with length of reading material [d]				12	6	4.0	4.00 – 5.00
Satisfaction with activities in work sheets [d]				17	1	4.0	4.00 – 4.00
Satisfaction with notes pages in work sheets [d]			1	14	3	4.0	4.00 – 4.00
Satisfaction with instructions in work sheets [d]				14	4	4.0	4.00 – 4.25
Satisfaction with frequency of sessions (1 per fortnight) [d]		1	2	13	2	4.0	4.00 – 4.00
Satisfaction with length of sessions (up to 2 hours) [d]		1	1	13	3	4.0	4.00 – 4.00

n_i is the number of respondents who rated the question as a score of 1, etc. All questions were answered on a five-point Likert scale. The following codes distinguish the various qualifiers for each question.

[a] None or very few-all

[b] No-yes

[c] Strongly disagree-strongly agree

[d] Very unsatisfied-very satisfied

Predicting success: stakeholder readiness for telehomecare diabetic support

M A Hebert[1], M J Paquin[2] and S Iversen[1]

1 Health Telematics Unit, Faculty of Medicine, University of Calgary, Alberta, Canada
2 Care in the Community – Home Care, Calgary Health Region, Alberta, Canada

Correspondence:
Dr Marilynne Hebert
Health Telematics Unit
G204 Health Sciences Centre
3330 Hospital Drive NW
Calgary
Alberta T2N 1N4
CANADA
(Fax: +1 403 270 8025; Email: hebert@ucalgary.ca)

Summary
Readiness to adopt a new technology is one factor that contributes to telehealth program success. Since one goal of telehealth is to improve care, it is appropriate to determine its success through a quality of care framework that addresses aspects of structure, process and outcome. A qualitative case study of homecare in the Calgary Health Region in Alberta set out to understand how clients, nurses, physicians and managers perceived their readiness to use video-visits for homecare. Focus groups, home visits, telephone and face-to-face interviews were used to collect data. Readiness to adopt telehomecare was compared between groups, as well as with behaviour predicted in the literature. Differences in perceptions were identified among the four participant groups. Clients and managers identified a higher degree of readiness – clients because of the potential to support independence in their homes and managers because of the potential efficiencies in the system.

Introduction
In the early 1990s telehealth technology became less expensive and more "user friendly". This generated renewed interest in the possibilities of telehomecare[1]. While the potential for telehomecare to increase access to services, improve quality of care and health outcomes has been widely recognised, expectations for its widespread adoption have not been met[2]. This may be related to a number of factors including characteristics of the innovation, its potential users and their environments (home or work)[3]. In addition, early perceptions, often influencing the decision to adopt a particular innovation, are reflected in a "readiness to change" on the part of individuals and organizations[4].

Telehealth technologies are expected to improve the quality of healthcare while maintaining or reducing costs. It is therefore appropriate to examine the success of these innovations through a framework which focuses on quality of care[5]. Hebert's adaptation of this *structure-process-outcome* framework included both individual and organizational levels, which are

important in understanding the effect of telehealth applications (Fig 1)[6]. Structural resources are often linked to telehealth "success," including training, equipment efficacy, effectiveness and location. Even when all these factors are in place, if individuals and organizations are not ready to use the technology, it may not be successfully integrated into the process of care, be sustainable, nor produce the outcomes expected.

The issues around readiness to adopt telehomecare hold considerable interest for those managing and caring for people with chronic illnesses. Within the Calgary Health Region located in Calgary, Alberta, Canada, this is of interest for diabetes care, which is a significant health concern. In 1998-99 approximately 2000 adult diabetics received homecare services in the Calgary Health Region. Homecare visits for these clients required 53,200 hours of nursing time at a cost of $1.8 million. This volume suggests that there may be significant potential for using telehomecare to reduce nursing travel time, improve client outcomes and minimize the number of return visits.

Methods

We studied the readiness of homecare clients, healthcare professionals involved in their care and managers of organizations to adopt telehomecare for adult diabetic clients within the Calgary Health Region. Qualitative data were collected through focus groups with clients and nurses, as well as by telephone interviews with physicians and key decision makers responsible for planning and resource allocation in diabetic homecare. Convenience sampling strategies were used to select all participant groups except managers who were selected to provide a representative sample of stakeholders in diabetic homecare management.[7] Two hundred invitations to participate were delivered to 20 community care coordinators (i.e. nurses who coordinated and delivered the homecare), along with a project description and distribution instructions. Client selection criteria included adult homecare clients who had diabetes as a primary or secondary diagnosis and were not cognitively impaired.

Physicians were notified of the opportunity to participate in the study through notices in two newsletters and direct contact with their offices. Nurses received notice of the focus groups through posters sent to their offices and through voice mail from their managers.

Data were collected from four groups of participants. Eight homecare clients participated in two focus groups and three home interviews. Thirteen nursing care coordinators participated in two nursing focus groups. Interviews were conducted by telephone or in-person with seven physicians and seven managers.

Participants were asked to describe current homecare activities and how these had changed over time. Following viewing a short videotape (used in the focus groups only) and/or posters illustrating video-visits from the client's and provider's perspectives, initial reactions to the technology were solicited. Participants were asked to consider circumstances where the technology may or may not be useful, potential advantages and disadvantages as well as organizational considerations if this was to be implemented locally.

Results

Readiness to adopt telehomecare was identified and compared for each study group. An iterative approach to data analyses compared these results with patterns predicted in the literature[8], specifically factors that influence an individual's intent to behave in a certain way, i.e. to use the telehomecare technology[9,10]. Participants' perceptions that potentially influence their use of telehomecare were sorted into *structure-process-outcome* categories with considerations at both individual and organizational levels.

Structure
Structural aspects of quality generally relate to infrastructure and appropriate use of resources to support video-visits. Clients and nurses were comfortable with the reliability of the technology. However some physicians expressed scepticism about fidelity of their results, i.e. they were concerned whether what they saw or heard accurately reflected the client's condition. Participants as a whole perceived the technology was easy to use and expressed few concerns about expected technical difficulties in using the videophones.

Process of care
Within the process of care, clients were, for the most part, very enthusiastic about using the technology as part of their health care visit because of its potential to support their independence at home. One 70-year-old client's description of his homecare visits illustrates this. His homecare nurse arrived every Thursday at 09:00 to check his blood pressure. He noted, of course, that it was never elevated at the time of her visit. He felt that it would be more effective for him to measure his own blood pressure when he didn't feel well, send this off to the nurse and get further directions at that time.

Nurses and physicians also focused on hands-on aspects of care, but they felt that the clients' needed to have health care professionals present in the home, a view which the clients did not share. On the other hand, managers were interested in gaining potential system efficiencies as well as how the technology might assist in providing a best fit of caregiver skills and client needs for better allocation of resources.

Outcome
Outcome measures important to clients were independence and freedom from being tied to a nurse's visit. They wanted to maintain their level of health, but with minimum intrusiveness. Nurses and physicians were more interested in measurable clinical outcomes such as managing blood pressure or glucose. Managers focused on outcomes that were cost-effective, although all four groups wondered who would pay for such a service.

Discussion
This study focused on readiness to adopt an innovation at individual and organizational levels. It is clear some degree of *synchronized readiness* is necessary to successfully launch a project and more importantly, to sustain it. Three areas merit further discussion: variability in readiness, selecting appropriate client groups for this service and study recruitment issues.

When examined through a quality of care *structure-process-outcome* framework there was evidence that the proposed change influenced each stakeholder group's perceptions of *readiness* for each dimension of the framework. The value in identifying these differences in perceptions is better understanding of how to approach implementation and what success indicators might be. For example, replacing scheduled homecare visits with video-visits when required will meet the needs of clients, but not the needs of nurses to deliver hands-on care in the home.

The second point concerns selection of the appropriate study population and potential users. While the selection criteria focused on people with diabetes, this did not prove to be an important factor. Participating clients had a multitude of medical and other challenges, with diabetes often being the least important of these with respect to care requirements. Participants themselves pointed out that while they all had diabetes, their experiences with this disease were quite different. Understanding the type of support needed to maintain independence and how video-visits might meet these requirements was a more important question to ask. If telehomecare applications focus on disease categories rather than need for care, projects may fail because the wrong target population was selected rather than other implementation issues. Clearly this area requires further investigation.

The third discussion point concerns difficulties encountered in recruitment and an unexpected role of "gatekeepers" in determining readiness of users. Inviting clients to participate through their nurses introduced the nurses in this gatekeeper role. Nurses, acting in what they thought were the best interests of their clients, did not distribute letters to clients who they felt either did not fit the selection criteria (in particular, had mobility challenges and were cognitively impaired) or would not be able to manage the technology.

Recruitment for physicians also met with a similar barrier through an office receptionist "gatekeeper," which meant that the Research Assistant was unable to make contact with most physicians. Including notices in two local physician newsletters was a more successful recruiting strategy. While this could potentially lead to responses from only supporters, this was not the case in practice and multiple views were represented.

Overall, the results of the study suggest that the successful integration of telehomecare into wider practice will depend on the readiness of a broad range of stakeholders, including clients, health care professionals, administrators and perhaps "gatekeepers." Clients and managers were more receptive to the idea, while nurses and physicians were less so. Results of the readiness study not only provide insights into the structural changes required, but also how potential users think about the process and outcomes of care.

Acknowledgements
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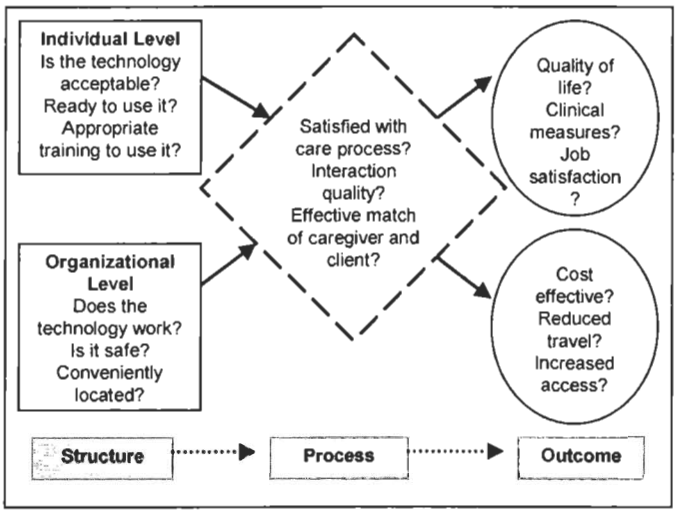

Fig 1. "Quality of Care" framework adapted for telehealth applications

Using the ANZTC framework to evaluate telehealth: identifying conceptual gaps

Emma Hughes[1], Chris King[1] and Sharon Kitt[2]

[1]La Trobe University, Victoria, Australia
[2]The Alfred Hospital, Victoria, Australia

Correspondence:
Emma Hughes
Ehealth Education and Research Group
School of Public Health
La Trobe University
Plenty Road
Bundoora
Victoria 3086
AUSTRALIA
(Fax: +61 3 9479 5811; Email: e.hughes@latrobe.edu.au)

Summary
Telehealth is strongly supported in policy rhetoric as being economically significant to Australia, but there is relative underdevelopment of evaluation standards to ensure that this is the case. The use of one such evaluation standard, the Australian and New Zealand Telehealth Committee (ANZTC) methodology for telehealth evaluation in Australia makes good sense. However, closer examination of this framework raises fundamental issues, as social contexts were subsumed to primarily economic and technical considerations. The combination of the economic rationalism of healthcare policy and the technological determinism of a tool model of information and communication technologies (ICTs), can result in evaluations that fail to match the complexities of the intersection of healthcare and ICTs. Using the ANZTC framework whilst at the same time focusing on explaining, rather than just describing, the links between interventions and outcomes seems a reasonable compromise. This involves understanding complex socio-technical networks and relationships, and requires investigators to engage with the gulf between private opinions, public statements and actual behaviour.

Introduction
Over the last few years, telehealth has risen in prominence as a method of health service delivery in Australia. Although much of its development has been uncoordinated and lacking in policy leadership, there have been attempts to standardise telehealth through initiatives such as the Australian and New Zealand Telehealth Committee (ANZTC). The Methodology for Telehealth Evaluation in Australia[1] was commissioned by the ANZTC and the Commonwealth Department of Health and Aged Care as part of a national strategy to standardise the implementation of telehealth and its evaluation.

The ANZTC evaluation framework is a set of tools for evaluation. It comprises a series of templates that act as a skeleton around which an evaluation can be built. Its format is summarised in Table 1.

Table 1. Areas of investigation examined at each stage

Stages	Current situation	Proposed change	All consequences	Important consequences	Areas of uncertainty	Summary
1.Description						
2. Data collection						
3. Analysis						
4. Results and summary						

Contextualising the evaluation of telehealth

There has been much rhetoric about the need for the rigorous evaluation of telehealth to ensure that sustainable projects meet demonstrable needs[2]. However, the 'evaluation of telemedicine remains a fairly narrowly focused endeavour, typically documenting satisfaction of providers and patients, frequency of usage, and economic impact'[3].

Social context is a specific set of social relationships, characterised by 'systems for using, organizing, and sharing information in different work groups and different roles'[4]. Hospitals are knowledge-intensive, service-based facilities that have important routines centred on complex communications involving high-level problem solving in an extremely safety conscious environment. The intense nature of these clinical-decision making environments, coupled with the amount of tacit knowledge and existing power relations all affect the implementation of telehealth[5,6].

There is a common perception that telehealth is an easily-implemented solution that can overcome access to care barriers. Unfortunately, this is not the case.[3] That is, it takes place in a complex set of inter-related technological, social and organisational systems. The convergence of these complex systems suggests that the evaluation of telehealth is more difficult than anticipated, because the unpredictability of outcomes makes it difficult to assess what component of an intervention is responsible for the change.

Models for evaluating information and communication technologies

The differences between the standard (tool) conceptualisation of information and communication technologies (ICTs) and an alternative socio-technical model for understanding the impact of ICT interventions are shown in Table 2.

Evaluations based on the 'tool model' will not determine the extent to which success or failure is due to the interaction between the technology and its environment, or intrinsic properties of the technology itself. Whilst we may know what happened, we rarely know much about why it happened.

Table 2. Conceptions of ICT in organisations/society (adapted from Kling[4])

Standard (tool) model	**Socio-technical model**
ICT is a tool	ICT is a socio-technical network
Business model is sufficient	Ecological view is also needed
One shot ICT implementation	ICT implementations are an ongoing social process
Technological effects are direct and immediate	Technological effects are indirect and involve different time scales
Politics are bad or irrelevant	Politics are central and even enabling
Incentives to change are unproblematic	Incentives may require restructuring (and may be in conflict)
Relationships are easily reformed	Relationships are complex, negotiated, multi-valent (including trust)
Social effects of ICT are big but isolated and benign	Potentially enormous social repercussions from ICT (overall quality of life, not just quality of worklife)
Contexts are simple (a few key terms or demographics)	Contexts are complex (e.g. matrices of businesses, services, people, technology history, location)
Knowledge and expertise are easily made explicit	Knowledge and expertise are inherently tacit/implicit
ICT infrastructures are fully supportive	Additional skill and work needed to make ICT work

Evaluating a telehealth project

We are currently undertaking an evaluation of a telehealth project in Victoria. The telehealth project involves the Gippsland Health Alliance – a partnership of eleven hospitals from the Gippsland region of Victoria and the three hospitals of the Melbourne Bayside Health network. Our concern at this early stage of the evaluation is to assess how using the ANZTC framework might constrain our ability to evaluate the project. That is, what are the consequences of using the framework, and does it adequately reflect the changing nature of telehealth? The framework may be operationally functional, but how useful is it if it does not contain any conceptual analysis?

Usefulness of the ANZTC framework

The project is still at an early stage and so any conclusions remain tentative. However, there must be questions about the utility of the framework which, it appears, has only been used to evaluate a single telehealth project in Australia – the South Australian Virtual Health Network[7]. Two early observations suggest that a shift in focus is required.

First, it appears that the ANZTC evaluation framework, with its focus on templates, is designed purely to answer questions about extending services to single sites or expanding the number of receiving sites. The framework is primarily designed to inform an organisational decision regarding telehealth implementation by juxtaposing a 'snapshot' of the current situation with anticipated outcomes. This is typical of a 'tool model' assumption in which there is a direct relationship between interventions and outcomes.

Second, there are pitfalls in assuming that the outcomes being measured are a direct result of the innovation being introduced. The project we are studying aims to reduce patient transfers, and if patient transfers are reduced, it may be concluded that telehealth has achieved the desired outcome. In fact, although patient transfers were reduced, it happened in an unexpected manner. When clinicians were asked to review scheduled patient appointments for their suitability for a videoconference instead, some patients were found not to require the outpatient appointment at all. No transfer occurred because no consultation was needed. This

is not to say that telehealth will not reduce transfers, but it highlights the need to be wary of making assumptions about the processes taking place. Issues of the complexities of health service delivery are also raised in this example that will require further examination.

Conclusion

Adopting a standard evaluation framework such as that commissioned by the ANZTC makes good sense. However, the combination of the economic rationalism of healthcare policy and the technological determinism of a tool model of ICTs, can result in evaluations that fail to match the complexities of telehealth. Thus there is a need for:

"...multi-perspective, multi-method evaluations...with evaluators from different backgrounds working together to produce an integrated evaluation, coupled with an awareness of the importance of qualitative methods". [8]

Using the ANZTC framework for evaluative research with a focus on explaining rather than just describing the links between interventions and outcomes seems a reasonable compromise. This is a complex task, made increasingly complex when multiple hospitals are involved, each with their own complex socio-technical internal networks and relationships. In order to understand these complexities, investigators must deal with the differences between private opinions, public statements and actual behaviour.

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Telehealth in older patients: the Hong Kong experience

Elsie Hui[1] and Jean Woo[2]

[1]Community Geriatric Assessment Team, Shatin Hospital, Hong Kong, China
[2]Department of Medicine and Therapeutics, Chinese University of Hong Kong, China

Correspondence:
Dr Elsie Hui
Shatin Hospital
33 A Kung Kok Street
Shatin
New Territories
Hong Kong
CHINA
(Fax: +852 2635 1037; Email: huie@ha.org.hk)

Summary
We studied the feasibility, acceptability and cost-effectiveness of using telemedicine to provide geriatric services to nursing home residents. A local 200-bed nursing home supported by the Community Geriatric Assessment Team (CGAT) participated in a one-year study, during which videoconferencing was used to replace conventional outreach or clinic-based geriatric care. The feasibility of telemedicine was evaluated by participating specialists. Other outcome measures included productivity gains, utilisation of hospital emergency and in-patient services and user satisfaction. Telemedicine was adequate for patient care in up to 99% of cases for different disciplines. The CGAT was able serve more patients and see them earlier and more frequently. Telemedicine was cheaper than conventional care, and well accepted by health care professionals as well as clients. Substantial savings were achieved in the study period through a 9% reduction in visits to the hospital emergency department and 11% fewer hospital bed-days. Telemedicine was a feasible means of care delivery in a nursing home setting and resulted in enhanced productivity and cost savings. Linking a greater number of institutions to care providers would further increase cost-effectiveness.

Introduction
Eleven percent of Hong Kong's 6.7 million inhabitants are aged 65 or older[1] and demands on health care continue to increase. In response, the Hospital Authority, which operates all the public hospitals in Hong Kong, introduced Community Geriatric Assessment Teams (CGATs) in 1995. Small groups of health-care professionals provide outreach geriatric services (including medical clinics, specialist nursing care and rehabilitation) to a large number of residential care institutions scattered over a wide catchment area.

In Shatin, the CGAT supports 21 nursing homes with over 3000 residents. The team includes a part-time geriatrician and psychogeriatrician, a nurse with training in geriatrics, a physiotherapist and an occupational therapist. The podiatrist also works closely with the

CGAT since half of her referrals are from nursing homes[2]. Residents are frequently sent to the hospital emergency department by emergency ambulance, albeit for fairly minor ailments. In 1998, we decided to explore the use of videoconferencing for service delivery to residential care homes.

Methods

A 200-bed nursing home covered by the CGAT participated in the pilot study from July 1998 to June 1999. The mean age of residents was 82 years (range 60 – 101) and the male to female ratios was 1:2. 36% of the subjects were chairbound and 10% were totally dependent in their activities of daily living.

Identical videoconferencing units (Viewstation, Polycom) were installed at the nursing home and Shatin Hospital, where the CGAT was based. The systems were conected by 3 ISDN lines each. A high-resolution portable camera (Samsung) was introduced subsequently which allowed better visualisation of lesions. A computer was connected to the Viewstation at the hospital site for downloading clinical photographs.

A research nurse was assigned to the nursing home to coordinate the project. Health care professionals from seven different disciplines (a geriatrician, a psychogeriatrician, a geriatric nurse specialist, a physiotherapist, an occupational therapist, a dermatologist and a podiatrist) participated in the study, using realtime teleconsultation instead of face-to-face consultations. Patients for routine follow-up as well as those with new problems were seen. The service operated from Monday to Friday during office hours.

Outcome measures

Following every consultation, health care professionals evaluated whether videoconferencing was able to replace conventional outreach or clinic activities, and comment on any difficulties encountered. A face-to-face consultation was conducted on or before the next working day if the user felt that the videoconsultation was inadequate for assessment or management of the patient; the exception being the dermatologist and podiatrist, where every case was routinely assessed by both methods.

A patient satisfaction survey was conducted at the end of the study. Inclusion criteria were an Abbreviated Mental Test[3] score of 6 or more, ability to recall using telemedicine service and to communicate with an interviewer. Responses were on a five-point Likert scale (1 represented strong disagreement and 5 strong agreement).

A questionnaire was distributed to nurses working at the home to assess their opinion on this mode of service delivery.

Costs for operation of telemedicine of different specialties were calculated using staff, drugs and material costs and setting up and recurrent costs, as well as duration of consultations[5]. Costs of conventional services, including outreach and clinic visits (Table 1), hospital emergency visit and in-patient beds were obtained from Hospital Authority data[4].

Table 1. Cost comparison between telemedicine and outreach or clinic visits.

Discipline	Telemedicine (HK$)	Outreach (HK$)	Outpatients (HK$)
Geriatrician	40	153	455
Psychogeriatrician	92	106	455
Dermatologist	118	N/A	455
Nurse	23	67	N/A
Physiotherapist	64	330	N/A
Occupational therapist	55	291	N/A
Podiatrist	29	N/A	161

N/A = not applicable 1US $ = 7.8 HK$

Results

During the study period, 1001 teleconsultations were made. Depending on the discipline, feasibility rates ranged from 60 to 99% (Table 2). Operating costs were lower for telemedicine compared with conventional services for all participating specialities (Table 1). Productivity gains included shorter waiting times for new referrals, more frequent review of old cases and increased total caseload. Notably, substantial savings of HK$236,451 (US$30,510) were incurred through reduced hospital emergency attendances (8.8%) and bed-days at the acute hospital (10.6%)[5]. A fall management programme using telemedicine to identify, assess and follow-up residents at risk of falling proved to be successful[6]. The service was favoured by 96% of patients who were cognitively intact: they felt comfortable with this mode of consultation and found it more convenient than having to travel to the clinic. Despite some increase in workload, nursing home staff felt that telemedicine increased their confidence in caring for residents, by strengthening the partnership between their institution and CGAT[6]. Papers reporting on individual specialist's experiences with telemedicine have been published[2,5-8].

Table 2. Feasibility of telemedicine according to speciality for 1001 consultations episodes

Discipline	Patient-episodes	% adequate
Geriatrician	356	97
Psychogeriatrician	149	99
Dermatologist	74	74
Nurse	101	89
Physiotherapist	105	87
Occupational therapist	117	60
Podiatrist	99	85

Limitations of telemedicine

Face-to-face consultations were necessary in those cases where chest auscultation was essential for the patient's management. Moreover, if subjects required hands-on treatment or assessment, which could not be performed by the nursing home staff, telemedicine was not adequate. Initially, the quality of images transmitted via videoconferencing was inadequate for assessment of skin and wounds. This problem was overcome by adding a portable high-resolution camera. Finally, telemedicine was unsuitable for patients who could not follow instructions or sit still for the camera to focus. Table 3 lists a variety of limitations encountered by different disciplines.

Table 3. Limitations of telemedicine in different specialties

Discipline	Limitations encountered
Geriatrician	Chest auscultation – an electronic stethoscope compatible with existing hardware has been introduced subsequent to the study New patients who required a thorough physical examination
Nurse/ Dermatologist/ Podiatrist	Patient with severe contractures where it was difficult to assess wounds – this was overcome by adding a portable, high-resolution camera Severely demented patients who could not sit still for the camera to focus on particular lesions Wound debridement Skin biopsy
Physiotherapist	Chest physiotherapy Examinations requiring palpation Massage therapy Measurement for assistive devices
Occupational therapist	Measurement for wheelchair and other special devices (e.g. splints, pressure therapy) Full assessment of patient's living environment

Discussion

In Shatin, funding has been obtained to link six nursing homes and a day care facility with the CGAT, covering about 1000 older patients. Telemedicine is now a routine component of the community-care package provided by the CGAT. Noting our success, several hospitals have introduced similar systems to support their local residential care homes.

In a study exploring the role of a nurse specialist in managing diabetic patients via telemedicine compared with visits to a diabetic centre, telemedicine was found to be as effective as conventional methods of diabetic patient education. Outcome measures included haemoglobin $A1_c$ level and measurement of self-efficacy, self-management activities and diabetic knowledge. Again, telemedicine serves a role of reaching more patients in the community to provide diabetes education[9].

Since over 90% of Hong Kong's older citizens still live at home, health promotion and screening services in this relatively healthy group are particularly relevant. A lower-cost product that provides real-time data on vital signs, e.g. blood pressure or oxygen saturation levels, may have a role in supporting patients with a history of repeated admissions, particularly those with chronic heart and lung conditions[10].

The pilot study demonstrated that a wide range of geriatric services could be provided via telemedicine. Savings were achieved and the service was acceptable to patients and care providers. Despite its limitations, telemedicine served a very important role in triaging cases, so that timely intervention could be offered to patients at high risk[2].

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The cost-effectiveness of telehealth in metropolitan hospitals

Sharon M. Kitt[1] and Lexie Clayton[2]

[1]Business Manager, Bayside e-Health, The Alfred, Victoria, Australia
[2]Director, Ambulatory and Community Services, The Alfred, Victoria, Australia

Correspondence:
Sharon Kitt
Bayside e-Health
The Alfred
Commercial Road
Prahran
Victoria 3181
AUSTRALIA
(Fax: +61 3 9276 3793; Email: Ehealth@alfred.org.au)

Summary
We have established a telehealth link between two inner-metropolitan health services that are less than 10 km apart. The realtime video link between the campuses is based on IP videoconferencing; ISDN connections are still maintained as a form of system redundancy and to connect to sites beyond the LAN. Approximately 15 sessions have been completed so far. The cost of a conventional consultation, in which the patient travelled to an outpatient appointment, was $170. The cost of a telehealth consultation was $99. The preliminary results of the present study suggest that the cost-savings from telehealth can be substantial. In addition there have been major benefits to continuity of patient care and clinical communication within the organisation.

Introduction
The Alfred provides a comprehensive range of specialist medical and surgical services in Victoria, and supplies the state-wide referral service for trauma, burns, hyperbaric and many other services. It accommodates 42 clinical units, offering every form of medical treatment with the exception of obstetrics and paediatrics. The Caulfield General Medical Centre (CGMC) is a large subacute campus of Bayside Health, with major services in aged care, rehabilitation, aged psychiatry and community and ambulatory services.

Patient flow within Bayside Health usually means that the short-term, acute-phase patients are treated at The Alfred, and then transferred to the CGMC for longer-term, sub-acute phase rehabilitation. Technically the patients remain as inpatients of the CGMC for rehabilitation, but they are regularly transferred back to The Alfred for outpatient care related to their acute stay. For example, patients are transferred back to The Alfred for orthopaedic, infectious disease, burns and other reviews. The distance between these two sites is approximately 10 km and in normal traffic conditions the journey takes 25 min.

Although geographically quite close, patients are often away from their inpatient wards for four hours per appointment due to problems with ambulance transport and outpatient service demand. Consequently, they can miss rehabilitation therapy sessions as well as other important aspects of care. For many of these patients transportation is a difficult and painful process that is difficult to justify. Alternatively, their outpatient appointments may be cancelled due to the difficulties of obtaining satisfactory transport. Information regarding these outpatient encounters which affect inpatient care, is often difficult due to communication between campuses. Although annotations to the medical record are made, these usually relate only to the outpatient encounter or the inpatient encounter, which are physically separated within the record.

Within Bayside Health, all the hospitals are a part of the same Local Area Network (LAN), with high capacity data links available between each campus. We have used realtime video links between the campuses based on IP videoconferencing. ISDN connections are still maintained as a form of system redundancy and to connect to sites beyond the LAN. However all intra-Bayside communication is now done via an IP connection.

Methods

For each element of a CGMC to Alfred outpatient appointment, we costed the following items:

transport
staff time - how long the clinician spent with the patient. Standard costs per hour are shown in Table 1.

Table 1. Costs of staff involved in an outpatient visit

Staff type	**Cost ($/hour)**
Clinicians/consultants	100.00
Senior medical officers (level 5)	36.52
Allied health staff, i.e. physiotherapist (grade 2, Year 4)	26.93
Nursing staff escort (registered nurse 1, grade 4A, Year 2)	27.99
Orderly	15.00
Telehealth staff	23.60

Common elements to both telehealth and conventional consultations, such as support and hotel costs (e.g. lighting, linen), were not included in the cost analysis.

The following items were not costed:

equipment and telecommunication costs for telehealth were not included, since existing IT infrastructure was used
staff escorts for patients transported to an outpatient appointment, since patients were not routinely escorted.

Results

The average transport cost was approximately $137 for a 20 km return journey. The cost of an outpatient consultation is shown in Table 2. Assumptions of this scenario were based on The Alfred consultant reviewing the patient during a 20 minute appointment, although in practice a less senior doctor is often employed instead. In a typical teleconsultation, there were usually additional staff involved, such as the CGMC-based intern or registrar, and an

allied staff member as well to ask questions regarding the effect on rehabilitation. However, there have been reviews where only the patient (at CGMC) and the treating clinician (at The Alfred) have been present.

Table 2. Consultation costs

	Standard consultation ($)	**Teleconsultation ($)**
Transport	137.00	0.00
Telecommunications	0.00	0.00
Staff		
	Consultant 33.00	Consultant 33.00
		Allied health 8.97
		Medical officer 12.17
		Telehealth staff 16.73
Total cost	170.00	70.87
Telehealth saving		*99.17*

Discussion

Approximately 15 sessions have been completed so far. The total cost savings were approximately $1500. It has been interesting to note that a number of transports have been cancelled because they were deemed clinically unnecessary. This was due to communication between the treating clinicians on both sites facilitated by the telehealth team members. So far there have been five cancelled sessions. These cancelled sessions were either duplicate appointments that had not been identified (the same patient being transported to the same clinic twice in two days) or deemed unnecessary through communication between the treating clinicians. They would have been suitable for telehealth if not cancelled for the reasons above.

As is commonly the case, the problems with costing telehealth savings are the intangible benefits[1]. It is difficult to assign a direct monetary value to benefits such as increased communication between clinical staff on different campuses and improvements in patient care. Conversely, it is also important to recognise that telehealth is not without cost consequences. In the model of care under discussion, there were clinical staff members at both sites of the telehealth interaction. For public hospitals the staff costs would be present regardless, as the telehealth sessions only run within the assigned outpatient time of a particular medical specialty. However it is important to acknowledge in telehealth that there is a time penalty, and therefore a cost, involved for staff participating in telehealth. This is particularly true at the CGMC site where the clinical staff members would not ordinarily be involved in such a review consultation. How time costs are measured in realistic terms other than through a salary apportioning requires further study.

Conclusion

The preliminary results of the present study suggest that the cost-savings from telehealth can be substantial. In addition there have been major benefits to continuity of patient care and clinical communication. A further and more detailed costing analysis is required to ensure that this early modelling truly reflects the economic benefit achievable through telehealth.

Acknowledgments
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Teleneurology in Northern Ireland: a success

Victor Patterson

Royal Victoria Hospital, Belfast, UK

Correspondence:
Dr Victor Patterson
Ward 21
Royal Victoria Hospital
Belfast BT12 6BA
UK
(Fax: +44 28 9044 8029; Email: VP498@utvinternet.com)

Summary
In March 1998 two neurologists and a Professor of Telemedicine met to solve a clinical problem – how to get neurological expertise to patients admitted acutely to hospitals which had no resident neurologist. Four years later, two new consultant neurologists were appointed in Northern Ireland with sessions in telemedicine, possibly the first such appointments anywhere in the world. This feat was achieved by combining science with politics. First we chose the most appropriate telemedicine equipment and bandwidth for our needs. Second we altered our neurological consultation to use this technology efficiently. Third we were able to show scientifically that teleneurology was reproducible, feasible in practice, safe, acceptable and cost-effective. This required money to pay for a research fellow and equipment which was obtained initially from some departmental research funds and a local hospital. Conventional research-funding bodies were on the whole unhelpful. We then had the serendipitous setting up of a Review of Neurology Services in Northern Ireland by the Department of Health. This identified our original problem as one that it wanted solved and we were in the fortunate position of being able to offer telemedicine as a tested solution. One final political push was required to get the money released. The result of this juxtaposition of science and politics should bring benefit to our neurological patients and will perhaps help others trying to set up similar projects elsewhere.

Introduction
Northern Ireland has a population of 1.7 million people. Health care is free at the point of delivery. All patients have their own designated General Practitioner who controls access to secondary care. In Northern Ireland, as in other parts of the UK and Ireland, there are relatively few neurologists – 1 per 250,000. Many people with neurological illness are seen by general physicians and other non-neurologists. The neurology services in Northern Ireland operate in a 'hub and spoke' system with the hub being in Belfast with consultants from there visiting other hospitals.

The problem
Neurological disease is common in Northern Ireland[1]. It is mostly dealt with by non-neurologists [1,2] and our feeling has always been that if neurologists were involved in it, then

patient care would be considerably improved [3,4]. We could never work out how to this because there were simply not enough in-patient neurology beds.

The solution?

Somewhat serendipitously, our hospital possessed the only Professor of Telemedicine in Europe, and, after falling into conversation with him we wondered whether telemedicine could enable us to solve our problem. The nature of telemedicine meant that we could see a way in which neurologists could be involved in patient management by consultation rather than by taking over their care. We used my existing links as a visiting consultant neurologist to the Tyrone County Hospital in Omagh as the basis for this.

The science

With the help of the Professor of Telemedicine, we conducted some laboratory tests to work out the most feasible way of conducting a neurological assessment. This resulted in using commercial 'off the shelf' ISDN videoconferencing equipment at a bandwidth of 384 kbit/s.

Our next step was to show that we could change the method of neurological examination in order to use telemedicine efficiently, which we could do. We showed that the technique was reproducible between different observers[5] and we showed that it could be incorporated in a busy hospital and we obtained preliminary data to show that it was safe[6]. We did a formal study to show that it was acceptable[7] to both patients and hospital staff who transmitted the examination and we published a number of case reports which showed that it was effective[8,9]. Cost-effectiveness was determined by a large comparative cohort study, where we managed patients at one hospital with an early teleneurology consultation, patients at an adjacent hospital being managed conventionally. We subsequently obtained data about long-term safety.

Practicalities and funding

We were able to use a purpose-built telemedicine studio at the Royal Victoria Hospital. We obtained a set of videoconferencing equipment at the Tyrone County Hospital through the generosity of the local Health Care Trust and we were also able to access technical expertise at the Institute of Telemedicine in Belfast.

We required funding for a research fellow because of the considerable amount of clinical work involved and our attempts to obtain this through conventional funding agencies were spectacularly unsuccessful. We therefore supplied the funding for this through some 'soft' money and then mounted a political offensive to promote telemedicine as an effective and eminently sensible method of providing healthcare. The campaign, which involved our Chief Medical Officer, the Permanent Secretary of the Department of Health and later the Minister of Health, was successful in funding a research fellow for a further two years.

During that period we were able to show that the system could be applied to other neurological applications, namely new neurological referrals to outpatients [10,11]. We were then able to restructure the examination so that nurses could perform it instead of junior doctors. We showed that a telemedicine system could be the basis of a nurse-led clinic for epilepsy, which is the most common neurological disease in the community, and we have begun to use a 'store-and-forward' technique for patients seen in general practice. We have now managed over 600 inpatients, 400 new outpatient referrals and 300 patients with epilepsy using this technique.

More politics

The second piece of serendipity was a Review of Neurological Services in Northern Ireland which was instigated by the Department of Health[12]. This reported favourably on the potential use of telemedicine to provide an inpatient consultation service to the many rural hospitals in Northern Ireland. Once published however, this report was consigned to a shelf and getting it implemented required another political push. This resulted in our final achievement of the appointment of two consultant neurologists with dedicated sessions in telemedicine and the extension of the teleneurology to four small rural hospitals within Northern Ireland. This will start in July 2002, just four years after the project first began.

Endpiece

There are four identifiable factors which have underpinned the success of this project. These are: (1) get the science right; (2) don't be too modest; (3) persevere; and (4) keep smiling!

Acknowledgements

This projected would have failed without the contributions of a team of people: Richard Wootton, Clive Russell, Danny McArdle, John Craig, Richard Chua, Helen Evans, Jenny Humphreys, Sinead Gormley, Liz Nixon and Ena Bingham.

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Tele-nursing: clinical nurse consultancy for rural paediatric nurses

Robyn Rosina, Jean Starling, Kenneth Nunn, David Dossetor and Kim Bridgland

Department of Psychological Medicine, Children's Hospital at Westmead, New South Wales, Australia

Correspondence:
Robyn Rosina
Department of Psychological Medicine
Children Hospital at Westmead
Locked Bag 4001
Westmead
NSW 2145
AUSTRALIA
(Fax: +61 2 9845 0413; Email: Robynr3@chw.edu.au)

Summary
Videoconferencing is increasingly being accepted as a medium for health care. Tele-nursing is in its infancy in Australia but has enormous potential for remote area nursing. The Child and Adolescent Psychological Telemedicine Outreach Service (CAPTOS) began in 1997 and in its first evaluation recommended more support for paediatric nurses. CAPTOS tele-nursing began as a new initiative in late 2001. The telenursing project aims to link ward nurses, to CAPTOS and local community teams, to provide clinical consultancy on nursing and interdisciplinary issues and also locally based relevant professional development. Telenursing supports nurses via site visits, videoconferencing sessions, an interactive website and sabbatical opportunities. Telehealth works with existing services to enhance the nursing care of young people with a complex mixture of psychological and physical health problems.

Introduction
In Australia, the prevalence of mental health problems among young people, aged 14-17 years, is high at 14%[1]. There is also concern that many young people are not able to access or are less able to seek access to mental health services. Barriers, such as distance, a shortage of skilled clinicians and the difficulties inherent in negotiating an often-fragmented health system are certainly evident[2,10].

These barriers are particularly challenging for young people their families and health workers, in regional, rural and arguably parts of metropolitan New South Wales. Young people with mental health concerns present to services such as hospital emergency departments and some are admitted to paediatric or general wards, often in crisis. Many nurses believe that they are now seeing patients admitted with concerning and risky behaviours at a much younger age than before. An early admission in terms of concerning behaviours may be consistent with early predictors of disturbance or distress and may be amenable to the opportunities of early intervention and prevention. Early recognition of emotional and behavioural concerns can

assist diagnosis, reduce the risk of self-harm, substance abuse, adult psychopathology and/or criminal behaviours. However, to enable early interventions and safe ward management of these young people paediatric nurses will require skill enhancement and clinical support.

Currently, New South Wales has very few facilities with suitable beds for the care of children and adolescents with urgent mental health concerns[3]. Many children and young people with concerning behaviours related to psychosocial and psychiatric crises may not be suitable for admission due to their age or developmental status. Arguably, a bed sooner and closer to home in a non-psychiatric environment is better in terms of early intervention and prevention, than either a position on a waiting list or a bed a long way from family, cultural support and community services, crucial to recovery. A brief admission to a local general hospital, particularly in times of crisis, has many advantages for the young person and their family. This can be thought of as 'admission to the least inappropriate place', in terms of safety and minimising the stigma attached to mental ill health. However, a balance is required between the young person's right to good care anywhere and the nurse's (and other health workers) right to a safe and satisfying workplace to provide care.

CAPTOS project

The CAPTOS (Child and Adolescent Psychological Telemedicine Outreach Service) began in 1997 to support rural clinicians, as well as young people and their families, with clinical services. The broad aim was to enable greater equity of access to specialist child and adolescent psychiatry services for rural communities and clinicians. Rural clinicians are provided with clinical support and relevant education either by site visits or by videoconferencing. An evaluation of CAPTOS found that young people, their families and rural clinicians expressed high overall satisfaction with the service [4]. The evaluation also found that CAPTOS had not substantially addressed the issues for paediatric and general nurses attempting to provide safe and appropriate care for young people in hospital wards in regional and rural New South Wales[5] The evaluation also recommended that a state-wide paediatric nursing consultancy service was required. The proposed specialist nursing service would support nurses who are asked to manage troubled young people, particularly when diagnosis is often uncertain[5].

CAPTOS tele-nursing began in late 2001 to provide child and adolescent mental health clinical nurse consultancy services for rural paediatric nurses. The clinical nurse consultancy (CNC) service has 27 ward areas that care for children and young people with mental health concerns and their families; with another 8 hospitals yet to be included in the network. The number of children and adolescents on each ward at any one time does not justify a CNC service at each ward, but the numbers across an area health service and across the state certainly emphasise the need for remote access to clinical support.

Rural nurses are increasingly being asked to perform a variety of advanced skills beyond their basic level of education and experience[6]. Expanding the practice of nurses allows rural communities to access more of their health care closer to home, but without relevant education and clinical support the work becomes hard to sustain[6]. Analysis of education and clinical support needs among rural nurses across New South Wales has shown the need for such services. Specifically, the nurses surveyed have attached importance to education directed at skill development to assess and manage the concerning behaviours of children and young people admitted to their wards. This finding contrasts with traditional educational preparation focussed on psychiatric disorders and interventions for psychiatric nurses caring for patients in mental health facilities[7]. The majority of mental health care is currently provided within non-specialised facilities, thus requiring different skills and CNC services, compared to the traditional education and support.

The two main aims of CAPTOS tele-nursing are to facilitate the enhancement of nursing skills and to provide clinical nurse consultancy services to paediatric nurses across the state. The Caplan model of consultation underpins CAPTOS tele-nursing[8]. Consultation in this context is used to describe an activity carried out by a person considered to be an authority on a given subject, even though they are not necessarily in authority[9]. The primary focus of the consultation may be clinical supervision, patient management issues as opposed to casework, or offering a solution to a current problem and promoting the nurse's ability to deal with future problems. Traditional Tele-nursing uses technology to deliver patient care to remote locations. The advocacy and caring ideology inherent in nursing practice is unchanged and the technology is simply a tool to deliver patient care. The consumer in CAPTOS tele-nursing is more often a colleague and indirectly a patient.

The practice of providing CNC services to nurses rather than patients, using videoconferencing and Web-based education, is in its infancy in Australia. The service is heavily reliant on technology, particularly equity in access to technology, to facilitate the network of clinical support for nurses and indirectly for patients. Many nurses in regional and rural New South Wales do not yet have access to videoconferencing equipment, email or Internet services. However, they are still expected to provide evidence-based best practice to patients with a range of health problems.

Conclusion

Telehealth can increase access to appropriate health care for young people and families. However, it is crucial to enhance clinical support and relevant education to local clinicians. In child and adolescent mental health nursing this will enable children, young people and families to receive good care anywhere. It will also assist nurses to overcome the barriers of distance, thus promoting their access to specialist clinical support and a safer workplace.

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Physical outcome measurements via the Internet: reliability at two Internet speeds

Trevor G Russell[1], Richard Wootton[2] and Gwendolen A Jull[1]

1 Department of Physiotherapy, University of Queensland, Brisbane, Australia
2 Centre for Online Health, University of Queensland, Brisbane, Australia

Correspondence:
Trevor Russell
Rm 418
Department of Physiotherapy
University of Queensland
St Lucia 4072
AUSTRALIA
(Fax: + 61 7 3365 2775; Email: t.russell@shrs.uq.edu.au)

Summary
We have developed a software application to enable interactive rehabilitation via the Internet. The reliability of the telemedicine application was examined by comparing it with face to face assessment. The physical outcome measures assessed were knee range of motion, quadriceps muscle strength, limb girth and an assessment of gait. One therapist performed both in-person and Internet based measurements of all outcome measures on 20 normal subjects. There was good agreement between the two techniques. Bland and Altman's technique for method comparison showed that the 95% limits of agreement included zero for all variables studies. Internet assessments were conducted at two bandwidths: ISDN at 128kbit/s and PSTN at 17kbit/s. Bandwidth had no significant influence on any of the measures. This study suggests that Internet-based physiotherapy interventions delivered to the home can therefore be developed in future.

Introduction
Physiotherapists rely on physical assessment data to implement, modify and terminate treatment interventions. Telerehabilitation, if it could be shown to work, would permit physiotherapy at a distance and might be useful in improving access to specialist services from rural areas.

Studies investigating the reliability of physiotherapy assessment via the Internet are scarce. Nitzkin et al[1] assessed 512 matched pairs of observations for physiotherapy assessment of the knee, neck and back via a high bandwidth (1.5 Mbit/s) video link. There was an 86% agreement between telemedicine and the reference measurement. Kappa coefficients of reliably varied for the knee (0.59), neck (0.47) and back (0.68). Lemaire and Jeffreys[2] used a store and forward technique over a low bandwidth (28.8 kbit/s) link to evaluate subject who required ankle-foot orthotics. Similar results between telemedicine and in-person assessments were found in 88% of cases.

We have developed a software application to enable interactive rehabilitation via the Internet (Fig 1). The software was developed chiefly to facilitate the collection of physical outcome measures through the use of specialized tools. It uses realtime videoconferencing (320 x 240 pixels) with still image and video capturing facilities. The present study was conducted to examine the reliability of the application at two Internet bandwidths.

Methods

Subjects were measured both face-to-face by conventional procedures and also using the software application at one of two different bandwidths. Twenty normal subjects (mean 24.1 years, SD 4.1) were recruited for the study and randomized to bandwidth group and order of assessment. No subject reported any previous knee pathology. Ethics permission was granted by the appropriate committee and informed consent was obtained from the subjects.

Outcome measures commonly used in the physical assessment of the patient following total knee replacement surgery were tested. These included knee range of motion (KROM), quadriceps muscle strength (MS), swelling of the knee as assessed by limb girth (LG) measurements, and an assessment of gait. Two different speeds of Internet connection were employed: a low bandwidth PSTN (17 kbit/s) and a higher bandwidth ISDN (128 kbit/s) connection. A physiotherapist sequentially rated all outcome measures on each subject via both Internet and face-to-face methods of assessment. A research assistant recorded the value of each measure so that the physiotherapist remained blinded to the measure.

KROM: Still pictures (320 x 240 pixels) of the realtime video image were taken by the Internet application once the subject's knee was positioned correctly. From these images the landmarks suggested by Norkin and White[3] were used to calculate the knee angle (Fig 2). Face-to-face measurements were made using a standard 30 cm universal goniometer (Baseline), utilizing identical landmarks located manually on the subject by the physiotherapist.

MS: The subject was positioned with their knee over a towel roll in 30 degrees of flexion. They were then requested to straighten their knee. One kilogram weights were progressively added to the distal end of the limb with muscle strength being defined as the maximum weight at which the subject could perform three knee extension manoeuvres through full range. Internet assessments were performed with the subject applying the weight to their own limb.

LG: Circumferential measures were performed at three positions on the limb with the use of a tape measure: the knee joint line, and 10cm above and below this point. The therapist guided the subject as to the correct positioning of the tape measure for the Internet measurements and made the measures directly in the face-to-face assessment.

Gait: Subjects were rated on 26 descriptors of gait on a five-point Likert scale. This assessment was made in real time in the face-to-face assessment and from a video recording produced by the Internet application for the Internet assessment.

Statistical analysis

All data were analyzed using the SPSS software package release 11.0. The modes of assessment were compared using repeated measures analysis of variance, Pearson's r correlation and Bland and Altman's[4,5] method of assessing reliability. The influence of speed of Internet connection was analyzed with one-way analysis of variance.

Results

Table 1 shows the means, standard deviation (SD) and correlation coefficients for the outcome measures KROM, MS and LG. The results of the analysis of variance for the effect

of the Internet connection speed on the Internet measurements revealed that the bandwidth had no significant influence on any physical measures (all $P>0.05$). Because there was no Internet speed effect we ignored the factor of speed in subsequent analysis. Bland and Altman's[4,5] limits of agreement calculation for KROM, MS and LG are shown in Fig 3. Exact agreement of gait assessments occurred in 76% (kappa = 0.59) of ISDN Internet measurements and 75% (kappa = 0.54) of PSTN Internet assessments.

Table 1. Mean values for face to face and Internet measurements

Outcome measure	**Face-to-face measures (SD) (n=20)**	**Internet measures (SD) (n=20)**	**F value**	***P*-value**	**Correlation**
KROM extension (degrees)	1.75 (3.96)	1.80 (3.90)	0.019	0.893	0.97
KROM flexion (degrees)	73.1 (11.4)	73.1 (11.7)	0.044	0.835	0.99
MS (kg)	13.4 (5.3)	13.5 (5.5)	0.446	0.512	0.99
LG measure 1 (cm)	36.1 (2.7)	36.4 (2.8)	2.157	0.158	0.97
LG measure 2 (cm)	42.8 (3.4)	43.5 (3.8)	3.777	0.067	0.90
LG measure 3 (cm)	32.9 (2.7)	33.0 (2.6)	0.162	0.691	0.97

Discussion

The Internet based physical assessments performed in this study were very reliable. This is evident in the high correlation associated with a lack of significant difference in the magnitude of measurements (Table 1). The least reliable was the second limb girth measurement ($P = 0.067$). This measurement was performed on the spongy quadriceps muscle bulk area 10 cm above the knee. Large differences in circumferential measurements could be expected with small differences in the traction forces applied to the tape measure.

The high level of reliability is further verified with the limits of agreement calculations (Fig 3) as described by Bland and Altman[4,5]. The limit of agreement calculation produces a range of scores between which 95% of the difference scores between the measurements will lie. The magnitudes of the observed limits of agreement scores in this study do not indicate a clinically significant difference. The assumptions of uniform bias and variability underlying the limit of agreement calculation were verified graphically with difference versus average plots for all outcome measurements.

Physical outcome assessments require the very close observation of subjects and as such, image quality (resolution) and frame rate are important for accurate assessments. The results of the present study showed that reliability was realized regardless of the speed of the Internet connection for all outcome measurements. This result is surprising as both image resolution and frame rate are proportional to bandwidth. The most sensitive of the outcome measurements observed in this study was the assessment of gait. In this assessment the therapist is required to observe such parameters as foot placement within the gait cycle. A possible explanation for the success of this assessment at low bandwidth may lie in the number of repetitions of the gait cycle used for observation. The subject completed five circuits of a 5 m track whilst being observed in both the frontal and sagittal planes. The number of repetitions appears to have allowed the therapist to observe all components of the gait cycle regardless of the poor frame rate of image transmission. The worst components of gait assessment were those concerning the distal limb such as foot placement and ankle angle.

The new Internet application that we have developed appears to produce valid and reliable assessments of the physical outcome measures investigated. Furthermore, reliability was independent of the speed of Internet connection for all outcome measurements. This has

implications for the further development of Internet based physiotherapy interventions delivered to the home.

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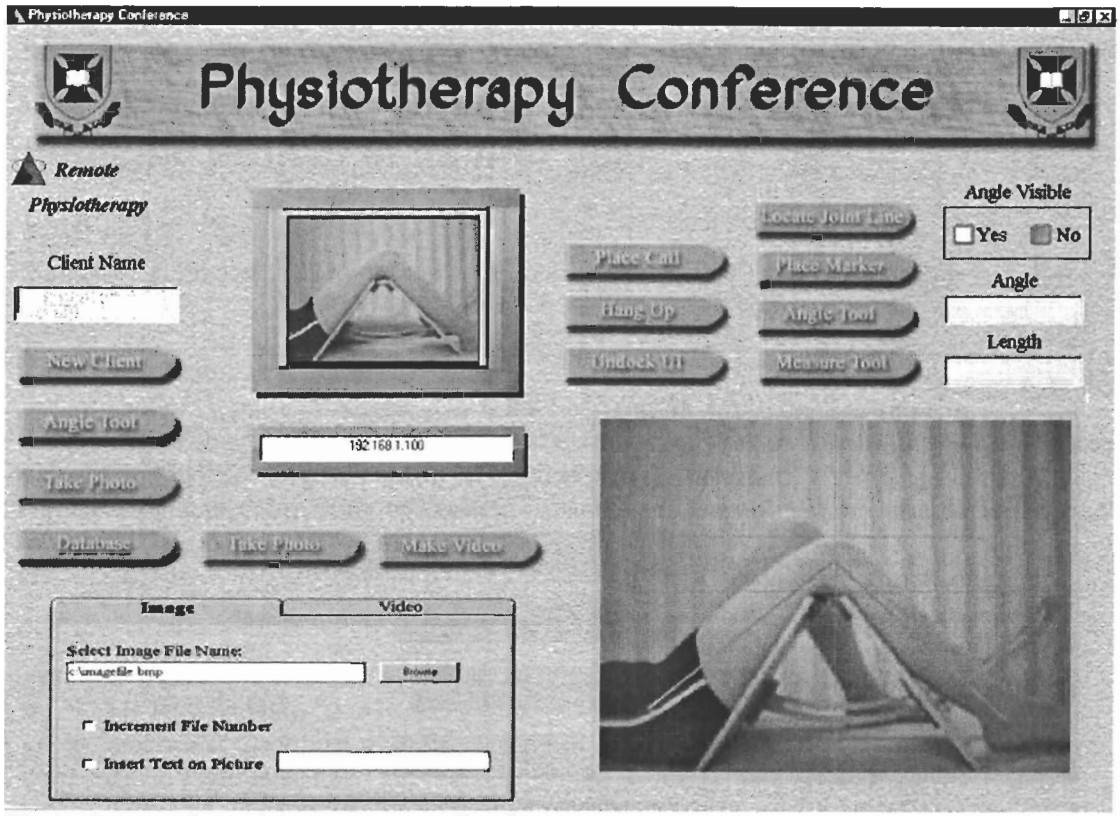

Fig 1. Screen view of the Internet application

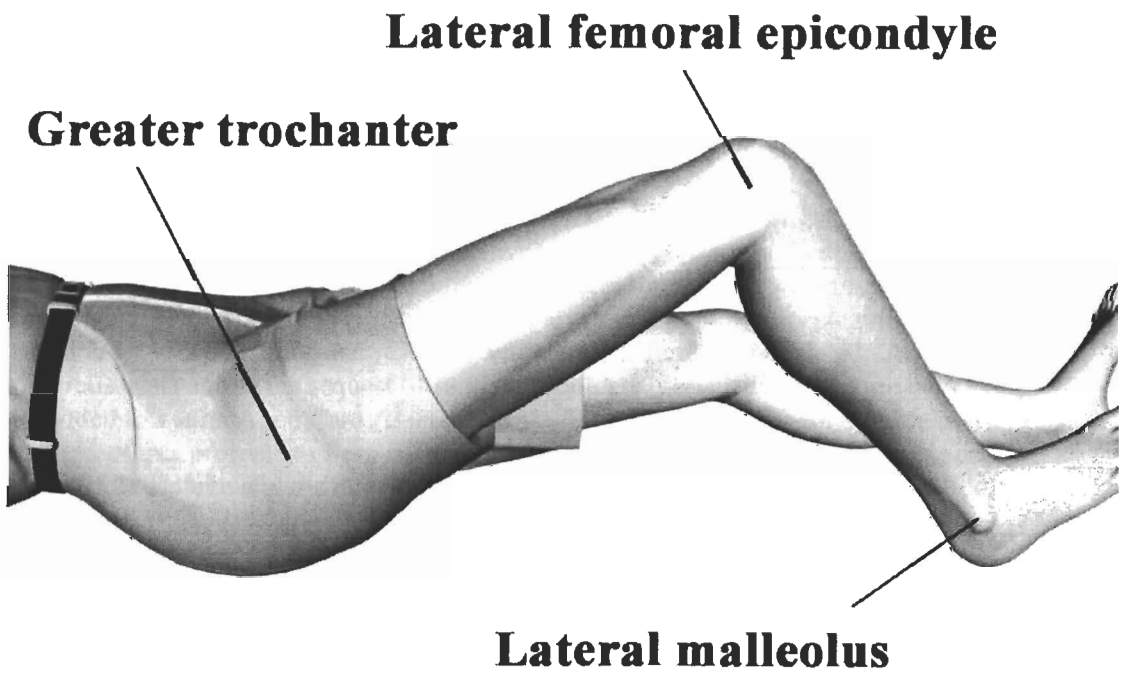

Fig 2. Landmarks used for goniometric measurements

Fig 3

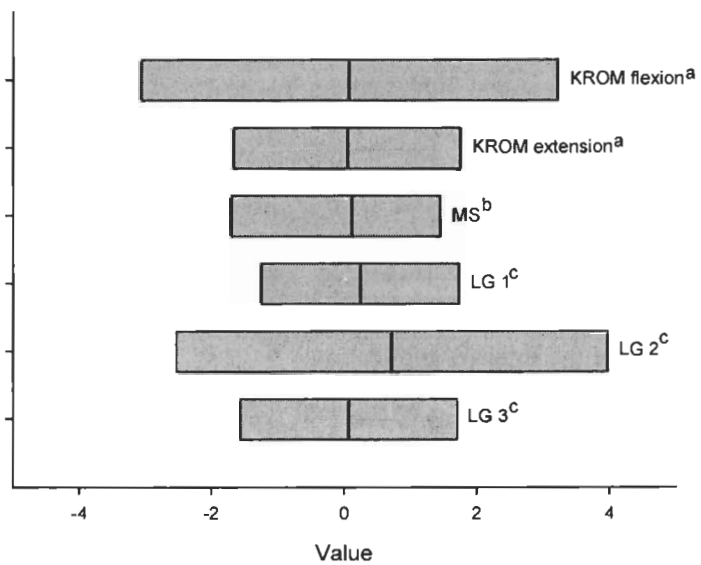

Fig 3. Limits of agreement calculations. Units: [a] = degrees, [b] = kg, [c] = cm. The limit of agreement calculation produces a range of values between which 95% of the difference scores between the two modes of assessment will lie.

The clinical achievements of a telehealth geriatric medicine project in its first year

J Saligari[1], L Flicker[2], P Goldswain[3], PK Loh[4], Sean Maher[5] and P Ramesh[5]

[1]Royal Perth Hospital, Australia
[2]Department of Geriatric Medicine, University of Western Australia, Australia
[3]Rehabilitation and Aged Care Unit, Health Department of Western Australia and Department of Geriatric Medicine Consultant, Royal Perth Hospital, Australia
[4]Geriatric Medicine, University of Western Australia and Department of Geriatric Medicine Consultant, Royal Perth Hospital, Australia
[5]Department of Geriatric Medicine Consultant, Royal Perth Hospital, Australia

Correspondence:
Ms Jane Saligari
Telehealth Coordinator
Royal Perth Hospital
GPO Box X2213
Perth 6847
AUSTRALIA
(Fax: +61 8 9224 1790; E-mail: jane.saligari@health.wa.gov.au)

Summary
A feasibility study was performed to test the validity of conducting standardised cognitive assessments via videoconferencing. There was a high correlation between the scores allocated during a face-to-face assessment and those reached during a videoconference. A second trial was conducted with patients with probable Alzheimer's disease living in a rural community. The validity and reliability of the assessment tools were reviewed with importance placed on diagnostic accuracy. Patient and clinician acceptability of the technology was examined and resource and recurrent funding calculated. As a result of the previous trials and at the request of rural stakeholders, geriatric services are now being provided to a rural Aged Care Assessment Team (ACAT) on a fee-for-service basis. The success of this project has been in its senior clinical and academic 'champions', dedicated telehealth resource and the development of protocols following ongoing evaluation.

Introduction
Western Australia is a large state with 30% of its population of 1.8 million located in rural and remote communities. However, the majority of clinical speciality services are located in the capital city, Perth. The department of geriatric medicine (DGM) at the Royal Perth Hospital (RPH) is responsible for providing tertiary clinical support to three rural health services within Western Australia. These range in distance from Perth from 100 km (Northam) to 2200 km (Broome).

In Australia it is predicted that by the year 2051, the population aged 65 years and over will be at least double its present size, increasing from 12% of the population in 1999 to 24-27%

in 2051 [1]. The services provided by the DGM include Aged Care Assessments (ACA), assessment of testamentary capacity, family conferences, and education and support for carers. The aim of an ACA is to determine the client's care requirements. An essential component of the appraisal is a dementia assessment, using standardised cognitive assessment instruments.

A number of studies have examined the feasibility of administering individual components of the Mini Mental State Exam (MMSE) [2-6] and assessing patient and clinician perception[7]. We have compared two forms of service delivery that could be used to conduct a cognitive assessment as part of an ACA.

First study

The aim of the study was to determine the validity of the MMSE and the Geriatric Depression Scale (GDS)[8] as assessment instruments for Alzheimer's disease using videoconferencing, and to assess the minimum technical requirements to conduct this type of consultation. A feasibility study was carried out involving 20 inpatients located on two campuses of the RPH. Subjects were older than 65 years of age, with or without dementia. They were selected at random by the treating clinician.

Two advanced trainees in geriatric medicine assessed each of the patients face-to-face (FTF) and via videoconferencing on the same day. Consultations were staggered to minimise the effect of learning by repetition. Videoconferencing consultations were conducted first in 55% of the cases. Videoconferencing units (Cruiser version 4.0, VCON) were used at various ISDN bandwidths (128-384 kbit/s).

The results showed that it was feasible to conduct a cognitive assessment via videoconferencing. There was a high correlation between FTF and videoconferencing scores for the MMSE and GDS. A technical protocol was then developed recommending the use of a minimum bandwidth of 384 kbit/s. As found in a previous study,[9] this improves both audio quality and the view of non-verbal communication.

Northam cognitive assessment trial

A second study was conducted between the DGM and Northam, a town visited by a RPH geriatrician each week. The aim of this study was to assess the validity and reliability of the standardised cognitive assessment instruments via videoconferencing, determine patient and clinician acceptability, and calculate resource and recurrent funding requirements.

Twenty consecutive patients referred from the community by the Northam Aged Care Assessment Team (ACAT) for a cognitive assessment were included. Patients or their carers gave informed consent. Videoconferencing units (MediaPro 384 MP, RSI) were used at a bandwidth of 384 kbit/s.

Patients were assessed using standardised cognitive assessment tools (MMSE and GDS) FTF by the visiting geriatrician and via videoconferencing by a different geriatrician located at the RPH. An ACAT nurse was present with the patient during all videoconferencing consultations. Both clinical assessors were blinded to each other's assessment scores till the completion of the study. All participants completed standardised evaluation forms. Questions were based on those of Field[10] to ensure reliability and validity, and were measured using a Likert scale. Cost data were collected retrospectively.

The results showed consistently reliable scores for all the standardised tests. The differences in the MMSE and GDS scores were not significant. Overall the participants felt satisfied

following the consultation. Improved access to care and convenience of the location of the consultation were contributing factors.

On three occasions when a bandwidth of 384 kbit/s was not established participants ranked audio and video quality lower and identified a lack of confidence in the patients understanding of the providing clinician. There were no concerns regarding patient privacy.

Kimberley ACAT service

The DGM began providing clinical services to the Kimberley ACAT in November 2001. Protocols and evaluation forms initially developed in the previous trials were reviewed. All recurrent costs of the service are being meet by the Kimberley ACAT.

A total of 13 clinical case conferencing consultations have occurred. On three occasions multipoint videoconferences have taken place. These have included all relevant clinicians and family, and on two occasions the patient and their carer have been present. Although a formal evaluation has not been conducted, satisfaction with the service is evident by the scheduling of a number of consultations throughout the next six months.

Discussion

The successful adoption and diffusion of telehealth geriatric services in the first year of operation can be explained by individual, organisational and technical factors. For example, a number of clinical and academic "champions" in the DGM implemented the telehealth service. This ensured that the project was clinically-driven and patient-focused, and that an evaluation was conducted throughout the project.

A need for this type of service was recognised by both rural users and providers. The development of rapport and respect amongst all health professionals had already taken place, and the traditional process for referring patients was used in the development of a clinical telehealth protocol.

The importance of a single fulltime telehealth coordinator has been identified by Smith[11]. In the present study the telehealth coordinator acted as the single point of contact for consultations, technical support and the provision of training. Doolittle[12] recognised the importance of testing equipment thoroughly before a service begins. During the feasibility trial certain technical compatibility issues were identified and the technical requirements were determined and developed into a telehealth protocol.

Conclusions

The concept of providing cognitive assessments to rural and remote patients via videoconferencing is particularly attractive in a state as large as Western Australia. We have been able to demonstrate the feasibility, validity and reliability of conducting a cognitive assessment via videoconferencing. There has been a high rate of patient and clinician satisfaction. The feasibility and clinical acceptability of conducting other aspects of a geriatric assessment be tested should now be examined.

Acknowledgments

This project was supported by the Commonwealth through the Networking the Nation Program of the Department of Information, Technology and the Arts and the Health Department of Western Australia. We thank the Royal Perth Hospital Telehealth Steering Committee, the Department of Geriatric Medicine (RPH) and the Northam and Kimberley Aged Care Assessment Teams.

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Telehealth policy – looking for global complementarity

Richard E Scott, M Faruq U Chowdhury and Sunil Varghese

Health Telematics Unit, Faculty of Medicine, University of Calgary, Alberta, Canada

Correspondence:
Dr Richard Scott
G204 Health Sciences Centre
Faculty of Medicine
University of Calgary
3330 Hospital Drive NW
Calgary
Alberta T2N 4N1
CANADA
(Fax: +1 403 270 8025; Email: rescott@ucalgary.ca)

Summary
Telehealth is gaining acceptance as a tool for bridging the local and global healthcare divides. However, integrating telehealth into existing health infrastructures presents a daunting challenge for governments, policymakers, telehealth advocates and healthcare workers. Developing specific inter-jurisdictional telehealth policies will significantly improve the ability to meet this challenge. In the policy context, one 'success' is the increasing number of jurisdictions addressing policy issues. However, policy decisions have largely been taken in isolation, within individual health institutions, regions, provinces / states, or countries. This represents a 'failure' of the current approach. Telehealth, by its very nature, has the ability to transgress existing geo-political boundaries. As a consequence, policy in any single jurisdiction may hamper or even cripple the ability of telehealth to fulfill its potential. Commonality – or at least complementarity – of approach to telehealth policy must be encouraged. To achieve this, it is essential to understand the current or anticipated regulatory constraints that may affect telehealth. We have begun a preliminary study of country-specific policy issues.

Introduction
Telehealth, or increasingly "e-health" [1], has been accepted by the World Health Organisation as an important tool in achieving the goal of health for all. It has also been accepted in developing countries[2]. The primary motivators include the expectation that e-health will reduce healthcare costs, expand services to underserved areas and populations, facilitate the change to a more public health orientation, and improve people's health, nutrition, knowledge, and livings standards[2,3,4]. However, there is a major need for e-health to be integrated into existing healthcare systems, both in a practical and policy sense. Indeed, policy decisions will have a major effect on the ability of e-health to function effectively and efficiently in a global manner.

In the policy context, 'success' can be seen in the increasing number of jurisdictions that are addressing policy issues. In contrast, 'failure' can be seen because these policy decisions

have been taken by individual health institutions, regions, provinces / states, or countries in isolation from one another. By its nature, e-health has the ability to transcend geo-political boundaries. This characteristic does not fit easily into traditional country-specific health systems largely unfamiliar with cross-border services. Thus, as perspective broadens and global e-health takes root, issues are arising such as competitiveness, data protection and sovereignty. If this situation continues, it will hamper or even prevent e-health from fulfilling its global potential.

Policy

What is policy? This is not so naïve a question as it may at first appear, and it is certainly important to have a clear understanding. Is policy written commands or step-by-step directives? Or is it loose agreement that results in movement in a particular direction within a given jurisdiction? Hernon's definition of `information policy' has been used as a guide to develop a specific definition[5]. E-health policy is thereby defined as '*a set of statements, directives, regulations, laws, and judicial interpretations that direct and manage the life cycle of e-health*'. This perspective is important as it tends to discard the looser preliminary activities (general agreement), yet retains the firmer 'statements' and 'directives' which are the progenitors of more defined material such as 'regulations', 'laws', and 'judicial interpretations'.

Methods

To counter the fragmented approach to policy development requires identification of common building blocks and steps that would encourage multi-national collaboration. We have designed a Telehealth Assessment Data Collection Tool, with a total of 102 specific questions and 101 sub-questions in six domains: Country Data, Demographic Data, Healthcare Setting, Telehealth Setting, Evaluation Setting, and Technology Setting. Standardised definitions for each data element were either adopted or developed, and as far as possible standardised sources were identified for each data element. The Data Collection Tool is being used to collect data for the 236 countries of the World Health Organisation's (WHO) country classification scheme. Data and responses are being collected at present.

Results

Collection of information about the Telehealth Setting and Evaluation Setting has been difficult. This is largely due to the lack of published data and the lack of response when attempting to contact government representatives. To date, 20 countries have been identified as having some defined e-health policy or clear policy activity, Table 1.

Table 1. Countries with identifiable e-health policy

Australia	Malaysia	Taiwan
Canada	Malta	Tanzania
China	New Zealand	Thailand
Croatia	Russia	UK
Denmark	Singapore	USA
Finland	South Korea	Vietnam
Iran	Sweden	

For example:

Malaysia is the country with the most public and clearly defined policy statements, including a 1997 Telemedicine Act[6], and a 2000 National Telehealth Policies statement[7].

Canada enjoys a significant level of federal and provincial policy support, and development of the e-health sector is viewed as a strategic priority. Several years of deliberation resulted in the creation of the Office of Health and the Information Highway (OHIH) in 1999. A Canadian Health Infostructure (CHI) initiative has also been established. The CHI is a national health information highway intended to improve communications among health care providers and between professionals and the general public[8].

Australia also views e-health as a strategic priority. There have been two recent publications[9,10]. These documents outline key policy objectives and specific strategies. Australia has also investigated e-health policies in other countries[11].

New Zealand's policy is closely aligned with that of Australia. This is demonstrated in a recent report[12].

Within the European Union (EU) many telehealth activities flourish, funded by both national governments and the EU, but policy development lags[13]. National e-health policy in some countries is absent because e-health is considered a responsibility delegated to regional authorities (e.g. Italy). The UK and some Nordic countries have well defined e-health policies[14]. Within the EU overall, e-health is considered to be a component of the Governmental healthcare telematics policy.

Discussion

Factors such as decreasing technology costs and 'globalisation', make closer interconnection and interdependence of nations inevitable[4]. Globalisation is defined as "growth and development of global interconnectedness: technological developments in transport and communications; economic developments such as multinational and transnational corporations; and the emergence of globally dominant cultural and organizational forms e.g. the standards, measures and nomenclature of science" [15]. Each jurisdiction will have to accept the fact that local and national e-health policy cannot be independent of the international environment. However, e-health policy development has occurred so far in a largely *ad hoc* manner, with only limited efforts to consider policy elsewhere[11,13]. This policy fragmentation is of as much concern as a policy void.

E-health is not merely the convergence of telecommunications and information technology with the healthcare setting. It is also the meeting point for a host of policy issues, most of which have yet to be confronted, and participants, many of whom have yet to address policy (Table 2). This complexity makes the formulation of complementary policy difficult. In addition, regulations that apply in the public sector may not apply in the private sector, which might create a new 'policy divide'. There is also an underlying sense that existing policy is adequate to accommodate e-health issues.

Even if complementary policy is accepted, a more crucial hurdle may then arise. Policy positions may represent either an attempt to accommodate the global environment, or they may represent an attempt to resist it. If e-health is viewed as a tool to facilitate the goal of 'health for all' – a patient centric stance – then accommodation is the appropriate response. Conversely, if e-health is viewed as an encroachment on sovereignty or simply a commercial opportunity, then parochialism and protectionism may prevail, creating further hurdles to development of a global e-health environment and complementary policy.

Healthcare policy - including e-health policy - will remain the sovereign domain of individual countries. But if a borderless e-health world is to be achieved, such policy must not be developed in an ad hoc and 'global policy naïve' manner. The predominance of loose rather than firm policy makes it difficult to identify elements of commonality, disparity, and gaps. However, it is already clear that much policy is parochial in nature, that there is a lack of

national policy leadership particularly in developing countries, and a lack of recognized international leadership in considering global e-health policy.

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Table 2. Examples of Policy Issues and Actors Converging on e-Health

Issues	Actors
Professional Credentialling Reimbursement Licensing Registration **Operational** Reimbursement **Institutional** Accreditation Authorisation **Ethical** Confidentiality Consent **Legal** Privacy Security **Interoperability** Technical Administrative **Communication** Cross-border acceptance Common 'Language' Common Policy	**International Bodies** WHO (World Health Organisation) ITU (international Telecommunications Union) ISO (International Standards Organisation) World Bank UNDP (United Nations Development Program) **Non-Government Organisations** Charitable groups Private Sector Foundations **Private Sector** Multinational corporations **Governments** National Regional (e.g. province, state) Local **Institutions** Hospitals (regional vs rural) Clinics Academic Institutions **Agencies** Accreditation agencies **Professional Groups / Associations** Physicians Nurses Dentists Allied Healthcare Professionals (multiple) **Public** Individuals Interest Groups

A comparison of telepaediatric activity at two regional hospitals in Queensland

Anthony C Smith[1], Michael Williams[3], Jasper Van der Westhuyzen[4], Robert McCrossin[2], Alan Isles[2] and Richard Wootton[1]

[1]Centre for Online Health, University of Queensland, Australia
[2]Royal Children's Hospital and Health Service District, Brisbane, Queensland, Australia
[3]Mackay Base Hospital, Queensland, Australia
[4]Hervey Bay Hospital, Queensland, Australia

Correspondence:
Anthony C Smith
Centre for Online Health
Level 3, Foundation Building
Royal Children's Hospital
Herston 4029
AUSTRALIA
(Fax: +61 7 3346 4705; Email: a.smith@pobox.com)

Summary
We conducted a 15-month feasibility study of telepaediatrics. A novel service was offered to two hospitals in Queensland (Mackay and Hervey Bay). We used data from all other hospitals throughout the state as the control group. Although both intervention hospitals were provided with the same service, the telepaediatric activity generated from each area and the effect on admissions and outpatient activity was markedly different. There was a significant decrease in the number of patient admissions to Brisbane from the Mackay region. In addition, there was an increase in the number of Mackay patients treated locally (outpatients). In contrast, little change was observed in Hervey Bay. We hypothesize that the observed differences between the two hospitals were due to various factors which influenced the use of the telepaediatric service. These factors included the method of screening patients prior to transfer to the tertiary centre and the physical distance between each facility and the tertiary centre. We believe that the screening method used for patient referrals was the most important determinant for the use of the telepaediatric service.

Introduction
In 2000, a telepaediatric referral service was offered to two regional hospitals in Queensland.[1] The service provided a single point of contact (via mobile telephone) for all telepaediatric enquiries for sub-specialist paediatric services in Brisbane. Enquiries were received by a telehealth coordinator, whose primary responsibility was to facilitate the required response. The introduction of the new service resulted in significant telepaediatric activity.

Methods

We compared paediatric activity at the Royal Children's Hospital (RCH) and the two intervention hospitals in Queensland (Mackay and Hervey Bay). We used data from all other hospitals throughout the state as the control group. Telepaediatric activity was measured in terms of the communication technique used, the number of patients referred to the service, the discipline, and the duration of the consultation.

Results

Telepaediatric activity

Between November 2000 and January 2002 a total of 387 patients were referred to the telepaediatric service, at the Centre for Online Health. 76% of these referrals resulted in a consultation via videoconference. The other 24% of 'online' responses included communication via email, telephone or by fax (Fig 1). As each site gained more experience with consultations via videoconference, there was a reduction in the number of ad hoc consultations and an increase in the number of pre-planned, routine clinics (involving up to 15 children per session, depending on the discipline).

Consultations via videoconference

Telepaediatric activity from both hospitals increased following the introduction of the new service. Almost half of the patient referrals (188) were made from Mackay. In comparison, 20% of referrals (79) were made from Hervey Bay. The remaining referrals involved patients from other hospitals throughout Queensland (Fig 2). Consultations involved 24 subspeciality fields including burns, cardiology, dermatology, diabetes, endocrinology, neurology, nephrology, oncology, orthopaedics and respiratory medicine.

Admissions and outpatient activity

Following the introduction of the telepaediatric service, there was a decrease in the number of children admitted to the RCH from the Mackay region. The average number of admissions fell from 9.7 to 6.0 patients per month, a reduction of 38% (Fig 3a). In comparison, there was an increase in the average number of RCH admissions from the Hervey Bay region – from 10 to 12.5 patients per month (Fig 3b).

There were a reduced number of patients referred to Brisbane for an outpatient appointment, from both Mackay and Hervey Bay. The average number of patients from Mackay changed from 7.9 to 5.7 patients per month, a reduction of 28% (Fig 4a). The average number of patients referred from Hervey Bay changed marginally from 15.8 to 15.4 patients per month (Fig 4b).

No significant change occurred in the number of patients admitted locally to the paediatric units in both Mackay and Hervey Bay. On average, about 130 paediatric patients per month were admitted to Mackay (Fig 5a). About 50 patients per month were admitted to the paediatric unit in Hervey Bay (Fig 5b).

Before the introduction of the telepaediatric project, an average of 78 patients per month were seen in the outpatients department in Mackay. This number increased significantly to an average of 134 patients per month (Fig 6a). In contrast, no change occurred in Hervey Bay. The average number of paediatric outpatients was 122 appointments per month (Fig 6b).

Population profiles

Demographic data for both localities were reviewed. Both areas experienced a population growth of between 1.8% (Mackay) and 2.5% (Hervey Bay) per annum (Fig 7).

Private practice
Private practice clinics were held in Mackay by paediatricians employed part-time by the regional hospital. Activity reports illustrated that the average number of patients seen by paediatricians (under private health cover) in Mackay remained unchanged (Fig 8). No private practice clinics took place in Hervey Bay, since both paediatricians were employed by the hospital on a full-time basis.

Discussion
Both intervention hospitals were provided with the same service. However, the telepaediatric activity generated from each area and the effect on admissions and outpatient activity was markedly different. There was a significant decrease in the number of patient admissions to the RCH from the Mackay region. In addition, there was an increase in the number of Mackay patients treated locally (outpatients). In contrast, little change was observed in Hervey Bay.

We hypothesize that the observed differences between Mackay and Hervey Bay were due to:

administration of the Patient Travel Subsidy Scheme (PTSS)
distance from the tertiary referral centre
population growth in each of the catchment areas
availability of private practice.

PTSS administration
In Queensland, the health department (Queensland Health) funds a Patient Travel Subsidy Scheme (PTSS) which covers the cost of travel and accommodation for the patient and one family member to attend a specialist appointment[2]. Once a referral has been made by the medical practitioner, a PTSS request form is submitted to the regional hospital for approval. Since the majority of sub-specialist services are located in southeast Queensland, patient travel from regional and remote areas of Queensland is a significant expense for Queensland Health. The arrangements for PTSS approval in the two intervention hospitals were quite different.

In Hervey Bay, PTSS approval was done in the conventional manner, typical of most regional hospitals in Queensland. Request forms were directed to the Medical Superintendent of the local hospital for approval. We suspect that there was too little time available to review each case in detail and determine its suitability for a telepaediatric referral. The opportunity to screen cases and investigate the option of a telepaediatric appointment rather than travel to Brisbane was not fully realised.

In Mackay, a new process for PTSS approval screening was implemented to coincide with the introduction of the telepaediatric service. The paediatrician at Mackay (responsible for telepaediatric work there) took responsibility for screening all paediatric PTSS requests - before approval by the hospital's Medical Superintendent. This encouraged thorough investigation of all PTSS requests and ensured that consequent transfers to Brisbane were restricted to those viewed to be absolutely essential.

This process was not intended to prevent all transfers to Brisbane, but was designed to distinguish potential candidates for the telepaediatric service. Once the paediatrician identified cases suitable for a telepaediatric consultation, they were referred to the telepaediatric coordinator. The coordinator in Brisbane then liased with the appropriate consultant and coordinated the necessary response (e.g. videoconference, email, telephone call).

Of the total number of patients referred to the telepaediatric service (387), only eight patients required transfer to Brisbane to see the specialist in person – or for further investigations/procedures conducted at the tertiary centre. Three of the eight cases were transferred to Brisbane, following a consultation via videoconference. The other five cases were deemed unsuitable for consultation via videoconference. Without this screening process, we suspect that a larger number of cases would have involved travel and management in Brisbane.

Travel distance

The second difference related to the distance between the intervention hospitals and Brisbane. Hervey Bay is about 300 km away from Brisbane, whereas the distance from Brisbane to Mackay is around 1100 km. Travel from Mackay to Brisbane (if by car), often required at least one night away from home. Although patient travel costs are subsidised by the government, there were additional costs met by the family. These costs included time away from work, childcare and meals. Time away from the family and school were other important considerations.

Given that the distance from Hervey Bay to Brisbane is far less than that of Mackay, most patients from Hervey Bay travelled to Brisbane with little hesitation. Although some families had driven from Mackay (approx 12 h) to Brisbane, the prospect was much more daunting, so there was a greater incentive for families in Mackay to be involved in the telepaediatric service. If a specialist opinion could be provided and the case managed locally (without the need for extensive travel), the patient and local health service were truly advantaged.

As is common in quantitative telemedicine studies, it is not possible to regard these findings as conclusive. There may be other reasons for the differences for the espousal and subsequent effect of telepaediatrics in the two hospitals.

Other factors

The population growth in the catchment areas of the two intervention hospitals was similar, approximately 2% per annum[3]. Private practice activity did not change markedly at Mackay, and there was no private practice activity in Hervey Bay. Neither factor can therefore explain the substantial differences in observed telepaediatric activity during the study.

Conclusion

Two main factors appear to have influenced the degree of success achieved. These were the physical distance between the tertiary facility and regional health service; and the process employed for the review and approval of patient travel requests for appointments in metropolitan areas. The changes that occurred in Mackay demonstrate the potential benefits of telehealth in a large state, such as Queensland. This study shows that a substantial reduction in the numbers of patients transferred to the tertiary centre (as admissions or outpatients) can be achieved, with a resulting increase in the number of patients treated locally on an outpatient basis.

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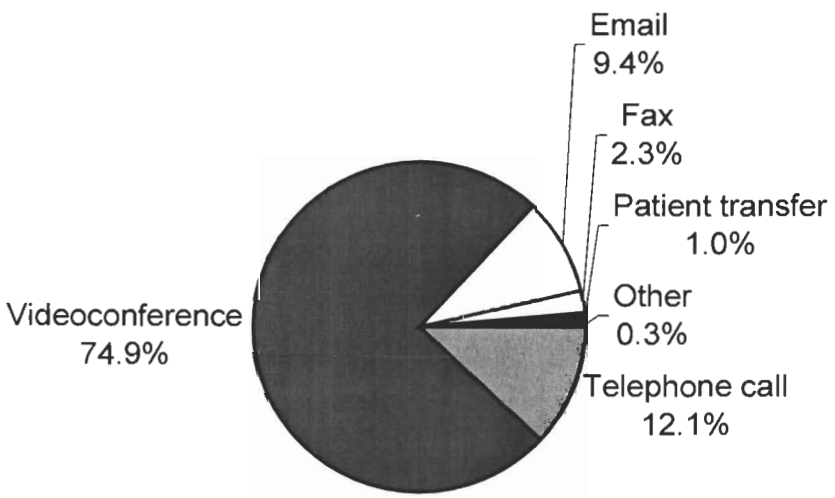

Fig 1. Responses following referral to the telepaediatric service

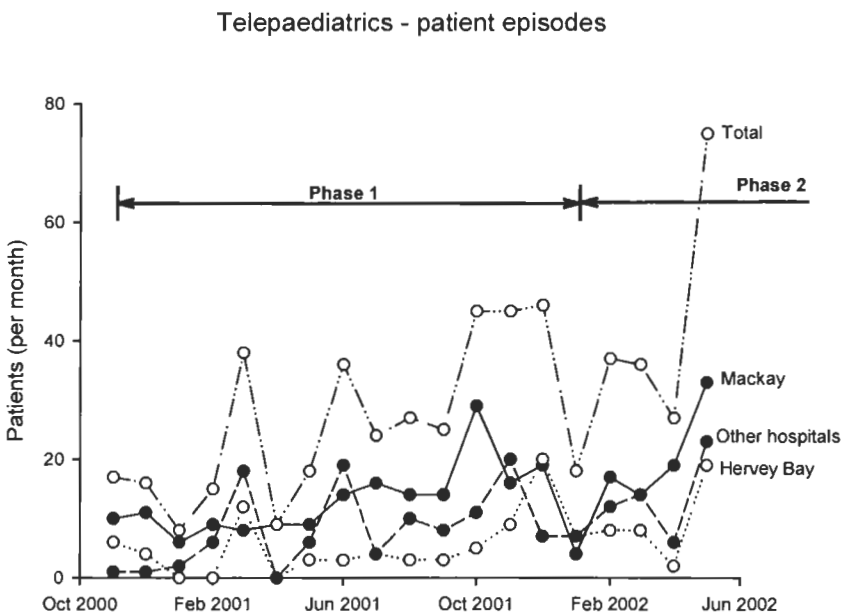

Fig 2. Number of patients referred to the telepaediatric service (episodes of care) per month

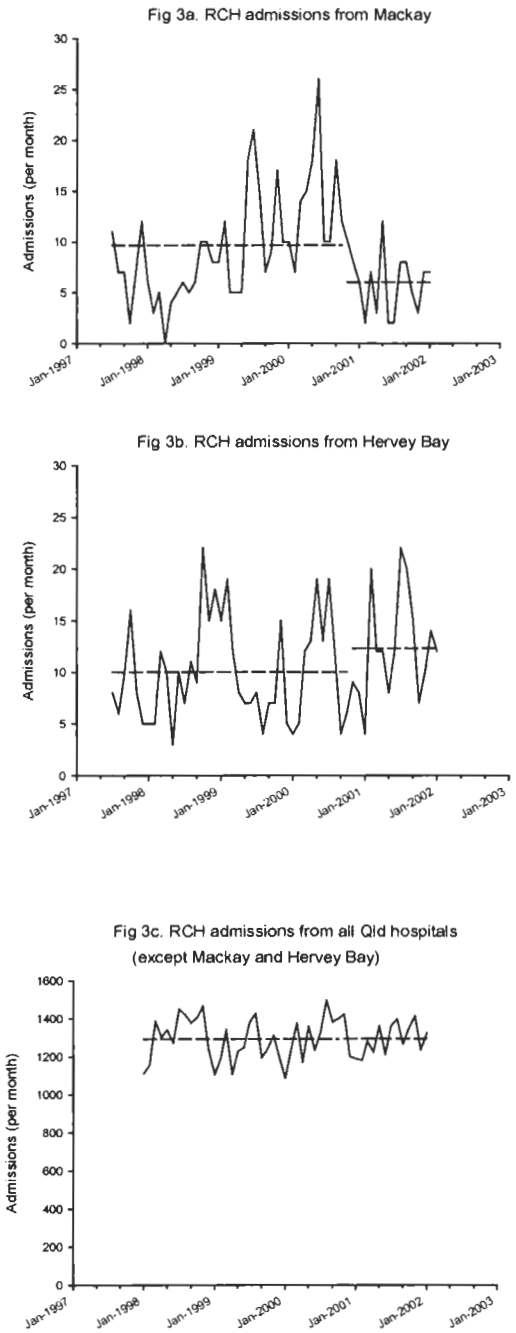

Fig 3. Children admitted to the Royal Children's Hospital from (a) Mackay, (b) Hervey Bay and (c) RCH admissions from all other Queensland Hospitals

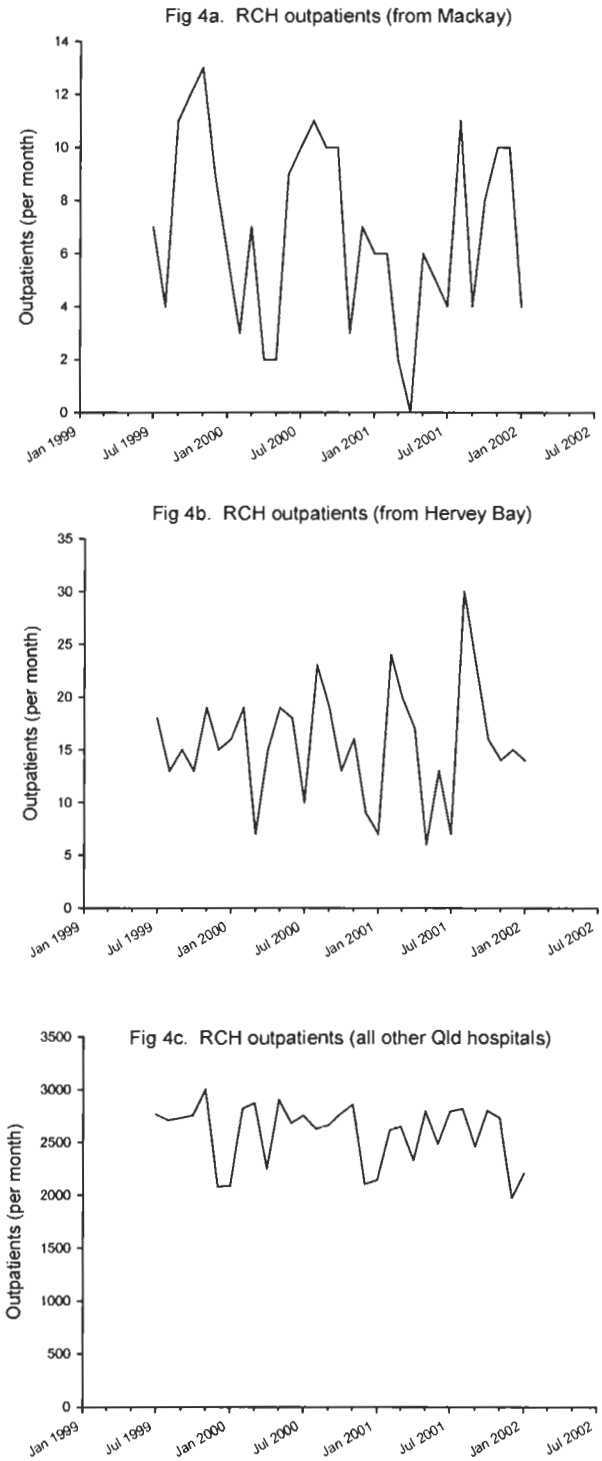

Fig 4. Children attending the Royal Children's Hospital for an outpatient appointment from (a) Mackay (b) Hervey Bay and (c) all other Queensland Hospitals.

Fig 5a. Mackay admissions

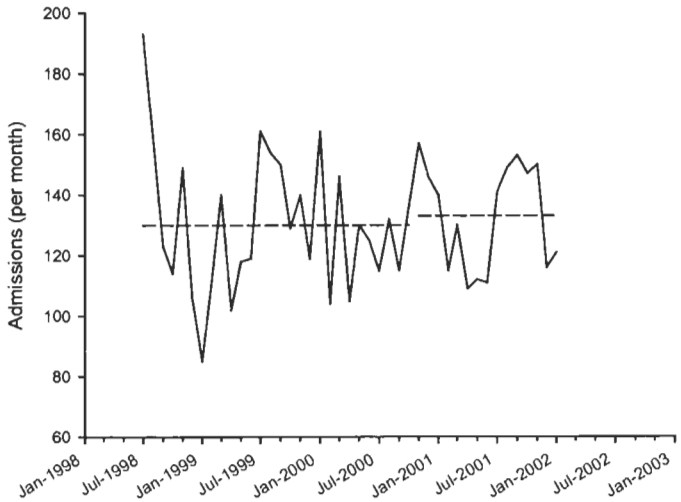

Fig 5b Hervey Bay admissions

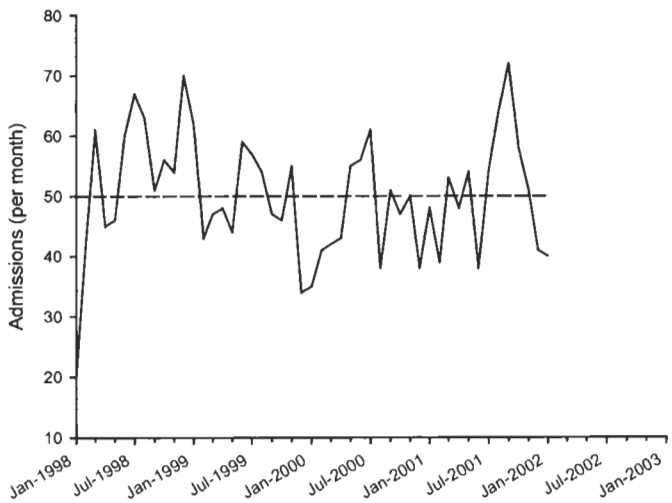

Fig 5. Paediatric admissions recorded locally in (a) Mackay and (b) Hervey Bay Hospital.

Fig 6a. Mackay outpatients

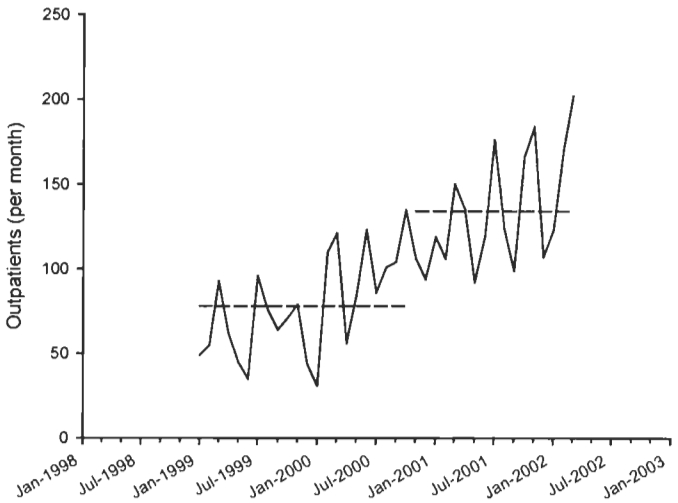

Fig 6b. Hervey Bay outpatients

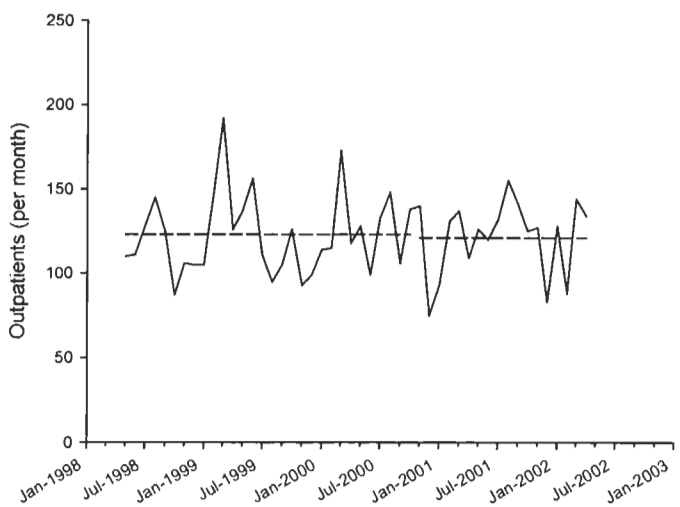

Fig 6. Paediatric outpatients recorded locally in (a) Mackay and (b) Hervey Bay Hospital.

Fig 7. Population

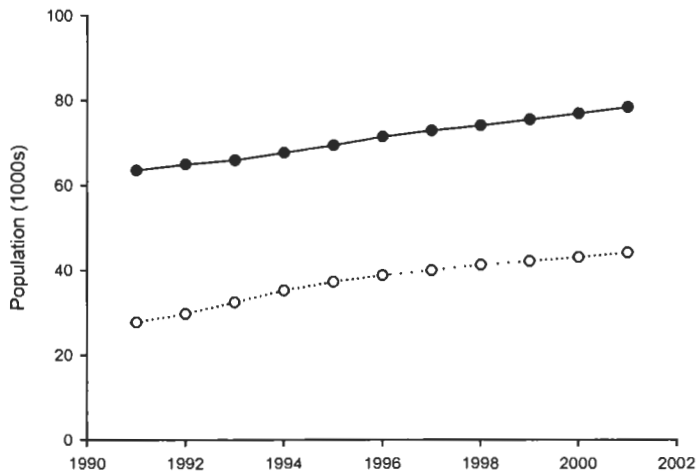

Fig 8. Private practice activity (Mackay)

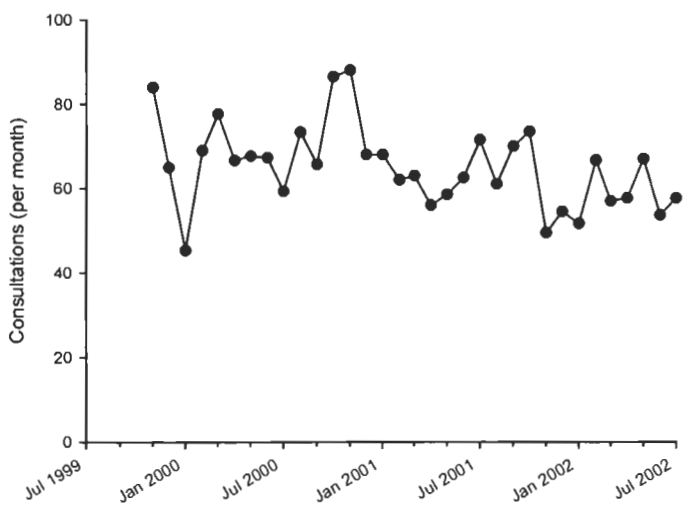

Fig 7. Population growth in Mackay (solid symbols) and Hervey Bay (open symbols)

Fig 8. Private practice activity in Mackay

Low-cost telemedicine in the developing world. Amateurs at work

R Swinfen and P Swinfen

Swinfen Charitable Trust, Canterbury, UK

Correspondence:
The Lord and Lady Swinfen,
The Swinfen Charitable Trust,
Dene House
Wingham
Canterbury CT3 1NU
UK
(Fax: + 44 1227 721 001; Email: swinfen@dene73.freeserve.co.uk)

Summary
The Swinfen Charitable Trust uses digital cameras and email to provide specialist advice to doctors in developing countries. The first link was set up in July 1999. By the end of a year there were three links to hospitals in Bangladesh, Nepal and the Solomon Islands. Initially the consultants, all of whom give their advice free of charge, were from the UK, but now are worldwide. To date there are 11 links in operation, including one on Tristan da Cunha, and three links approved and awaiting equipment. On evaluation the advice given is helpful to the referring doctors and benefits patients. Failures have been due to using obsolescent equipment, computer viruses, lack of communication with the referring hospital before setting up a link, and referring doctors not chasing up their own referrals. Problems yet to be solved include the unreliability of the Internet, certain medicolegal issues and assessing the quality of medical consultants. In future there will be the problem of managing a rapidly-growing number of links.

Introduction
For the last few years the Swinfen Charitable Trust has used low-cost telemedicine to provide specialist advice to doctors in developing countries. This work first began in Bangladesh. From 1992 onwards, we had been making regular visits to Bangladesh, to help the Centre for Rehabilitation of the Paralysed (CRP). Lord Swinfen was working for a charity in the UK for people with physical disabilities, with a particular emphasis on encouraging them to become as independent as possible. The CRP had the same approach and did not discharge any patient until they had been trained in some activity that would enable them to generate an income. There is no state welfare in Bangladesh.

In Bangladesh, as in many other countries, there is a shortage of doctors in many areas at consultant level, and they may not be up to date. To provide a partial solution, we founded the Swinfen Charitable Trust in 1997, with the idea of providing telemedical links to the developing world.

SCT telemedicine

We examined a number of possible forms of telemedicine, including real-time videoconferencing. None was practicable, or affordable, in the context of a developing country. We therefore settled on the use of email, supplemented by clinical pictures where appropriate, taken with a digital camera. The link to the CRP was set up in 1999, following a training visit we made there.

At about the same time we were asked to supply telemedicine equipment to a doctor taking up a post at the Patan Hospital in Kathmandu, Nepal. The doctor had previous experience of real time telemedicine in Northern Ireland. A final year medical student, doing an elective in the Solomon Islands, was also trained. Thus by the end of the first year we had three telemedicine links in operation.

The SCT is run from home, by the two of us. New referrals are allocated to a panel of medical consultants, who give their advice free of charge. We have consultants in 23 specialties, who are located in the UK, Australia and the USA. Referrals are co-ordinated, and records kept of each referral and reply. Email messages are checked 3-4 times daily, seven days a week. Should a referral not receive a reply, we are able to intervene and seek another specialist's advice.

At the time of writing, the Trust has 11 telemedicine links in operation: three in Bangladesh, five in Nepal, two in the Solomon Islands and one on Tristan da Cunha. Another hospital in western Nepal will be linked up shortly.

A telemedicine link for Tashkent will begin as a pilot study, with up to 12 subsequent links planned to follow.

Successes

The SCT operation is a voluntary scheme. It must be counted as a success that no consultant, once approached, has ever refused to provide advice. But does the advice do any good? Evaluation of the pilot link to CRP,[1] showed that the advice was helpful for the referring doctor and of benefit to the patients. It was cost effective. It was of educational value to the referring doctor. The benefit in terms of medical education is not all one way.

On leaving to take up a post in Tasmania, the Director of Gizo Hospital in the Solomons said "*I can leave knowing that help is only an email away*".

When the Gujarat earthquake occurred in India in January 2001 we came up with the "SCT Emergency Pack". This has a high-resolution digital camera, a laptop computer and a satellite telephone. All are powered by portable solar panels (Fig 1). In May 2001 we took a prototype of this pack to Tansen Hospital in the western hills of Nepal, an area mainly controlled by Maoist Terrorists. The Medical Director said "*The satellite link provides us with a mantle of safety*".

Failures

The last three years of telemedicine work in several countries of the developing world have been very rewarding. However, there have, inevitably, been failures as well as successes.

1. Equipment

For our first link we installed an obsolescent satellite telephone, as a back up means of communication. However, it quickly failed.

Lesson. It is worthwhile obtaining up-to-date and reliable equipment.

2. Computer viruses
A great deal of trouble with the central coordination of the telemedicine work occurred when our computer was infected by a computer virus. This has happened more than once.

Lesson. Install a good anti-virus program and keep it up to date.

3. Poor communication
On 23 December 2000 a hospital sent a referral that was not answered for 11 days. This represents a major failure. (For comparison, the mean delay in answering CRP referrals was 1.6 days during the first year of operation[1]).

We had major problems with our desktop computer caused by the virus and the computer was sent away for repair. The referral in question was made between the time the computer became inactive and before a standby computer could be brought into operation. The first we knew of the referral was when we received a copy of the consultant's reply on 5 January 2001.

Lesson. Referring doctors need to keep an eye on responses to their referrals and to have an expectation about how long to wait before raising the alarm.

4. *Poor communication ... cont*
In 2000 we lent equipment to a medical school, so that students on elective could establish telemedicine links on our behalf. In practice, we found that none of the patients on whom referrals were made were actually treated - they could not pay!

Lesson. As a result of this we now ask all hospitals requesting a SCT link about their policy on treating the very poor. We ask that the very poor are treated free of charge (all the consultants give their advice free of charge).

Unsolved problems
All of the above represent the lessons of hard-earned experience. Nonetheless, they represent problems that we have solved. However, there are other more intractable problems. These include:

The Internet
Email is not a totally reliable means of communication (and indeed, may never be). The hospital in Sierra Leone, which should have been on line in June 2001, is still not operational because their server is still down. In addition, one of the remote hospitals in Bangladesh, which sends its referrals through Dhaka, has difficulty in receiving replies, due to telephone and server difficulties.

These problems should be solved as technology improves.

Medicolegal issues
Patient confidentiality is important and it is a point that we always emphasise. However names are not always removed from X-rays before they are digitized, for example. There have been cases where the patient's face has been shown on images when it has not been

essential for medical reasons. There has been one instance of a patient being identifiable by place of work and job.

This is partly a matter of training. But how does one ensure that the remote hospital fully understands the reasons for strict confidentiality?

Quality assurance

We are not doctors. How do we ensure that the consultants give the best and most appropriate advice? Since they will not always know if a particular treatment or medication is available at the remote hospital, they normally give a list of preferred treatments, thus enabling the referring doctor to use the most appropriate. In practice, this seems to work well.

A more difficult problem is this: how do we ensure that the consultants themselves are up to date? The obvious answer is to employ some kind of medical audit. But where do we find a panel of top consultants in each field prepared to review the referrals and the advice given?

Feedback

Probably the most difficult problem of all concerns the absence of feedback for the consultants, and to a lesser extent, for the referring doctors. Because of the nature of medicine in the developing world, it is usually the case that patients are lost to follow-up once they leave the hospital. This prevents the closure of the "feedback loop", since neither referring doctor nor specialist can then know whether the recommended treatment was successful.

The future

In three years we have grown from supporting one hospital with telemedicine to supporting more than a dozen, with at least another dozen more if all the potential Uzbekistan hospitals join the scheme. At the same time, the number of volunteer consultants has grown from about eight to over 60. All this is managed from home by the two of us, checking email messages several times every day.

The work of the SCT demonstrates that low-cost telemedicine is feasible and, in the right circumstances, very successful. It is clear that there is a substantial demand for the sort of service we have been offering. But how do we scale it up? Clearly we need an automatic system that can be operated by people with no technical knowledge or expertise and is capable of being used by those, very often with only basic English, in remote places. Such a system is under development at present.

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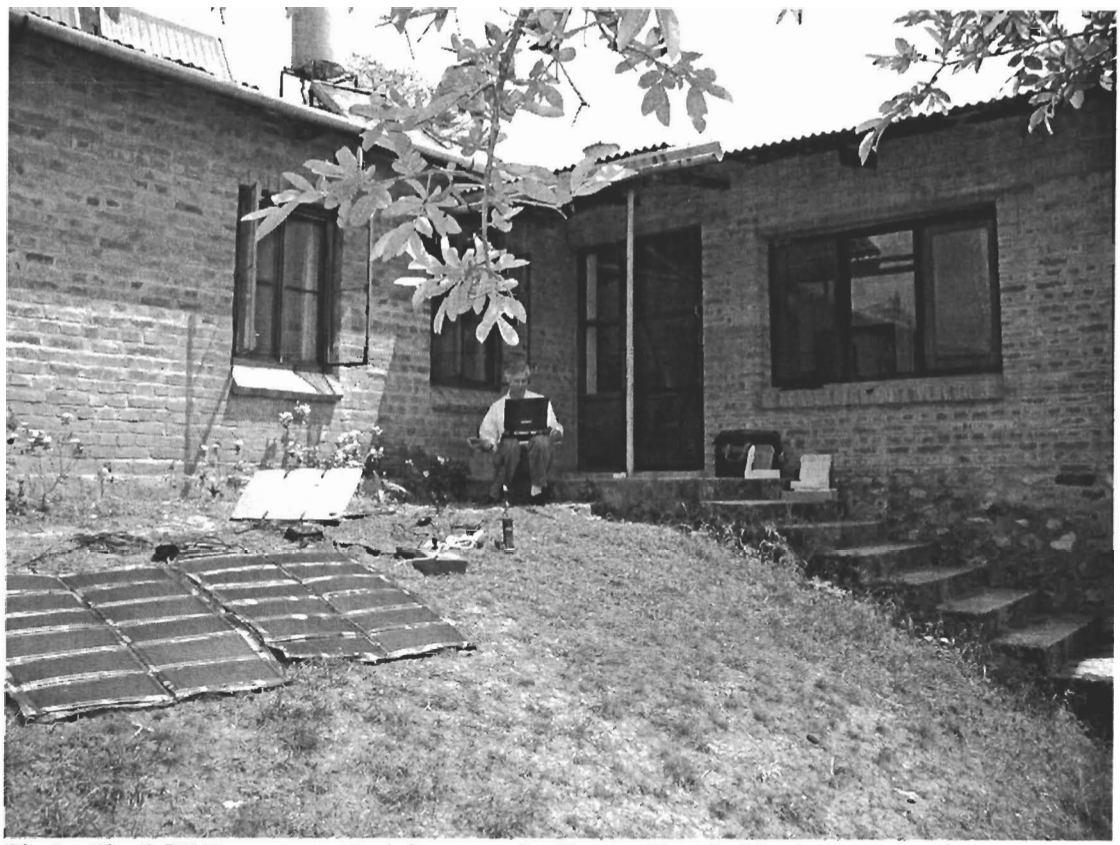

Fig 1. The SCT Emergency Pack in use at the Tansen Hospital in the western hills of Nepal. Solar panels provide the power for a digital camera, a laptop computer and a satellite telephone.

International distance education and the transition from ISDN to high bandwidth Internet connectivity

Dale S Vincent[1], Benjamin W Berg[2], Suwicha Chitpatima[3] and Donald Hudson[4]

1Department of Medicine, Tripler Army Medical Center, Honolulu, Hawaii, USA
2Tripler Army Medical Center, Hawaii, USA
3Royal Thai Army, Bangkok, Thailand
4Pacific Telehealth and Technology Hui, Honolulu, Hawaii, USA

Correspondence:
COL Dale S. Vincent, M.D.
Department of Medicine
MCHK-DM
Tripler Army Medical Center
Hawaii 96859-5000
USA
(Fax: +1 808 433 1555; Email: Dale.Vincent@amedd.army.mil)

Summary
Project THAI-HI is an international distance education project between two teaching hospitals in Honolulu and Bangkok that uses videoconferencing over three ISDN lines. A "morning report" format is used to discuss clinical cases primarily covering infectious disease and critical care topics. An Audience Response System is used at both sites to add interactivity. From July 2001 to May 2002, 816 healthcare providers attended 20 clinical conferences. Audiences rated the conferences as highly relevant, with high training value. In August 2002 we plan to convert the telecommunications to a high bandwidth Internet connection. The Honolulu site will use a 45 Mbit/s commercial connection to the Hawaii InterNetwork Consortium, which links to the Abilene Network on the US Mainland. The Bangkok hospital will use a 155 Mbit/s wireless optical connection to UNINET Thailand, which has a 45 Mbit/s circuit to Abilene.

Introduction
The Tripler Army Medical Center (TAMC) is a 259-bed tertiary care centre of the US military in Honolulu and the Phramongkutklao Medical Center (PMK) is a 1000-bed tertiary care centre of the Royal Thai Army in Bangkok. In 1999, the TAMC identified an educational need to teach resident physicians about diseases endemic to Southeast Asia and the PMK identified a desire to increase teaching activities in critical care medicine. The Thailand-Hawaii Assessment of Interactive Healthcare Initiative (THAI-HI) is an international distance education project that was designed to meet the needs of the internal medicine residents at both sites.

Methods

Similar videoconferencing equipment was used at both sites (PictureTel 970) connected by ISDN lines at 384 kbit/s. Realtime video pictures were projected on a screen at the front of the conference room and additional material (e.g. PC displays) were shown on two plasma display panels flanking the screen. An audience response system (ARS) was used with 50 hand-held wireless sender units and a receiver.

Conferences take place at 15:00 on Tuesday in Honolulu and 09:00 on Wednesday in Bangkok. The format is "morning report" from Thailand and "checkout rounds" from Hawaii. Handouts are prepared in advance. The ARS is normally used three times during a presentation, and at the end of the conference to assess its quality. Simultaneous audience responses are seen in Bangkok and Honolulu.

Results

Clinical sessions

20 conferences were held between July 2001 and May 2002 with 263 Hawaii (H) attendees and 553 Thai (T) attendees. Categories of attendees were physicians (H 66%, T 82%), medical students (H 14%, T 13%), nurses (H 1%, T 1%), allied healthcare workers (H 12%, T 3%), and other (H 8%, T 2%).

Audiences used the ARS to rate "relevance to you as a healthcare worker" on a scale of 1 to 9 (not relevant at all to highly relevant), see Table 1. Audiences found the conferences very relevant with high training value. Sound quality had the lowest scores, but was still acceptable. A seminar called "Dengue Outbreak in Hawaii" was held in October 2001. Experts from five US institutions and three Thai institutions participated. There were 66 Hawaii and 32 Thai attendees.

Table 1. Mean scores on a nine-point Likert scale (1 = awful, 9 = outstanding) (SDs in parentheses)

	Hawaii audience (n=263)	**Thailand audience (n=555)**	**Combined**
Number of survey respondents per session	13 (5)	32 (15)	45 (13)
Sound quality	7.1 (0.9)	6.9 (0.7)	7.0 (0.8)
Live video quality	7.4 (0.6)	7.3 (0.4)	7.3 (0.5)
Still image quality	7.9 (0.4)	7.6 (0.4)	7.8 (0.4)
Relevance to you as a healthcare worker*	8.2 (0.5)	7.9 (0.5)	8.0 (0.5)
How well was the conference presented?	7.6 (0.7)	7.8 (0.4)	7.7 (0.7)
What was the training value of the conference?	7.6 (0.7)	7.8 (0.4)	7.7 (0.6)

*1 = not relevant at all, 9 = highly relevant

High bandwidth Internet

We plan to change from the use of ISDN to high bandwidth Internet in August 2002. In Hawaii, the connection is through the Hawaii InterNetwork Consortium, a partnership of several federal organizations, the University of Hawaii, the Defense Research and Engineering Network, and the Maui High Performance Computing Center. A 45 Mbit/s commercial circuit connects TAMC's network to the US mainland, where it connects with the Abilene Network (Internet2). In Thailand, there is a 45 Mbit/s circuit from Abilene to the UNINET office in Bangkok. From there, there is a 155 Mbit/s wireless link to the roof of a PMK building. An initial test between the University of Hawaii and UNINET demonstrated a latency of 260 ms.

Discussion

Audiences at both sites found the conferences relevant to their practice of medicine. Sound quality ratings improved over time, possibly due to new hardware. Ratings of still image and live video quality also improved over time, due to software upgrades. Early sessions had a noticeable degradation of image quality if the speaker used a mouse to move a cursor during the presentation.

The distance education initiative succeeded in engaging two different audiences, and encouraged both institutions to develop high bandwidth Internet capability. In another international distance education initiative in Europe, Demartines et al described weekly surgical case conferences using videoconferencing between six hospitals (four at a time) in Switzerland, Belgium, Germany and France. Seventy conferences had an average of 30 participants each over a two-year period, with a high degree of satisfaction among participants.[1]

At an international symposium on the state-of-the-art in telemedicine/telehealth, Bashur et al made broad recommendations for international telemedicine networks, suggesting that networks should accommodate cultural as well as infrastructure diversity, support the development of testbeds and develop mechanisms for ensuring cooperation on future telemedicine projects.[2] Our initiative may be a prototype for distance education initiatives in the Asia Pacific region.

We have learned a number of lessons:

> Standardize. The use of similar equipment reduced interoperability problems. The conference format was already familiar to both institutions
> Simplify. ISDN communication was chosen first because it is simple and reliable
> Practice. Speakers may be intimidated by the technology, so we encouraged presenters to have a practice session
> Location is important. The videoconferencing sites are located in the heart of each hospital, in the same areas that the physicians see patients. Thus, conferences can be integrated into daily routines
> Pronunciation is crucial. Key technical phrases and words should be written. Acronyms should be avoided
> Participation matters. The ARS seemed to engage participants in the educational process.

We have also had some failures. The first clinical conference failed when a microphone did not work. An electronic whiteboard was purchased but was never used. WinQuery software was purchased to use with the Audience Response System. Although the software has many sophisticated features, it cannot be used when another program is running. We ended up using simpler PowerPoll software, a PowerPoint plug-in.

Conclusion

The international distance education collaboration between two teaching hospitals in Hawaii and Thailand has been very successful. As a result, a high bandwidth Internet connection has been made available at both sites. Its potential for teaching will be explored.

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this manuscript are those of the authors and do not reflect the official policy of the Department of the Army, Department of Defense, or the U.S. Government.

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The diffusion of innovation: factors influencing the uptake of telehealth

Judi Walker and Sue Whetton

OnLine Development, University Department of Rural Health, Tasmania, Australia

Correspondence:
Sue Whetton
OnLine Development
University Department of Rural Health
University of Tasmania
Locked bag 1-372
Launceston
Tasmania 7250
AUSTRALIA
(Fax: +61 3 6324 4040; Email: Sue.Whetton@utas.edu.au)

Summary
The actual use of telehealth, particularly for clinical consultations, has in many cases been less than anticipated. The literature identifies a number of factors or barriers. These include legal issues, technical difficulties, time and convenience, cost and training/familiarity with equipment. No single factor has been identified as being consistently present. Rogers' diffusion of innovation theory suggests that organisational structures and cultures will affect health professionals' perceptions of telehealth. The introduction of telehealth services affects existing work practices and workflows. We believe that it is necessary to develop strategies for the introduction of telehealth applications which take into account the idiosyncrasies of the health service sector and the particular structures and cultures of individual organisations within that sector.

Introduction
Research suggests that the actual use of telehealth, particularly for clinical consultations, has in many cases been less than anticipated.[2,3] The literature identifies a number of factors or barriers. These include legal issues, technical difficulties, time and convenience, cost and training/familiarity with equipment. No single factor has been identified as consistently present.[2,3,4] It appears that one or more factors may be present in particular telehealth environments, but may not be perceived as barriers.[5,6] To explain this somewhat confused picture, we have drawn on Rogers' diffusion of innovation theory [1] and the knowledge barrier metaphor of Tanriverdi and Iacono.[2]

Health service structure
There are a number of structural characteristics common to the modern health organisation which appear to affect technological innovations including telehealth. These characteristics include an hierarchical structure, complexity and formalisation.[7,8,9]

The hierarchy of the modern health organisation is commonly based on the biomedical model of health. This model is represented by traditional medicine and a scientific approach to illness.[10] Medical knowledge represents the power base and doctors have traditionally been perceived as being the most knowledgeable professionals in the hierarchy.[7,10] These organisations have been found to be inherently conservative[7,10] and the health professionals within them have been found to be equally conservative. While some studies show health professionals can act as innovators[11,12] there is a considerable body of research which indicates that health professionals are conservative in their approach to technological innovation.[8,9,13,14]

However alternative models of health care delivery have emerged recently. In some services there has been a move towards an emphasis on teamwork and collaboration, which has resulted "*in several occupational groups seeking to lay claim to territories of ambiguous ownership in health care, with a consequential heightening of traditional power struggles*".[15]

Evidence suggests that technologies such as telehealth may be contributing to this conflict. The use of telehealth often requires the development of new procedures and routines, which alter traditional practices and relationships.[2,13] Health service organisations include a lot of vested interests and therefore change very slowly.[16]

Introduction of telehealth

Research shows that size and complexity have a positive influence on the diffusion of technology, while formalisation and centralisation have a negative effect.[1,4,17] An organisation that is complex and decentralised has the potential to introduce telehealth-services relatively easily. However a highly formalised structure will dominate and thus override that potential.

The interplay of formalisation, lack of resources and limited management support, combine to influence participants' responses to the voluntary nature of using telehealth. "Voluntariness" has been found to be significant, but the extent to which it influences users to adopt or reject a technology is linked to the characteristics of the organisation.[5,18,19] Telehealth can become an imposition to be ignored rather than an opportunity to be grasped.

Planning for the introduction of telehealth in organisations needs to include strategies compatible with the dominant characteristics. It might be necessary, for example, to mandate the use of the technology, develop clear, precise procedures for use, and to recruit champions in strategic management positions, rather than adopt a more relaxed, voluntary adoption strategy.

User perceptions

In the case of user perceptions of telehealth, Rogers[1] argues that an innovation is more likely to be adopted if it is perceived as having a relative advantage over the method it supersedes, being compatible with existing values and needs, is easy to understand and use, can be experimented with on a limited basis, and results of its use can be readily observed. We suggest that these perceptions are very much coloured by the position and power of the potential user within the organisation. In telehealth services based on a hub and spoke model (which link remote locations to one or more hubs, usually in a metropolitan area), we found that remote sites frequently viewed telehealth as having a relative advantage and being compatible. In the hub sites, however, telehealth was more often viewed as offering no relative advantage and as being incompatible with the environment.

There are two factors at work here. The first relates to geographical location. Telehealth at the remote site improves access to many services previously available on a limited basis and usually involving travel. On the other hand, in the hub site the health professional provides the service regardless and usually it is the patient who travels. In the former environment, telehealth clearly offers relative advantage, but not so in the latter.

The second factor relates to the traditional structure of the health organisation as outlined above. Effective telehealth consultations require a degree of collaboration and teamwork between the professionals involved. If this requires an adjustment of roles and practices, then there may be user resistance and perceptions of incompatibility. In the hub sites, arguably the bastion of the traditional health structure, the use of telehealth has frequently been perceived as requiring changes to traditional practices and roles. This appears to be less frequently an issue in spoke sites.

Strategies for introducing telehealth

Research consistently shows that relative advantage and compatibility are important for the adoption of health innovations.[2,20,21] Strategies are therefore required which present the telehealth application within the context of the potential telehealth site and which include development of procedures which are cognizant of established procedures and roles. This may be as straightforward as placement of the technology within the centre, or it may involve more complex strategies like modification of traditional workflows and practices in a way that does not overtly threaten existing relationships and structures.

Users may be prepared to learn to use new technology if they perceive that the system is critical to their job performance or quality of service.[2,5] We found this to be the case with the rural and remote sites, where potential users indicated more willingness to make time to participate in training, and were more tolerant of technical difficulties. This further emphasises the need to ensure that telehealth applications do enhance job performance and quality of service.

We suggest that issues such as cost, technical and legal issues relating to telehealth need to take into account the idiosyncrasies of the overall health service sector and the particular structures and cultures of individual organisations. Failure to do so may well create organisational barriers around issues of practice and work flow (particularly if distribution of resources and power are affected), and behavioural barriers around potential changes in work practices.[2]

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Success and failure in a Michigan telepsychiatry programme

Pamela Whitten and Jill Rowe-Adjibogoun

Department of Telecommunication, Michigan State University, USA

Correspondence:
Pamela Whitten
Department of Telecommunication
Michigan State University
East Lansing
MI 48824-1212
USA
(Fax: +1 517 355 1292; Email: pwhitten@msu.edu)

Summary
Telemedicine projects are ultimately judged to succeed or to fail. In reality, however, telemedicine programmes are often complex undertakings that result in combinations of success and failure. Michigan State University and LifeWays received a grant for a four-phase telepsychiatry research project in 2000. We employed multiple data collection techniques, including patient and provider surveys, in-depth interviews, observation, patient chart analyses, and organizational archival data analyses. Of the four phases in the project, two proved to be successful, one failed in its initial goal but succeeded with a redefined goal, and one failed completely. Issues that significantly affected success or failure included human resource conflicts, organizational structure, inter-organizational relationships and allocated resources.

Introduction
In 2000, Michigan State University received a grant from the US Department of Commerce to implement a telepsychiatry project in southern Michigan. The behavioural health organization for this project, LifeWays, provides a wide range of behavioural health services to a population area of more than 25,000 people living in Jackson and Hillsdale counties in Michigan. LifeWays does not directly provide these behavioural health services. Instead, it subcontracts with dozens of freestanding organizations (most of whom only have LifeWays as a client).

Our patient surveys demonstrated strong support for each of the four phases of the telepsychiatry project. Two projects within the programme, clinic-to-clinic care and home-health services, met their goals. One project, care to patients in a crisis home, failed in its original goal and succeeded in a redefined goal. The fourth project, services to a county jail, was a complete failure.

Clinic-to-clinic care - success
This phase of the project set up a direct connection between two clinics in the LifeWays' service area, approximately 90 minutes' travel time apart. The telemedicine connection was through a videoconferencing unit connected via a high bandwidth link. The intention was to link providers in an urban area with their patients in a rural area. This phase of the project was the most successful by far. The key factors were several providers who could see the advantages of using the system in their practices; and an extremely competent nurse at the rural site who had served in that particular location for a number of years making her comfortable and well-acquainted with the patients there. This was important in assisting patients to become comfortable with the system.

The challenges of this phase of the project involved building the confidence of additional providers and aiding them in making a smooth transition in the utilization of the equipment for their patients. Some providers were quite willing to transition to telemedicine and some simply refused. Another problem for this phase was to identify long-term solutions to the challenge of the accountability of staff concerning assisting providers in that transition.

Home health services - success
Another successful phase of the project involved putting videophones (PSTN) into patients' homes. For this phase of the project three specific subunits in the LifeWays' organization were chosen. Videophones were deployed by one of these organizations as a supplement to mandatory telephone protocols for high-risk patients. Providers could see the patients during these daily calls. Videophones were also employed to provide site visits to children. In this case, the videophones were assigned to specific clinical staff members whose job descriptions involve therapeutic behavioural health management techniques with patients in their homes. This was seen as a key feature since early analysis of pre-test surveys indicated that transportation issues were one of the most frequently cited reasons given by patients regarding failure to keep clinic appointments. Using the videophones improved access to these providers.

The videophones were also used in unique treatment conditions. In one case, a unit was provided to a patient with antisocial/dangerous behaviour who was not allowed in LifeWays facilities. In another case, a patient was completely homebound so a unit was placed in their home for delivery of psychiatric care.
Some difficulties encountered in this phase of the project involved confidence building for senior administrative staff concerning their apprehensions about possible misuse of videophones among persons in their patient base. Utilization also appeared to be closely linked with providers; those who liked telemedicine actively used them and those who did not avoided the units.

Crisis-home care - partial success and failure
A less successful phase of the project involved both an ISDN link and a PSTN unit between a community-based crisis home, LifeWays' administrative offices and two other organizations in the LifeWays' family. This phase of the project involved both successes and failures.

Originally, the service was implemented to create an ISDN-link between the crisis home and an active psychiatrist for patients in the crisis home. Even though he initially expressed enthusiasm for the project, he refused to use the system once it was installed. The largest barrier here was that this provider proved to be "anti-technology". The irony was that prior to selection and placement of the unit in this field site, the provider claimed with great pride that he was in fact very "pro-technology."

On the successful side, videophones were utilized in provider to patient contact for a variety of services. Some of these services included: patient satisfaction surveys for state quality assurance mandates, medicine reviews, behavioural health emergencies, staff-to-psychiatrist contact and medicine stabilization observations.

The saving grace of this phase has been the regular use of the videophone by two independent psychiatrists who installed units in their own homes and regularly visited their patients after hours via telemedicine. A second saving grace resulted from use of the ISDN unit by crisis home staff who successfully made the case to the CEO of LifeWays' that they should use the dormant ISDN unit for weekly conference meetings between LifeWays' staff and crisis home staff.

Correctional care - failure

The fourth phase of the project involved establishing a telemedicine link between the Jackson County jail and LifeWays' main administrative office where the psychiatrists practiced. The purpose of this connection was to provide behavioural health management to LifeWays' patients who were being detained at the jail. This phase of the project started out with a bang but quickly fizzled out. It failed because, unknown to us originally, there was a conflict between LifeWays and one of their sub-contracted agencies which was profitably and firmly established in providing daily onsite behavioural health management to inmates at the jail. Because the relationship between the jail and this subcontracted agency was established before the installation of the telemedicine system, the jail staff had no incentive to begin using the telemedicine system.

Perhaps the final nail in the coffin for this project was due to the lack of coordination and communication between LifeWays' administrative and provider staff. A behavioural health provider refused to see the first inmate referred for a telemedicine visit. By the time the provider realized that she was supposed to see the patient via this medium, the damage had been done.

The main lesson learned from this phase was the importance of communication between agencies about protocols and project expectations. In addition it is vital to have a clear understanding of the services already in place at proposed telemedicine sites.

Discussion

This case study allows the main factors affecting the success or failure of a project to be identified. These include human resource conflicts, organizational structure, inter-organizational relationships and allocated resources[1]. The implications from this study suggest that telemedicine organizations can maximize the chances of success by addressing the organizational and resource challenges.

Of particular importance in this case study is the lesson that organizational and human issues were more important than the traditional supposed barrier to telemedicine in the US, namely reimbursement. LifeWays is a Medicaid Managed Care provider that is paid a capitated sum to provide behavioural health services. Yet, the overall enthusiasm of individual providers determined if and how telemedicine was employed. Ambiguity within the organization regarding job roles and responsibilities led to less than optimum customer service in several instances. Too many cooks in the kitchen led to conflicting agendas among agencies and departments that overpowered the organizational goals. Organizational issues emerged as the biggest predictor of failure. Individual provider enthusiasm and perception of patient benefit emerged as the biggest predictor of success.

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Logistical aspects of large telemedicine networks. 1: site directories

Richard Wootton, Anthony C Smith, Sinead Gormley and Jessica Patterson

Centre for Online Health, University of Queensland, Royal Children's Hospital, Brisbane, Australia

Correspondence:
Professor R Wootton
Centre for Online Health
Level 3, Foundation Building
Royal Children's Hospital
Herston 4029
AUSTRALIA
(Fax: +61 7 3346 4705; Email: r.wootton@pobox.com)

Summary
We carried out a survey of the site coordinators in a mature telemedicine network of about 200 sites. The site directory contained information about 221 videoconference facilities. There were 191 site coordinators in all (i.e. some coordinators were responsible for more than one site). Of the 221 sites, we were able to contact 87 on first attempt and 155 by the fourth attempt. Thus there were 66 sites (30%) which were not contactable. We asked each site coordinator to describe any videoconference activity that had taken place over the previous five working days. 78 of the 155 sites reported some videoconference activity during the period in question. The total reported videoconference activity was 12,800 min during the one-week monitoring period, i.e. an estimated 924 h per month. The most common categories of work were educational (511 h) and management or training (225 h), which between them accounted for 80% of all reported videoconference activity. 50 of the 155 sites (32%) reported that the equipment was not located in an area suitable for patient consultations. In addition, 20 sites (13%) volunteered that their videoconferencing facilities were not in working order at the time of the survey. We did not ask this question in the survey, so that this result represents a lower bound for the true number of inoperable systems.

Introduction
There are no very large telemedicine networks. Simple observation leads to the conclusion that there is an apparent upper limit on network size, at about 250 sites, see Fig 1 for example[1]. While there may be several reasons for this, one major factor is probably the logistical difficulties inherent in operating large networks. One might expect that the support requirements would grow in proportion to n^2, rather than n.

Part of the provision of support in any telemedicine network concerns the business of notifying all sites of any address changes (e.g. additions or alterations to the ISDN numbers). This is often done by compiling a directory of site details, which is updated regularly and circulated to all the sites in the network. There appear to be no previous studies of how well

this works in practice. We therefore studied the site directory for a mature telemedicine network of about 200 sites.

Methods

A short (12-question) telephone survey was constructed and piloted on two sites. Minor modifications were made to the questionnaire and we then surveyed all sites listed in the site coordinator directory. The survey was completed within six working days. The current edition of the *Videoconferencing Site Directory* (March 2002) was used for primary contact information. This directory is revised and distributed several times a year.

The surveys were conducted in March 2002 between 09:00 and 15:00, i.e. during normal business hours. If the nominated person in the directory did not answer, a maximum of four attempts was made to contact them over the subsequent two-day period. If some other person answered, they were asked whether they were able to act as the substitute for the listed person.

If no contact was made, the record was marked not contactable.

Once contact had been made with the nominated person or a substitute, participants were introduced to the study and invited to answer the set questions. The study addressed five areas:

1. *Contact details*. Were the contact details provided in the directory correct?
2. *Record keeping*. Did the site keep a record of videoconference activity? Did the site keep a record of actual activity? i.e. we asked what was recorded if the booking was cancelled.
3. *Videoconference activity*. We asked each site coordinator to describe any videoconference activity that had taken place over the previous five working days.
   duration. Estimates were made to the nearest 5 min. This information was converted to hours, multiplied by 52 (weeks/year) and divided by 12 to give the estimated activity per average calendar month.
   purpose. We also asked about the purpose of any sessions. The categorization used by the Australian and New Zealand Telehealth Committee and employed in the Queensland Health telemedicine audit surveys were used[2]. We subdivided all videoconference activity into two categories: *Telepaediatric* - any videoconferencing activity involving paediatric services for children under 18 years of age or under *Other*- all other videoconferencing activity.
4. *Equipment*. We asked each site coordinator if the videoconference facilities were located in an area suitable for patient consultations.
5. *General themes*. Participants were invited to make any comments related to videoconferencing service offered in their organisation. These responses were grouped according to main theme.

Results

Contact details

The site directory contained information about 221 videoconference facilities. There were 191 site coordinators in total (i.e. some coordinators were responsible for more than one site). Of the 221 sites, we were able to contact 87 on first attempt and 155 by the fourth attempt. Thus there were 66 sites (30%), which were not contactable, see Table 1.

Table 1. Number of attempts required to make contact with the videoconference site coordinator listed in the network directory.

Number of attempts	Number of sites contacted	Proportion (%)
1	87	39
2	127	57
3	147	67
4	155	70
Not contactable after 4 attempts	66	30
Total	*221*	*100*

Of the 155 contacts, 136 were the person listed in the directory and 19 were substitutes. Two people refused to answer the survey questions.

Of the 221 sites listed in the directory, we were able to confirm that the details were correct in 159 cases (72%). We were able to confirm that the details were incorrect in 43 cases (19%) and were unable to confirm the validity in the remaining 19 cases (9%).

Record-keeping

The following data are based on responses from 131 contacts about 155 sites. A total of 121 sites (78%) kept a diary for videoconference bookings. A total of 54 sites (35%) kept a record of actual videoconference usage.

Videoconference activity

78 of the 155 sites reported some videoconference activity during the period in question. The total reported videoconference activity was 12,800 min during the one-week monitoring period, i.e. an estimated 924 h per month (Table 2).

Table 2. Videoconference activity at 155 sites. Estimated number of hours per month (calculated from the reported number of hours per week of the survey: see text)

Category	Paediatric	Non-paediatric	Total	Proportion (%)
Direct clinical care (patient present)	3.3	68.6	71.9	7.8
Indirect clinical care (patient not present)	19.5	46.9	66.2	7.2
Education or training	99.7	411.3	511.0	55.3
Management or administration	0	225.3	225.3	24.4
Research or evaluation	0	4.3	4.3	0.5
Health promotion or public health	0	43.3	43.3	4.7
Other	0	2.2	2.2	0.2
Total	*122.4*	*802.0*	*924.4*	*100*

The most common categories of work were educational (511 h) and management or training (225 h), which between them accounted for 80% of all reported videoconference activity.

Direct clinical care (with the patient present during the consultation) was estimated to be 72 h per month (7.8% of all activity). Indirect clinical care (patient not present) was estimated to be 66 h per month (7.2%).

25 out of 155 sites reported some form of telepaediatric activity. A total of 122 h of paediatric activity was reported, of which 99.7 h (81%) was educational.

Equipment

50 of the 155 sites (32%) reported that the equipment was not located in an area suitable for patient consultations. Over half of the videoconferencing equipment was located in a conference room or an office (Table 3).

Table 3. Location of videoconferencing equipment

Location	**Number of sites**	**Proportion (%)**
Conference room	43	28
Office	37	24
Other*	28	18
Library or training area	16	10
Ward or clinic	14	9
Staff room	7	5
Emergency department	5	3
Lecture theatre or auditorium	5	3
Total	*155*	*100*

*including 6 unknown

In addition, 20 sites (13%) volunteered that their videoconferencing facilities were not in working order at the time of the survey. We did not ask this question in the survey, so that this result represents a lower bound for the true number of inoperable systems.

General themes

Out of the 131 coordinators who volunteered a comment, the five most common themes were:

56 said that they were generally happy with the way that videoconferencing worked in their area and thought that it was very useful

35 thought that videoconferencing was under-utilised, and that there should be more education and promotion to get doctors and other health care staff involved

20 commented on the high quality of support provided in their district

19 were unhappy about the quality of their equipment (both their own, and that used at the far end), and about the audio delay during videoconferencing

16 said that technical difficulties, and the time taken to get equipment repaired, prevented them from using videoconferencing more often.

Discussion

The present study was carried out to examine how well a site directory works in practice. Only 70% of the site coordinators could be contacted in four telephone calls. The data are consistent with about 26% being uncontactable no matter how many attempts are made, Fig 2. If only two-thirds of site coordinators can be contacted within a reasonable time, is this a practicable method of booking videoconferences? Would a centralised bookings system be better?

A by-product of the present survey was a snapshot of telemedicine activity, since respondents were asked what activity had taken place during the preceding five working days. It was reassuring to note that our one-week estimate of videoconferencing activity was not dissimilar to the previously-published audit data for the network in question. However, the reported clinical activity (15%) was significantly higher than previously published values (approximately 8%); this may reflect a growth in clinical activity in the two years since the previous network audit was performed.

It was clear that record-keeping was generally weak. There was also poor separation between the prior *booking* of the facility and what *actually* happened on the day. We suspect that many videoconferencing reports reflect the former, rather than the latter. This has implications for decisions about resource allocation, which may often be made on the basis of poor or inaccurate information.

The present study provides a snapshot survey of a single telemedicine network. Without further work it is not possible to extrapolate the results to the general case. It is to be hoped that other such surveys will be conducted.

Acknowledgements
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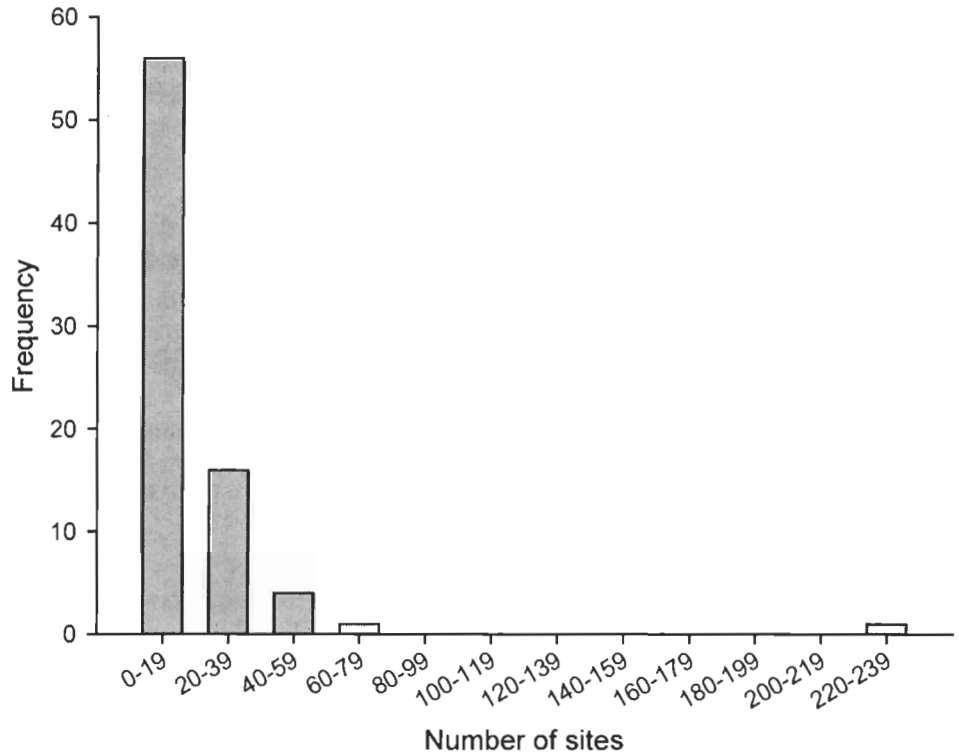

Fig 1. Numbers of sites in the US telemedicine programmes responding to the ATSP annual survey[1]. The largest of the 78 programmes had 235 sites (median 8 sites).

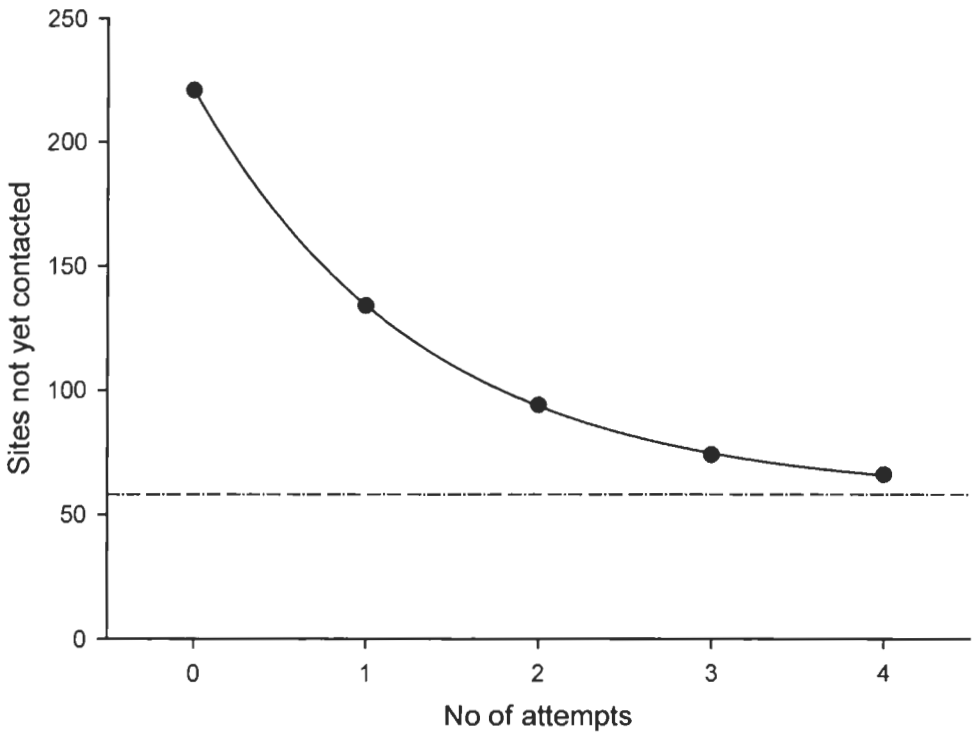

Fig 2. Number of sites remaining to be contacted after a given number of attempts. The nonlinear regression line shown is $y = 58 + 163 \exp(-0.76x)$. The broken line is the asymptote

Logistical aspects of large telemedicine networks. 2: measurement of network activity

Richard Wootton, Anthony C Smith, Sinead Gormley and Jessica Patterson

Centre for Online Health, University of Queensland, Royal Children's Hospital, Brisbane, Australia

Correspondence:
Professor R Wootton
Centre for Online Health
Level 3, Foundation Building
Royal Children's Hospital
Herston 4029
AUSTRALIA
(Fax: +61 7 3346 4705; Email: r.wootton@pobox.com)

Summary
We carried out a retrospective review of the videoconference activity records in a university-run hospital telemedicine studio. Usage records describing videoconference activity in the telemedicine studio were compared with the billing records provided by the telecommunications company (telco). During a seven-month period there were 211 entries in the studio log, including 108 calls made from the studio and 103 calls made from a far end location. We found that 103 calls from a total of 195 calls reported by the telco were recorded in the usage log. The remaining 92 calls were not recorded, probably for one of several reasons, including: (1) failed calls – a large number of unrecorded calls (57%) lasted for less than 2 min (median 1.6 min); (2) origin of videoconference calls – calls may have been recorded incorrectly in the usage diary (i.e. as being initiated from the far end, when actually initiated from the studio); and (3) human error. Our study showed that manual recording of videoconference activity may not accurately reflect the actual activity taking place. Those responsible for recording and analysing videoconference activity – particularly in large telemedicine networks – should do so with care.

Introduction

Part of the management of a telemedicine network involves measuring the activity that has taken place. This may assist, for example, with resource allocation: sites in which very large workloads are being handled may be given extra resources, while sites in which there is little activity may have equipment and facilities withdrawn.

What is network activity?

Network activity is conventionally reported in various different ways. For example, each site may report its telemedicine activities (duration and type) during a particular survey period, and the whole may be summed across the network. This has the disadvantage of muddling the distinction between point-to-point and multipoint activity. Also, as has been pointed out,[1] there is the problem of double-counting, or worse.

Where clinical work is being done, another metric commonly employed is the number of patients being dealt with at a particular site. Again there is the problem of double-counting: the referring site (i.e. with the patient) and the referral site (i.e. with the specialist) will both report that a patient has been dealt with by telemedicine. Multipoint teleconsultation further confuses matters.

Recording methods
Another problem is how to record activity. There appear to be few automated reporting systems in use at present. Most telemedicine networks resort to manual reporting techniques, e.g. keeping activity logs, either on paper or on computer. These have the obvious disadvantages of any manual operation.

A feature of the lack of quality assurance in telemedicine generally is the lack of audit about recording methods. The present study was carried out to examine this.

Methods
We carried out a retrospective study of the manual records of a telemedicine (videoconferencing) studio. The studio is a combined university (research) and hospital (service) facility, operated by university personnel who have a special interest in telemedicine research. A manual log is kept in the studio which is completed after each telemedicine episode.

For comparison, we obtained the billing records of the telecommunications company (telco) responsible for supplying ISDN services to the studio.

Results
We reviewed all entries made in the studio usage during a seven month period (from 24 May 2001 to 20 December 2001, inclusive). There were 211 entries, including 108 calls made from the studio and 103 calls made from a far end location.

Of the 211 studio entries, 110 were classified as 'clinical'. According to the studio usage log, 55 clinical calls were initiated locally and 55 clinical calls were initiated by a far end location.

The studio usage log included details of 108 separate telemedicine episodes initiated locally. These comprised of 55 clinical episodes, (51% of total usage), 11 educational, 13 research, 20 administrative and 9 test calls.

Telehealth (telepaediatric) activity records were matched to the entries made in the studio diary. We were able to identify the number of patients seen in each clinical session. 77 of the 110 reported clinical cases involved a single patient. The remainder (33 cases) involved more than 1 patient. The total number of patients seen during the seven-month period was 218.

During the same period, the telecommunications company's billing records contained details of 416 separate ISDN calls. Videoconferences were conducted at bandwidths from 64-384 kbit/s, so calls made on the first channel were used as a surrogate for a videoconference made on one or more channels. The billing records therefore reflected 195 separate videoconference episodes.

A reconciliation of the conferences recorded in the studio log with those recorded by the telco is shown in Table 1.

Table 1. Comparison of manual and telco records

Item	No
Calls recorded by both parties	103
Calls recorded by studio log but not by telco	5
Calls recorded by telco but not by studio log	92

The durations of the 92 calls recorded by telco but not by the studio log were examined to determine the call duration. Call duration ranged from <1 min to 123 min (median 1.6 min), see Fig 1.

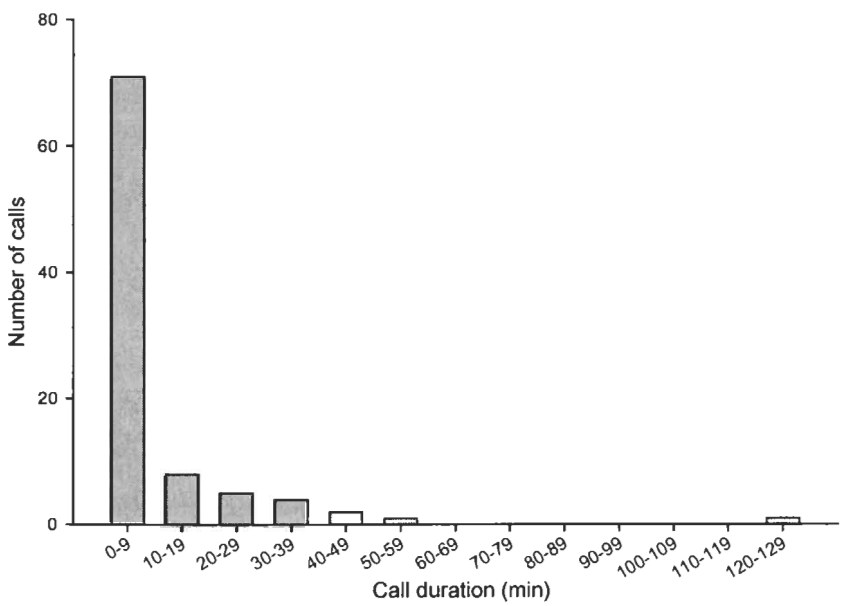

Fig 1. Calls recorded by the telco, but not recorded in the studio log (n=92)

Discussion

The present study shows that in circumstances in which manual recording of videoconference activity might be expected to be good (i.e. a committed university research staff), there were significant discrepancies with the telco's billing records. A large proportion of the discrepancies (77%) were probably due to failed calls, since they were short (i.e. codecs failing to establish a videoconference); the majority of the unrecorded calls (57%) lasted for less than 2 min (median 1.6 min). There were no instructions in the studio about recording unsuccessful attempts to initiate a videoconference, so this is perfectly understandable. Nonetheless, there remained other unexplained discrepancies (22%), and one videoconference lasted for more than an hour (1%). Assuming that the telco billing records can be relied upon, then the explanation for this is probably that the conference was recorded in the log as being initiated by the far end, but was actually initiated in the studio.

If recording telemedicine activity at a site such as the one examined is error-prone, then one must question the accuracy of activity records derived in surveys of large telemedicine networks, where peripheral sites pay little attention to record-keeping[2]. Manual recording of

videoconference activity may not accurately reflect the actual activity taking place and those responsible for recording and analysing videoconference activity – particularly in large telemedicine networks – should do so with care. Further work is therefore required to develop better methods of measuring telemedicine network activity. Until automated systems can be implemented the best method of measurement may be the snapshot telephone survey.

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Cardiac PACS and telecardiology – a technology awaiting adoption

Bernard Crowe[1] and David Hailey[2]

[1]Bernard Crowe and Associates, Canberra, Australia
[2]Department of Public Health Sciences, University of Alberta, Edmonton, Canada

Correspondence:
Dr Bernard Crowe
10 Warren Place
Chifley
ACT 2606
AUSTRALIA
(Email: bernie.crowe@acslink.aone.net.au)

Summary
Diagnostic and therapeutic procedures associated with cardiology are heavily supported by diagnostic imaging technology. The management of imaging data, including X ray, ultrasound echocardiography examinations and cardiac angiography studies both within a hospital and to clinics and physicians' rooms, requires a suitable means of handling data. A number of manufacturers are now offering Picture Archiving and Communication Systems (PACS) and telecardiology options. These could greatly improve the efficiency of data management for cardiac examinations, including linkage to radiology and hospital information systems and electronic patient records. A barrier to the implementation of cardiac PACS has been the relatively high capital cost. There have also been technical difficulties in implementing a suitable interface. A historical problem has been "turf wars" between different specialist groups and a reluctance to shift from well established practice patterns. Early cooperative work between radiologists and cardiologists in the development of coronary arteriography has been replaced by contention between cardiologists, radiologists and vascular surgeons, often driven by economic considerations rather than the needs of the patient. At this stage, cardiac PACS and telecardiology have great potential for improving the co-ordinated care of cardiac patients in Australia.

Introduction
Over the last few years, there have been a number of significant developments in Cardiac Imaging and Information Management Systems (CIIMS). These systems are now capable of being integrated with a hospital Picture Archiving and Communication Systems (PACS). The management of imaging data, including X-ray, ultrasound echocardiography examinations and cardiac angiography studies, both within a hospital and to clinics and physicians' rooms, requires a suitable means of handling data. A number of manufacturers are now offering Cardiac PACS and telecardiology options[1]. These could greatly improve the efficiency of data management for cardiac examinations, including linkage to radiology and hospital information systems and electronic patient records.

Integration of CIIMS with existing Hospital Information Systems
The majority of public hospital IT environments include a Patient Administration System (PAS), as well as a Radiology Information System (RIS) and a Pathology Information System. Obviously, a CIIMS would need to interact with the PAS using the HL7 standard for transfer of patient data. The RIS could be used for the distribution of cardiology reports throughout the hospital. It is desirable for radiology and cardiology reports to be closely linked, so that for example, the radiology report on a patient's chest X-ray can be reviewed at the same time as the cardiology report.

Ideally, a PACS Web server should also be capable of displaying the associated chest X-ray image while the angiography study is being reviewed by the cardiologist. It is desirable that all relevant patient data, demographics, age and gender, previous radiology studies (images and reports) and cardiology images, as well as relevant pathology reports, should be available to a physician when reviewing a patient's case. In addition, there may be a requirement to link with patient's physiological data and to have access to teaching and research files.

Barriers to CIIMS implementation in Australia
There are a number of barriers to CIIMS implementation in Australia.

Cost issues
An impediment to the wider application of Cardiac PACS systems is the cost to hospital budgets. Investments of the order of AUS$9M for PACS have already been made at some 18 hospitals in Australia, such as the Princess Alexandra Hospital (PAH) in Brisbane. The increase in expenditure to extend such systems to cover the transmission of cardiac catheter studies and echocardiography examinations would be modest. A combined Radiology/ Cardiology PACS should be considered at the planning stage as the additional benefits of Cardiac PACS could strengthen the business case. A recent assessment of PACS at the PAH indicated that there were a number of hidden IT support costs and these would need to be examined in considerable detail with each prospective vendors to ensure that cost- effective solutions could be developed[2].

Technical issues
As regards physical interfaces to cardiac imaging modalities, it is essential to provide a connection to vascular laboratories to allow these images to be viewed at the same time as the angiographic images. In addition, it would be desirable to be able to display ECG tracings, although there are large numbers of ECG machines in a hospital. Connection to these modalities may increase the image data requirement. Vascular DSA runs can be complex and a decision would need to be made about storing the complete DSA run in cine format or only storing selected reference images.

A further logical connection would be access to the cardiac echocardiography studies which are traditionally stored on video cassettes. This is a complex matter and would require discussion between the cardiac and the ultrasound departments. Vendors, such as Medcon Telemedicine Technology Inc, have developed the TCS Cardiac Image Management System to provide digital image management and archiving for both X-ray angiography and echocardiology laboratories.

To review a patient's cardiac history it is desirable to have immediate access to both angiography and echocardiography images and reports. However an integrated image management system requires specialised design, since the two modalities have different workflows and different features. Catheter laboratories use black and white images, whereas echocardiography images are in colour. Catheter laboratory images are viewed side by side

for comparison between present and past history views while echocardiography studies are presented four per screen.

On balance, it appears that the technical issues surrounding the introduction of an integrated approach to radiology and cardiology PACS at major teaching hospitals are capable of solution, given that the cardiology catheter laboratory may be already linked to the RIS for scheduling and reporting purposes. There would also be benefits from the implementation of integrated cardiac/PACS systems in private hospitals, physicians' rooms and homes. The subject of Web access, including access to large angio/video cine loops, needs to be addressed as part of the archive strategy for hospital areas. At present, cost and bandwidth considerations may exclude this option in Australia, and it may be desirable to consider the distribution of reference images and reports.

Co-operation issues
Historically there has been little cooperation between radiology and cardiology departments in Australia, and indeed elsewhere. Another impediment to the implementation of a Cardiac PACS is the reluctance to shift from well established practice patterns and the fact that "turf wars" occur between different specialist groups. Early cooperative work between radiologists and cardiologists in the development of coronary arteriography has been replaced by competition between cardiologists, radiologists and vascular surgeons. This is often fuelled by economic considerations rather than the needs of the patient

However, the cost-effectiveness of integrated systems and the emergence of suitable HL7 and DICOM standards has enabled a hospital-wide approach to image management to be considered by systems planners and clinicians. The advantages of an integrated approach are improved patient management and better use of cardiologists' time. From a single cardiac workstation, a cardiologist can gain rapid access to a patient's current and historical radiology images and reports, as well as cardiac reports. At the same time, the cardiologist can obtain a UR reference number for dynamic studies stored on compact disks. These can be manually retrieved and replayed on the cardiac workstation. Cardiac reports can then be prepared using digital voice dictation, corrected on screen, and stored in the RIS for immediate viewing throughout the hospital. The advantages of the intranet for remote viewing at other sites or the consultants' rooms or homes also need to be considered.

Discussion
Expensive cardiac catheter laboratory systems are being purchased by hospitals with cardiac imaging archive sub-systems. An option for hospital managers and systems analysts is to include the catheter laboratory purchase and associated archive with an integrated Cardiac/PACS as part of a staged evolution of the overall IT strategy.

For the cardiologist in Australia, there has been little progress in the integration of cardiology, radiology and other hospital information system data in the management of patients. Manual retrieval systems still commonly in use are inefficient and do not permit the best use of a specialist's time. Routine transmission of images from the catheter laboratory or imaging centre for remote viewing to support management decisions is still rare. Telecardiology would facilitate consultation, second opinions, referrals, conferencing and distance learning needs.

Networking of cardiology reports through the RIS has been implemented at a number of hospitals in Australia. The distribution of dynamic cardiac studies for diagnosis is not seen as a high priority, given the transmission costs involved. However, the attachment of cardiac reference images in JPEG format for distribution with reports via the RIS could be considered, as well as secure email distribution.

Given costs, technical issues and the well-known turf battles between radiology and cardiology, a rapid move to integrated cardiology and radiology imaging systems in Australia is unlikely. The hybrid approach adopted by the Royal Brisbane Hospital (RBH) using the Agfa Cardiac Web 1000 workstation connected to the Agfa PACS probably represents the best that can be achieved in Australia at present. An advantage of the Agfa approach to cardiac PACS is that the workstation can be linked to the Hospital Information System for downloading patient demographic data. It can also be linked to the Agfa Web 1000 PACS so that appropriate radiology images and reports, such as chest X-rays, can be viewed on the cardiac workstation. In addition, it can be linked to a RIS, for storing cardiac reports alongside radiology reports by UR Number. As the workstation is MS Windows NT based, there is also network access by desktop icon to Pathology reports. The RBH approach involves an integrated system for viewing radiology and cardiology reports with radiology images (e.g. chest X-rays) available on line from PACS and dynamic cardiac studies retrieved by hand from CDs and played back on the cardiac workstation.

Despite the rapid pace of overseas developments in cardiac PACS by vendors and standards groups such as the IHE[3,4], there has been little interest in these important initiatives in coordinated patient care by administrators and clinicians in Australia. At this stage, cardiac PACS and telecardiology are technologies of great potential for improving the coordinated care of cardiac patients in Australia whose promise has yet to be realised.

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Controlled trial of discharge planning by video-link in a UK urban mental health service: responses of staff and service users

Paul McLaren, Sab Jegan, Johanna Ahlbom, Fidel Gallo, Fiona Gaughran and Carlos Forni

South London and Maudsley NHS Trust, London, UK

Correspondence:
Dr Paul McLaren
South London and Maudsley NHS Trust
Speedwell Mental Health Centre
62 Speedwell Street
Deptford
London SE8 4AT
UK
(Fax: +44 1580 201 006; Email: PMcl639251@aol.com)

Summary
We examined the use of videoconferencing in a UK urban mental health service for discharge planning within the framework of the Care Programme Approach (CPA). The study was an AB design. Baseline data were collected over a three-month period, before the introduction of CPA by videoconferencing. Service users and professional participants were asked to complete the Guy's Communication Questionnaire at the end of the meeting. Responses were compared for the face-to-face and video-link conditions. No significant differences were found in satisfaction measures between the two conditions. These data suggest that the video-link medium is acceptable to service users and professionals alike for discharge planning.

Introduction
Modern mental health services are geographically dispersed systems with complex communication challenges. The North Lewisham catchment area suffers from traffic congestion and significant professional time is lost in travelling between mental health service sites. Videoconferencing has been piloted as a tool for remote consultation and treatment in mental health[1] in this area. This study will examine the use of videoconferencing to facilitate clinical communication.

The framework for communication in community mental health care in the UK is the Care programme Approach (CPA). Attendance rates at Care Programme Approach (CPA) meetings are variable. Service user in, carers, members of the Community Mental Health Team and the GP are expected to attend. We have carried out a preliminary study to determine the responses of service users and professionals to using videoconferencing for clinical meetings.

Methods

The Community Mental Health team (CMHT) in North Lewisham is based at the Speedwell Mental Health Centre and provides social work, occupational therapy, community psychiatric nursing (CPN) and psychiatric support. All CPA meetings are documented using a standard CPA form and recorded on the electronic patient record.

The study was conducted in two phases, each lasting three months. In the baseline phase participants in consecutive discharge planning meetings were asked to complete a travel questionnaire stating from where and by what means they had travelled to the meeting. They were also asked to complete the Guy's Communications Questionnaire (GCQ), a brief self-report instrument seeking their views on the quality of clinical communication.

In the video-link phase, consecutive service users admitted to the catchment area ward were asked to consent to having their discharge-planning meeting by videoconference. They were asked to complete GCQs and a travel questionnaire.

The equipment used was a set-top videoconferencing system (Tandberg 500) connected by ISDN at 128 kbit/s. A training half-day was provided for staff to give them an introduction to the technology and to provide them with the opportunity to role play talking to service users over a video-link.

Results

27 CPA meetings were held in the baseline phase of the study and 23 during the video-link phase. The number of participants is shown in Table 1. No service user asked to terminate the link or expressed discomfort during any meeting.

Table 1. Numbers of participants

	Face to face	**Video-link**
Hospital based professionals	36	27
Community based professionals	58	61
Service users	27	23
Total	*121*	*111*

A total of 204 GCQs were completed (88% of those issued). The results are summarised in Table 2 for all participants and in Table 3 for service users alone.

Table 2. GCQ combined responses of service users and other attenders

	Video-link data		**Face-to-face data**		
Question	**Yes**	**No**	**Yes**	**No**	**Difference**
Did you achieve your aims during the meeting?	87	10	80	14	Non-significant
In the meeting, could you see everything you needed to see?	82	15	93	4	Non-significant
Could you hear all you needed to hear?	79	19	93	5	Non-Significant
Would you like to have another meeting like this again?	92	4	84	3	Non-Significant

	Video-link data		Face-to-face data		
Question	**Just right**	**Too close/too far**	**Just right**	**Too close/too far**	**Difference**
How close did you feel to the person(s) you were talking to?	83	15	97	4	Significant

Table 3. GCQ from service users only

	Video-link data		Face-to-face data		
Question	**Yes**	**No**	**Yes**	**No**	**Significance**
Did you achieve your aims during the meeting?	7	1	12	2	Non-significant
In the meeting, could you see everything you needed to see?	6	2	15	1	Non-significant
Could you hear all you needed to hear?	9	1	15	3	Non-significant
Would you like to have another meeting like this again?	9	0	14	0	Non-significant

	Video-link data		Face-to-face data		
Question	**Just right**	**Too close/too far**	**Just right**	**Too close/too far**	**Significance**
How close did you feel to the person(s) you were talking to?	8	2	18	2	Non-Significant

The only significant difference was in the combined response for whether the reseponder felt too close or too far from the interlocutors, or at the right distance. Unsurprisingly significantly fewer responders felt that the perceived distance was just right in the video-link condition. Table 3 shows that all nine service users who replied would have been willing to use the video-link again. Seven out of eight felt that they achieved their aims for the meeting mediated by the video-link.

The questions on the GCQ forced a choice from: 'Yes', 'No' and 'Don't Know'. Additional comments on the GCQ were made by those involved in the video-link condition. The following positive comments were received: "*Very high Tech. Not too difficult to adapt to time delay*"; and "*Persons on video-link felt very close as if they were in the room with the multidisciplinary team*".

The following negative comments were received: "*Faces were not clear*"; and "*Some background interference*". Also: "*The client was sitting furthest away and I was unable to see her clearly. It made it difficult to see reaction to things I said during the meeting*"; and "*Preferable is a meeting where everyone is present. I accept video-link is a good use of process over time. My concern is that it limits discussion*".

Discussion

The present study was performed in a hard-pressed urban community mental health service. None of the professionals involved were project 'drivers'. The introduction of the video-link was greeted with scepticism by the professionals within the service. This changed rapidly with experience and the link is now used readily by staff at Speedwell to communicate with the ward.

The low number of service users completing the GCQ reflects the high levels of morbidity in this sample. The questionnaires were passed around at the end of the meetings but no check was made on service users completing them.

This study shows encouraging levels of acceptance of the technology in this setting. Professionals were able to achieve their aims during the meeting as readily as in the face-to-face condition. The video-link has been integrated into the everyday running of this service.

Acknowledgements

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Problem based learning: A case study in providing e-health education using the Internet

Jennifer G Tichon

Center for Online Health, University of Queensland, Australia

Correspondence:
Jennifer Tichon
Center for Online Health
Level 7, GP South Building
Staff House Road
University of Queensland
St Lucia 4072
AUSTRALIA
(Fax: +61 7 3365 4311; Email: jtichon@uq.edu.au)

Summary
The current trend among many universities is to increase the number of courses available through online delivery. However, there are fundamental problems inherent in transferring traditional education courses to virtual formats. Delivering current curricula via an online format does not assist to overcome the negative effects on student motivation inherent in passively providing information rather than requiring interaction with the material and developing in students an understanding of the benefits of such knowledge. Utilizing problem-based learning (PBL) online is discussed as a method by which computers can become a tool to encourage active learning among students. Curricula delivered via goal-based scenarios has the flexibility to allow different students to learn at different rates and can successfully shift online learning from memorization to discovery. This paper reports on a web-based eHealth course that has been delivered via PBL for the past twelve months. Thirty distance students undertook postgraduate courses in eHealth delivered via the Internet utilizing asynchronous communication. Data collected via online student surveys indicate the PBL format is both flexible and interesting. Problem based learning has the potential to significantly increase the quality of the educational experience of students in online environments.

Introduction
A disadvantage of online teaching is its inherently static nature and at worst it can be seen as electronically-delivered pages of information that simply duplicate face-to-face lecture information transfer styles or a cunning act by universities to transfer the costs of postage and printing to the student[1]. For courses utilizing Internet delivery to be successful, it is suggested courses should aim to create lessons and projects that allow students to become thinkers and problem-solvers[2].

While computers and PBL are both significant trends in contemporary educational practice they appear not to have been previously applied to e-healthcare education. Preliminary

evaluations of a course on teacher education suggests that the strengths of online teaching and PBL can be combined to produce a good effect[3]. In traditional face-to-face settings PBL has been utilised in a range of tertiary education fields including engineering, law, business and medicine[3].

In PBL problems serve as the context and the stimulus for learning[4]. The need to work through problems results in a process that is learner-centred. Students are assessed on their information retrieval and evaluation skills in addition to the content of their answers. However, PBL has also been associated with a range of disadvantages. These include, students being unclear about course objectives or unclear about the standard of work required or PBL may not suit the learning styles of some students[5].

Methods

The course analysed in this paper is the University of Queensland course in e-healthcare A. It was designed to introduce students to the interface of technology and healthcare and to the variety of technological applications that are currently being utilised in the e-Heath arena. The content is delivered via asynchronous communication through specifically designed web pages, as shown in Fig 1 and 2.

All students who completed the e-healthcare A course were included in the study. Participants were recruited through the online course material. Students were asked as part of the course to complete an online evaluation at the end of the semester. Completing and returning a survey form was voluntary.

During the semesters under study, semester 2, 2001 and semester 1, 2002, 30 students ranging from 21 – 40 years of age undertook the e-Healthcare A course.

Survey instrument

The first nine items of the evaluation survey gave a choice of five responses. The possible answers were; strongly agree, agree, neutral, disagree and strongly disagree. They inquired about three major domains application of principles, problem-base learning and online delivery. The last three items of the survey were open-ended and asked about the strengths of the subject, ways in which the course could be improved and for any additional comments on the course. All questions were based on the Subject Evaluation Questionnaire developed by the Teaching and Educational Development Institute, The University of Queensland.

Data analysis

The responses to the first nine survey questions were interpreted at two levels. The first level of interpretation was simply to take each item in turn at its face value and determine the extent to which students agree or disagree with the proposition put to them. The second level of interpretation was to examine the distribution of responses over the group to each item. The qualitative data provided in answers to the last three survey questions were condensed into themes to make it systematically comparable.

Results

Twenty-four completed surveys were received. All students returned the survey in 2001 and 80% returned the survey in 2002. Table 1 shows the student evaluation results. The percentages reported are based on the number of students who answered the particular question.

The majority of students reported positive outcomes of the course. Positive effects were more pronounced in the questions concerning online delivery than the questions concerning

problem-based learning. This may reflect a prior comfort with using technology, but reduced comfort with PBL formats derived from limited prior exposure.

Qualitative data collected via the online student surveys indicated that the PBL format was both flexible and interesting. Problem based learning appeared to significantly increase the quality of the educational experience of the students in this online environment.

One aim of PBL is to encourage students to search themselves for the information to solve the problem using a variety of information sources. In the present study, students reported that they not only gained skills in researching online for health information but also developed a personal library of online resources they can use in their own health field. Education in the e-health field is often delivered to experienced, practicing health professionals who are studying to up-date and innovate their practice. Their priorities are to receive practical and relevant information they can shift directly into their practice. The online PBL approach appears to offer a method that can meet this need.

Explicitly negative comments only appeared in the question requesting recommendations for areas of the course requiring improvement. These were restricted to problems that the students experienced in accessing the web pages and resource links. This feedback provided useful guidance on managing the online delivery more effectively in the future.

Discussion

The present study indicates that PBL has the potential, through online delivery, to overcome some of the disadvantages of traditional university teaching and learning. Responses collected via online student surveys indicated that the PBL format was both flexible and interesting in the delivery. Combining PBL with Internet delivery resulted in students learning to access the Internet to locate e-healthcare information, build resource lists of online information resources and collections of data specific to e-healthcare and learn how to organise and evaluate this information.

Gaining student evaluations has been useful to identify areas of the course and its delivery where improvements can be made. The Internet has opened up a new world of teaching and assessment possibilities to postgraduate teachers. Course delivery styles need to keep pace with these trends, moving beyond traditional information delivery techniques to those which complement the advantages of new technologies. Problem-based learning has been introduced as one method that may assist online teachers, however, more research on the PBL process in online teaching environments is needed.

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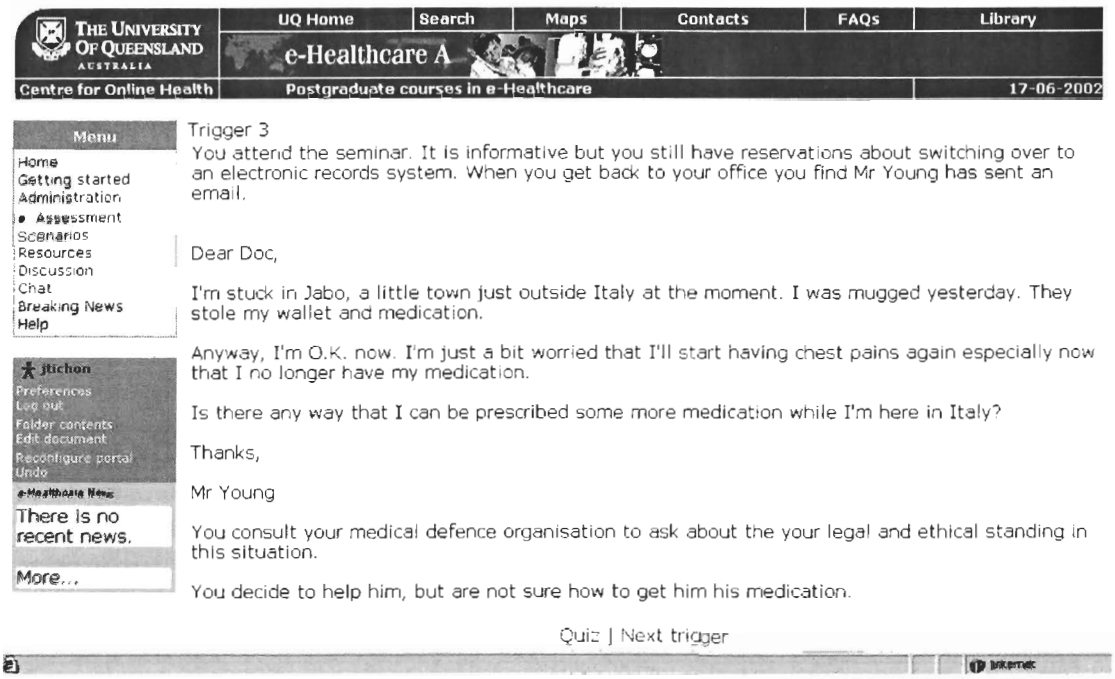

Fig 1. Screenshot

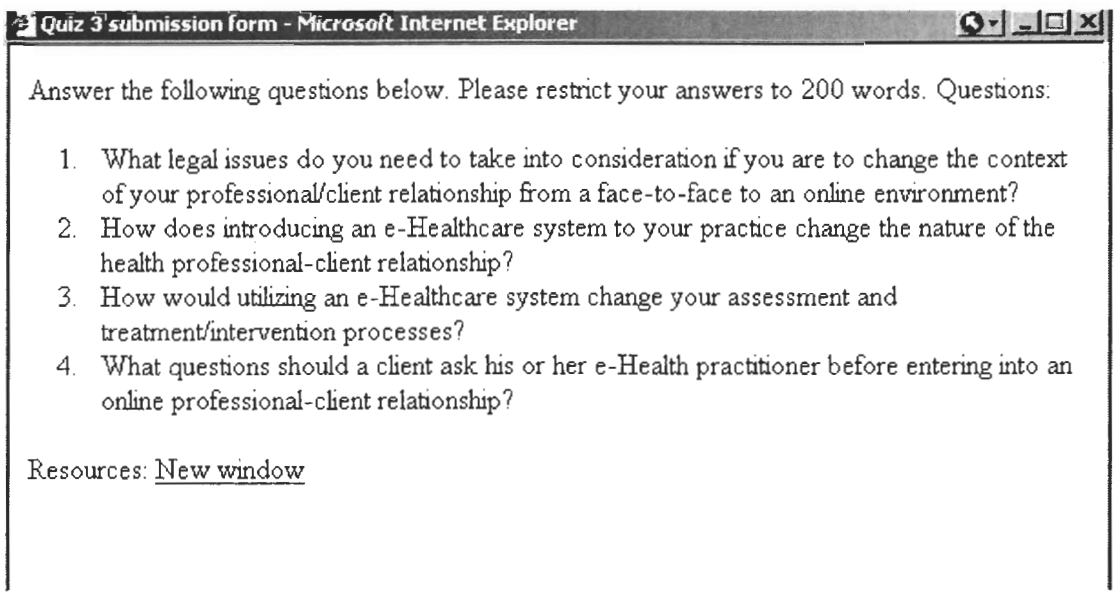

Fig 2. Screenshot

Table 1. Statements relating to the evaluation of e-Healthcare A by participating students. Values shown are proportion (%) of respondents (n=24)

Question	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I have gained a better understanding of the field	91				
I have learned to apply principles from this course in new situations	75				
The skills and content of this course will be useful professionally	91				
I have developed the ability to solve problems in this field	71				
I appreciated the ability to work at my own pace	84				
The connections between the triggers and associated quiz questions were clear	91				
I learned things I would not have learned if the course was in lecture mode	63				
The website was easy to navigate and use	100				
The way the website was structured was helpful to my learning	91				
The discussion board provided a high level of interactivity	100				

Argentina's national telemedicine programme: reasons for a premature failure

Xavier Urtubey and Marcelo Petrich

ERA Digital Foundation, Buenos Aires, Argentina

Correspondence:
Dr Xavier Urtubey
Olazabal 940 – p 11
C1428DGN – Buenos Aires
ARGENTINA
(Fax: +54 11 4802 8675; Email: xurtubey@eradigital.org)

Summary
In July 1999 the Argentinean government decided to extend the national telemedicine network from 8 to 108 hospitals or medical schools. In April 2000, a telemedicine workstation was donated to every hospital, although there was no training, no guidelines and no overall objectives. We have been leading this project since June 2000 as part of the National Information Society Programme, with an initial US$50,000 budget for the first semester. Since then, we have raised funds; deployed a large cooperative network; developed training, seminars, content; and we have proposed a global action plan. Nevertheless, the programme in that time has twice suffered a change of government, the budget has changed five times and the priorities have changed three times. At present, the team finds itself with no contract and no political action plan in a national context which is not in favour of ICT projects.

Introduction
In July 1999, the Argentinean government decided to extend the existing national telemedicine network from 8 to 108 hospitals or medical schools. To fund the project, the administration applied a law which penalised one of the telephone trust companies. The Communication State Secretariat asked its telemedicine team to make a telemedicine hardware list amounting to some US$3 million. Between September 1999 and April 2000, nine institutions received modern telemedicine systems with 384 kbit/s videoconferencing, a set of patient data acquisition peripherals, digital video recorder and video-microscope adapter; 12 hospitals received a similar system, but with less modern 384 kbit/s videoconferencing with fewer peripherals; 17 institutions were equipped with 128 kbit/s videoconferencing PCs without telemedicine peripherals; and 68 hospitals received a PC with a 64 kbit/s modem, including a low-budget medical image acquisition software program.

Results
In March 2000, all the Information and Communications Technologies (ICT) national public projects were grouped into one National Information Society Programme (PSI) [1], at that time

under the Science and Technology Secretariat. In June a new telemedicine team was in charge of the "National Telemedicine Programme", the largest for Latin America.

At that time, no training courses had been prepared and there were no project materials except a delivery note of information from the government to the hospitals. This means that there were no national or regional guidelines and no methodology or objectives to pursue. The health professionals did not know how to use the workstations and only a minority had some notion of telehealth. There was no network architecture design, no best practice publications, nor any indication about who each hospital should develop its telemedicine activity with.

Only 10% had any kind of connection, including ISDN or ordinary telephone lines and 15% had only one telephone line for the whole institution. On the political side, the national authorities allowed an initial budget of US$50,000 for the programme's first seven months. We accepted after a gentlemen's agreement of an operational liberty and the promise that this budget would be reviewed if we succeeded in fund-raising.

Since that time, we have carried out several actions:

we have "educated" the politicians on whom we depended about the importance and the potential of the network;
we contacted the local authorities to inform them about the possibilities of a large telemedicine programme;
we proposed a global action plan that established the programme mission, contained clear objectives and the activities in telemedicine and telecare, health tele-education, epidemiological telemedicine and ICT applied to health administration. All local network participants, the national authorities, WHO telemedicine responsible and the International Telecommunication Union (ITU) experts to whom it has been presented have agreed to take part;
we found funds for a consequent budget and had the agreement with the ITU to administer them;
we deployed a cooperative network at local, national and international levels interconnecting project leaders with scientific, technical and medical teams from Latin America, Europe, Canada and the United States. We worked with all teams regardless of which political party they belonged to;
we developed training courses, a national seminar, network activities and contents.

Nevertheless, in September 2001, all the efforts did not fulfill a reasonable part of our expectations, there were no possibility to reach the action plan goals and all issues seemed to have no answer from our national authorities.

Discussion

A number of factors have contributed to the relative lack of success of telemedicine in Argentina.

National factors

In July 2000, Argentina begun the third year of a continuous economic recession. In order to decrease the public deficit, the Ministry of the Economy reduced all public salaries by 12%. In this environment, ICT development was not a priority.

During the 1990s the two national telecommunication companies invested in infrastructure modernisation. Since 1998, the economic recession has affected these young corporations more than non technology firms. Besides this, in 1999, due to the Nasdaq improvements and to the Y2K bug expectations, public and private sectors overspent their ICT budgets. This

will affect negatively the private sector's investments and their natural tendency to help public sector's projects in Argentina.

Political factors
After 10 years of government, the changes appear to be drastic. In Argentina they have included changes at technical levels which have produced a lack of continuity.

On September 2000 an ITU delegation came to Buenos Aires. They focused their attention on the high operational potentials of having so much ICT infrastructure and human resources in one unique government programme. Understanding this, the politicians in charge of the PSI raised a project of an ambitious National Information Society Agency. But it required spending not suitable to a crisis and ended with just a change of governmental dependency after the Science and Technology Secretary's resignation.

Budget factors
The ICT budget was based on a system of tax reductions that had to finance social telecommunication programmes. It was over-estimated because economic depression was not expected.

Once the funding mechanism was accepted both by private companies and by the administration, a discussion over the exact amount began that lasted until the March 2001 political-economical crisis that stopped all financial income to ICTs.

Project factors
A series of implementation steps were taken against all wisdom about telemedicine projects. Among others:

there was no previous studies of specific health needs;
the implication of the local authorities was made throughout massive journeys where health professionals teams to be included were not all presents;
there was no previous work on guidelines nor on common objectives for research;
there was no informatics initiation, nor preparation or adaptation to ICT tools for the hospital's professionals.
there was no follow-up team, and no evaluation criteria to guide nor medical audit.

Material problems
Telemedicine acquisition peripherals were in the hospitals which had specialised health teams and not in those with just general practitioners. 90% of the material could not be tested on-line, and no telemedicine transmission of any kind was made. The telemedicine stations were delivered but not installed in 75% of the institutions.

The local informatics team found that more than 30% of the video cards were useless and the warranty covered just the first semester. No technical service was planned, nor help-on-line. The user's manuals were not included and when the commercial company was asked, they provided photocopies in English.

Factors due to our own responsibility alone
With the benefit of hindsight, we can highlight the following mistakes:

Accepting an unrealistic budget
This means taking a high risk.

Dependency on others results
Being part of a national ICT programme was the opportunity to decrease costs and increase effectiveness. But in such a scheme you depend on the results of other teams. The loss of independence is a problem.

Too ambitious?
In retrospect, we believe that our programme goals were perhaps too ambitious. This can be the origin of much frustration when objectives are not met.

Conclusions
Despite the social, economical and political crisis, the national telemedicine programme has tremendous potential. However, it will need the full support of the authorities at every level if itis to realise this potential.

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Government relations, government regulations: jumping through the hoops

Peter Yellowlees

Centre for Online Health, University of Queensland, Australia

Correspondence:
Professor P Yellowlees
Centre for Online Health
Level 7, GP South Building
St Lucia 4072
AUTRALIA
(Fax: +61 7 3365 4671; Email: p.yellowlees@mailbox.uq.edu.au)

Summary
Over the last decade, telehealth in Australia has been primarily facilitated and driven by government funding. The government now has a major policy initiative in online health. However, in pursuing the broad initiative there is a danger that some of the smaller components can get lost, and this is probably what has happened to telehealth. There appear to be a number of steps that need to occur if we are to continue to progress telehealth actively in Australia, and keep up the pace of development that occurred in the 1990s, as we move into what is now being called the era of e-Health, involving broadband Internet health service delivery. This area is changing extremely rapidly, and is increasingly migrating away from the public sector in Australia, where most of the developmental work has occurred, and into the private sector. Many of the issues that require consideration within the domain of e-Health in Australia, are also relevant to other countries. E-health will significantly change the way that healthcare is practised in future, and it is clear that it is the human factors that are more difficult to overcome, rather than the technological ones.

Introduction
In Australia telehealth has been primarily facilitated and driven by government funding over the past decade[1-3]. Most programmes have been developed and managed at a state level, with all states and territories active in telehealth in one form or another[4]. Many of these programmes have been assisted by Commonwealth (i.e. central government) funding. On the whole there has been a great deal of duplication and wastage of resources, partly driven by undue competition between the states, and the lack of knowledge transfer between programmes, and across states boundaries.

A National Telehealth Committee was set up under the auspices of the National Health Information Management Advisory Committee (NHIMAC) with representatives from all states and territories but this was disbanded in 2000, and was always only minimally funded so that its ability to undertake major works was limited. Despite long-standing negotiations to have telehealth recognised on the Medicare Benefits Schedule as an item number usable in the private sector, this has still not happened. The latest proposals for telepsychiatry item

numbers may come to fruition by the end of 2002, although this is uncertain. The only possible item numbers usable for telehealth at present are the rather cumbersome general practice-focused case conferencing item numbers. This lack of central payment for telehealth has severely restricted interest in the private sector. Given that telehealth has been so dominated by State and Federal government policies and funding it is worthwhile examining some of the issues that have affected this process in the past, and will continue to do so, in the future.

The need for data on clinical and cost effectiveness

The telehealth literature is becoming increasingly clear, and it appears that the disciplines of radiology, psychiatry, pathology, dermatology and cardiology, and probably ophthalmology, are those that are most clinically and cost effectively practised with telehealth.[5] While there have been a number of studies[6-8] from Australia examining the effectiveness issue, and the publication of a comprehensive document on Research and Evaluation from the National Telehealth Committee, (http://www.telehealth.health.gov.au) there has been little money put into research. The great majority of programmes have been 'clinical pilots' and there has only been one randomised controlled trial, that in mental health[2]. The National Health and Medical Research Council has received a number of applications for research funding over the years, and has not yet funded any projects in this area, to the best of my knowledge. In an era where evidence-based medicine is, quite appropriately, prevalent, telehealth is still severely lacking and this is an important 'catch-22' at the government level as it hard to provide data on effectiveness, if studies on this are not properly funded. It is well known that such studies are difficult to run and are potentially extremely expensive, but telehealth programmes are now suffering because of the lack of objective data demonstrating their effectiveness.

Budget flexibility

Most telehealth programmes operate across quite substantial distances, yet most state health programmes fund on an area basis, so that the telehealth programmes cut across these areas. A major difficulty in achieving telehealth funding has been arranging for cost savings in one area to be transferred to another so that it is worthwhile, for instance, for central city areas to provide teleheath services to remote areas. Many of the savings made accrue to patients, although health systems also make potentially substantial savings in travel, but these savings tend to come from separate budgets and relatively few health departments have the facility to be flexible internally with their budgets. The lack of data on travel costs, for example, in Queensland has significantly hampered the development of telehealth as it has not been possible to identify high travel cost areas or needs, and therefore high savings potential, areas or types of clinical activities.

Government 'ownership' of telehealth

Telehealth is as much a clinical process involving technology, as it is also a clinical and educational tool, and agent for change. While the literature strongly supports the need to have clinical champions driving telehealth programmes[9], there is still a substantial problem at government level as to whether telehealth should 'come under' clinical or technical areas centrally, or should be devolved local health services. This uncertainty reflects the breadth of telehealth as a particular process that crosses the majority of clinical areas, has a major technological focus, and involves large numbers of varying stakeholders from patients, clinicians, IT professionals, to external consultants, the telecommunications and IT software and hardware industries with links into areas such as Corrections and Social Services. This breadth means that it is fairly unlikely that one will be able to find single points of contact within government health departments for telehealth, and also tends to restrict funding levels that might otherwise be appropriated for this activity.

Competition or collaboration

Telehealth is by its nature a very collaborative process that occurs across time and space, across discipline and involving multiple technologies. Unfortunately the health sector, driven by national policy decisions, is becoming increasingly competitive and whilst this may be beneficial in many areas of health, it is probably not so in telehealth. The issues here are best seen using the example of interstate rivalry. The lack of communication between the states, territories and the commonwealth is well understood, and efforts to commence a national telehealth association, mirroring perhaps the American Telemedicine Association in the US, or the Telemedicine Forum in the UK, have been unsuccessful because no state or territory has been prepared to contribute some initial seed funding to the common good, despite requests. The same is true of the lack of a National Conference on Telehealth. Annual conferences have been held in Queensland for the last three years, and are now established as part of the scene, but are run by the Centre for Online Health at the University of Queensland. A small annual commercial conference has occurred for the last four years in Sydney. New South Wales runs internal telehealth meetings. There has however been no major nationally supported attempt at information exchange and mutual learning, beyond the papers produced by the National Telehealth Committee, and two consultancy reports focused mainly on the state of the telehealth industry by John Mitchell[10,11].

Negotiating with governments

I have spent a considerable amount of time over many years negotiating with multiple people in both the State and Federal Health Departments. The single most difficult task has been to gain substantial long-term financial support for telehealth, although this has recently been provided in Queensland where telehealth programmes are being moved beyond the project stage into regular funding streams. At a State level it is usually possible, without too much difficulty, to find the individual, or group, that has funding responsibility for telehealth, even if it is sometimes very hard to identify those with clinical responsibility. At the Commonwealth level, however, this is not the case. I have been involved in a range of negotiations to develop telepsychiatry item numbers for the private sector for more than five years, and with a large number of changing policy executives, all of whom have different levels of interest, motivation and knowledge. The inability to negotiate with the Commonwealth Department of Health and Aged Care on behalf of either an industry group, or a national association, both of which are sorely lacking in a telehealth field, has further hampered the outcomes from these negotiations, which in the end have had to be taken on primarily by the Australian Medical Association and the relevant specialist colleges, such as the Royal Australian and New Zealand College of Psychiatrists.

Government policy initiatives

The National Health Information agenda strategy is to bring health online (http://www.healthonline.com.au). This set of policies is genuinely exciting, innovative and forward-looking and, if the objectives of Health Online can be implemented in a reasonable timeframe, say within ten years, then there is no doubt that Australia will have a dramatically improved, modernised and changed health system. Health Online covers all areas of information and knowledge management and e-Health services, with telehealth making up a small, but important component. The difficulty that all governments have when they embrace a policy such as Health Online is that some of the smaller components can easily get lost as a fine detail within a broader plan, and this is probably what has happened to telehealth, in parallel with the cessation of the National Telehealth Committee.

Future directions.

There appear to be a number of steps that need to occur if we are to continue to progress telehealth actively in Australia, and keep up the pace of development that occurred in the 1990s, as we move into what is now being called the era of e-Health, involving broadband Internet health service delivery. These are:

the development of a National Strategy for the implementation of Telehealth/eHealth initiatives under the auspices of Health Online, associated with appropriate funding
the funding of substantial scientifically thorough research programmes to demonstrate the clinical and cost effectiveness of a variety of e-Health strategies
the creation of a National Association to embrace multiple stakeholders in e-Health across public and private sectors, and including relevant industry groups. This will need government core funding. It has been shown through the recent demise of the Collaborative Health Informatics Centre CHIC in 2002 that such an advocacy and information body is not yet sustainable purely through private payments
the creation of a number of Medicare Benefit Schedule item numbers in the six clinical areas where best evidence supports cost effectiveness. These are at present radiology, psychiatry, pathology, dermatology, cardiology and ophthalmology
the creation of a National Conference, to act as an information exchange process where clinicians, politicians and industry groups may meet
the creation of a National Leadership Group in e-Health, perhaps through the Medicare Agreement, that will focus on e-Health, and explore all types of clinical opportunities offered by not just traditional telehealth systems, but involving the use of broadband Internet, email and telephony. In this respect it is pleasing that a reference group on Information Technology, e-Health and Research has been set up under the auspices of the Australian Health Ministers Advisory Council to report on the national opportunities that e-Health may bring, and to make recommendations as to how these can best be implemented within the next State and Federal Healthcare Agreement.

Conclusions

Telehealth has merged into e-Health over the last few years, and now incorporates clinical activities provided at a distance using a variety of technologies. In future e-Health will predominately use broadband Internet protocols[12] and ultimately every doctor's desktop will include a set of e-Health services. This area is changing extremely rapidly, and is increasingly migrating away from the public sector in Australia, where most of the 'developmental' work has occurred the last decade or so, and into the private sector. Many of the issues require consideration within the domain of e-Health in Australia are also relevant to other western countries in particular. e-Health will significantly change the way that healthcare is practised in future, and it is clear that it is the human factors that are more difficult to overcome, rather than the technological ones.

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POSTERS

Telehealth success requires both technology and technique

Isabelle Ellis and Lesley Czulowski

Department of Health, Western Australian Country Health Services, Kimberley Region, Australia

Correspondence:
Isabelle Ellis
PO Box 62
Broome 6725
AUSTRALIA
(Fax: +61 8 9192 3884; Email: isabelle.ellis@health.wa.gov.au)

We have evaluated two education programs delivered by videoconferencing for the Kimberley Health Service, a geographically isolated region in outback Australia.

The two projects were: a diabetes management training program run by Diabetes Australia through the Kimberley Public Health Unit and a management skills program developed and run through the Kimberley Health Service. Both projects used multipoint videoconferencing in the very remote hospitals in the Kimberley with a maximum of four sites being connected at once. In both projects the presenters were often different from session to session. A facilitator managed one project and the other was organised by the Workforce Development Coordinator at the beginning of the project and then run with little assistance.

We used a traditional measure of success: participant satisfaction surveys. One project was perceived to be a very unsuccessful pilot project and one was perceived to be very successful. The results of the study have been used to improve management practices across the Kimberley Health Service and improve collaboration and care for people with diabetes in the Kimberley Region.

The role of patient recruitment protocols in telehealth

Sarah Grady[1], Sharon Kitt[1] and Lexie Clayton[2]

1 Bayside e-Health, Bayside Health, Prahran, Victoria, Australia
2 Ambulatory and Community Services, The Alfred, Prahran, Victoria, Australia

Correspondence:
Sarah Grady
Bayside e-Health
The Alfred
PO Box 315
Prahran VIC 3181
AUSTRALIA
(Fax: +61 3 9276 3793; Email: Ehealth@alfred.org.au)

The literature on telehealth and telemedicine often addresses the efficacy of this model of care within specific clinical categories but rarely considers the individual characteristics of patients comprising that group. That is, telehealth appears to be constructed solely on the biomedical model of care, where patients are selected to participate in programmes solely on clinical grounds with little acknowledgment of their broader sociocultural, physical or psychological context.

We have developed recruitment protocols which recognise patient-specific circumstances. We have evaluated the efficacy of such recruitment models throughout Bayside e-Health's telehealth service.

An audit of patients at a sub-acute facility who were to be transferred to an acute facility for outpatient appointments was conducted. Patients were classified as physiologically appropriate or inappropriate. For the physiologically appropriate patients, further assessment considered whether or not the treating clinicians deemed them suitable to participate in telehealth and if not, the reasons for this.

The results of the audit indicate that although patients may be physiologically appropriate to participate in telehealth, patient-specific circumstances can influence clinical decision-making when determining whether a patient is appropriate to participate in telehealth. Common reasons for patients being deemed inappropriate to participate in telehealth were identified and then used to develop a recruitment protocol.

Online documentary training

Judith Hewitson

Independent Living Centre Association, Queensland, Australia

Correspondence:
Judith Hewitson
Independent Living Centre Association
94 Payne St
Auchenflower 4066
AUSTRALIA
(Fax: +61 7 3394 1013; Email: judithhewitson@ilcqld.org.au)

Online Documentary Training (ODT) was piloted at the Independent Living Centre in 2001. It is a model of culturally-appropriate online training that was designed for indigenous health and community workers in isolated indigenous communities. Unlike other online training, ODT provides a real-life situation in real time in a virtual environment. It is designed for communities with few resources, especially those with a lack of professional skills.

ODT promotes (a) local problem solving for health related issues, (b) cultural ownership of technology and (c) a networking which brings the necessary skills and resources into the communities. The training is based on documentary story-telling, motivating participation through interactivity which overcomes local apathy and crisis.

The pilot trial successfully showed that technology could bridge the divide between the "haves" and the "have-nots" (see http://www.ochre-shores.net/odtp). ODT is applicable to training in developing countries. It can be adopted by universities, non-government organizations and government bodies for cross cultural and professional training/assessment. It can meet diverse community needs in a cost effective way.

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A versatile, economical microscopy imaging solution for the Pacific

Christina P Belnap[1], Judy H Freeman[1], Donald A Hudson[2] and Donald A Person[3,4]

[1]Department of Pathology, Tripler Army Medical Center, Hawaii, USA
[2]Pacific Telehealth and Technology Hui, Tripler Army Medical Center, Hawaii, USA
[3]Department of Clinical Investigation, Tripler Army Medical Center, Hawaii, USA
[4]Department of Pediatrics, Tripler Army Medical Center, Hawaii, USA

Correspondence:
Donald A Hudson
Pacific Telehealth and Technology Hui
1 Jarrett White Road, 4E-B100
Tripler Army Medical Center
Hawaii
USA 96859-5000
(Fax: +1 808 433 1920; Email: donald.hudson@haw.tamc.amedd.army.mil)

Tripler Army Medical Center (TAMC) is the United States largest military medical facility in the Pacific Basin. The Department of Pathology and the Pacific Telehealth and Technology Hui (a Hawaiian word meaning group) sought a suitable digital pathology imaging system for a cervical cancer diagnosis project, comparing images with glass slides. The project called for remote site pathologists to submit digital images and corresponding glass slides to TAMC, for blind review by a cytopathologist.

We identified the Nikon Coolpix 990 camera, equipped with a Nikon or Optem microscope adapter, as an easy to use solution which was adaptable to pathologists' work-styles. At TAMC the camera and adapter was used to capture images of lung tissue affected by Churg-Strauss Syndrome. The images were shared with a Bangkok audience in a medical videoconference with the Royal Thai Army's Phramongkutklao Hospital and College of Medicine.

A camera and adapter were also sent to Belau National Hospital in the Republic of Palau, with the intention of supporting consultations in the Pacific Island Health Care Project, a seasoned consultation and referral website. The adapter was initially used for a cervical cancer consultation. Palauan physicians discovered that the adapter fitted their colposcope as well as their microscope, and forwarded images of an abnormal cervix along with stained cervical secretions. Subsequently the Palauan physicians used the adapter for a second cervical cancer consultation, and reported that the adapter fitted their slit lamp as well.

Despite these successes, there has been a dearth of recent telepathology activity. This has been partly due to the logistical difficulties associated with typhoons in the western Pacific.

An analysis of a telehealth model of Tai Chi in Australia

Xiaodong Jiang and Shuanghong Wu

American Tai Chi Association, Virginia, USA

Correspondence:
Mr Xiaodong Jiang
13130 Thornapple Place
Oak Hill
VA 20171
USA
(Email: xiaodongj@hotmail.com)

We have conducted a web site comparison to analyse the important factors for Tai Chi professionals to build up a successful telehealth model on their web sites. We compared the telehealth model on an Australian Tai Chi website with the telehealth model on several US-based Tai Chi websites. The comparison was done using the following benchmarks: quality of the online forum providing health and life style support; quality of the information about Tai Chi and its effects on health; website maintenance; navigation features; and the revenue model supporting the telehealth operation. The comparison allowed us to identify factors that have contributed to the success of the Australian model, and revealed the constraints that prevent the US model from growing.

The major difference between the Australian model and the US model was that the Tai Chi expert who built the Australian web site was more knowledgeable about technology than his counterparts who built the US web sites. In addition he made effective use of the Internet. Thus, although both models had an online forum, the expert in the Australian model committed to the forum on a more regular and active basis, and hence attracted a lot of traffic. Other factors were that information search and navigation in the Australian model were simpler and more user-friendly.

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The highs and lows of telehealth in Far-North Queensland

Denise Petersen

Cairns Base Hospital, Queensland, Australia

Correspondence:
Catherine Wright
Paediatric Unit
Cairns Base Hospital
PO Box 902
Cairns 4870
AUSTRALIA
(Fax: +61 7 4050 6748; Email: Catherine_Wright@health.qld.gov.au)

Three different types of videoconferencing equipment are used in far-north Queensland. The desktop systems are PC-based, and there are also set-top and group systems. Over 20 videoconferencing systems are in use.

There are parallels between the highs and lows in the weather in far-north Queensland and the successes and failures of telemedicine there. Just as winds, floods and cyclones are part of the wet season and can result in loss of power and road damage, so the lack of technical support and IT education can have an adverse effect on the smooth running of the telemedicine equipment.

Telehealth provides an alternative to the challenges of delivering expert specialist care and advice across the vast distances. Technological advances may have improved access to medical expertise. However they have also meant that medical and nursing staff now rely on technical staff to service and set up the equipment. To allow for efficient and effective use of the system, its operation is now part of our standard orientation for nursing staff. Although operational difficulties have lessened with staff training, technical problems still persist.

Telepsychiatry services: reaching beyond clinical consultation

Jean Starling, Robyn Rosina, Ken Nunn and David Dossetor

Child and Adolescent Psychological Medicine Outreach Service, Children's Hospital at Westmead, New South Wales, Australia

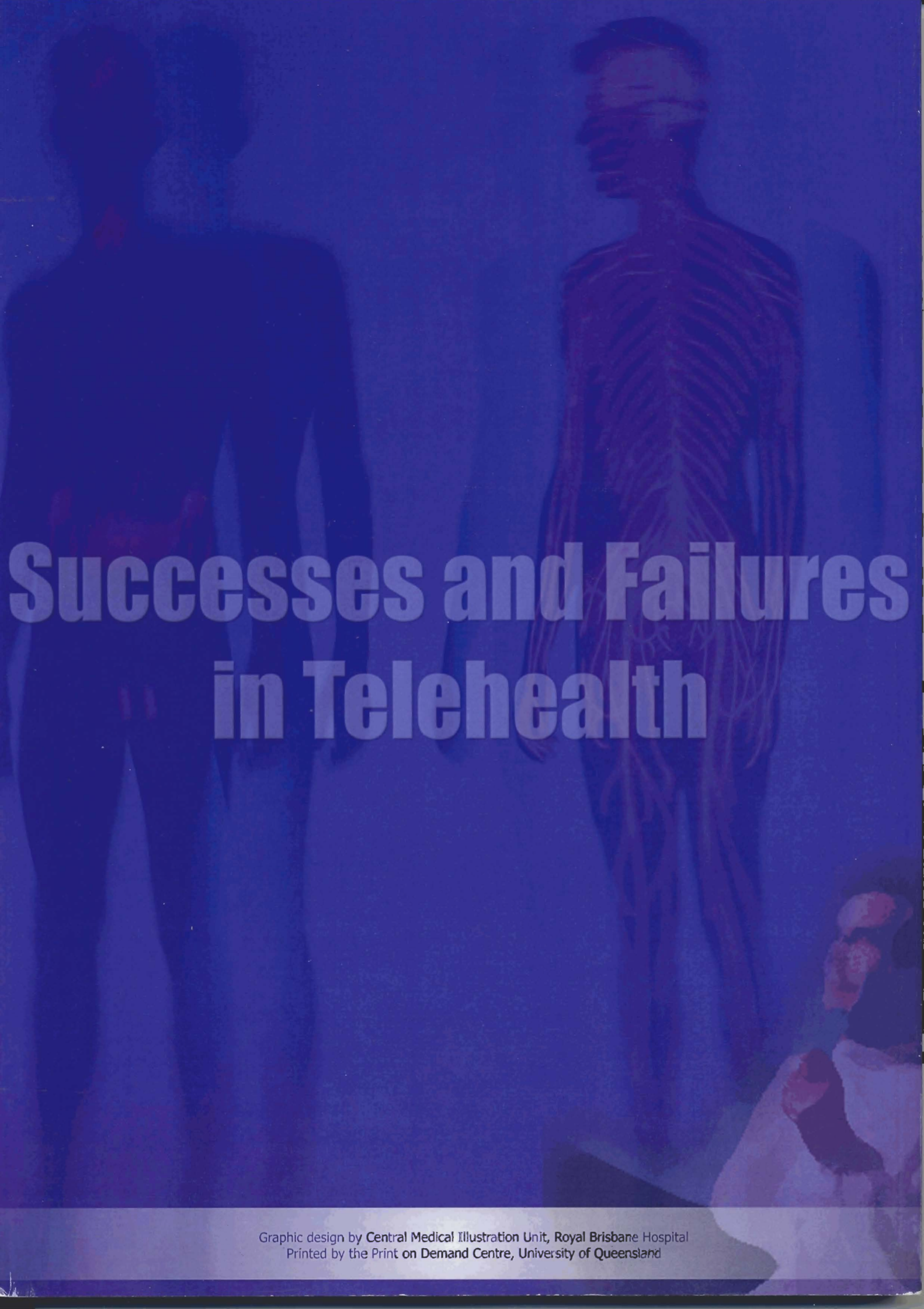
Correspondence:
Jean Starling
Children Hospital at Westmead
Locked Bag 4001
Westmead
NSW 2145
AUSTRALIA
(Fax: +61 2 9845 0413; Email: JeanS@chw.edu.au)

The Children's Hospital at Westmead has provided a Child and Adolescent Psychological Medicine Outreach Service (CAPTOS) to rural and remote New South Wales for five years, with the current service being provided to all eight rural and remote regions. An evaluation of this service was carried out in 2001. The service has since been extended to provide professional support and training, especially to support rural clinicians in developing general clinical confidence, as well as building specific skills. One new approach includes adding sessions to the rural site visits. These are interactive presentations, using adult learning techniques and actively involving rural clinicians as experts in rural practice. This is in addition to didactic teaching, which if used alone can reduce the confidence of local staff. A clinical skills workshop was also held in late 2001, for a group of 40 rural staff. This also allowed them to meet each other and develop professional networks.

Programmes that have developed to build specific skills include family therapy training, which consists of a year of theoretical training and clinical supervision. This has been conducted so far in two rural services. The training has been coordinated by a senior clinician at the Children's Hospital. The trainer and the small group of rural clinicians initially meet together face to face to plan the training and distribute reading material. There are then monthly videoconferences where there is case discussion and further training. At the end of the year rural clinicians feel more confident in working as therapists with families.

These enhancements have made the service better able to meet the needs of rural clinicians, expanding the skills and networks of the rural teams, and integrating them with the other forms of good clinical practice.

INDEX



Successes and Failures in Telehealth

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