

Prescription and Assessment of Technical Aids using Internet Video



Final Report

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Table of Contents

Project Partners	Page 3
The Applicant and partners	Page 4
Project background	Page 5
Project objectives	Page 5
Reasons for undertaking this project	Page 6
Data analysis	Page 6
Performance analysis	Page 7
Samples of usage	Page 8
Impact on non-profit organizations	Page 11
The need for more research	Page 12
Attainment of objectives	Page 12
Challenges and barriers to achieving the project objectives	Page 12
Major achievements of the project	Page 12
Impact on health care quality	Page 13
Impact on the health of participants	Page 14
Impact on health policies	Page 14
Technological performance	Page 15
Unanticipated issues	Page 16
Transferability of the technology and knowledge	Page 16
Viable alternatives	Page 16
Conclusion	page 17
Appendices	Page 19

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The Applicant and partners:

The applicant organization, New Brunswick Easter Seal March of Dimes (NBESMOD), works in partnership with people with disabilities so they may obtain independence and equality of opportunity generally available in the community. To accomplish this, NBESMOD provides direct services to people with disabilities in the area of assistive devices for communications, mobility, environmental control and computer access. In addition, NBESMOD assists healthcare providers in the assessment of assistive devices, and appropriate technology to meet client needs. NBESMOD works with government and other agencies to avoid duplication of efforts. Ongoing programs with The New Brunswick Departments of Education and Human Resources and Development work to ensure that appropriate technology is available in schools and other areas. Primary work involves assessing needs, troubleshooting of problems and equipment provision. For this project NBESMOD provided technical support and assessed the system with many of their clients.

The recipient organization is the Institute of Biomedical Engineering (IBME). IBME is a research institute located on the Fredericton Campus of the University of New Brunswick and was created in 1965. The IBME has provided an upper limb prosthetic fitting service since 1981. This service currently serves approximately 120 amputees primarily from Atlantic Canada. IBME also has extensive experience in computer applications in health care and has worked with the Stan Cassidy Centre for Rehabilitation (SCCR) in Fredericton and NBTel Interactive to develop similar technology funded through the HEN97 program of CANARIE. The current application benefited from the equipment and knowledge gained through the CANARIE funded project. IBME staff provided primary integration of the interactive Internet video components, and followed the prosthetics clients to be seen as part of the project.

SCCR and Extramural Hospital (EMP) are part of the provincial government Hospital Services Corporation. Both maintain teams specializing in many aspects of rehabilitation service. Rehabilitation specialists from these organizations helped in the assessment and protocol development of the Internet video system.

NBTel's responsibility was to assist in the development and creation, in partnership with IBME and NBESMOD, of the Internet Based Interactive Video in Rehabilitation Internet access needs. NBTel also provided all the ADSL network bandwidth for this project.

Project Background

The Atlantic Provinces in general and New Brunswick in particular are relatively rural and even the cities are small. On the other hand, the level of telecommunications service is very high and NBTel provides Internet access throughout the province. The NBESMOD is the primary referral service for high technology assistive devices for rehabilitation clients in New Brunswick.

Rehabilitation centres such as SCCR, the provincial tertiary rehabilitation centre in the province and the Extramural Services of the Hospital Corporations in New Brunswick rely on the technical expertise of NBESMOD to ensure the successful prescription of technical aids to clients throughout the province. The IBME is a research Institute at the University of New Brunswick which maintains a state-of-the-art prosthetics fitting centre and is the primary provider of powered upper limb prostheses in Atlantic Canada.

NBESMOD, SCCR, and IBME, are all located in Fredericton and face a common problem. When clients who have recently been fitted with prostheses, or have been supplied with assistive technology return home, they are remote from the technical support service and in many cases remote from the health care professionals in the rehabilitation centres. Problems with fit or technology function that cannot be described well over the telephone then require a trip to the centre for evaluation. NBESMOD faces an even more difficult challenge in that they need to communicate not only with the client using the technology but also with the healthcare professionals who are providing the rehabilitation service to the client.

Project Objectives

Our objective was to develop and test the use of Internet Based interactive video connections to link clients at home and in remote clinics with health care professionals at the Institute of Biomedical Engineering (IBME) and the Stan Cassidy Centre for Rehabilitation (SCCR), and with technical support personnel at the New Brunswick Easter Seal March of Dimes (NBESMOD) using networking facilities provided by NB Tel. This project tested the technology in the field, assessed the efficacy of the technology and improved it in light of the field trials, tested the use of such connections to support clients in other provinces, and assessed the use of connections which allow multi-point communication for client support groups, or three way conversations between client, health care provider, and technical support personnel.

The reasons for undertaking this project

This project provided advantages to both the rehabilitation client and the clinic professionals. Video, rather than telephone, gives the ability to see problems. The interactive nature allowed problems to be addressed with the client in their home, reducing the time and expense for travel, and making the response to problems or concerns more timely. It also allowed problems that are specific to the home environment to be addressed more directly. For the clinic professionals, links such as this allowed for making better use of scarce time and resources. From a networking standpoint, once clients become familiar with the use of the systems, direct client-to-client links for support groups and similar activities may become feasible. In addition, it may be possible to do much more in terms of follow-up over the network. Clinic-to-clinic or hospital-to-hospital networking has many possible uses in distributing services such as clinical engineering. This technology has application to healthcare facilities across Canada.

Data Analysis

The log sheets have allowed us to gather data relevant to the usage and performance of the computer based videoconferencing equipment used during the trial stage of this project. The videoconferencing sessions primarily included consultations with clients and other rehabilitation professionals, equipment viewing sessions, system demonstrations, and system testing sessions. The Internet network access was primarily ADSL high bandwidth along with some sessions using the University of New Brunswick LAN to access the Internet.

The statistics we gathered using the log forms are described as follows:

The average setup time of the equipment required to do the videoconference was 4.7 minutes.

The average videoconference session lasted 19.7 minutes.

98% of the videoconference sessions attempted were successful at establishing a connection between the computers.

All sessions used high bandwidth Internet access when videoconferencing. 83% of the sessions used ADSL Internet network connections while 17% used the University of New Brunswick High Bandwidth LAN to access the Internet.

The level of difficulty when establishing a connection for a videoconference was estimated by the users using a scale from 1 to 10. A rating of 1 signified establishing the connection was very difficult and a rating of 10 signified establishing the connection was very easy. The average level of difficulty for establishing a connection was 8.0.

The audio clarity of the videoconference sessions was estimated by the users using a scale from 1 to 10. A rating of 1 signified the audio clarity was very unclear and a rating of 10 signified the audio clarity was very clear. The average level of audio clarity for the videoconference sessions was 7.5.

The video clarity of the videoconference sessions was estimated by the users using a scale from 1 to 10. A rating of 1 signified the video clarity was very unclear and a rating of 10 signified the video clarity was very clear. The average level of video clarity for the videoconference sessions was 7.5.

The comfort level when using the videoconferencing system was estimated by the users using a scale from 1 to 10. A rating of 1 signified they were very uncomfortable using the system and a rating of 10 signified they were very comfortable using the videoconferencing system. The average comfort level when using the videoconferencing system was 9.5.

31% of the sessions experienced problems during the setup of a videoconference session.

33% of the sessions experienced problems during the videoconferencing sessions.

77% of the videoconference sessions report meeting the objectives of their videoconference session.

83% of the sessions, when the objective of a session was applicable, reported their session replaced a clinic or outreach visit.

Performance Analysis

The data indicates the users of the videoconferencing system were quite comfortable using the computer based Netmeeting videoconferencing system and were pleased with the quality of both the audio and video. The connection process was setup as a speed dial and made connecting to others very easy. This ease of connection is more a reflection on the user friendliness of the system than on the actual trouble free connection with remote computers.

The 31% of the sessions who reported problems while connecting to others and the 33% of the sessions reporting problems while videoconferencing are a reflection on the instability of consumer level computer based videoconferencing technology that is available today. The problems encountered included issues such as computers hanging, lost connections, audio not working or the video not working. The lost connections issue was sometimes resolved by simply redialing the remote system, while the other problems usually required rebooting the computer system experiencing the problem.

The data indicates 77% of the sessions report meeting their objectives for the session. This number should be evaluated in the context that most sessions were initiated with an initial

preconception that the computer based videoconference medium would be satisfactory for the purposes intended. It should also be noted that all sessions that reported not meeting their objectives reported experiencing problems with the computer based videoconferencing system for that session.

The computer based videoconferencing system was reported to replace a clinic or outreach visit 83% of the time when a session had an objective of replacing a clinic or outreach visit. The sessions which consisted mainly of equipment viewing or health professional consultations were not included in this calculation as the outcome of replacing a clinic or outreach visit was not applicable to these sessions.

The performance of the 3-way computer based videoconference sessions was below what we thought would be acceptable for use in the health care field. The 3-way videoconferencing software packages we evaluated were not very user friendly, most had limited bandwidth usage capability, and most importantly the instability of the available options made the use of such a system in the field quite difficult.

Samples of usage

The following pictures illustrate some of the uses for the computer based interactive video systems.



Figure 1. Face-to-Face communication



Figure 2. Equipment viewing



Figure 3. Assessing the options of a device



Figure 4. Demonstrating the usage of equipment options and distance education

Impact on Non-profit organizations

The impact on the non-profit organizations has been positive. The New Brunswick Easter Seal March of Dimes organization has benefited from this project in several different ways. The technological equipment used during the course of this project has allowed the NBESMOD staff to develop new computer skills and videoconferencing skills using the latest technologies and this exposure will have a lasting effect on the organizations personnel. It was discovered that one employee in particular has exceptional video camera skills, which facilitated the displaying of complex devices to remote health care personnel viewing the devices. The limited funds available to non-profit organizations often limit the access to new technologies especially when the use is for research or product evaluation. The technology has allowed NBESMOD staff to develop new and stronger relationships with health care professionals in New Brunswick as well as with other non-profit organizations. The technology was demonstrated to many people who visited the NBESMOD office such as non-profit groups serving persons with disabilities, health care workers and government employees. The point was stressed to these people that we would like to see this technology expand across New Brunswick as it can have a beneficial impact on the quality of services to persons with disabilities. These meetings and demonstrations have led to the formation of partnerships between NBESMOD and other organizations to further investigate the possibilities that exist for providing enhanced health care services using computer based interactive video technology on the Internet.

The NBESMOD clients benefited from this project as they received better and faster service due to the increased communication between NBESMOD staff and the clients health care workers.

This project has had a positive impact on the image of the NBESMOD. This project has helped portrait NBESMOD as a leader in the field of high technology and services to persons with disabilities. This positive image increases the ability of NBESMOD to fund raise because of the new image and new level of impact on clients, professionals and the public. As an agency dependent upon donations and the general good will of the community at large this image building is vital for NBESMOD. Although image building was not an original objective of the project it is a valuable outcome.

The NBESMOD organized a two day forum attended by the leaders from the different professional rehabilitation disciplines in New Brunswick to discuss how to improve rehabilitation services in New Brunswick. The Prescription and Assessment of Technical Aids using Internet Video project was demonstrated and displayed during the two day forum to many interested viewers who were able to try the system by conferencing with another individual located at the IBME display table. The NBESMOD expects positive effects from this project will be felt for many years.

The need for more research

Although the project was scheduled to be completed on September 30, 2000 we continue to use these systems to allow for additional data collection and experience with the technology. We believe the technology has a positive impact on health care delivery in New Brunswick and we are interested in continuing our research in this area with hopefully additional units to be deployed throughout the province. We are seeking funds to allow us to expand the research project and also implement recent technological advances that have become available. Further research will allow us to create a model that addresses the needs of an increased number of disciplines in the health care field.

Attainment of objectives

The project attained its objectives as the technology was developed, tested and evaluated in the field. A list of web cams considered is included as Appendix "A" and a list of computer based videoconferencing software considered is included as Appendix "B". The model Hardware and Software for our project are included as Appendix "C". Procedures for communicating with the use of the technology were developed for both 2-way (Appendix "D") and 3-way (Appendix "E") interactive video sessions. Project participants gathered information about the sessions through the use of the log forms we developed. A sample of the base and remote log forms used is included as Appendix "F".

Challenges and barriers to achieving the project objectives

The challenges and barriers from a management perspective related to the availability of high bandwidth Internet network connections in some of our originally targeted areas and personnel changes. The result of the challenges and barriers were delays with certain phases of the project. The availability of high bandwidth Internet network connections issue was resolved by providing access for the intended participants in alternate locations. The alternate locations were less convenient for the users but allowed for testing the model system at the proper bandwidth.

Major achievements of the project

The major achievements for this project include the specification of hardware and software for interactive video using the Internet (Appendix "C"), the development of procedures for communication with the use of this technology (Appendix "D"), the development of evaluation forms (Appendix "F") to gather the data for the project evaluation and the promotion of this technology for use in the health care field (Appendix "I" & "J").

Impact on health care quality

The access to health care services was enhanced through the availability of specialized remote consulting services with interactive video to enhance communication. Therapists had the opportunity to view assistive equipment before it was sent to them so they could identify potential problems and correct them before shipment resulting in faster and more accurate health care service delivery.

The participants involved in the project all benefited from the exposure to Information Technology equipment and how it can relate to improving health care delivery services. The log forms to report information about the session required the completion of IT related questions regarding the equipment used.

The communication and information resource sharing was increased through the use of interactive video sessions. Participants were able to see as well as hear the information being transmitted.

The education and access to information component was facilitated through the use of the interactive video sessions. The participants were not only accessing information related to the health care of individuals but they were also learning about the use of computers, the Internet, and the possibilities this technology has in the delivery of health care services for their clients.

Patient management was enhanced, as specialty services were available remotely. The use of interactive video to view patients in their community reduced travel and allowed for clients to be seen on a more regular basis for follow up reasons.

The patient satisfaction with remote health care services using interactive video is increased through the reduction in travel and quick access to health care advice. The possibility of showing a problem in addition to a verbal description can sometimes eliminate the need of a follow up remote clinic visit. The possibility of communicating with non-verbal clients using the interactive video allowed for directly including the non-verbal client in the discussion regarding their health care issue.

The speed of service is increased due to the increased information being shared. The provision of equipment is more accurate resulting in less waiting time for items that may not have been included or fully described in the original equipment request. An example of this is a case when a wheelchair was viewed before shipment and upon viewing it was discovered that the leg rests, the removable side, and the push bars were not appropriate. The problem was corrected before shipment and resulted in substantial time and money savings.

Impact on the health of participants

The health status outcomes for this project were mainly related to the efficiency of the system when communicating with participants. The possibility of remote follow up allowed for decreased travel and quicker viewing and remediation of problem situations but data was not accumulated to reflect this, as we did not have a control group to compare against. It is obvious that some positive outcomes include better health, and use of assistive technology, due to better communication but these are difficult to measure as this was more of a proof of concept research project as opposed to a controlled group research project where a comparative analysis would have been possible.

Impact on Health policies

This project could impact the provincial health policy area of Care Protocol, as the possibility for efficient remote monitoring of remote clients will be possible. This may affect the length of time a specialist is required to follow a client after discharge from a specialized center and the amount or timing of actual follow up visits to the specialized center.

The provincial Health Sector funding could be impacted by this project in a positive way due to reduced travel requirements for specialized health care teams. The reduced travel may result in travel costs savings. The possibility exists that less health care staff may be required if the travel is reduced to the point of impacting the staffing requirements resulting in reduced health sector funding required for certain positions. The institutional or regional Information Technology Health Sector funding may need to be accessed to provide facilities with the equipment necessary for Internet based video conferencing and broadband Internet access. This project model hardware and software (Appendix "C") uses consumer level computer equipment and low cost Broadband Internet access to create a model that is affordable and sustainable even in small rural facilities.

The patient privacy and confidentiality is an important issue when considering the transmission of audio and video over the Internet. The national and provincial privacy/confidentiality health policy may need to be reviewed in light of this new communication medium and appropriate security steps may need to be established to protect the privacy and confidentiality of the users of the system. Our assessment of the privacy/confidentiality risks involved with the technology used for this project (Appendix "G"&"H") revealed very little actual risk although the information transmission medium in itself instills a certain level of risk into the system.

The impact this technology can have in the institutional and regional training related area could be very beneficial to the health care providers. The technology used for this project offers the possibility of distance education as a one-on-one or one-to-few training tool. It can also be used in a larger setting with the image projected on a screen for many to view although the remote site would need to channel its information through one main operator.

The use of this technology could impact the level of care that can be provided in remote communities through better communication between specialists and local health care providers. This sharing of information between specialists and local health care providers results in additional training for the local health care providers. The long-term effect of additional training will result in a reduction in the number of referrals to specialists due to the increased competence of local health care providers.

Technological Performance

The technological performance of the systems deployed must be described in three sections as the technology includes hardware, software, and Internet access.

The hardware used during this project consists of desktop and notebook computers with network cards for high bandwidth Internet access and video capture cards with web cams. The computers are regular consumer level units and proved powerful enough to handle the requirements needed to videoconference without being a barrier that would limit the quality of the videoconference sessions. The video capture cards included PCI cards for the desktops and PCMCIA cards for the notebooks. The video capture cards seemed to perform well and our research indicates that the video capture cards outperform both the USB and Parallel port options for connecting web cams (Appendix "A"). The 3Com Big Picture web cam with video capture card seemed to provide the best picture quality of all models tested.

The project enabled us to review and test many different consumer level PC based videoconferencing software packages (Appendix "B") for possible use in this project. We found the Microsoft NetMeeting software to perform best among the possible choices for one-on-one videoconference sessions. The NetMeeting software allowed for the throughput necessary for clear video communication and appeared more stable than most other options. The barriers we encountered with the NetMeeting software were more related to options that were not available within the software although we feel they would certainly be beneficial to the project. The option to transfer a call to another computer system, the option of multiparty videoconferencing, and the option to record an incoming message if unable to take a call would make NetMeeting a better product. The NetMeeting software also has a problem reconnecting to a web cam if a problem occurs during a videoconferencing session, forcing the user to completely reboot the system to re-enable the video capability of the system. This problem seems inherent to all software packages we tested. The choices for three-way communication were less numerous and seemed to be more unstable than the NetMeeting software used for the one-on-one communication. We found the Ivisit software to meet many of our needs but the instability of the software makes it difficult to recommend or use in a health care setting.

The Internet access used for this project consisted primarily of Asymmetrical Digital Subscriber Line (ADSL) technology. This high bandwidth Internet access option provides the needed bandwidth for maximum quality videoconferencing using the equipment and software used in this project. The ADSL service from NBTel is rated at 700kb upload and 2MB download. The barriers encountered while using this technology have been primarily related to the availability of the service within the province. The performance of the ADSL lines is good although we have had to get some lines tested and adjusted, as we were not achieving the performance expected.

Unanticipated issues

The project encountered some unanticipated issues such as the lack of funding for the network costs associated with this project. We had anticipated that the NBiNet program would cover these costs, however we were unsuccessful in our application to this program. This lack of funding combined with the lack of ADSL availability at the SCCR caused problems providing the SCCR with a high bandwidth Internet connection. The solution to this problem was to provide access to the SCCR participants at the offices of the IBME and NBESMOD when they wanted to videoconference with remote units. The overall effect of less direct or convenient access to the system resulted in less than anticipated participation from this project partner.

Transferability of the technology and knowledge

The project can be implemented in other health care areas and regions that have access to high bandwidth Internet connections such as the ADSL service. This high bandwidth Internet access option is growing at a rapid pace across Canada. The computer hardware and software used throughout the project are off the shelf components that any health care facility may have readily available or can easily acquire.

Viable alternatives

We have not encountered any systems that could be considered a viable alternative to the systems used for this project. Other options are at a much greater price and include expensive dedicated network lines and dedicated equipment. Our system uses affordable Internet access network lines, free software, and hardware that can be shared between the videoconferencing system application as well as other computer applications. The systems used can be viable solutions for health care facilities large and small while other systems can only be affordable for the very large health care facilities.

Conclusion

The use of a computer based interactive video communication system is an option for providing remote health care services to both therapists and clients in remote locations when high bandwidth Internet access is available. This system is also a very useful tool to enhance communication when interacting with equipment suppliers as remote viewing of equipment can increase the probability that the equipment will be appropriate for the intended individual. The users of the system seem satisfied with the quality and user friendliness of the system although the instability of the system is a serious concern that will hopefully be further addressed in future developments in both the computer operating system and the Netmeeting videoconferencing software. The acceptance of this technology will be greatly enhanced when it is as stable as the telephone service and it works problem free every time you use it.

This technology can impact the Canadian health care field in several different ways. The possibility of therapists being able to consult with specialists remotely decreases travel costs, increases efficiency and also increases the level of knowledge available in local communities. The time saved when not having to travel to remote locations allows for more time to actually see clients and provide services. The hazards associated with traveling in Atlantic Canada during the winter months are reduced when less travel is required. The use of this technology can also reduce the isolation felt by therapists in remote areas as well as have a positive effect on health care professional retention in these remote areas.

The clients receiving remote health care services using computer based interactive video systems benefit from reduced travel for certain services and can also benefit from more timely and feasible follow up when receiving specialized equipment. The remote troubleshooting capability is of great benefit when dealing with specialized equipment.

The non-profit groups who provide services to persons with disabilities in Canada benefit from such a system as it allows them to better communicate with both its clients and their health care professionals. The cost savings when health care professionals are able to view equipment before it is shipped is considerable as problems with equipment or its suitability for a client are determined before the item is shipped. This possibility increases the quality of the service to the client by reducing the time required to deliver the appropriate item. The efficiency of this is evident when considering the time required in finding suitable options or alternatives to fit equipment which has already been shipped, as additional shipping costs are encountered and it is often difficult to be sure of the exact fit for accessories once the main component is not available to try it on.

Clients receiving new prosthetic devices benefit from the increased accessibility and feasibility of remote follow up services. The Institute of Biomedical Engineering prosthetics fitting service provides services to clients across the Atlantic provinces and the ability to follow up these clients after a new fitting is necessary but very expensive and time consuming. The computer based interactive video system allows for more frequent follow ups at a fraction of the cost and can reduce the burden of travel and its associated costs for the client and family.

The computer based interactive video systems should evolve, mature and stabilize in the upcoming years as will the availability of high bandwidth Internet connections in remote areas. This option will become an increasingly attractive medium to deliver remote health care services due to its low cost, ease of use and its availability. The Netmeeting software met most of our needs for this project but enhancements such as the ability to transfer calls to another party, 3-way videoconferencing and a video answering machine would be of great benefit to this product.

Appendices

The appendices are available by request from the Institute of Biomedical Engineering

Appendix A Webcams

Appendix B Videoconferencing software

Appendix C Model Hardware and Software

Appendix D 2-way communication procedures

Appendix E 3-way communication procedures

Appendix F Log forms for data gathering

Appendix G Client consent form

Appendix H Netmeeting privacy statement

Appendix I Promotional material

Appendix J Atlantic Rehabilitation Research Association (ARRA) presentation slides