THE CHILD TELEPSYCHIATRY PROJECT - A RANDOMIZED CONTROLLED TRIAL

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(A COMPARISON OF INITIAL CHILD PSYCHIATRY ASSESSMENTS CONDUCTED VIA TELEMEDICINE TO ASSESSMENTS CONDUCTED FACE-TO-FACE)

By

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ABSTRACT

Telemedicine - the use of telecommunications technology to transmit medical information to and from a distant location, has many potential benefits. A variety of technologies can be used to conduct telemedicine and it has applications in every field of medicine. This thesis investigates the use of a PC-based videoconferencing system to conduct child psychiatric assessments at a distance. Using a randomized, controlled design, 23 patients and their parents completed a telemedicine interview and a face-to-face interview. Self-report questionnaires and semi-structured interviews were used to obtain data for the study. The data were coded and the evaluators blinded. The diagnosis, treatment recommendations and participant satisfaction with the telemedicine and face-to-face assessments were compared. An independent evaluator concluded that in 22/23 cases (96%) the diagnosis and treatment recommendations made via telemedicine were clinically the same as the diagnosis and treatment recommendations made face-to-face. Overall, participants responded positively to the telemedicine assessments. All five psychiatrists stated that telemedicine assessments were an "adequate alternative" to face-to-face assessments and did not interfere with making a diagnosis. However, if given the choice they "preferred" to assess a patient face-to-face. The majority of patients "liked" using the system to talk to the psychiatrist and 5/17 children (29%) said they preferred talking to the doctor using the telemedicine system versus face-to-face. Parents were also positive toward the telemedicine system with 21/23 (91%) stating that if they had to travel a long distance to see a psychiatrist they would prefer to use the system. General conclusions include: 1) it was possible for psychiatrists to conduct a child psychiatry assessment using the PC-based videoconferencing system, 2) psychiatrists make the same diagnosis and treatment recommendations via telemedicine as they do face-to-face and 3) psychiatrists, patients and parents were satisfied with the telemedicine system.

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INTRODUCTION

Definition of Telemedicine

> "Despite the fact that telemedicine has been talked about and tried for more than three decades and a substantial national investment in research and demonstration projects has been made, we have yet to reach a consensus on what it is and what it is not." (Bashshur, 1995, p. 20)

The literal definition of the word telemedicine is "tele" meaning "distance", and "medicine" meaning "the art and science of the diagnosis and treatment of disease and the maintenance of health". Combined, telemedicine is "The diagnosis and treatment of disease and maintenance of health at a distance." This definition is quite broad and many individuals have tried to limit it. The first definition of telemedicine in a peer-reviewed journal was by Willemain and Mark in 1971. They defined telemedicine as "any system of medical care in which the doctor and his patient are in different locations." (Willemain and Mark, 1971, p.9). The definition is noteworthy because it included the concept of telemedicine as a "system of medical care" and did not include a technological component. Some later definitions of telemedicine include:

> "The practice of medicine without the usual physician-patient confrontation, via an interactive audiovideo communications system." (Bird, 1975, p.90)

> "The use of telecommunications technology to assist in the delivery of health care." (Conrath, Dunn, & Higgins, 1983, p.24)

> "The use of electronic information and communications technologies to provide and support health care when distance separates the participants. (Field, 1996, p. 1)

All these definitions include a technological component and some even specify the type of technology, e.g. interactive audiovisual communication system. In fact, most definitions have tended to focus on the technology (particularly interactive television) and only recently has the concept of telemedicine as a system of care re-emerged. Bashshur states, "only when viewed as a complete and integrated network will telemedicine's unique distributive capabilities and integrative functions be maximized." (Bashshur, 1997, p. 6-7). For this paper, the author has defined telemedicine as:

> *"A health care system that uses telecommunications technology to transmit medical information between sites."*

This definition encompasses a broad range of technologies and does not limit telemedicine to the use of interactive television or even to computers. The term medical information includes information of all types, e.g. text, numerical data, audio, still images, and video. Finally, the definition does not limit telemedicine to a specific application, e.g. medical consultations but recognizes that it can also be used for other purposes such as education. Possibly, the best way to view telemedicine is as an "innovation bundle" (Rogers and Shoemaker, 1971). Innovation bundles consist of several components, not all new, but brought together in a unique way.

Telemedicine - A Panacea or Pandora's Box?

Enthusiasts say telemedicine will solve many of the problems in the health care system while opponents say its hasty implementation will simply cause more problems, a form of "technological thalidomide" (Elford, 1996). If you are involved in health care, it is important "to understand the principles of telemedicine, why this field has

suddenly emerged from relative obscurity, where it may lead, and what benefits or pitfalls may exist along the way" (Perednia and Allen, 1995, p. 483). A 1995 editorial in the Lancet stated, "Telemedicine is here to stay and is likely to play an increasing role in future health care." (Lancet, 1995, p. 74). In the inaugural issue of the Telemedicine Journal, the lead article was entitled, "Telemedicine has come of age" (DeBakey, 1995, p. 3). Finally, Dr. Richard Wootton editor of the Journal of Telemedicine and Telecare says, "Having become technically and economically feasible, it deserves proper investigation." (Wootton, 1996, p.1375)

Rationale for Telemedicine in Canada

> "The geographic characteristics of Canada,with its narrow band of populated areas and immense, sparsely-settled territories, should encourage the development of telemedicine and telepsychiatry, both as a partial solution to the well known problem of medical manpower maldistribution and as a source of support for isolated practitioners." (Dongier et al., 1986, p. 32)

Canada is a vast country (9 976 139 km^2). Its size and relatively small population (29 606 100 in 1995) combine to give it one of the lowest population densities in the world (2.9 persons / km^2) (Canada Year Book - 1997). The majority of Canadians live in centers located within 250 km of the country's southern (American) border, with the rest of the country being sparsely populated. Travel in remote areas is often difficult due to the geography or inclement weather conditions. For many Canadians in rural communities, transportation to medical centres takes a

long time, is costly and is sometimes dangerous. "Distance, climate, and patterns of population distribution combine to create special challenges in the delivery of health care in Canada, particularly in the North." (Chouinard, 1983,p.850). Because of these factors, the patient's diagnosis and treatment are often delayed and their condition deteriorates. Patients in remote communities also do not have equal access to health promotion or education programs that are commonly available in larger centres. Health care providers working in remote areas are disadvantaged as they often have to practice without backup from specialists, access to special tests, and have limited opportunities for continuing education programs or interaction with their peers.

Equalizing access to health services is not just a moral obligation in Canada. In 1984, the Canadian government passed the Canada Health Act, which building upon the Medical Care Act of 1966 established criteria and conditions that the provinces had to meet before they would receive federal monetary assistance for health care. The five principles, sometimes called the pillars of the Canadian Health Care system are (Crichton, 1990):

1) **comprehensiveness** - meaning coverage of all insured health services provided by hospitals, medical practitioners or dentists and other designated professionals

2) **universality** - 100% of insured persons are entitled to insured health services under uniform terms and conditions, with a waiting period for provincial residents not to exceed three months

3) **portability** - residents moving to another province would be covered during the waiting period by the old province

4) **public administration** by a public nonprofit authority responsible to the provincial government

5) **accessibility** - reasonable access by insured persons to insured health services unprecluded or unimpeded, either directly or indirectly, by charges or other means.

The combination of universality and accessibility imply that any person in Canada should receive the same standard of care independent of where they live. If the provinces do not adhere to these principles, they risk losing a portion of the federal money that would normally be transferred to the province.

One potential solution to maintain the above principles is to increase the number of health care professionals, services and facilities available in remote communities. However, improved methods of diagnosis and treatment depend on expensive equipment, on highly trained staff to operate and maintain this equipment, and on specialists, technologists and doctors to interpret the data, diagnose the patient and provide treatment. Unfortunately, the cost of providing this standard of medical care for all Canadian citizens is excessive. In many cases, the low population density in rural Canada simply does not justify the expense. It follows that health care staff and resources must be concentrated in a few locations, where they can provide the most service per dollar expended. Dr. House, a Canadian telemedicine pioneer said,

> "The challenge of designing medical services for a small population scattered amongst numerous isolated settlements dispersed over a rugged land mass with poor transportation links, a harsh climate and varying communication facilities is enormous." (House and Roberts, 1976, p. 17)

The need to provide medical services in a cost-effective manner is becoming increasingly important. In 1993, Canada spent $72.1 billion on health care, or 10.1% of the GNP ($2,507 / person). This compares with only 7% of GNP in 1980.

Globally, Canada is second only to the United States (14.4%) for the %GNP spent on health care (Sutherland and Fulton, 1994). The federal government is faced with the task of paying for an increasingly expensive system in the face of mounting debt. Funding from the Federal government which used to cover 30.8% of the total provincial health care expenditures in 1975 has been gradually reduced over the years so that by 1991 federal funding covered only 24.4% of the total (Sutherland and Fulton, 1994). The decrease in transfer payments has made it increasingly difficult for the provinces to fund health care services as the provinces themselves face large debts. Subsequently, many provinces have initiated or made severe budget cuts that will effect all areas of provincial jurisdiction, including health care. "Health expenditures, at 25% to 33% of total provincial and territorial budgets, are being further limited or reduced. Through actions to improve the efficiency and management of their health systems, the provinces and territories are striving to live within their fiscal capacity." (National health expenditures, 1993, p.10). Telemedicine is seen by many health care administrators as one way to continue to provide health services while containing costs.

Why Child Psychiatry was chosen as the Research Topic

There are a number of areas in medicine that could potentially benefit from telemedicine technology; however for this thesis it was necessary to focus on one specific area. Child psychiatry was chosen as the research topic for the following reasons:

1. There was a tremendous need for child psychiatry services in the province.
2. The literature was very positive towards telepsychiatry, particularly child telepsychiatry.
3. All five child psychiatrists in the province were interested and agreed to commit time to doing research.
4. Technically, the equipment needed to do telepsychiatry was simpler and less expensive than required for most other medical specialties.

Mental Health Needs in Newfoundland and Labrador

The Province of Newfoundland and Labrador has a shortage of mental health professionals, e.g. psychiatrists, psychologists, nurses, social workers and support personnel. From 1985 until 1995, the provincial population has remained relatively constant at approximately 575 000 (Statistics Canada, 1995). The recommended psychiatrist-to-population ratio according to the Canadian Medical Association - Royal College Committee is 1:8 400 (El-Guebaly N et al., 1991). In 1991, the

national psychiatrist to population ratio was 1:9 498. In Newfoundland, the ratio was 1:18 121, nearly one-half the national average (El-Guebaly N et al., 1991). The shortage is particularly severe for child and adolescent psychiatric services. In 1995, there were approximately 133,500 children (age's 0-16 years) in Newfoundland and Labrador (Statistics Canada, 1995). National studies suggest that 18-20% of these children will suffer from an emotional / psychiatric disorder that would benefit from an assessment by a mental health professional, and 4-5% are predicted to have a severe, persistent disorder (El-Guebaly N et al., 1991). Health and Welfare Canada (1990) projected that in 1994, 1/4 -1/3 of all mental health referrals in the province would be for children. No formal recommendations have been made for a child psychiatrist to population ratio; however, it would be reasonable to assume that if 1/4 of all referrals were for children, the ratio should be 1/4 the recommended psychiatrist to population ratio, e.g. 1:33,600. Based on this ratio, the recommended number of child psychiatrists for the Newfoundland and Labrador would be seventeen. In 1995, there were only five child psychiatrists in the province. Unfortunately, it is unlikely that Newfoundland will be able to attract the recommended number of psychiatrists, especially with the recent federal and provincial budget cuts.

The severe shortage of child psychiatrists is compounded by their uneven distribution. All five child psychiatrists practice in St. John's, located on the eastern coast of Newfoundland. As there are no child psychiatrists practicing elsewhere in the province, many children who need to be assessed for mental health problems are referred to St. John's. This means children and their parent(s) who live on the western side of the island may have to travel up to 800 km to see a psychiatrist and the only

realistic option for patients in Labrador is to fly to St. John's. In poor weather, referrals may be delayed due to hazardous travel conditions. It is likely that the cost and time needed to travel from distant communities to St. John's have a negative impact on some children's access to mental health professionals and subsequently the mental health of these children suffers. It is also likely that the stress of traveling has an adverse effect on the patient's mental health. Potential benefits of using a telemedicine system to conduct child psychiatric assessments at a distance include:

- Improved access to child psychiatric services for patients living in communities outside St. John's.
- Reduced travel for patients and their parents (or guardians).
- Reduced need for child psychiatrists to travel to smaller centres.
- Increased number of patients managed in the community and a subsequent decrease in the number of patients referred to a tertiary care centre. This could lead to a decreased need for tertiary care psychiatric beds.
- Cost savings for patients primarily due to decreased travel expenses.
- Cost savings for the health care payer due to decreased reimbursement for travel (particularly for patients covered by social services), and increased utilization of less expensive non-tertiary care (e.g. community) facilities.
- Increased likelihood of obtaining consultation services at short notice with subsequent faster medical decisions and probability of shorter stays in hospital.
- Facilitation of patient follow-up and long-term care without the patient having to travel extensively.
- Sharing of relatively rare specialist expertise throughout the province.
- The use of videoconferencing for a variety of other applications, e.g. medical / educational rounds, echocardiography transmission, administrative meetings.

LITERATURE REVIEW

Introduction

Psychiatry was one of the first medical specialties to utilize telecommunications technology to deliver services at a distance. Psychiatry is an ideal telemedicine application because the diagnosis and therapy of mental illness is primarily through audiovisual communication. Although it may be difficult to imagine a psychiatrist and patient being able to develop a therapeutic relationship over a television, the literature documents that it is possible. Overall, the literature is very positive towards telepsychiatry, providing evidence that it improves access to mental health professionals, is clinically effective and that psychiatrists and patients are satisfied with the medium. Only one study has specifically investigated child telepsychiatry. Four other studies mention that children were occasionally seen over the telemedicine system. Subjective comments from these studies indicate that children liked using the telemedicine system and some even preferred seeing a psychiatrist over it compared to face-to-face interviews.

From an evidence based standpoint, the quality of evidence supporting telepsychiatry is poor. This is because most telepsychiatry studies to date have been descriptive and even the few controlled studies have a number of biases and limitations. Consequently, further research needs to be conducted; in particular well designed research trials that can provide quality evidence for or against the use of telepsychiatry.

Definition of Telepsychiatry

A universally accepted definition of telepsychiatry has yet to be made. This is not surprising, as there have been similar difficulties defining the more general term telemedicine. The first use of the word 'telepsychiatry" in a peer reviewed journal was by Dwyer (1973). His use of the term implies a psychiatric consultation by interactive television. Later, Maxman (1978) also referred to telepsychiatry as the psychiatric use of interactive television. Dongier (1986) similarly defined telepsychiatry as a consultation carried out using two-way interactive television. These early definitions limited telepsychiatry to a specific technology, e.g. interactive television. Since the most common technology used for telepsychiatry today is digital videoconferencing systems, the earlier definitions are no longer appropriate. It is also likely that new technologies in the future will replace those being used today. It is the author's opinion that the definition of telepsychiatry should not be limited to a specific technology, but allow for a wide variety of technologies, e.g. videoconferencing, multimedia computers, telephone. It should also include a wide variety of applications within mental health, e.g. consultation, education, supervision, administration. Therefore the following definition of telepsychiatry is proposed:

Telepsychiatry - the use of telecommunications technology to conduct mental health activities at a distance.

Division of telepsychiatry literature into two categories

To simplify the review, the telepsychiatry literature has been divided into two categories: 1) Early Analog Era (Pre-digital) and 2) Modern Digital Era. The Early Analog Era began in 1955 and ended in the late 1980's. The technology used by all telepsychiatry programs during this era was analog based. The Modern Digital Era

began in the late 1980's and is characterized by the use of videoconferencing systems, codecs (coders-decoders) and digital compression. The telepsychiatry activities occurring during each era will be summarized and the methodology and conclusions of the publications critiqued.

Early Analog (Pre-Digital) Era

The majority of telepsychiatry projects in the Early Analog Era were demonstration or "test of concept" projects. They were done to show that telepsychiatry was technically possible. They were not designed to answer specific research questions and no control groups were included for comparison. Most of the early papers were descriptive and simply described how the telepsychiatry system was set up, what it was used for and how it performed. The conclusions were based on the subjective opinions of project participants. Consequently, the validity and generalizability of the results are poor. Two studies in the Early Analog era did include a control group. However, both suffered from a number of biases and limitations and the validity and generalizability of their conclusions are also questionable. Looking back, it is easy to criticize the methodology and quality of the evidence generated by these early studies; however they did generate a lot of empirical evidence and much can be learned from their experiences. Table 1. summarizes the early telepsychiatry sites with peer-reviewed publications.

Table 1. Early Analog Telepsychiatry Sites with Peer-reviewed Publications

Site	Years Active	Peer-reviewed Publications
Nebraska Psychiatric Institute Omaha, Nebraska (USA)	1955 – mid – 1980's	Wittson & Dutton (1956) Wittson, Affleck & Johnson (1961) Benschoter, Wittson & Ingham (1965) Hedman & Mansfield (1967) Benschoter (1967) Wittson & Dutton (1967) Menolascino & Osbourne (1970) Wittson & Benschoter (1972)
Massachusetts General Hospital Boston, Massuchussets (USA)	1968 – early 1970's	Fisch & Dwyer (1972) Dwyer (1973)
Dartmouth-Hitchcock Centre Hanover, New Hampshire (USA)	1968 - 1970	Solow, Weiss, Bergen & Sanbom (1971)
Mount Sinai Hospital New York, New York (USA)	1973 – 1975	Straker, Mostyn & Marshall (1976)
Review of the early telepsychiatry programs		Maxmen (1975)
Albitibi General Hospital Albitibi, Quebec (CANADA)	1984 - 1985	Dongier, Tempier, Lalinec & Meunier (1986)
University of Western Ontario London, Ontario (CANADA)	1984 – late 1980's	Jerome (1986) [Letter 1] Jerome (1993) [Letter 2] Jerome (1993) [Letter 3]

First use of telecommunications technology for psychiatric activities

When the Nebraska Psychiatric Institute (NPI) was built in 1955, it was designed to anticipate the potential of closed circuit television (CCTV) as a teaching and training tool and the entire institution was wired for CCTV. Portable CCTV units could be used in a number of different rooms including a 180-seat auditorium. Initially, the system was used for the following purposes: 1) to aid nurses in maximum security, 2) to show professional visitors the facility, and 3) to improve classroom teaching. Regular lectures were supplemented with live or taped video sequences to

illustrate the material. In the first year, 1018 students in psychiatry, psychology, psychiatric social work, occupational therapy, undergraduate and graduate psychiatric nursing and related disciplines were exposed to the system. Wittson and Dutton (1956, p. 14) state, "This first year of experimentation has shown us that closed-circuit television is technically very satisfactory and that effective teaching programs can be produced at little expense."

In 1959, two-way television was used for the first time to link individuals located in different facilities. Until then all telepsychiatry activities had been conducted from one room to another within NPI. A coaxial cable link allowed instructors at NPI to transmit patient demonstrations and case information to medical students located in laboratories across campus.

First telepsychiatry research study

In 1961, the Nebraska Psychiatric Institute (NPI) received a grant to investigate the value of two-way television for group therapy. The study involved eight patient groups (consisting of 4 or 5 individuals each) and two therapists. Four groups met with a therapist via two-way television for six sessions of group psychotherapy. The four other groups met for six sessions using conventional face-to-face psychotherapy techniques. After the interviews, the patients and therapists completed questionnaires and the responses were compared. The method of choosing and allocating patients to the experimental or control group and the questionnaires used in the study were not described.

The authors state that during the first session, most patients showed an interest in and commented on the television system. However, after the first session, patients seldom referred to the technique itself, but began to focus on typical problems discussed in small group sessions, e.g. concern about hospital, going home, interpersonal problems, difficulties with their psychiatrists and other mental health workers. Little concern was expressed regarding privacy; all participants were introduced to the therapist, principal investigator and technician before the study began and assured that these would be the only people to view the discussion groups. One of the four television groups showed an atypical pattern. According to the authors, three of the five patients in the group, had previously manifested anti-social and negativistic behavior and no relationship of trust in the therapist or willingness to discuss problems emerged in this group. Instead, they utilized the television technique to strengthen their resistance, and by whispering excluded the therapist from discussion for some time.

Group and therapist ratings of the televised and non-televised group-therapy sessions were compared and preliminary results indicated that ratings were influenced substantially more by the therapist and the selection of the group members than the television technique. A subsequent paper (Wittson and Benschoter, 1972) refers to the 1961 study and concludes,

> "Analysis of rating scales of patients and therapists showed that the choice of therapist and the selection of group members influenced the effectiveness of therapy more than the use of the TV technique. In other words, the presence of television was neither a problem nor asset." (Wittson and Benschoter, 1972. p. 624).

First telemedicine network established

In 1964, the National Institute of Mental Health (NIMH) awarded Nebraska Psychiatric Institute (NPI) a $480,000, seven year grant to set up a two-way closed circuit television system between NPI and Norfolk State Hospital, a 1 100 bed mental hospital 180 km away (112 miles). The network became operational on December 1, 1964 and was the first of its type in the United States. "Nationally, this project will serve to demonstrate the worth of modern methods of communication as a partial solution to problems regarding education, research, and treatment that most state hospitals presently have in common." (Benschoter et. al, 1965, p. 100). The primary objectives of the project were: 1) To permit more frequent clinical consultations between the two facilities to improve patient diagnosis and treatment, 2) To expand teaching and training assistance to the state mental hospital, using NPI's extensive resources, 3) To provide Norfolk with more frequent contact with families in the Omaha area to facilitate information -gathering and counseling, while maintaining family interest in patients by enabling visits via the television network, 4) Increase collaborative research activity.

In January 1965, an NPI staff psychiatrist began administering a patient ward at Norfolk via television (Benschoter, 1967; Wittson and Benschoter, 1972). A closed, disturbed women's ward was selected for the experiment. The psychiatrist spent 30 minutes each day discussing ward problems with the head nurse and charge aide and talking to patients periodically. Three months later, 17 of the 35 patients were able to leave the ward (accompanied) and half were acceptable to other wards

with less security, and another third were transferred to nursing homes. Although no formal evaluation was made, the program was said to be so effective that eventually three psychiatrists administered 10 wards at Norfolk by television. Notably, the total inpatient population dropped from 900+ in 1965, to 476 in December 1968 (Wittson and Benschoter, 1972). The hospital administrators felt that the TV psychiatrists were certainly contributing factors in this decline.

Dr. Robert Osborne, Clinical Director at Norfolk, states "after the brief initial hesitation and skepticism on the part of the staff at this hospital, the TV network and its uses have generally been widely and enthusiastically accepted. It most certainly has contributed to maintaining our staff at our current manning levels and has served to maintain high morale." (Benschoter, 1967, p.476). In the first 15 months of service only one patient (a geriatric case) found the television upsetting.

Hedman and Mansfield (1967) report on the use of the NPI - Norfolk two-way closed circuit television system and video tapes for psychiatric nursing training and education. "Nurses at both hospitals have said they feel better prepared to function as team members." (Hedman and Mansfield, 1967, p. 809). Menolascino and Osborne (1970), describe the use of the existing NPI-Norfolk two-way television network for psychiatric consultation and supervision of mentally retarded adults. "This consultative arrangement reaches the "front lines" of patient care - the aides and orderlies - and motivates them to enlarge, improve and utilize their repertoire of helping skills in aiding mentally retarded patients." (Menolascino and Osborne, 1970, p. 162).

Review of NPI's Activities

In 1972, Wittson and Benschoter reviewed the University of Nebraska Medical Centre's use of two-way television in medical treatment and education. During the first six years the two-way network was active, beginning in 1964, the scheduled hours of use averaged 45-50 hours a week. Disadvantages of the two-way television system included difficulty in sound pick-up and camera operation with large groups requiring a technician to manually operate the camera during these sessions. Costs also were reported to be a major drawback. Maintaining dedicated transmission channels between NPI and Norfolk averaged approximately $48,000 / year over the six years.

In addition to the NPI-Norfolk link, another two-way television network introduced was in 1968 which linked NPI with three Veteran Affairs (VA) hospitals, located in Omaha, Lincoln and Grand Island. In 1970, the VA system logged 1,267 on-line hours (approximately 3.5 hours / day). Approximately 68% of the time was spent in educational activities, 25% in patient care functions and 7% for miscellaneous purposes. Wittson and Benschoter conclude:

> "Two-way television has considerable potential for extending health education and health services beyond the confines of the medical centre to local and distant institutions, clinics or community hospitals, and perhaps eventually to the physician's office, the high school counselor, or the small town PTA meeting. Like all communications tools, it will be effective in direct proportion to the amount of careful planning put into selecting the best system, determining appropriate uses, and encouraging interest and participation, both within the medical centre and with the individuals, groups or institutions beyond."(Wittson, 1972, p. 139).

Follow-up of NPI's telepsychiatry activities

No further publications detailed the fate of NPI's two-way television network; however, Baer, Cukor and Coyle (1997) contacted Dr. Benschoter in 1995. They found that although NIMH funding for telepsychiatry at NPI had expired in 1970, telepsychiatric activities continued with VA hospitals into the 1980's, until VA funding ended. Dr. Benschoter's recollection was that telepsychiatry activities ended not because of a lack of clinical interest in the system by VA physicians, but due to increasing technical problems with the aging equipment and high cost of transmission. In addition, psychiatrists and other medical specialists were eventually recruited to the remote sites and many of the services that the telemedicine system provided were no longer needed. Dr. Benschoter noted that reimbursement was not an issue, as physicians were salaried and services were provided solely to state and VA hospitals. She recalled no legal problems or licensing problems as services were not provided across state lines and prescriptions written and prescribed by a remote psychiatrist were always countersigned by a local psychiatrist.

Critique of the NPI Publications

Wittson & Dutton (1956), Wittson, Affleck & Johnson (1961), Benschoter, Wittson & Ingham (1965), Hedman & Mansfield (1967), Benschoter (1967), Wittson & Dutton (1967), Menolascino & Osbourn (1970), Wittson & Benschoter (1972)

Seven of the eight peer-reviewed articles referring to the mental health activities conducted at NPI are descriptive. They describe how the telemedicine

networks were set-up, the clinical, educational and administrative uses of the networks, the frequency of use, and the benefits and problems encountered. Two articles mention specific objectives (Benschoter et al., 1965) (Menolascino and Osborne, 1970) however, no formal research study was designed. The conclusions the authors make are based on personal observation and subjective responses from project participants. Although the authors' comments are very positive and compelling, from an evidence-based standpoint there is little objective evidence to support their claims. Hence, the validity and generalizability of their conclusions are poor.

Wittson, Affleck and Johnson, (1961) was the first paper to describe a controlled telepsychiatry research study. The project had a clear purpose and used a formal study design. Four patient groups receiving therapy over the telemedicine system were compared to four patient groups receiving therapy face-to-face. The paper was also the first to describe many of the logistics involved in setting up a two-way television interview. For its time, the study was well designed and far surpassed any other evaluations of telepsychiatry for many years. It demonstrated that two-way television could be used for group therapy and that the influence of the medium, i.e. CCTV, on the therapy appeared to be less important than individuals involved. However, the study suffered from a number of weaknesses: small sample size, selection bias, lack of randomization, use of unknown (non-standardized) questionnaires and non-blinded analysis of the data. For these reasons, from an evidence-based standpoint the study's validity and generalizability are poor.

Telepsychiatry used in an urban setting

In 1968, Thomas Dwyer began conducting telepsychiatry consultations over a bi-directional television system, called Telediagnosis (TDX), that linked Massachusetts General Hospital (MGH) to a health station 4.5 km away at the Boston Logan International Airport (Dwyer, 1973). Over a two and a half year period, Dwyer and colleagues saw approximately 150 patients from 2 -20 times each. Services provided ranged from diagnostic interviews with adults and children (47%), treatment using interview techniques alone or a mixture of interviewing and prescribed drug therapy (20%), brief intervention in acute crises (33%) and prolonged supportive and explorative therapy for some patients (7%). Group therapy was said to be especially effective. Dwyer states,

> "I approached the use of television to interview psychiatric patients with considerable negative prejudice, believing that the degree of personal contact with the patient would be limited and that many of the skills that are useful in a psychiatric interview would be diminished or lost. I was delightfully surprised to discover that this was not true." (Dwyer, 1973, p.867)

Dwyer mentions that other psychiatrists who had been skeptical initially, subsequently became positive about TDX's potential for one-to-one and group therapy after using the system. Dwyer found the initial strong negative reaction of some professionals a matter of interest and a subject worth investigating. He also felt that because one can have psychiatric transactions with all the usual developments, including transference and countertransference reactions, it called for a re-examination of the fundamental concepts about the nature of a relationship between two people.

Dwyer felt that it was too early to say that nothing was subtracted from the television encounter and encouraged further research to determine if there are kinds of patients or professionals who find a crucial ingredient missing in IATV contact. Experience with the system suggested that some patients, i.e. schizophrenics, adolescents and younger children, found talking to the IATV easier than talking to a psychiatrist in the same room. It was hypothesized that for these groups using the IATV was less intimidating than talking to a psychiatrist in person.

The IATV system was also used for a number of other non-clinical purposes. Fisch and Dwyer (1972) describe the use of bidirectional television as an educational vehicle to present psychiatric information to foreign trained psychiatrists preparing for specialty board exams, beginning in March 1970. Fisch and Dwyer state, "interactive television not only allows the development of a group relationship but also actually intensifies it." (Fisch and Dwyer, 1972, p. 913). The following changes were said to have resulted from the television course: 1) increased factual knowledge, 2) increased skill in literature reviews, 3) increased interest in further learning, 4) greater confidence in professional abilities, 5) a therapeutic response. The author's conclude, "The potential for generalizing this experience to upgrade professionalism in isolated federal and state institutions is great." (Fisch and Dwyer, 1972, p. 913)

Critique of the (Dwyer, 1973), (Fisch and Dwyer, 1972)

Dwyer's (1973) article is very positive and is based on experience with over 150 patients seen multiple times by over 30 mental health professionals. His

enthusiasm, although compelling, is not supported by any formal research. No research questions were asked, no study designed or outcome measures used to obtain data. His conclusions are based on personal experience and subjective responses from other participants. He himself states that the issues raised await systematic study. As such the validity and generalizability of the study's conclusions are poor.

The paper by Fisch and Dwyer (1972) describes the use of interactive television to teach a course to foreign trained psychiatrists as they prepare to write their Board Exams. The authors mention that information was gathered prior to beginning the course and during the project but the type of data and how it was gathered was not reported. A number of changes were said to have occurred due to using the interactive television for distant education, e.g. increased factual knowledge, but it is not stated how these changes were measured. Unfortunately, no outcome measures were described and there was no description of how the results were analyzed. In addition the study suffers from the following weaknesses: small sample size and no control group. The authors conclusions appear to be based on their personal observations and subjective responses from the participants. As such the validity and generalizability of the study are poor.

Telemedicine used for psychiatric consultations and distant education

In 1968, a CCTV telepsychiatric network was established linking the New Hampshire Dartmouth-Hitchcock Mental Center to Claremont General Hospital 40 kms away (Solow, Weiss, Bergen and Sanbom, 1971). The two year project was

designed to evaluate, 1) the utility of television as a medium of communication in psychiatric interviewing and consultation at a distance, and 2) the effectiveness of readily available psychiatric consultation as an educational program for physicians in the community who would not ordinarily take advantage of formal post-graduate psychiatry courses. Emphasis was placed on helping the referring physician maintain the patient in Claremont General Hospital if at all possible. In total there were 199 consultations (142 new and 57 follow-up) conducted over the telemedicine link. Overall, 90% of the cases were managed in the community, 70% by a physician, and 20% at the local mental health clinic. Patient acceptance of the system was said to be "impressively high". Solow et al. state that, "television has presented almost no difficulties as a medium for psychiatric consultation." (Solow et al., 1971, p. 122). Only once, when a severely agitated patient paced unpredictably about the studio, was there a significant problem in keeping the patient in view.

The paper also indicated that the participating general practitioners reported positive changes in their use and knowledge of psychotropic drugs and employed a wider variety of drugs, chosen more selectively and at more flexible and adequate dosages. The authors state, the "experience seems to dispel the mystery surrounding psychiatric work." (Solow et al., 1971, p. 1686). Solow et al. conclude,

> "two-way closed circuit television provides a means of psychiatric interviewing at a distance, in the setting of community medical practice, with a diagnostic and therapeutic effectiveness approximating that which is obtainable in face to face interviewing." (Solow et al., 1971, p. 122)

Critique of (Solow, Weiss, Bergen and Sanbom, 1971)

This article summarizes the use of an interactive television system for psychiatric consultations and as a tool to educate general practitioners about conducting a psychiatric interview. The conclusions are very positive, stating that the diagnostic and therapeutic effectiveness of telepsychiatry approximates a face to face interview. The number of consultations, e.g. 199, is also impressive. Unfortunately, the conclusions are not based on results from a controlled study. It is assumed that some type of questionnaire or interview was given to the physicians, as the paper states, "the general practitioners reported...", however, the measurement tools are not described and no quantitative data is given. Limitations include: lack of a control group, lack of randomization, lack of standardized questionnaires. Therefore, the validity and generalizability of the conclusions are poor.

First Child Telepsychiatry Study

The first telemedicine study to investigate the use of telecommunications technology for child psychiatry was initiated in 1973. The Mount Sinai School of Medicine set-up an interactive CCTV link to the Wagner Child Health Station in East Harlem, approximately 2.8 kms away (Straker, Mostyn, and Marshall, 1976). The link was used primarily by pediatric nurse practitioners to consult with pediatric specialists. Psychiatrists at the medical school used the system to conduct conferences with nurses and health workers, perform consultations with children and their families, and teach residents and medical students. During the 18 month project, there were 34 patient

consultations and 58 staff conferences discussing 138 cases. Before the telepsychiatry link, almost all referrals to the hospital to see a child psychiatrist were refused or were not attended by the East Harlem patients and their families. However after the introduction of IATV, 69% of the patients who were referred kept their scheduled appointments. The authors state, "This electronic link has opened the doors of the medical center to patients who would previously have been unable or unwilling to use its facilities." (Straker et al., 1976, p. 1204)

It was hypothesized that the success of the project was because the patients did not have to go to an unfamiliar hospital, and could see the psychiatrist on their own "turf", and because their own nurse or health worker was present during the interviews. Straker et al. mention that all mothers responded positively to 'being on television' and that, "They also seem to gain a sense of heightened self-esteem that is not as noticeable after an in-person consultation." (Straker et al., 1976, p. 1205). Psychiatrists were also said to view the service positively as they were able to provide consultations at a safe distance from the real or imagined dangers of an inner city ghetto. In conclusion Straker et al. state,

> "our experience to date suggests that bidirectional cable TV can be an important new and effective method of mental health care delivery to inner-city children who would often be untreated otherwise." (Straker et al., 1976, p.1205)

Critique of (Straker, Mostyn, and Marshall, 1976)

This was the first telemedicine study to focus on child psychiatry. Like most of

the early literature, it is descriptive in nature. Outcome measures were not defined or quantified and no formal data were gathered or analyzed. Although positive, the conclusions made by the authors were based entirely on subjective experience. The validity and generalizability of the conclusions are poor.

First Matched Controlled Telepsychiatry Study

A Canadian study, (Dongier, Tempier, Lalinec-Michaud, Meunier, 1986) compared CCTV to face-to-face psychiatric interviews in a controlled manner. For the study, a two-way CCTV system was set-up in Centre Hospitalier Malartic in Albitibi, a small town 560 km (350 miles) north-west of Montreal. The system linked two rooms on different floors of the hospital, simulating a long distance encounter. The purposes of the study were to: 1) carry out a quantified and controlled assessment of patients' and staffs' psychological reaction to telepsychiatry, 2) provide governments with objective data on the feasibility of telepsychiatry and 3) begin to gather data necessary to obtain a baseline for future comparisons with the cheaper slow-scan technology.

The study population included a representative clinical sample of 50 patients (both in-patients and outpatients) selected from consecutive admissions to the Albitibi Hospital. A control group of 35 patients matched with the previous sample for diagnosis, sex and age was selected for face-to-face interviewing. Likert-type questionnaires were filled out immediately after the interview by the patient, consultee and consultant.

Results indicated that patients rated the majority of CCTV interviews as "above average". No significant difference was found between the CCTV and control group scores ($p>.10$) for patients, although the direction of differences consistently favoured the control interview, i.e. face-to-face interview. Even schizophrenics with ideas of reference including being talked about on public television programs, accepted the CCTV interaction very well and had no observed exacerbation of their delusions. The majority of consultees also rated the CCTV as 'better than average". However, CCTV interviews were rated significantly inferior to the control interview for global assessment ($p < .05$) and diagnosis ($p < .01$) and tended to be inferior ($p < .10$) for the written consultation. The estimated mean difference in scores however, was only 0.25 out of 5.0 (SE 0.12). The consultants ranked the CCTV interview inferior compared to the face to face encounter for all items on the scale. The estimated mean difference in scores for global assessment was 0.41 out of 5.0 (SE 0.10). The authors state that the sample sizes used provided sufficient power for the detection of clinically relevant differences, particularly for evaluations between consultees and consultants (since their responses were less variable than the patients).

The researchers found that, in the case of adult patients, the CCTV interview was inferior to the control interview by both consultee and consultant ($p<0.05$). The authors state the number of children tested was insufficient to allow firm conclusions to be drawn regarding child psychiatry, however the direction of the differences was similar to those in adults. The investigators global conclusion was "largely positive: bidirectional CCTV interviews can be an effective method of mental health care delivery." (Dongier et al., 1986, p.34).

Critique of (Dongier, Tempier, Lalinec-Michaud, Meunier, 1986)

This is the second telepsychiatry study that directly compared a telepsychiatry interview to a face-to-face interview in a controlled manner. It was the first to include a matched controlled group, to quantify the responses of the participants and to analyze the responses for statistical significance. Although the study did show that both the consultees and consultants found the CCTV interview inferior to the face-to-face interview ($p<0.05$), they still ranked it as average or above average. The authors conclude that telepsychiatry, "can be an effective method of mental health care delivery". This seems to indicate that the differences between a face-to-face and telemedicine interview, although statistically significant, were not clinically significant. This raises an important question in telemedicine research. What level of statistical significance is clinically significant? Even if a telemedicine interview is inferior to a face-to-face interview is it still good enough? What aspects of care are achievable with telepsychiatry at least at the same level as in a face-to-face encounter; what aspects are inferior to a face to face encounter?

Although this was a controlled study, several methodological weaknesses should be considered. First, the selection and allotment of subjects to either the control or experimental group were done using matching (on the basis of sex, age, diagnosis) rather than random selection. This type of subject selection has the following disadvantages. First, it may be susceptable to selection bias on the part of the participants and investigators. Second, it precludes the use of many statistics, such as the t-test used by the authors, which assumes random selection of subjects. The outcome measure used in the experiment, i.e. the five point questionnaire, was

probably not a validated test measure and the authors do not report any previous validity or reliability testing. The authors say the study had adequate statistical power to detect clinical differences. However, they do not mention in the paper how this was determined. Overall, the study was well done, and the results are likely to be valid for the specific population and equipment tested. Although, the study was stated to have adequate numbers, it is questionnable whether the results are generalizable to other sites.

First fee for service billing for telepsychiatry

In November 1980, an interactive telehealth network began operating linking the University of Western Ontario teaching hospital in London, Ontario to the General Hospital in Woodstock (WGH), approximately 200 km (140 miles) apart (Jerome, 1986), (Mount, 1981). The objectives of the program were to: 1) provide access to continuing health education from a university setting, 2) permit elective consultations, 3) determine how the television link influenced the practice of medicine in the community, 4) decrease the sense of professional isolation, e.g. attract staff and decrease turn-over of present staff.

During the first year of the network, the majority of consultations done were in the area of psychiatry. The interactive system allowed three general psychiatrists at the Woodstock General Hospital to make use of subspecialty services, e.g. psychoanalysis, forensic psychiatry, geriatric psychiatry, and child psychiatry. Mount states, "probably the most amazing aspect of this exchange has been the minimal

interference technology has made in a clinical setting which requires the greatest degree of rapport for a successful consultation." (Mount, 1981, p. 22)

From November 1984 to August 1985, weekly child psychiatry consultations took place over the system. No patients refused to be seen. Mount states that patients of all types found the television consultation easy to do and that the staff men all had "a positive regard for the potentials of this type of work." (Mount, 1981, p. 22).

The London - Woodstock connection was the first telemedicine project to directly address the issue of fee-for-service reimbursement and medico-legal liability. Billing for services rendered over the system commenced in January 1982 and were billed as though the service was delivered face-to-face. In addition, the Canadian Medical Protective Association (CMPA), the Canadian organization responsible for malpractice insurance, indicated that they would provide coverage for this "unorthodox style" of practice.

Jerome (1986) does mention some disadvantages of the system. Technical difficulties made it impossible to focus on a family member when having the general view of the family, significantly less hypothesis generating took place with team members, and there was a strong feeling that face-to-face contact was preferable and the television link was seen to be a second best option. Jerome concludes,

> "Despite the reservations, the link was felt to be useful in providing child psychiatric consultation and ongoing treatment to an under-serviced area. The link provided adequate clinical assessments of a routine and crisis nature with a 50% reduction in clinical time for the consultant when comparing on site consultations. Patient acceptability was high." (Jerome, 1986, p. 489)

Critique of (Jerome, 1986), (Jerome, 1993), (Mount, 1981)

The information for this project was taken from three letters written by Jerome published in a peer-reviewed journal supplemented with information from a non-peer reviewed paper by Mount. Although specific objectives were outlined, no formal study was designed or data collected. Only a descriptive summary of the project was ever published. As such the validity and generalizability of the conclusions are poor.

A New Era in Telepsychiatry

From 1955 until the late 1980's, all telepsychiatry sites utilized black and white analogue closed circuit television technology transmitted over coaxial cable or microwave to provide two-way television (interactive television). One of the inherent difficulties with analogue video was the large bandwidth required for transmission, i.e. 6 MHz. The only telecommunications media that had the capability to transmit this amount of information were microwave, coaxial cable or satellite and all were expensive. The other drawback to these early systems was that the telecommunication links had to be leased and paid for even if they were not used, e.g. dedicated lines.

Advances in telecommunication and information technologies in the 1980's led to a change in the type of technology used for telepsychiatry. Digital technology, e.g. digital videoconferencing systems and multimedia computers, began to replace analog technology. The advantages of digital technology were that it allowed audio, data and video information to be stored, packaged and transmitted together over the same

telecommunications links. There was also less degradation of the information over distance and most importantly it could be compressed. Information that previously required a large bandwidth to transmit, could now be compressed and sent over much smaller bandwidths. For example, to transmit the digital equivalent of CCTV video, a bandwidth of approximately 90 Mbps is required (the equivalent of 1,400 digital telephone lines). With compression, "acceptable" video, could be transmitted using fractional T1 digital telephone lines, e.g. 128 - 384 kbps (2 - 6 digital telephone lines). The significant reduction in bandwidth requirements resulted in substantially reduced transmission costs.

The other major advance that helped drive the change to digital interactive video systems was the development of the digital telecommunications infrastructure. These networks were ideal for transmitting digital information of any type, e.g. data, voice, images, video. Combined with other technologies like inverse multiplexors, multiple digital telephone lines could be added together to give bandwidths ranging from 128 kbps - 1.54 Mbps - ideal for compressed video. Many of these digital networks were also dial-up, meaning you only paid for the lines when you used them. Due to the benefits of the new digital technologies, all telepsychiatry sites in the 1990's began to use digital videoconferencing systems or multimedia computers running videoconferencing software programs.

The major disadvantage with digital technologies was a result of using compression, specifically the more compression used, the lower the quality of the resulting audio and video. This added a whole new dimension to telemedicine

research. The question changed from, "Can telepsychiatry be done?" to "What bandwidth is necessary in order to have acceptable video and audio quality to do telepsychiatry?" A number of sites in the 1990's are beginning to address this question.

It is probable that different mental illnesses and types of consultations, e.g. initial versus follow-up, adult versus children, may require different levels of audio and video quality. Different "quality levels" may also be needed in order for psychiatrists to feel confident diagnosing and treating patients and for participants to be satisfied with the experience. Table 2. summarizes the modern telepsychiatry sites with peer-reviewed publications.

Table 2. Modern Digital Telepsychiatry Sites with Peer-reviewed Publications.

Site	Years active	Publications
Guys's Hospital London, England (UK)	1990 - present	McLaren, Ball, Summerfield (1992) Ball, Scott, McLaren & Watson (1993) Ball & McLaren (letter) (1995) Ball, McLaren, Summerfield, Lipsedge& Watson (1995) McLean, Ball, Summerfield, Watson & Lipsedge (1995) McLaren, Blunden, Lipsedge & Summerfield (1996) McLaren, Laws, Ferreira, Lipsedge& Watson (1996) Ball, McLaren, & Watson (1996)
Royal Adelaide Adelaide and Whyalla (AUSTRALIA)	1995 - present	Kavanagh & Yellowlees (1995)
Queensland Telmental Health Queensland Project Townsville, (AUSTRALIA)	1996 - present	Trott (1996)
Harvard Medical School Boston, Massachusetts (USA)	1995 - present	Baer, Cukor, Jenike, Leahy, O'Laughton & Coyle (1995) Baer, Cukor Book (Chapter) (1997)
Telemedicine Department Tromso, Norway	1996 - present	Gammon, Bergvik, Bergmo & Pedersen (1996)
Telepsychiatry Survey of the United States		Brown (1995)

First telepsychiatry research conducted on digital telemedicine systems

A research team at the United Medical and Dental Schools (UMDS) Department of Psychiatry in London, England, was the first to investigate the use of digital telecommunications technology for a variety of tasks in clinical psychiatry beginning in the late 1980's (McLaren, Ball, Summerfield, Lipsedge, 1992). The department is currently the most active telepsychiatry research group and has published more articles on the telepsychiatry than any other site.

The telemedicine system used for UMDS's first telepsychiatry studies was a low cost videoconferencing (LCVC) system. It was PC-based, had a monochrome

12" monitor and the video image only filled a quarter of the screen. Resolution of the image was 160 x 128 pixels, with either 16 shades of grey at 25 fps, or 64 shades of grey at 12.5 fps. The telecommunications link was a 2 Mbps telephone link. A Technics amplifier and loudspeaker running in parallel with the video link, giving hi-fi quality sound generated sound. The cost of the system was approximately US $2500. It is important to note that this system did generate quality audio but did not generate high quality video. There was also a bit of a delay between the audio and video signals.

In 1992, McLaren, Ball, Summerfield, Lipsedge, (1992) reported on the use of the LCVC for use with medical student training in psychiatry. Students were to present the patient case over the LCVC interviews and face-to-face to a staff member. The order was randomly assigned. A total of nine face-to-face and eight LCVC were completed. Six students completed both interviews and MSFOS questionnaires. Self-report questionnaires were used to obtain results. Results were analyzed for statistical significance.

Results indicated that "No significant difference was detected on student assessment of case presentations on the LCVC compared with face-to-face." (McLaren, et al. 1992, p. 47). The project demonstrated that the LCVC could be used for the clinical presentation of patient cases and the general response of users was positive. The most prominent negative response to the questionnaire was in response to feelings of self-consciousness. The authors anticipated that this effect would diminish with repeated use. The conclusion from the pilot study was that the use of a

digitized low cost videoconferencing system for remote interactive psychiatry teaching was broadly acceptable to students and teachers.

Administration of a standardized psychiatric screening test over a telemedicine system

Ball, Scott, McLaren and Watson (1993) compared the administration of the Mini-Mental Status Exam (MMSE) via a low-cost videoconferencing system to face-to-face administration. The MMSE was modified for the LCVC, e.g. writing had to be 1.5 cm high to be legible and the three part command (take the paper in your right hand, fold it in half and place it on the floor) was changed to putting the paper on the patient's head so it could be seen.

The order of testing was random, with the second test done within 48 hours. Twelve patients were enrolled in the trial and eleven patients completed both parts. The results of the study indicated that the mean scores of the eleven patients were highly correlated, $r = .89$, and rescoring of illegible material resulted in a correlation of $r = .92$. The researchers conclude,

> "this study has provided evidence that a standardized cognitive screening test can be reliably carried out using the LCVC in an adult population with acute psychiatric illness." (Ball et al., 1993, p. 306).

They recommend that further studies be conducted to demonstrate that this finding is more generally applicable to a wider age group, across a greater range of diagnostic categories and cognitive states.

Comparison of different communication modes in adult psychiatry

Ball, McLaren, Summerfield, Lipsedge & Watson, (1995) compared different modes of communication in adult psychiatry (i.e. face-to-face, telephone, hands free telephone, and LCVC) Hands free telephone was simulated by using the LCVC equipment without the video.

For the study, physicians and patients were asked to perform tasks that would be part of the normal routine on the ward. The encounters were repeated by each pair of individuals in all four modes in random order. Assessment methods included observation, studying non-verbal behavior, verbal response modes, and self-report measures.

Results indicated that for different modes, the results were significantly different ($F=15.9$, $P<0.001$). Patients in a nonvisual mode had the least relaxed body posture. No significant difference was found when looking at the effects of subject and communication mode. However, it was found that senior doctors asked more questions ($F=6.3$, $P<0.015$). High levels of mutual gaze were recorded in both the face-to-face and LCVC interviews (75% vs. 72%), with no significant difference.

Self-report measures for patients found no significant difference between the face-to-face interactions and the three other modes. Patients did report lower levels of anxiety in the visual modes and felt better having "seen" their doctor. The LCVC did induce the greatest frustration, the least sense of having been understood, and the most disappointment with the consultation. However, the level of satisfaction, level of reassurance received and sense of being understood were reported to be high in all

modes.

Doctors' self report measures showed that there were no significant differences between face to face and other modes. The satisfaction expressed by the doctors and the degree to which they felt they understood the patient were reduced when visual cues were removed. This also caused them to be more frustrated and reduced their ability to develop rapport. New technology seemed to produce the greatest anxiety in the doctors.

The authors state that it is likely that technological enhancement of visual cues (i.e. bigger picture and higher resolution) may increase patient and physician satisfaction with the procedure. Increased experience with videoconferencing systems may also decrease the level of frustration and anxiety.

The authors conclude that "this study suggests that visual cues are important for both doctors and patients but that traditional face to face interactions are not the only way these can be provided." (Ball et al., 1995, p. 25)

UMDS upgrades the telepsychiatry equipment

In 1996, the group at UMDS upgraded their videoconferencing equipment to a medium cost videoconferencing system (MCVC). The major differences compared to the older LCVC, was that the video image filled the entire 30 cm (12") monitor and was of higher quality. The transmitted picture had a resolution of 128 x 128 pixels with 64 grey scales, refreshed at about 25 frames per second. Sound was transmitted via the public telephone network, running in parallel via the computer link.

Case report of the use of a MCVC system for psychiatric consultation

The first reported use of the MCVC system was in McLaren, Blunden, Lipsedge & Summerfield, (1996) describing the use of the MCVC system for three telepsychiatry consultations in an inner-city community psychiatric clinic. The authors state that the link demonstrated that the system could be used to support psychiatric outpatient activities in an inner-city. It also showed that it was not effective for some purposes and an alternative arrangement may be needed, e.g. having an assistant to read the small print on the pill bottles.

Use of a MCVC for outpatient psychiatry

McLaren, Laws, Ferreira, Lipsedge and Watson (1996) evaluated the use of the MCVC for outpatient adult psychiatry consultations. The controlled study compared outpatient interviews conducted via telemedicine to interviews conducted face-to-face. The service connected the department of psychiatry in Guy's Hospital to a community mental health center located 8 km (5 miles) away.

Of 26 patients asked to participate, 15 agreed but only seven were interviewed in both modes during the study period. Technical problems prevented the other eight patients from being seen over the MCVC and time restrictions prevented rescheduling. Outcome measures included observation, review of videotapes and three different self-completion questionnaires.

Results indicated the patients rated using the videolink more positively than the psychiatrists in all cases and rated the videolink as more efficient than the face-to-face interview. Physicians had reduced confidence in their clinical judgments using video compared to face-to-face and had more difficulty accurately assessing certain emotions. The authors suggest that clinician confidence may be improved by improving the picture quality.

Difficulties reported included a failed link on two occasions, the monochrome picture which made it difficult to interpret facial expression for black patients, and the sound quality which was inadequate to the demands of the clinical interview. The authors conclude, "The link significantly increased the clinician's uncertainty in making symptom ratings and this effect should be sought with more advanced systems." (Ball et al., 1996, p.62)

Use of a MCVC for training of medical students

Ball, McLaren & Watson, (1996) discuss the use of communications technology in mental health education. The authors conclude, "Certain forms of teaching lend themselves particularly well to the use of mediated communication, but any introduction must be evaluated by rigorous controlled trials using existing, familiar and cheaper forms of equipment." (Ball et al., 1996, p. 64).

Critique UMDS publications

(McLaren, Ball, Summerfield, Lipsedge, (1992), (Ball, Scott, McLaren and Watson, 1993), (Ball, McLaren, Summerfield, Lipsedge & Watson, 1995), (McLaren, Blunden, Lipsedge & Summerfield, 1996), (McLaren, Laws, Ferreira, O'flynn, Lipsedge & Watson, 1996), (Ball, McLaren & Watson, 1996)

The article (McLaren, Ball, Summerfield, 1992) is significant as it is the first peer-reviewed publication that investigates the use of a compressed digital interactive video system for mental health activities. The methodology used for the project is experimental, however it does have a number of limitations. The most significant is the small sample size. It is unlikely that with such small numbers that the study has adequate power, e.g. the ability to detect small differences. Another problem is that not all students completed both interviews. As the authors mention, there may have also been a learning effect, e.g. the observing student learned by watching another student present a case. Ideally, randomization should cancel this out. Although the authors designed the questionnaires based upon results from preliminary work, the questionnaires were not truly validated. Overall, although this is a well designed study, the validity and generalizability are questionable, primarily due to the study's small sample size.

The study (Ball, Scott, McLaren and Watson, 1993) was well designed. Care was taken to modify the MMSE for use over the LCVC and this was tested separately before the study. The order in which the patients did the MMSE was randomized (telemedicine versus face-to-face). The correlation found between the two modes is

almost identical to the results obtained by Folstein (who designed the MMSE). The results from this study suggest that conducting a MMSE over the LCVC system is possible and valid. However, some caution must be taken with the results of this study. Most significantly, the study had a small sample size (N=11), which could lead to biased results. Additionally, the sample was not representative of all psychiatric patients, e.g. most patients were schizophrenic and no adolescents or elderly patients were included. As the authors mention, further studies are needed to demonstrate that the findings are more generally applicable to a wider age group, and across a greater range of diagnostic categories and cognitive states. Overall, the evidence in the study suggests that the conclusions are valid and probably generalizable for the age group studied.

The study ((Ball, McLaren, Summerfield, Lipsedge & Watson, 1995) utilized a randomized-block design with each patient experiencing all four of the communication modes. This is one of the most rigorous experimental designs used in a telepsychiatry project. The study was very similar to one conducted almost 20 years earlier by Conrath and Dunn (1978), which compared face-to-face, telephone, hands free telephone, slow scan and CCTV interviews. Possible practice effects were controlled through the randomization of the order of exposure to each communication mode for each subject. Some limitations were identified with the study. First, as with most previous studies, the sample size was small and the results may be misleading due to this alone. Second, although effective use of self-report questionnaires and logbook recordings were utilized, some misclassification of outcome may have occurred because of the subjective nature of the tools. The validity of the outcome measure

may have been improved through the use of both verbal and non-verbal content. The study conclusions are probably valid for the groups studied but generalizability is questionable primarily due to the small sample size.

McLaren, Blunden, Lipsedge & Summerfield, (1996) is a case report of two patient encounters. It is simply an observational study and no valid or generalizable conclusions can be generated from it.

The study (McLaren, Laws, Ferreira, O'flynn, Lipsedge & Watson, 1996) is a controlled study and suggests that patients are more positive towards videoconferencing than physicians. This corresponds with the results from other studies that patients are usually very satisfied with the technology and more readily accept the technology. This may be because the physicians have a different and more stringent standard than patients or that the patients feel that they are getting special attention either due to their participation in a research project or because their physician seems to be paying more individual attention to them. The study also suggests that patients viewed the MCVC system as more efficient than the face to face link. Unfortunately, although these results are interesting, a number of weaknesses are evident in this study. Foremost is the poor response rate of patients (out of 26 patients asked, only 15 consented and because of technical problems only 7 completed both interviews). As such, the validity and generalizability of the study are poor.

(Ball, McLaren & Watson, 1996) describes the authors' views toward the use of communications technology for medical education purposes. No conclusions can

be drawn from it.

General critique of the UMDS telepsychiatry research

The UMDS group is the most active telepsychiatry research group. Unlike most current telepsychiatry sites, they have chosen to focus on lower cost technologies. Their work suggests that high quality video is not always needed for telepsychiatry activities to be successful, particularly educational activities. However, some of their studies suggest that higher quality video may be necessary in order for mental health professionals to feel satisfied with the encounter and to access certain mental health conditions. Overall, the research the group has conducted has been well designed. Unfortunately, all their studies have been limited by small sample sizes.

Psychiatric rating scales conducted over telemedicine compared to face-to-face

Baer, Cukor, Jenike, Leahy, O'Laughlen & Coyle, (1995) assessed the use of a PC-based videoconferencing system to test the reliability of several psychiatric rating scales in 26 patients diagnosed with anxiety disorder, and obsessive-compulsive disorder. Video quality was approximately 280 x 128 pixels, in 24 bit color, at 12 - 15 fps on a 27 inch monitor transmitted over a 128 kbps ISDN telephone link. The cost of the equipment was approximately $50 - 60,000 per site.. The units were located at hospitals separated by approximately 32 km (20 miles).

For the study, one rater sat at the local site in front of the videoconsulting

equipment and asked questions, while the patient and a second rater sit together at the remote site. Both raters score the patients answers to the rating scale items. The rating scales used included the Yale-Brown Obsessive Compulsive Scale, Hamilton Depression Scale, and the Hamilton Anxiety Scale.

Near perfect reliability was found in all questionnaires used in the study. The severity of obsessive compulsive disorder, as measured by the Yale-Brown Obsessive Compulsive Scale did not differ significantly between patients in the live interview compared to the patients in the video group. (mean = 18.43, SD = 7.98 vs. mean = 18.34, SD = 8.11) ($t=0.8$, $df=24$, $p=0.93$). The correlations coefficients were: Yale-Brown Obsessive Compulsive Scale (live, $r=.99$ vs. video, $r=.99$), the Hamilton Depression Scale ($r=.98$ vs. $r=.98$) and the Hamilton Anxiety Scale ($r=.97$ vs. $r=.99$). On the patient self-report measures, the means scores for all questions fell between "average" and "better than average". For the raters, all mean scores were either "average" or "above average".

The authors conclude, "Telemedicine using narrow-bandwidth transmission over one ISDN telephone line resulted in near-perfect agreement on scores on semi-structured rating scales for obsessive-compulsive, depressive, and anxiety symptoms in patients with obsessive-compulsive disorder." (Baer et al., 1995, p. 1384)

Critique of (Baer, Cukor, Jenike, Leahy, O'Laughlen & Coyle, 1995)

This study uses a between-subjects design, e.g. subjects were exposed to either the control (in person) or experimental (video transmission) conditions but not

both. This design has the advantage of decreasing the chance of practice effects over time for individual subjects. However, random error is increased in between-subject designs because of individual differences (i.e. each subject no longer acts as his/her own control). Positive aspects of this study were the valid and reliable outcome measures used as well as the random selection of subjects. The major limitation is the small sample size. Results from this study are probably valid, but the generalizability is questionable. As the authors state regarding telepsychiatry, "Its use for other disorders and for more in-depth assessments should be explored." (Baer et al., 1995, p. 1383)

Use of telepsychiatry for use with patients with schizophrenia

Zarate, Weinstock, Cukor, Morabito, Leahy, Burns and Baer (1997) assessed the reliability of different psychiatric rating scales under three conditions: in person, videoconferencing at low (128 kbps) and by videoconferencing at high (384 kbps) bandwidth. Forty five patients, all meeting DMS-IV criteria for schizophrenia, were examined. Validated scales were used and included the Brief Psychiatric Rating Scale (BPRS) , Scale for the Assessment of Positive Symptoms (SAPS) and the Scale for the Assessment of Negative Symptoms (SANS). Previously conducted live interviews were used as the standard for comparison. The technical equipment was the same as described in Baer et al, 1996.

The results indicated that BPRS and SAPS were reliably assessed by all three methodologies. Total score on the SANS were less reliably assessed at low bandwidth as were several specific negative symptoms which depended heavily on visual cues.

Video interviews were well accepted by all patients; patients in the high bandwidth group were more likely to prefer video interview to live interview than patients in the low bandwidth group. Acceptance of the assessment medium was good for both conditions. Surprisingly, 14 of the 27 (51.8%) patients with schizophrenia reported preferring the video interview to a live interview. In general, video consultation was found to be a reliable method of assessing schizophrenic patients in remote locations who have limited access to expert consultations.

Zarate et al. comment that the selection of a video consulting system and bandwidth will depend on several factors: (1) systems using the higher resolutions 640 x 480 pixels at 24-30 fps are more likely to be accepted due to reduced movement artifact, and may provide more reliable assessment of specific psychiatric symptoms, especially those involving movement disorders and non-verbal cues. (2) systems using the lower resolution, i.e. 128 kbps bandwidth, appear to provide adequate assessment of global severity of serious psychiatric illness, but insufficient reliability for fine-grained analysis of symptoms involving movement disorder or other motor movements. These systems appear to result in lower, but still acceptable patient comfort with the medium and are lower in equipment and transmission costs. In the case of undeserved populations the use of 128 kbps video and the resulting reliable global assessment can represent a significant improvement in mental health care delivery.

Critique of (Zarate, Weinstock, Cukor, Morabito, Leahy, Burns and Baer, 1997)

Zarate et al. (1997) is a well designed study, used validated outcome measures

and has a sample population that is probably adequate. As such its conclusions are probably valid and generalizable for the population evaluated, e.g. adult schizophrenics. The study suggests that different mental health conditions may require different levels of video quality in order to adequately assess the patient. Obviously, other studies will need to be done in order to determine how to best match the technology and mental health needs together.

Telepsychiatry in Australia

Kavanagh and Yellowlees (1995) describe the use of videoconferencing to provide mental health services in South Australia. Technology used was PictureTel videoconferencing units connected at 128 kbps over digital telephone lines (audio and video quality were not described). Significant clinical findings included: patients were much more involved in the decision making regarding their management than in conventional interviews and patients appeared to benefit from having someone they already know with them on the system as a close supporter. The authors found it fascinating that patients with paranoid delusions and ideas of reference regarding televisions were able to differentiate between the clinician talking to them on the telemedicine system and their unreal psychotic perceptions. Many patients seemed to be less threatened by telemedicine interviews, possibly because they could walk out of the room or move out of sight without personally offending the interviewer and because they had someone they already knew in the room. The authors summarize their experiences,

> "It is possible to assess patients with a wide range of psychiatric disorders from personality disorders through to frank and severe psychosis." and "While video conferences cannot solve the inequity in service delivery, they can work as a useful adjunct to current service delivery strategies." (Kavanagh & Yellowlees, 1995, p. 1246)

The Queensland Northern Regional Health Authority TeleMental Health Project was implemented to help address the problem of poor access to mental health services by consumers living in rural communities (Trott, 1996). Equipment chosen for the project was based on a desktop computer, i.e. the PictureTel Live PCS 100. Each unit cost approximately A$11,500 per site. The telecommunications link used was dial-up ISDN at 128 kbps.

Trott (1996) states that despite initial enthusiasm to use the videoconferencing system, professional acceptance was poor. The primary reason given by the professionals was that they could not afford the time. Already under-resourced, their existing heavy workloads acted as a barrier to taking the time to learning about and get used to videoconferencing. Trott states the key to increasing utilization was formal scheduling of outpatient clinics. After formal scheduling was put in place, clinical usage averaged 15 hours per week. Applications included general adult psychiatry, child psychiatry, psychological and forensic services.

Qualitative and quantitative analysis questionnaires were used to evaluate participants responses to videoconferencing. Quantitative response was measured on a visual analogue scale (1-10). Generally, there was high acceptance of the videoconferencing system by mental health professionals. They were happy with the audio and visual quality although there was criticism regarding visual artifacts, e.g.

tiling and movement distortion and audio problems, e.g. echo, transmission delay and loss of sound. All found the system useful and indicated they would be happy to use it again. Prior familiarity with the patient contributed to a more satisfactory videoconference interview. Generally there was high patient acceptance in utilizing videoconferencing. Patients and interviewers who had never used the system and who did not know each other had more difficulty in establishing rapport and tended to rate videoconferencing less favorably. Previous knowledge and familiarization with videoconferencing significantly contributed to favorable acceptance and continued use. Patients who had never used the system had expectations that the video would be similar to that of television broadcasting. Support staff for psychotic or agitated patients was necessary to alleviate the occasional emotional distress during and after videoconferencing sessions.

Trott states that the system was useful and that users were satisfied with it, however, "consumers rate face-to-face interviews more favorably than videoconferencing interviews." (Trott, 1996, p.103)

Critique of Australian literature

(Kavanagh & Yellowlees, 1995), (Trott, 1996)

(Kavanagh & Yellowlees, 1995) is a descriptive summary. The number of patients treated was not mentioned and no formal evaluation was conducted. As such no definite conclusions can be drawn from the study.

Trott, (1996) mentions specific objectives and uses a qualitative and quantitative questionnaire to evaluate participant satisfaction with the videoconferencing system. How the data was analyzed was not described. The quantitative data indicate that individuals who had never used videoconferencing and who knew each other ranked videoconferencing more favorably than if they did not know each other. This suggests that: 1) videoconferencing may be more satisfactory for follow-up than for initial consultations, 2) video quality used for initial consultations may need to be higher for participants to view videoconferencing more favorably or 3) most individuals simply find the initial interviews (no matter what the medium) more uncomfortable than subsequent interviews. The lack of a face-to-face control group and unknown sample size make interpretation of the results difficult. Since, the data is primarily descriptive, no definitive conclusions can be made. Validity and generalizability are poor.

Telepsychiatry in Norway

The use of videoconferencing for mental health activities surged in northern Norway following the implementation of a national Integrated Services Digital Network in mid-1995 (Gammon, Bergvik, Bergmo, Pedersen, 1996). To monitor the activity, the Telemedicine Department at the University Hospital of Tromso sent out a survey to 35 videoconferencing sites that were available to mental health professionals in the region. During the last six months of 1995, a total of 1028 individuals (psychologists, psychiatric nurses, psychiatrists, social workers, and patients)

participated in 140 videoconferencing sessions, representing 185 hours of videoconferencing, from 26 different institutions. The primary reasons for using videoconferencing in mental health included meetings (50%), supervision/ teaching/ training (31%), clinical (14%) and tests/ demos (5%). The total number of patients seen over the system was low (12 patients). The alternative forms of contact which videoconferencing replaced included travel (59%), no contact (25%), telephone (14%), and mail or fax (2%). No problems were reported in 55% of the sessions; in 19% there were audio problems, in 14% there were picture problems, in 5% attempts to connect failed and in 5% disconnection occurred. In spite of the technical problems the majority (87%) reported they were satisfied or very satisfied with the facility; (8%) were uncertain and (5%) were less satisfied or totally dissatisfied. Most telepsychiatry sessions (63%) were conducted at 384 kbps.

Critique of the Norwegian literature

Gammon et al. (1995) is a descriptive survey conducted at the Telemedicine Department, University Hospital of Tromso. It is one of the first telemedicine studies to quantify a number of variables in mental health videoconferencing, for example who is using videoconferencing, how often, for what sort of activities and the problems encountered. The increasing use of videoconferencing by mental health workers in Northern Norway with no promotional effort provides some empirical evidence that videoconferencing is useful. Since the study is descriptive, no definitive conclusions can be made.

Earlier reviews and surveys of telepsychiatry

The first peer-reviewed publication reviewing of the use of telecommunications in mental health was by Maxman (1978). He summarized the telepsychiatry activities occurring at the four different sites (described in this paper in the Early Analog Era section). He divides the evolution of a telepsychiatry system into four stages. Initially, skepticism restrains the development and use of IATV. Then, as professionals see that it does not dehumanize the therapist-patient relationship, enthusiasm envelops the project. Inevitably routinization sets in, leading to decreasing interest and a readjustment of priorities. Generally, he says this last stage has resulted in IATV being used less for the delivery of health services and more for the provision of psychiatric training. Maxman states, "Both the providers and the recipients of telecommunication mediated psychiatric services have found that these systems do not interfere with the establishment of an effective therapist-patient rapport." (Maxman, 1978, p.455). He felt that the cost of telepsychiatry was a major obstacle to its extensive use.

In 1994, Telemedicine Today summarized the active telepsychiatry sites in North America (Telemedicine Today, Summer - 1994). They found that there were 10 sites that were delivering mental health services and six more proposed sites. Two sites used telecommunication links at 56 kbps and the remainder at 384 kbps or higher. All used roll about or desktop units and most sites were delivering care to rural areas. In the first 6 months of 1994, over 285 patients had been seen by telepsychiatry for 484 actual consultations. Five sites stated that they were investigating using telemedicine for children's mental disorders. At most sites the average length of

consultation was 45-60 minutes, with a range from 20 minutes to 2 hours.

Brown (1995) conducted a survey of telepsychiatry in the United States and identified 10 sites as active. He classified telepsychiatry into four broad areas: educational, administrative, research and clinical. Of the five sites reporting the number of patient contacts, a mean of 1.35 patients per week (SD=1.40) were seen over 375 weeks of active program use. The most active site, operating for 20 months with 300 patient contacts, used videotelephone and averaged 3.75 patients per week. It was the only program that was clearly stated to be cost-effective. Significantly, no sites reported any adverse outcomes to patients. The only problem reported was there was occasional difficulty with audio and video quality, which could distract from examination of the patient. Brown suggests that at the present rate of patient contacts, a freestanding telepsychiatry program would be difficult to justify unless the equipment was shared with other services or providers. He concludes, "The findings from this survey suggest that it is reasonable to expect that a cost-effective telepsychiatric program can be developed successfully." (Brown, 1995, p.21)

Critique of the reviews and surveys

Maxman (1978) was a thorough review of the literature at the time and provided some interesting insights regarding how to set up a telepsychiatry system and potential barriers to its implementation. However, Maxman did not critique the methodology and conclusions of the early studies. The major limitation to the review is that it is dated.

Allen and Allen (1994) and Brown (1995) were two recent surveys of telepsychiatry programs. They are useful as they indicate how much current telepsychiatry activity there is, where it is occurring, and how it is being accomplished. Neither paper is a comprehensive review of the literature or critically appraises the methodology used in the different studies.

Will Telepsychiatry Save Money?

Intuitively, it makes sense that the use of telepsychiatry could decrease the need for patients to travel to obtain health care services (or decrease the need for health care professionals to travel to provide health services) and that this would decrease the costs to the health care system. Unfortunately, there were no telepsychiatry studies in the literature that address the issue of cost-effectiveness. Subsequently, the telemedicine literature in general was reviewed.

There have been only a few studies in the telemedicine literature that have investigated the costs involved in setting up a telemedicine system compared to the traditional methods of delivering health care services. The majority of studies that have been done, have been relatively crude, e.g. simply determine how many patients were not transferred as a result of using telemedicine. Often significant indirect costs are not included in the calculations, e.g. income lost because the patient (or family) had to take time off work.

The majority of studies have concluded that implementing telemedicine would result in significant health care savings. A study by Arthur D. Little Study (1992),

looked solely at the economic impact of "electronifying" the American health care industry, estimated that annual USA health care costs could be reduced by more than $36 billion through four telecommunication information applications:

1) Electronic management and transport of patient information:
   savings $30 billion
2) electronic submission and processing of health care claims:
   savings $6 billion
3) electronic inventory management: savings $600 million
4) videoconferencing for CME and remote medical consultations:
   savings $200 million

Other studies have also concluded that implementing telemedicine could directly or indirectly decrease costs:

- 14 - 22% decrease in costs, including patients transfers and physician travel (Preston, 1989)
- 19% decrease in transfer flights (Watson, 1989)
- 15.1% decrease in transfers; telemedicine system pays for itself in 2.7 years (Preston, 1993)
- 81% of patients were kept in the rural hospital (Sanders and Tedesco, 1993)
- 25% of soldiers did not have to be transferred (Walter Reed, 1993)
- predicted 14 - 50% did not have to be transferred (Grigsby, 1994)
- a cost savings of $381.22 per patient (Jennett et al., 1995)
- predicted savings of $466.35 - 543.40/ patient (Reid, 1993)

Not all studies however have been positive. A study evaluating a telemedicine system in northern Canada in the early 1980's found, "that the system was not cost effective. It was found that there were more transfers, not fewer, as a consequence of the presence of the video system. One possible explanation for this is that patients were receiving more careful attention than they were in the past, although this cannot be verified objectively." (Higgins et al., 1984). More recently a Norwegian study

found implementing a teleradiology system would not be cost-effective (Halvorsen and Kristiansen, 1996).

A recent cost analysis conducted by an economist investigating a teleradiology system that had been operational for a number of years, found that that teleradiology was cost-effective when there was a high volume of films read, but was not cost-effective with low volume (Bergmo, 1996). It is logical that this would apply to most telemedicine situations. Due to the high start-up costs of telemedicine, when patient volume is low, the service is not cost-effective, but when volume exceeds a certain amount it becomes cost-effective.

This lack of agreement has led to the conclusion that, "The overall impact of telemedicine on health care costs is unclear." (Randall, 1994, p. 3)

General Summary and Critique of Literature

A total of 31 peer-reviewed publications detailing telepsychiatry activities conducted at 11 different sites were found in the literature. Of these 31 publications, 16 were observational describing the telepsychiatry activities occurring at the site. Eight included a control group, four were letters, two were surveys, and one was a review article. Overall, the publications reviewed were very positive towards telepsychiatry. A minority of publications did express some negative comments, however, they all predicted that the technology would be increasingly prevalent in the future and recommended that further research be conducted. The literature provides some evidence that: 1) it is possible to deliver mental health services at a distance

using telecommunications and information technology, 2) it is effective, e.g. psychiatrists are able to diagnosis, treat and educate at a distance, 3) psychiatrists and patients are generally satisfied with telepsychiatry, 4) it is most beneficial in locations where mental health specialists are not easily accessible, e.g. rural areas, inner city. Only one study looked specifically at child telepsychiatry although four other papers indicated that children were occasionally seen over the telemedicine system.

The quality of the evidence is variable. Most of the publications reviewed based their conclusions on the subjective responses of the participants and are subject to a number of biases and limitations. Most articles do not ask specific research question(s) or design formal studies to answer the questions. As a result, no definitive conclusions can be made from these articles. According to evidence based standards, the internal and external validity of these papers' conclusions is poor. A few articles describe studies that ask a specific research question(s) and use a controlled design. Although the conclusions from these studies are more likely to be valid and generalizable, most have a number of weaknesses: 1) small sample sizes, 2) lack of randomization, and 3) the failure to use valid and reliable outcome measures. Sample size is an important consideration because small, inadequate samples may decrease the chance of detecting a small difference between the experimental and control groups (i.e. decrease statistical power). Many studies did not randomly select patients or randomly assign them to an experimental or control group. Rather, subjects were chosen for reasons of accessibility and convenience. The use of valid and reliable assessment tools is necessary in order to avoid possible misclassification of outcomes due to systematic error. The eight controlled studies based their conclusions on a

comparison of an experimental and control group and are more likely to have internal validity. Generalizability is questionable due to the small sample sizes.

Barriers to the Diffusion of Telepsychiatry

Despite positive demonstrations and studies spanning four decades, the widespread acceptance of telepsychiatry in clinical practice has been slow. In fact, in almost every instance, telepsychiatry has only been able to survive during periods of significant grant funding. In most cases, when the grants expired, the programs soon ended. Several factors have been identified in the literature as responsible for the failure of previous telemedicine projects to succeed past federal funding support (Preston, 1995, Sanders & Bashshur, 1995). The primary reasons include high operating and maintenance costs, difficult-to-use equipment, poor project management and lack of reimbursement for clinical services. The issue of reimbursement is almost universally agreed to be crucial to the long-term viability of telemedicine. Sanders and Bashshur noted: "Obviously, without reimbursement, telemedicine would not simply lose its charm, it would be rendered unsustainable" (Sanders and Bashshur, 1995, p. 121). Reimbursement will only happen once studies have shown objectively that telepsychiatry is a reliable and valid way to deliver psychiatric services. This will encourage funding agencies to accept telepsychiatry. At the present time, the barriers most likely to prevent the diffusion of telepsychiatry are the lack of fee-for-service reimbursement, a lack of standards and the need to reorganize the health care delivery

system to take advantage of the technology.

With telemedicine equipment and telecommunications infrastructure and operating costs coming down, and with increasing user-friendly technology, the barriers are being overcome. According to the latest telemedicine magazines and newsletters, in early 1997 there are more than 10 active telepsychiatry sites in the United States and an equivalent number spread around the world. Most of these sites are relatively immature and have not published their experiences in peer-reviewed publications. Almost all of these sites receive grant money and it is uncertain whether they will continue after funding ends.

The bandwidth needed to do telepsychiatry is an issue that needs to be addressed as the audio and video quality needed to conduct an effective telepsychiatry interview is debatable. Some telemedicine advocates say that six digital lines (384 kbps) are necessary whereas others feel that a single digital line (56 kbps) is adequate. It is likely that different bandwidths will be needed for different patients, mental health conditions and types of consultations. It is also probable that this issue will become irrelevant in a few years (similar to how the issue of using black and white versus color television became a non-issue when the cost of color television became comparable to black and white). In the future, the cost between two and six phone lines is going to be insignificant or compression will improve to the point that high quality video can be sent over a single phone line.

According to evidence based standards the ideal study is a double blind, randomized, placebo-controlled study with an adequate sample size. Although clinical

telemedicine studies can approach this ideal, they will never reach it. Unlike a placebo controlled medication study where patients do not know which drug they receive, patients in telemedicine study do know when they are being interviewed face-to-face versus telemedicine. Until telemedicine is accepted as a valid way to conduct psychiatric interviews, it is unlikely that large numbers of patients can be enrolled in studies to obtain adequate sample populations.

Recommendation for the Present Use of Telepsychiatry

According to evidence based standards, there is insufficient evidence to recommend the widespread implementation of telepsychiatry. Further studies need to be done to determine when telepsychiatry is an effective way to deliver psychiatric services, for what age groups and psychiatric conditions, and whether it is cost-effective. It is necessary to obtain more supporting evidence from well designed studies before physicians, governing medical bodies, licensing authorities and patients accept telemedicine as a legitimate way to deliver mental health services. Until further evidence is available, a recommendation to use telepsychiatry on a limited basis, e.g. in a research setting or in underserved communities where it may be the only option, is considered prudent by the author.

Future Research Questions

The major research questions that need to be answered are:

- Is telepsychiatry clinically effective?
- Are physicians, patients and parents satisfied with telepsychiatry?
- Does telepsychiatry improve access to mental health services?
- Does telepsychiatry save money?

Ideally, studies that address the above questions should compare mental health services delivered using a telemedicine system to the delivery of mental health services face-to-face.

The Child Telepsychiatry Project will investigate the clinical effectiveness and participant satisfaction with child psychiatric assessments conducted over a videoconferencing system compared to face-to-face assessments. The questions related to improved access and cost will not be addressed.

Goal

To determine if children with mental health problems can be effectively assessed by child psychiatrists using a telemedicine system.

Research Questions

A. Is it possible to conduct psychiatric assessments of children over a telemedicine system?

B. Do child psychiatrists make the same diagnosis and treatment recommendations using a telemedicine system as they do when they assess a child face-to-face?

C. How satisfied are psychiatrists, patients and parents with telemedicine assessments compared to face-to-face assessments?

Objectives

1. Assemble and test a telemedicine system that can be used to conduct child psychiatric assessments at a distance.
2. Familiarize the child psychiatrists with the telemedicine system.
3. Design outcome measures to evaluate clinical effectiveness and participant

satisfaction with telemedicine and face-to-face assessments.

4. Determine if child psychiatric assessments can be conducted using a telemedicine system.

5. Compare the child psychiatrist's attitudes towards the telemedicine system before and after using the system.

6. Compare the diagnosis and treatment recommendations made by child psychiatrists using the telemedicine system to the diagnosis and treatment recommendations made after a face-to-face assessment.

7. Compare psychiatrist, patient, and parent satisfaction with telemedicine assessments to their satisfaction with face-to-face assessments.

Methodology

Patients and parents enrolled in the study were randomly divided into two groups: Group A and Group B. Group A was first assessed by a child psychiatrist via the telemedicine system and then the following day by a different child psychiatrist face-to-face. Group B was first assessed face-to-face then the next day via the telemedicine system. All patients had two psychiatric assessments. For the face-to-face assessments, the child psychiatrist, parent and patient were all in the same room. For the telemedicine assessments, the child psychiatrist was located in a different room from that of the patient and parent. Due to the length (approximately two hours) and intensity of the assessments, the second assessment was scheduled the following day.

Every attempt was made to schedule the second assessment within 24 hours and for it to begin at approximately the same time of day.

Child psychiatrists were randomly assigned to the initial assessments. For the patient's second assessment, the remaining four child psychiatrists had an equal opportunity to assess the patient. The child psychiatrist who conducted the first assessment did not discuss the diagnosis and treatment recommendations with the parent and patient. Discussion of the diagnosis, treatment recommendations and arrangements for therapy or follow-up were done after the second assessment. If the second assessment was done via telemedicine, the child psychiatrist joined the parent and patient to discuss the diagnosis and management, after all parties had completed their questionnaires.

Patient recruitment

Parents of children who met the following criteria were contacted (phoned) by the research assistant.

- Child was referred to the Janeway Child Health Centre to see a child psychiatrist
- Patient's age was from 4 –16 years.
- The referral was not an emergency.
- The family lived in the St. John's area. (This was so that traveling between home and the Janeway Child Health Centre would be relatively easy.)

Parents with whom the research assistant was able to make contact were informed about the study and asked to participate. If the research assistant could not

talk to a parent directly, no message was left. If the parent was interested, he or she was given further details regarding the project over the phone and an information package explaining the project was mailed to the parent. Details of where to meet the research assistant before the first assessment were also discussed and included in the information package.

Obtaining Informed Consent

When the parent and patient arrived at the Janeway Child Health Centre for their first assessment, the research assistant met them at the Child Psychiatry Department. The project was described again and all parents who agreed to participate signed a consent form (HIC approved). The research assistant then took the parent and patient to the room where they were to be interviewed. If the first interview was face-to-face, they were simply taken to the child psychiatrist's office and introduced to the child psychiatrist. If the first interview was via the telemedicine system, the research assistant took them to the telemedicine room, demonstrated and explained the technology, and then dialed up the other telemedicine unit and introduced them to the child psychiatrist (on the monitor). For all telemedicine interviews, the RA remained nearby and accessible, in case there were any problems (technical or clinical).

Sample Size

Dr. Rashid Bashshur, a telemedicine veteran researcher states,

> "In view of the multiplicity of measures of the dependent variable, it may be futile to attempt to estimate a precise effect size (or the precise amount of change that is likely to occur as a result of telemedicine) in order to determine the sample size required to give the hypothesis adequate statistical power for being proven correct." (Bashshur, 1995, p. 31)

Determination of sample size reflects a tradeoff between statistical power, logistical constraints and costs. Using Kraemer and Thieman tables (1987) created for determining sample size, a total sample size of 616 participants, divided evenly between randomly selected experimental and control groups will have a power of 0.80 and a delta of 0.20. This should provide adequate statistical power for most studies. Unfortunately, 616 patients is larger than could be obtained in the limited time frame and budget allocated for this project. Subsequently, the sample sizes used in previous telepsychiatry studies were reviewed. No studies approached 616 patients and even the largest descriptive telepsychiatry study had 199 patients (Solow et al., 1971). Only one telepsychiatry study to date was stated to have had adequate statistical power to detect clinical differences (Dongier et al., 1986). It was a matched controlled study and had 50 patients in the experimental group and 35 in the control group.

After reviewing the literature, consulting with a statistician and taking into account the restrictions placed upon this study, a minimum of 30 cases was felt to be

adequate to detect large differences between responses after a telemedicine and face-to-face assessment.

Instruments used to measure outcomes

Most telepsychiatry sites that have evaluated their programs, have designed their own questionnaires. Of the eight controlled telepsychiatry studies, only three have used validated instruments (Ball et al., 1993), (Baer et al., 1995) (Zarate et al, 1997). The instruments were a psychiatric screening test and a variety of psychiatric scales. No useful questionnaires for child telepsychiatry were found in the literature. Personal contact with a number of active telepsychiatry sites did not reveal any outcome measures useful for child telepsychiatry.

Consequently, the principal investigators (Drs. Rod Elford and Max House), in collaboration with the five participating child psychiatrists, designed the outcome instruments for this project. Instruments included self-report questionnaires for the child psychiatrists and questionnaires for the parents and patients (administered by the research assistant during a semi-structured interview). Initial drafts of the questionnaires were reviewed by a child psychiatrist in Ontario who had just recently starting doing telepsychiatry consultations, by two Ph.D. psychologists at Harvard Medical School who were involved in telepsychiatry research, and by the research assistant (registered nurse with pediatric experience). The questionnaires went through a number of drafts and were approved by the participating child psychiatrists

before being implemented. Table 3. summarizes the questionnaire schedule. A copy of the questionnaires can be found in the Appendix A.

After the project was completed, the principal investigator (Dr. Rod Elford) met with all five child psychiatrists for a group debriefing session and then individually for follow-up interviews.

TABLE 3. Questionnaire Schedule

Questionnaire	Completed by	Implemented
1) Pre-Project	Psychiatrists	Before study began
2) Post - Project	Psychiatrists	After all assessments were completed
3) DTS (Diagnosis, Treatment and Satisfaction)	Psychiatrists	After every assessment
4) Technology Evaluation	Psychiatrists	Only after a telemedicine assessment
5) Parent Satisfaction	Parents	After every assessment
6) Parent Comparison	Parents	After the second assessment
7) Patient Satisfaction	Patients*	After every assessment
8) Patient Comparison	Patients*	After the second assessment

*Children ages 4-11 completed a different questionnaire from adolescents age 12-16.

Psychiatrist Questionnaires

All questionnaires completed by the child psychiatrists were self-report questionnaires. The Pre-Project Questionnaire, looked at a variety of factors including

educational background, experience with electronic and communications technology and subjective attitudes regarding the use of telemedicine for child psychiatry assessments. The Post-Project Questionnaire asked the child psychiatrists how they felt about the telemedicine system after having used it, primarily to see if their attitudes had changed.

After every assessment, the child psychiatrists completed a Diagnosis, Treatment and Satisfaction Questionnaire. The diagnosis section was primarily short answer and asked specifically about the psychiatric diagnoses (Axis 1 - 5) and confidence with the diagnoses. The Axis 4 and 5 questions were validated scales, commonly employed by psychiatrists for adult patients. Treatment questions were open-ended and management questions were "Yes / No". Psychiatrist satisfaction with the interviews was assessed by a number of Likert scale and "Yes / No" questions. After a telemedicine assessment, the child psychiatrists completed a Technology Evaluation questionnaire that asked how the telemedicine system had performed.

Parent Questionnaires

Parents did not complete the questionnaires themselves; rather the research assistant asked all questions and filled in the answers. This was done to avoid any potential problems with illiteracy, illegibility due to poor handwriting and confusion with the questions. The research assistant also recorded any spontaneous parent responses that were not part of the questionnaire.

Parents completed a Parent Satisfaction Questionnaire after every assessment. Likert scale and "Yes / No" questions were designed to look at a number of aspects of the interview that might effect satisfaction. The Parent Comparison Questionnaire, given after the second assessment, asked parents to directly compare the telemedicine interview to the face-to-face interview and also asked them to comment on the technology.

Patient Questionnaires

Patients did not complete the questionnaires themselves; rather the research assistant asked all questions and filled in the answers. This was done to avoid any potential problems with illiteracy, illegibility due to poor handwriting and confusion with the questions. It was also felt to be a more reliable way to get responses from children. The research assistant also recorded any spontaneous patient responses.

Patients completed a Patient Satisfaction Questionnaire after every assessment. The questionnaires were tailored to the age of the child, e.g. one for children ages 4-11 and another for adolescents ages 12-16. The Patient Comparison Questionnaire asked patients to directly compare the telemedicine interview to the face-to-face interview and to comment on the technology.

Technology

A) Equipment at the psychiatrists location included:

- One 14" SVGA monitor capable of displaying millions of colors, later upgraded to a 17" SVGA monitor
- Pentium computer with 133 Hz processor, 16 MB RAM
- Canon camera capable of pan, tilt, zoom placed directly on top of the monitor
- plain mike, later upgraded to a Polycom uni-directional mike
- writing tablet (instead of a mouse) to move the cursor on the screen
- PCPoint software program* and Zydacrom videocard. This combination turned the computer into H320 compatible videoconferencing unit. The system had the capability of dialing up (e.g. 2 - 6 lines) any H320 compatible videoconferencing unit.
- An inverse multiplexor was used to separate the out-going signal into six digital telephone lines and to recombine the incoming signal.

*The PCPoint software was Windows based and was configured to start up automatically when the computer was switched on. The software digitized the analog image from the camera, compressed it and packaged it for transmission. When connected with six digital lines, picture resolution was approximately 340 x 256 pixels in 24-bit color, refreshed at 30 frames per second. The psychiatrist's system was configured for picture-in-picture viewing. This was so that the psychiatrist could see a small window of himself on the monitor at the same time as he/she was viewing the patient and parent. The system was set-up so that the incoming image (i.e. patient and parent) was approximately 2/3rds the size of the screen. The outgoing image (i.e. child psychiatrist) was about 1/4 screen size. The size of the incoming or outgoing video images, i.e. windows, could be changed by the child psychiatrist as desired

simply by clicking and dragging the corner of the window. The software also allowed for manipulation of the remote camera.

B) Equipment at the remote site included:

- One 14" SVGA monitor capable of displaying millions of colors, later upgraded to a 17" SVGA monitor
- Pentium computer with 133 Hz processor, 16 MB RAM
- Canon camera capable of pan, tilt, zoom
- plain mike later upgraded to an omni-directional mike with two peripheral mikes that could be located around the room.
- No writing tablet was used, as the patient did not have to manipulate the images or the remote camera.
- PCPoint software program and Zydacrom card. The software was set up so that when the Research Assistant turned on the equipment, the patient and parent saw a full screen image of the child psychiatrist. There was no picture in picture, e.g. the patient and parent did not see an image of themselves, as this was felt to be unnecessary.
- An inverse multiplexor was used to separate the out-going signal into six digital telephone lines and recombines the incoming signal.

Telecommunications link

The telecommunications link used for the project was six digital telephone lines. Specifically, the link went from an Integrated Services Digital Network (ISDN) to the public telephone utility switching centre, then returned via a Switched 56 network. The ISDN to Switched-56 network configuration was chosen because it replicated a cross-island connection. In the psychiatrist's room three ISDN B channels (2 digital lines per channel) were used, giving a total bandwidth of 384 kbps (1/4 T1).

In the patient's room six Switched-56 channels were used, giving a bandwidth of 336 kbps. The actual bandwidth available was limited to the lower bandwidth digital service, e.g. 336 kbps.

Technology Costs

Each videoconferencing unit cost approximately $35,000 per site (including computer, software, video board, camera and audio system). Digital telephone line installation costs were approximately $500 per room. Monthly maintenance costs were approximately $400 / month for six lines. Long distance charges were approximately $15 / line / hour. A typical assessment was done using six lines and lasted approximately two hours costing approximately $180.

Rooms chosen for the assessments

All child psychiatry assessments took place in the Child Psychiatry Department of the Janeway Child Health Centre.

A) Face-to-face assessments

All face-to-face assessments were done in the office of the child psychiatrist who was conducting the assessment. This was the usual procedure for child psychiatric assessments.

B) Telemedicine assessments

Telemedicine assessments were conducted by linking two different rooms in the hospital. Since space at the hospital was at a premium and no rooms were available strictly for telemedicine, three rooms were chosen in order to facilitate scheduling. The rooms chosen included: 1) a child psychiatrists office, 2) a psychiatry resident's office and 3) the hospital board room. The two offices were located in the Child Psychiatry Department and the boardroom was located two floors directly above the Department. The child psychiatrist's were always located in the boardroom or resident's office. Patients were always located in the child psychiatrist's office. The videoconferencing units were on portable stands and could easily be moved to the appropriate rooms as needed.

Analysis

All questionnaires were coded and the only person who had the key to the questionnaires was the research assistant. The responses to the questionnaires were entered into the EpiInfo software program and the raw data printed to check for errors. Once the data were verified, the telemedicine and face-to-face data were analyzed using a number of descriptive tests. The raw data was then taken by the principal investigator (blinded) and used for statistical analysis.

Three tests were used to compare data from telemedicine assessments to face-

to-face assessments and check for statistically significant differences. Likert scale questions, e.g. 1 = strongly disagree, 2 = moderately disagree, 3 = moderately agree, 4 = strongly agree, were analyzed using the Sign Test - Paired Data. Questions that had a "Yes / No" answer were analyzed using the McNemar Chi-Square Test. Questions that used a visual interval scale were analyzed using the Means Test. For all tests, statistical significance was set at $p = 0.05$. See below for a more detailed description of each test.

The DTS questionnaire filled out by the psychiatrists was photocopied and sent to an independent evaluator (blinded) for evaluation. The independent evaluator was a child psychiatrist in private practice who was not involved with the project. She was asked to compare the questionnaires and decide if the diagnoses and treatment recommendations made by the child psychiatrists via telemedicine were the same as the diagnoses and treatment recommendations made face-to-face. If she felt there was a clinical difference, she was asked to describe why.

Sign Test - Paired Data

The Sign Test - Paired Data was used to analyze the responses from Likert questions because the answers to Likert questions are non-parametric. Specifically, the difference between 1 (strongly disagree) and 2 (moderately disagree) is not necessarily the same as between 2 (moderately disagree) and 3 (moderately agree). The Sign Test is used when the data to be analyzed are ranks rather than measurements on an interval or ratio scale. It compares the median values between

the two sample groups not the mean values. The only assumption made with the Sign Test is that the distribution of the variable of interest is continuous. For the Sign Test - Paired Data, the two groups compared should be as similar as possible (in this study the patients act as their own controls). The Means Test is sometimes used to compare responses from Likert scale questions, however it is an inappropriate test since it should be used only for parametric data.

To perform the Sign Test - Paired Data, the number obtained in response to a question after a face-to-face assessment was subtracted from the number obtained after telemedicine assessment. For example, if Group A responded with a 4 = "strongly agree" and Group B responded with 2= "moderately disagree", the difference would be 4-2 = +2. The absolute value, e.g. "2" is not important, only the sign, e.g. "+" or "- ". The responses that are equivalent, e.g. 4 - 4 = 0, are not included in the statistical calculation. All telemedicine and face-to-face responses are compared in this way and the number of positive and negative signs determined. The number of positive and negative signs are then used when referring to a binomial statistical table which informs the investigator of the p value of the results. For this study, alpha is set at 0.05. The null hypothesis is that telemedicine assessments are the same as face-to-face assessments. Since no assumption is made whether telemedicine or face to face assessments are superior, (e.g. two tailed test) results will only be considered significant if their calculated p value is less than 0.025 (1/2 x 0.05). A significant difference would result in the null hypothesis being rejected, meaning that the responses after telemedicine assessments are statistically different from responses after face-to-face assessments.

McNemar Chi-Square

Questions that had a "Yes / No" answer were analyzed using the McNemar Chi-Square Test. The test is similar to the Chi-Square Test calculated from a 2 x 2 Contingency Table; however, it is used for non-parametric data and only includes data that is different between the two sample groups, e.g. if both respondents answer "Yes" then it is not considered in the equation. The McNemar Chi-Square equation is:

$$X^2 = \frac{(/b - c/ - 1)^2}{b + c}$$

For this study, results are considered significant if the calculated X^2 value is greater than 3.841 ($p < 0.05$). The null hypothesis is that telemedicine assessments are the same as face-to-face assessments. A significant difference would result in the null hypothesis being rejected, meaning that the responses after telemedicine assessments are statistically different from responses after face-to-face assessments.

Means Test

To compare questions that used an interval scale, the Means Test was used. The Means Test is a common test used to compare two sample means derived from the same or different populations. For the Means Test the following assumptions are made: the population is normally distributed and the population variances are known. The null hypothesis for this test is that the responses after telemedicine and face-to-face assessments would have equal means. If the calculated z value from the Means Test is less than -1.96 or greater than $+1.96$ ($p=0.05$), the two samples are

significantly different. A significant difference would result in the null hypothesis being rejected, meaning that the responses after telemedicine assessments are statistically different from responses after face-to-face assessments.

RESULTS

Patient Selection

The research assistant contacted 34 parents of children who met the selection criteria. Of these parents, 25/34 (74%) agreed to participate in the project. Parents reasons for not participating included: 5/9 stated that their child was a teenager and they felt they would have a difficult time getting their child to see the psychiatrist for just one assessment, 2/9 said they were not interested, 2 /9 felt that their child no longer required the services of a psychiatrist (e.g. problems had cleared up).

Number of subjects

Initially, it was anticipated that 30 patients would be enrolled in the study. However, due to a delayed start date (approximately two weeks) only 25 patients were scheduled for assessments. Unfortunately, the project time line could not be extended because of budgetary reasons. Of the 25 patients who agreed to participate, 23/25 completed both a telemedicine and face-to-face assessment. In one instance, the patient and parent did not show up for the telemedicine assessment, and in the other case, the videoconferencing units could not connect and the assessment was cancelled.

It was later discovered that the inability to connect had been a network problem (not a problem with the videoconferencing units). Both of these "missed" appointments were near the end of the project and there was not enough time to re-schedule either assessment. All patients had their second assessment within 24 hours of the first. All assessments lasted approximately two hours.

Patient demographics

The average age of the patients who participated in the project was 9.1 years (SD = 3.7) and ranged from 4 – 16 years. The sex ratio of the patients was 18 males and 5 females. None of the patients had seen a child psychiatrist before. In follow-up interviews, the child psychiatrists stated that the mean age and the male/female ratio were representative of their mental health patient population.

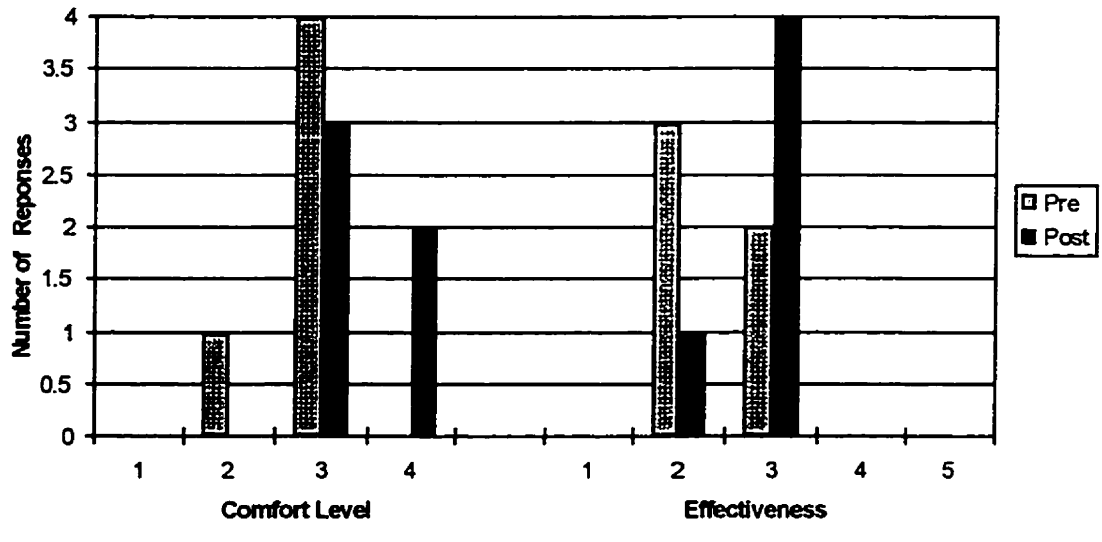
Psychiatrist demographics

Five Canadian certified child psychiatrists participated in the project (no other Canadian certified child psychiatrists practiced in the province). They all practiced at the Janeway Child Health Centre in St. John's and had faculty appointments at Memorial University of Newfoundland. The average number of years in practice was 4.8 years and ranged from 1 - 10 years. Four of the five had completed medical school at Memorial. All five had completed their psychiatry residency and their child psychiatry fellowship at Memorial. The chief psychiatrist had been involved in training the other four psychiatrists.

Pre and Post-Project Questionnaire

Responses from the Pre-Project questionnaire found that most of the child psychiatrists owned electronic audiovisual equipment and computers and were "moderately comfortable" using them. Only one stated that she was "very uncomfortable" with technology. Four of the five had no experience with videoconferencing and the fifth stated he only had a few practice sessions with the equipment. Figure 3. compares the psychiatrists "anticipated" level of comfort and effectiveness of the telemedicine system before the study to their responses to the same questions after the project was over. Light bars represent the psychiatrists' responses before the study and the dark bars represent the responses after the study. Higher numbers along the x-axis indicate greater comfort or effectiveness.

Figure 3. Psychiatrist Pre and Post Test Responses



The results indicate that the child psychiatrists became more comfortable with the telemedicine system and ranked its effectiveness higher after having used the system. In the post-study questionnaire, 4/5 psychiatrists ranked the telemedicine system "just as effective" as a face-to-face assessment and one psychiatrist ranked the system "a little less effective".

Concerns about the system

All five child psychiatrists had concerns about using the telemedicine system for psychiatric assessments before the project began. The concerns mentioned by two or more psychiatrists included: 1) afraid that they would miss "something", 2) afraid they would miss non-verbal cues from the patient, 3) felt they might not be able to interact with patient and parent, 4) were anxious about learning to use the equipment, 5) uncertain what would happen if there were equipment problems.

After the project, many of the psychiatrists' initial concerns appeared to be alleviated, as most of the original concerns were not mentioned in the Post-Project Questionnaire. Two psychiatrists did not mention any concerns at all. The only concern mentioned both before and after the project was the one regarding equipment problems and / or failure. After the project, psychiatrists no longer mentioned concerns about whether the equipment would cause them to "miss something", but were concerned about whether the system could be used for follow-up therapy and for emergency situations. Another concern mentioned by one psychiatrist was that the system created a bit of an impersonal atmosphere.

When the child psychiatrists were asked if there were any particular psychiatric illnesses/ conditions that they felt could not be adequately assessed over the system, they responded that the system might not be adequate for teenage depression, difficult teenagers who refuse to participate, and emergency situations.

Psychiatrists Preferred Assessment Mode

All five child psychiatrists stated that they would "prefer" to conduct psychiatric assessments face-to-face versus via the telemedicine system. However, all five stated that the telemedicine system was an "acceptable alternative" to face-to-face assessments and that it did not hinder them from making a diagnosis. When asked if they would use telemedicine again, four out of five answered "yes" and one answered "probably".

Other observations

During a telemedicine assessment an adolescent patient used the telemedicine system to distance herself from the psychiatrist. She did this by talking in a very soft voice so that the psychiatrist could not hear her. Initially, the psychiatrist thought that there was a problem with the audio system, and tried to change some of the settings; however he soon realized that the patient was in fact "playing games". This episode demonstrated that adolescent patients had enough understanding of the telemedicine system and gain "control" over the interview.

Diagnosis and Treatment Recommendations

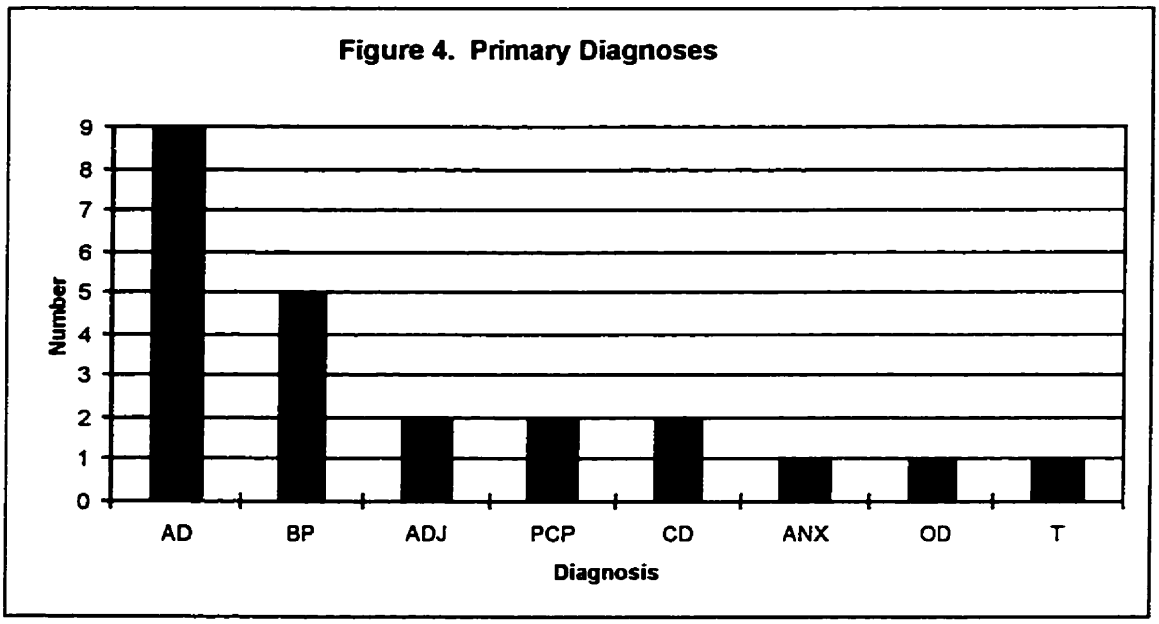
When telemedicine assessments were compared to face-to-face assessments, **Psychiatrists made the same diagnosis and treatment recommendations in 22/23 cases, (96% of the time).**

The independent evaluator stated that in 1/23 cases the diagnosis made by a child psychiatrist using telemedicine was clinically different from the diagnosis made after a face-to-face assessment. In the one case that was different, the two psychiatrists who had interviewed the child had both recorded two diagnoses, i.e. attention deficit disorder and behavioral problems. However, each psychiatrist had decided to emphasize one diagnosis over the other. One psychiatrist recorded attention deficit disorder as the primary diagnosis and behavioral problems as the concurrent diagnosis. The other psychiatrist had reversed the order of the diagnoses.

With regards to the treatment recommendations, the independent evaluator found a clinical difference in only 1 of the 23 cases. This difference was related to the diagnostic discrepancy. Both child psychiatrists had recommended behavioral therapy; however the one who made a primary diagnosis of attention deficit disorder had also recommended starting a medication, i.e. methylphenidate. The other psychiatrist had not.

Diagnoses

The primary diagnoses of the patients (made by the second psychiatrist) are summarized in Figure 4.



AD = attention deficit disorder, BP = behavioral problems, ADJ = adjustment disorder, PCP = parent / child problems, CD = conduct disorder, ANX = anxiety disorder, OD = oppositional defiant disorder, T = Tourettes.

In follow-up interviews, the psychiatrists stated that this pattern of diagnoses was typical, e.g. attention deficit disorder and behavioral problems were the two most common diagnoses that they made.

Confidence in diagnosis

Child psychiatrists were asked to mark on interval scales their level of confidence with their: 1) primary diagnosis (0-100% visual scale), 2) Axis 4 diagnosis

- Severity of psychosocial stress scale (0-6 visual scale) and 3) Axis 5 diagnosis - Assessment of global functioning scale (1-9 visual scale). The Axis 4 diagnosis is the psychiatrist's subjective interpretation of the patient's level of stress. The Axis 5 diagnosis is the psychiatrist's subjective evaluation of how well the patient is functioning in normal day to day activities. Both Axis 4 and 5 scales are validated instruments commonly employed during mental status exams with adult patients. Table 4. Summarizes the psychiatrists' responses.

Table 4. Psychiatrist Confidence in Primary, Axis 4 and Axis 5 Diagnoses

Scale	Mode	Mean	SD	z score
Primary Diagnosis	TM	76.3	11.1	+ 0.3499
	FTF	75.2	10.2	(not significant)
Axis 4 Diagnosis	TM	2.65	0.98	- 0.3659
	FTF	2.77	1.23	(not significant)
Axis 5 Diagnosis	TM	6.22	1.0	+ 0.1169
	FTF	6.18	1.3	(not significant)

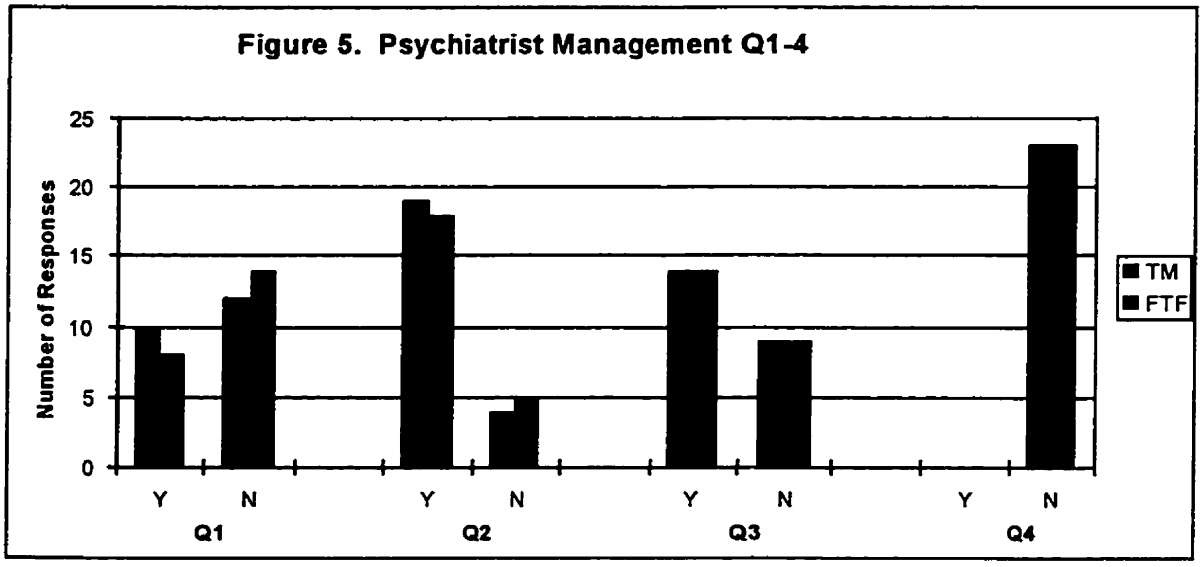
TM = telemedicine, FTF = face-to-face

For all three diagnoses, e.g. Primary, Axis 4, and Axis 5, the calculated z scores (using the Means Test) fall between -1.96 and $+1.96$ ($p = 0.05$). Consequently, the null hypothesis is not rejected. No significant difference was found between psychiatrists' confidence in their Primary, Axis 4 and 5 diagnoses when made via telemedicine compared to face-to-face assessments.

Patient management

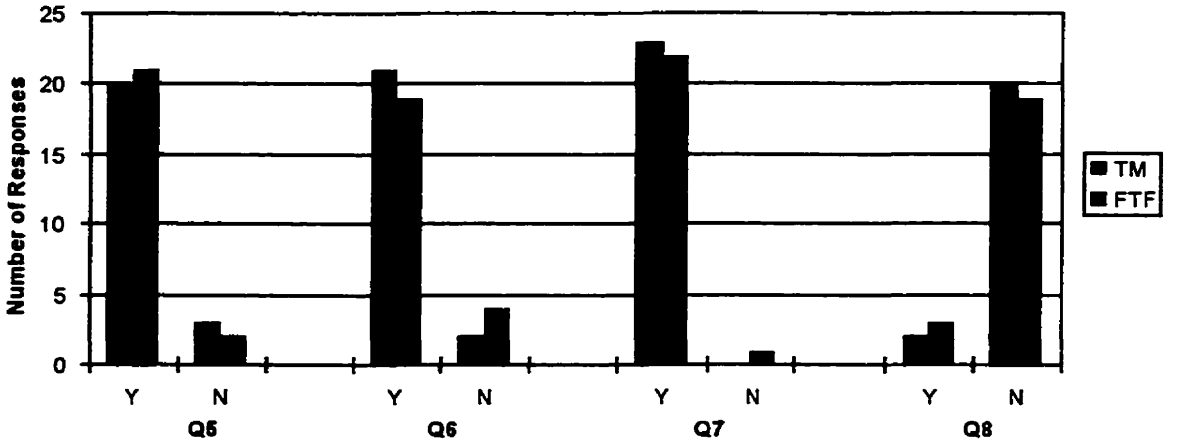
Psychiatrists were asked eight specific patient management questions. All management questions had "Yes / No" answers. Figures 5 and 6 summarize the psychiatrists' responses. The lighter bars represent the psychiatrists' responses after a telemedicine (TM) assessment and the darker bars represent responses after a face-to-face (FTF) assessment. Under each figure are the specific questions, and in brackets after each question is the calculated McNemar Chi-Square value.

Figure 5. Psychiatrist Management Q1-4



Q1 = Does this patient require another session for assessment by a child psychiatrist? (Chi = 0.071)
Q2 = Does this patient require follow-up with a child psychiatrist? (Chi = 0.000)
Q3 = Do you feel this patient requires comprehensive treatment by a child psychiatrist? (Chi = 0.000)
Q4 = Does this patient require admission to the Janeway for treatment? (Chi = 0.000)

Figure 6. Psychiatrist Management Q5-8



Q5 = Do you think this patient can be treated in the community if the services were available? (Chi = 0.000)
Q6 = Would you recommend any further investigations? (Chi = 0.059)
Q7 = Would you recommend involving other disciplines? (Chi = 0.000)
Q8 = Would you recommend that this patient be assessed by another physician (non-psychiatrist?) (Chi = 0.000)

It is obvious by looking at the graphs that the psychiatrists' responses were similar. Using the McNemar Chi-Square Test, all eight of the management questions were found to have McNemar Chi-Square values less than 3.841. Consequently, the null hypothesis is not rejected. This means that for all patient management questions the responses after a telemedicine assessment were not statistically different from the responses after a face-to-face assessment ($p < 0.05$).

Psychiatrist satisfaction

Descriptive summary

Descriptive analysis indicated that in 21/23 cases the psychiatrists stated the telemedicine interviews went "moderately well" or "very well". The 2/23 telemedicine interviews that were stated to have gone "moderately poorly" were due to problems with the audio. When asked how easy it was to use the telemedicine system, 3/5 psychiatrists said it was "very easy" and 2/5 said "moderately easy". When asked how easy they thought it would be to teach other physicians how to use the telemedicine system, 1/5 responded "very easy" and 4/5 responded "moderately easy".

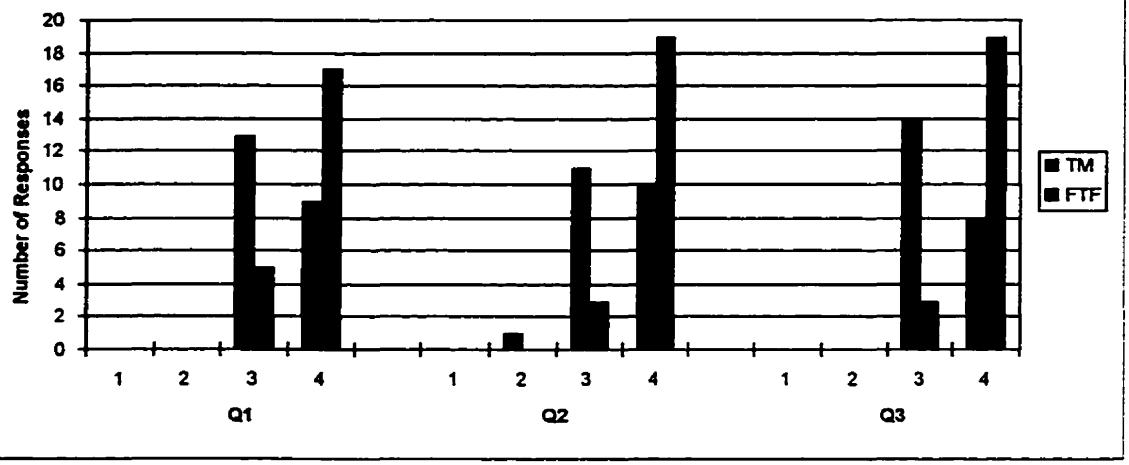
Subjective comments included: "Overall, a very exciting and worthwhile project", "I feel there is a great potential for the system in psychiatry in this province", "It was much better than I thought it would be", "best not to have siblings in the room" (due to the extra noise).

Statistical analysis

Psychiatrist's satisfaction with the telemedicine assessments were compared to their satisfaction with face-to-face assessments. Satisfaction questions included three Likert scale questions and two "Yes / No" questions. Figure 7. summarizes the psychiatrists' responses to the Likert questions. The lighter bars represent the psychiatrists' responses after a telemedicine (TM) assessment and the darker bars represent responses after a face-to-face (FTF) assessment. The higher the number along the x-axis the more positive the response. Under the figure are the specific

questions. In brackets after each question are the number of times one assessment was ranked higher than the other, followed by the calculated p value, (e.g. TM 1, FTF 6, p = 0.0170).

Figure 7. Psychiatrist Satisfaction Q1-3



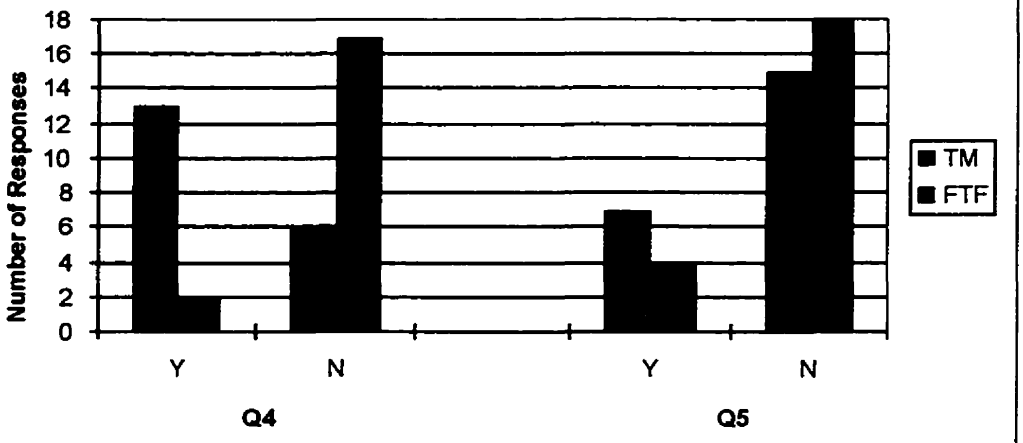
Q1 = How well do you think the interview went? (TM 1, FTF 9, p = 0.0107)
Q2 = How well were you able to communicate with the patient and parent? (TM 1, FTF 10, p = 0.0059)
Q3 = How well do you think the patient and parent were able to understand you? (TM 1, FTF 12, p = 0.0017

Using the Sign Test - Paired Data, all three Likert satisfaction questions were found to have calculated p values less than 0.025. Consequently, the null hypothesis was rejected. This means there was a statistical difference between the responses after telemedicine and face-to-face assessments, all favoring the face-to-face assessments. The psychiatrists' responses indicate that they felt face-to-face assessments went better overall, they were able to communicate better with the patient, and the patient and parent were able to understand them better compared to telemedicine assessments.

Figure 8. summarizes the psychiatrists' responses to the "Yes / No" satisfaction questions. The lighter bars represent the psychiatrists' responses after a

telemedicine (TM) assessment and the darker bars represent responses after a face-to-face (FTF) assessment. Under the figure are the specific questions and in brackets after each question is the calculated McNemar Chi-Square value, e.g. (Chi = 7.69)

Figure 8. Psychiatrist Satisfaction Q4-5



Q4 = Was there anything you would have like to have changed / improved? (Chi = 7.69)*
Q5 = Did you have any difficulties during the interview (other than technical)? (Chi = 1.33)

Statistical analysis of the responses using the McNemar Chi-Square Test found that for question four (Q4) the calculated value was greater than 3.841. Consequently, the null hypothesis was rejected. For question #4, there was a statistical difference ($p < 0.05$), indicating that the psychiatrists would have liked to have changed / improved more during the telemedicine assessment compared to the face-to-face assessment. Question five was not statistically different, indicating that the psychiatrists did not experience any more difficulties (non-technical) with the telemedicine assessment compared to the face-to-face assessment.

Technical satisfaction

Psychiatrists were asked to comment on the equipment, including technical problems or difficulties they had with the system. In 17/23 of the telemedicine interviews psychiatrists commented on the technology. The majority of these comments were negative and related to the audio (N=14), e.g. "volume too low", "poor quality audio", "distorted sound", "echo", "delay in hearing the words", "muffled". Other problems mentioned were: video froze N=1, picture not clear N=1, could not see child on floor N=1. In 10 assessments the psychiatrists stated that the problems encountered interfered in some way with their ability to assess the patient, e.g. "had to repeat what I said", "hard to hear", "took longer", "unable to understand answers".

Most of the negative comments were made at the beginning of the project. As a result of the comments, the audio system was changed. After trying two different audio systems, the psychiatrists comments changed, e.g. "the audio is now a lot better", and "audio excellent". To solve the video problems, the telemedicine system was disconnected and then reconnected by re-dialing (took less than five minutes). Not being able to see the child on the floor was solved by simply physically repositioning the camera, e.g. the back of the camera was propped up so that its neutral position was slanted downward. Another comment made by a couple of psychiatrists was "boardroom appears to have better audio".

Audio quality more important than video quality

One key observation was that the quality of the audio had more of an effect on how satisfied the psychiatrists were with the telemedicine assessments than the video

quality. All psychiatrists agreed that high quality audio was more important than high quality video. Follow-up interviews with the psychiatrists indicated that they would be willing to sacrifice video quality, particularly "fluid movement", in order to have or maintain high quality audio.

Parent Satisfaction

Descriptive summary

In 18/23 cases, parents stated that it was "somewhat easy" or "very easy" to talk to and understand the child psychiatrist. The remaining 5/23 parents said that it was "somewhat difficult" to talk to or understand the child psychiatrist. The primary reason was due to problems with the audio. Overall, 12/23 parents preferred the face-to-face assessment, 10/23 had no preference and 1/23 preferred the telemedicine assessment. Reasons given for preferring the face-to-face assessment included it was "easier to talk and hear the psychiatrist" and "more personal", whereas with telemedicine interviews there was "lack of eye contact" and "missed sentences". A couple of parents also mentioned that they had difficulty communicating with the child psychiatrist because she had an accent. This was only mentioned during the telemedicine interviews and not during face-to-face interviews with the same psychiatrist. Four of 23 parents stated that the personality of the psychiatrist had influenced which interview they had preferred. In 1 of the 4 cases, it caused the parent to prefer the telemedicine assessment.

In 10/23 cases parents commented that they did not like something about the telemedicine assessment. Reasons included: "cancel out sound when spoke together", "sometimes psychiatrist didn't hear", "had to repeat things", "difficult to concentrate", "Dr. missed out on facial expressions". However, only three parents said there was something they could not say or do because of the equipment. Reasons given for this included "conscious of equipment", "unable to say everything", "forgot to say things". Early in the study, a few parents stated that they thought the picture was "too small" and caused the assessment to feel "impersonal". This resulted in upgrading the monitor from a 14" to 17" screen.

When asked if they would want to use the system again, 19/23 said they would. Reasons given for not wanting to use the system again were: they did not like the "delay/time factor" or the "time to repeat". One parent said she would use it "perhaps with a different doctor". Another parent said that she would not use it again but it "might be OK for someone else". Overall, 21/23 parents said that if they lived a long distance from St. John's, e.g. Corner Brook, they would prefer to see the psychiatrist over the telemedicine system rather than traveling.

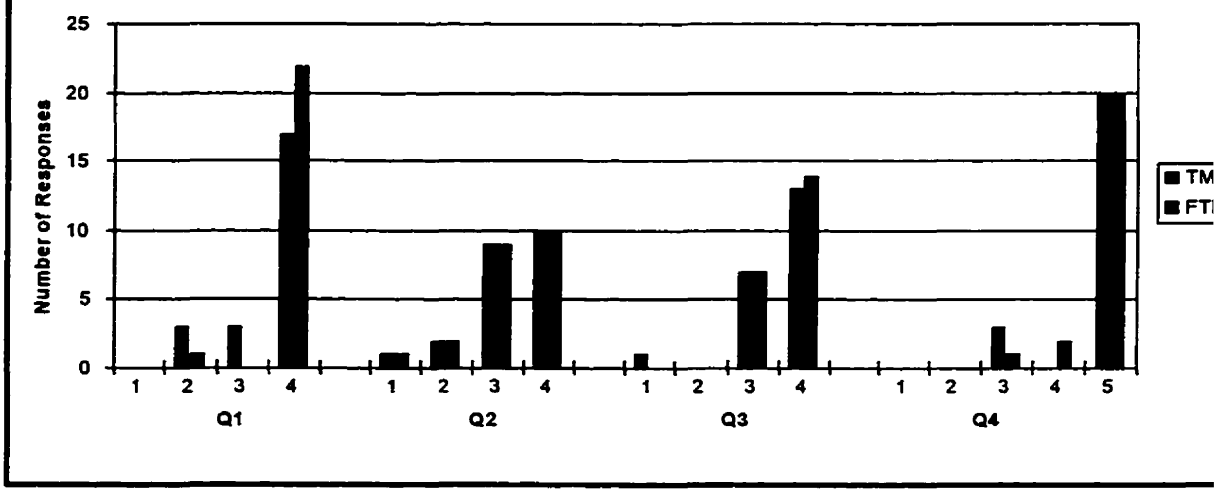
Finally, 20/23 parents responded that the telemedicine service should be paid for by government. Two parents felt the costs should be shared between the family and government and one parent was not sure who should pay.

Statistical analysis

Parents answered six Likert questions related to satisfaction with the assessments. Figure 9. summarizes the parents' responses to four of the six

satisfaction questions. The lighter bars represent the parents' responses after a telemedicine (TM) assessment and the darker bars represent the responses after a face-to-face (FTF) assessment. The higher the number along the x-axis the more positive the response. Under the figure are the specific questions. In brackets after each question are the number of times one assessment was ranked higher than the other, followed by the calculated p value, (e.g. TM 1, FTF 6, p = 0.0170).

Figure 9. Parent Satisfaction Q1-4

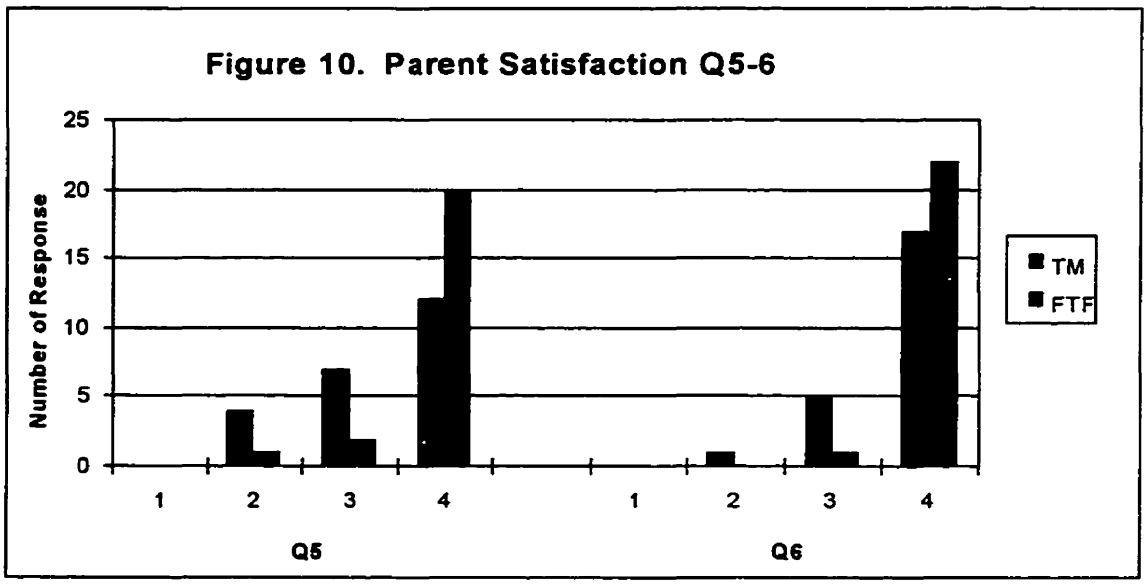


Q1 = How easy was it for you to talk to the psychiatrist? (TM 1, FTF 6, p = 0.0625)
Q2 = How easy do you think it was for your child to talk to the psychiatrist? (TM 4, FTF 8, p = 0.6128)
Q3 = How helpful do you think the interview was? (TM 3, FTF 5, p = 0.3633)
Q4 = How often were you able to tell the psychiatrist everything you wanted? (TM 2, FTF 2, unable to calculate p value due to the small number of differences)

It is obvious from looking at Figure 9. that the parents' responses were similar for questions one to four (Q1-4). Using the Sign Test - Paired Data, all calculated p values were greater than 0.025. Consequently the null hypothesis was not rejected. There was no statistical difference found between the telemedicine and face-to-face responses. Parents' responses indicate that in neither assessment was it easier for them

to talk to the psychiatrist or for their child to talk to the psychiatrist and there was no difference in how helpful the interview was or in their ability to tell the psychiatrist everything they wanted.

Figure 10. summarizes the parents' responses to satisfaction questions 5 and 6. The lighter bars represent the parents' responses after a telemedicine (TM) assessment and the darker bars represent the responses after a face-to-face (FTF) assessment. The higher the number along the x-axis the more positive the response. Under the figure are the specific questions. In brackets after each question are the number of times one assessment was ranked higher than the other, followed by the calculated p value, (e.g. TM 1, FTF 6, $p = 0.0170$).



Q5 = How comfortable were you during the interview? (TM 2, FTF 9, p = 0.0327))
Q6 = How easy was if for you to understand the psychiatrist? (TM 0, FTF 5, p = 0.0312)

The Parents' responses to questions 5 and 6 were more variable. The p values calculated using the Sign Test – Paired Data were close to, but still greater than 0.025. Consequently, the null hypothesis was not rejected. The responses after telemedicine and face-to-face assessments were not statistically different. However, the responses to questions 5 and 6 indicate that there may be a trend toward parents being more comfortable and it being easier to understand the psychiatrist in a face-to-face assessment, but not enough to be statistically significant.

Patient satisfaction

There were 23 patients involved in the study, 18 children (ages 4-12) and five adolescents (ages 13-16). The two age groups were given different questionnaires. The adolescent's questionnaire was similar to the parent questionnaire. The children's questionnaire was much shorter and simpler. One child refused to answer some of the questions and therefore some of the results are calculated with a sample of 17 children.

Descriptive summary - Children

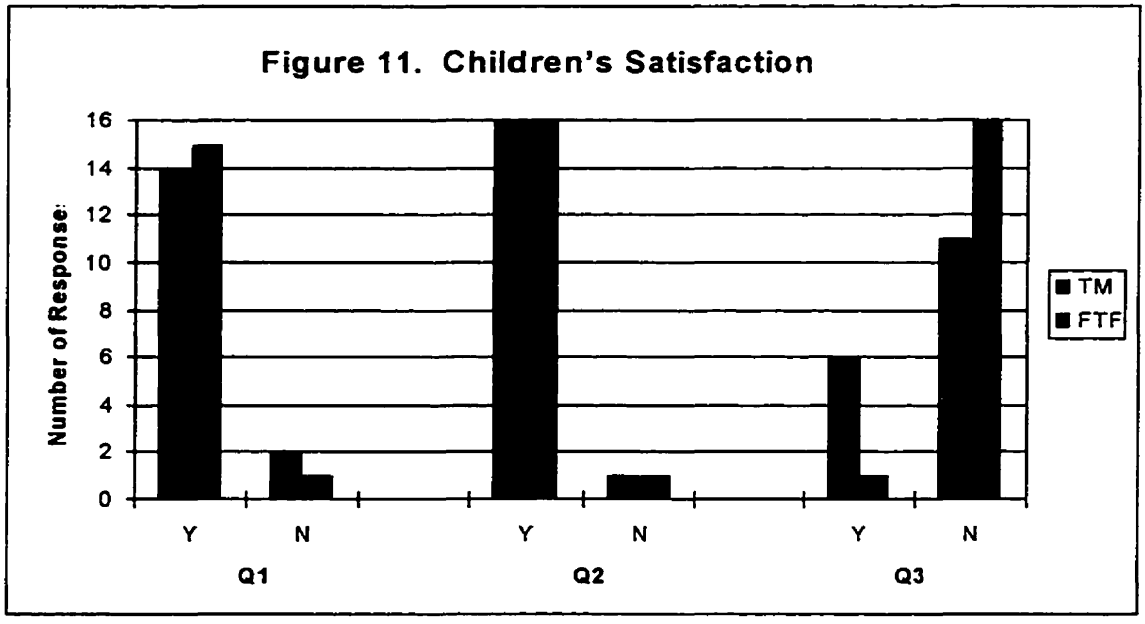
Overall, children were very positive towards the telemedicine system. In total, 16/17 said they liked talking to the doctor on the television and when asked which interview they preferred, 5/17 said they preferred the telemedicine interview, 5/17 preferred the face-to-face assessments and 7/17 did not prefer either interview.

Comments made by the children included: "would definitely rather see psychiatrist over TV", "I thought it was "cool", " I liked talking to doctor using the television", "it was neat", "it was good and cool", "weird...but its OK". One child asked if all his friends could see him on television.

In total, 20/23 children and adolescents stated that they would use the system again.

Statistical Analysis – Children

The children were asked three "Yes / NO" satisfaction questions. Figure 11. summarizes the children's responses. The lighter bars represent the children's responses after a telemedicine (TM) assessment and the darker bars represent responses after a face-to-face (FTF) assessment. Under the figure are the specific questions and in brackets after each question is the calculated McNemar Chi-Square value, e.g. (Chi = 0.000).



Q1 = Did you like talking to the doctor? (Chi = 0.000)
Q2 = Could you understand the doctor? (Chi = 0.000)
Q3 = Did you have any problems talking to the doctor? (Chi = 1.800)

For all three questions the calculated McNemar Chi-Square value was less than 3.841. Consequently, the null hypothesis was not rejected. There was no significant difference between the responses after a telemedicine or face-to-face assessment.

Children's responses indicated that they liked talking to the doctor and could understand the doctor equally well in telemedicine and face-to-face interviews. In question #3, there was a trend towards children having more problems talking to the doctor in a telemedicine interview compared to face-to-face but it was not enough to be statistically significant.

Descriptive Summary - Adolescents

Overall, adolescent responses were similar to their parents and not as positive as the children's responses. Three of the five adolescents preferred the face-to-face interview, one preferred the telemedicine interview and one was neutral. Two out of five said they liked using the television "very much", 1/5 "somewhat", 1/5 "not very much", 1/5 "very little". Three out of five said they would prefer to use it again instead of traveling if they lived a long distance from St. John's.

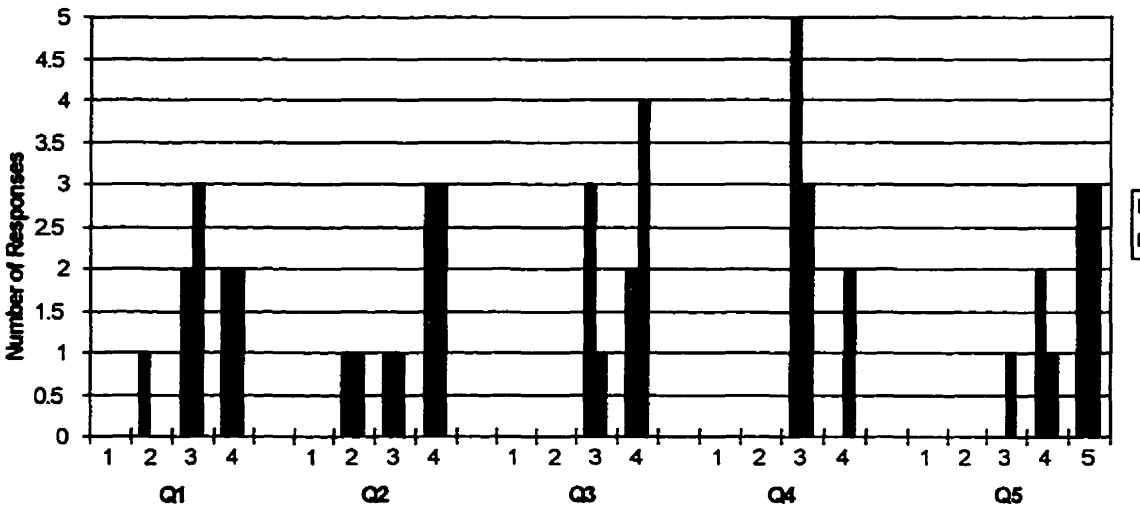
All five adolescents thought it was "just as easy" to talk to the psychiatrist via telemedicine as face-to-face, and were able to say and do everything they wanted. When asked to compare telemedicine to face-to-face interviews, four out of five said it was "about the same" and 1/5 said telemedicine interviews were "a bit better". The same patient who said the telemedicine interview was a bit better also said that she felt that the psychiatrist could understand her better over the telemedicine system.

Adolescents comments included: "sound sometimes a problem", "I didn't like being in a different room", "I didn't like talking to the screen", "it was easier to talk to doctor in person", and "I think it's very interesting and cool." Adolescents were also the first to ask if anyone could "tap" into lines and hear them.

Statistical Analysis - Adolescents

The number of adolescents in the study (N=5) was not enough to perform a statistical analysis. Figure 12. summarizes the adolescent's responses to the Likert scale satisfaction questions. The lighter bars represent the adolescents' responses after a telemedicine assessment and the darker bars represent responses after a face-to-face assessment. The higher the number along the x-axis the more positive the response.

Figure 12. Adolescent Satisfaction



Q1 = How comfortable were you during the interview?
Q2 = How easy was it to talk to the psychiatrist?
Q3 = How easy was it for you to understand the psychiatrist?
Q4 = How often do you think the psychiatrist was able to understand you?
Q5 = How helpful do you think the interview was?

Descriptive analysis indicates that most adolescents responded in a neutral fashion, e.g. did not prefer one type of interview to another. If there was a preference,

most of the time adolescents favored the face-to-face assessments. One adolescent had a definite preference for the telemedicine assessments.

DISCUSSION

Equipment and telecommunications

The original equipment chosen for the project was not satisfactory. Although it was found to be acceptable in a laboratory situation, a number of problems arose when it was placed in a clinical situation. The majority of complaints about the system were related to the audio. The most common complaints were: low volume or inability to hear the patient, delay between when the persons lips moved and when the sound was heard, audio cancelled out when both sites talked at the same time, and echo (what was said was repeated). It became obvious that the audio system that came with the computer was intended for a single person sitting close to the computer. The microphone's ability to pick-up audio from two people situated farther away was not satisfactory. This was particularly evident when the child moved around the room. These complaints resulted in the audio equipment being changed. The second system tried was more expensive, but it too received a number of negative comments and was found not to be satisfactory. A third audio system designed specifically for videoconferencing was tried and found to be satisfactory. Looking back, the audio system should have been tested more stringently before being implemented.

The original 14" monitors used in the study were felt by some participants to be too small. One parent stated she felt like she was "straining to peer into a box" and that this made the assessment impersonal. Parents said they would prefer a larger monitor that made the doctor appear more life size. As a result, the monitors were changed to 17". The original monitors had been chosen for technical reasons, e.g. the best resolution of the image was with the 14" monitor. However, the participants seemed to prefer images that were closer to life size even if it meant the quality of the image was not as good.

Although it would have been ideal not to have changed the equipment during the middle of the study, it was felt to be necessary because of the participants' comments. It was decided that if the technology could be changed easily and at little expense all attempts should be made to find equipment that satisfied the participants.

The use of six digital telephone lines for assessing patients was found to be acceptable. The number of lines used is directly proportional to the quality of the video and audio, e.g. smaller the bandwidth the poorer the quality. When the psychiatrists were exposed to videoconferencing sessions using fewer lines, (e.g. two or four lines), they said they would accept the poorer video quality as long as the audio quality was kept constant. This corresponds with the empirical results obtained by child psychiatrists in Toronto who use a four-line digital telephone link for their telepsychiatry assessments (personal communication with Dr. Elsa Broder, 1996).

Over the course of the project, there was only one incident where it was not possible for the telemedicine units to connect. Later it was discovered that it had

been a network problem (not a problem with the videoconferencing units). The reason for the inability to connect was never specifically determined.

Rooms chosen

The comment by one of the psychiatrists, e.g. "boardroom appears to have better audio" was interesting. In follow-up interviews with the other four psychiatrists, the comment was mentioned and they agreed. Theoretically the audio quality should not have been different because the same telemedicine system was used in all rooms. A possible reason for this observation was that the boardroom had thicker walls and carpeting and therefore provided better insulation from outside noise and better dampening e.g. less sound echoed off the walls and floor.

Study design

The study design in this project was experimental and directly compared telemedicine assessments to face-to-face assessments. Randomization was used to assign patients into an experimental and control group and to assign the psychiatrists to each assessment. Descriptive studies that do not have a control group can only offer subjective evaluations and expert "opinions". Control groups are needed in order to see how patients respond in a "normal" situation. For example, when asking patients how satisfied they were with telemedicine assessment, it is important to know how satisfied they are with face-to-face assessments. One cannot automatically assume that all patients will be 100% satisfied with face-to-face assessments.

The answers from well designed telemedicine research studies can help in the design and implementation of future telemedicine systems and determine if a telemedicine system is even worth implementing. Most telemedicine research thus far has come from descriptive studies. Although these studies provide valuable information, they have a number of limitations. Ideally, experimental telemedicine studies should be done, where the effects of an intervention on the events are analyzed. Experimental studies are preferable because the results are more likely to be reliable and have internal validity and less likely to be influenced by bias or due to chance.

The study design used in this project was quite rigorous, however it did have a number of potential biases and limitations:

- Patients and parents had two interviews. This means that there could have been a learning effect from the first interview. Patients and parents may have thought about some of the questions they had been asked in the first interview and prepared "better" answers in the second interview. It is also possible that they may have forgotten to say something in one interview that they did in the other. These differences could have influenced the psychiatrist's conclusions. In either case, randomization was used to help decrease this potential problem.
- Interviews were not conducted with the patient and parent at the same time on the same day. This could have influenced the assessments as the patient and parent may have felt and / or behaved differently during the two assessments or there may have been a significant event that occurred between the first and second interview. To decrease these potential problems interviews were scheduled within 24 hours of each other and were conducted at approximately the same time of day. Since the time between the assessments was only 24 hours it would have been unlikely that the patient's mental health problem would have changed. By scheduling it at the same time of day, it was hoped

that the parent and patient would be in a similar mood / mind frame.

- Five child psychiatrists participated in the study. Differences between the child psychiatrists could have influenced the results in a number of ways. Some psychiatrists because of their interview style or understanding of the technology may have been more effective using the telemedicine system. Patients and parents may have also reacted differently to each psychiatrist because of a number of factors, e.g. male / female, light skinned / dark skinned, personality. Randomizing the psychiatrist who did the assessment was done to decrease these potential problems.

Sample size

The final sample size was 23 cases; specifically 23 patients and their parents were assessed by a child psychiatrist face-to-face and by a different child psychiatrist via telemedicine. This is not a large sample and does not have adequate power. However, it is the largest controlled child telepsychiatry study to date. Only two other controlled telepsychiatry studies (with adult patients) had larger sample sizes (Dongier et al., 1986), (Zarate et al, 1997). The largest had 50 patients in the experimental arm and 35 in the control group, the second largest had 45 patients in each arm of the study (patients acted as their own controls).

Questionnaires

Ideally, it would have been best to use validated outcome measures for the study, but unfortunately none existed. A lot of time and effort went into developing the questionnaires, however they still were not ideal. After obtaining all the responses,

it was found that some of the questions were ambiguous, as participants had obviously interpreted the questions differently. For example, when the child psychiatrists were asked if the patient needed to be seen again by a child psychiatrist, some interpreted the question as "should" he/she be seen again, and others as "would" he/she be seen again. The questionnaires were also lengthy. This was necessary as we felt we "needed to ask about everything", because we did not know what was going to be important. This is a problem with any pilot study. There were certain items that we did not ask that should have, e.g. how long each assessment lasted. In follow-up interviews psychiatrists stated that telemedicine and face-to-face assessments took about the same length of time, e.g. approximately two hours.

The research assistant noted that having her read out the questions and write in the answers for the parents and patients was a good idea, particularly for the children. Although the questions were relatively straightforward, parents often asked for clarification. The research assistant also recorded patient and parent responses that were not part of the questionnaire. This proved to be beneficial in a number of ways. For example, during one of these semi-structured interviews, it was discovered that when the child moved about the room to play with the toys the psychiatrist was having difficulty hearing him. It was also during one of these interviews that the solution to the problem was proposed, e.g. put extra mikes close to the toys.

Implementation

Hiring a competent research assistant was key to the success of the project. It is recommended that the research assistant should have the following characteristics:

- Health care professional –the research assistant stated that many patients appeared to be more comfortable knowing that she was a nurse. In fact, a number of parents asked specifically whether she was a health professional during the initial telephone call. An experienced nurse is probably the ideal research assistant as he/she would be comfortable talking to patients about sensitive matters and understand patient confidentiality and the health care culture.
- Interpersonal skills - need to be able to educate and convince parents and health care professionals that telemedicine is useful and that they should become involved in the project.
- Well connected - someone who is familiar with the staff at the hospital and knows whom to contact is very useful. It is also helpful if the person is aware of the personality characteristics of individuals at the hospital.
- Flexible - telemedicine is a new area and there are a lot of little things that need to be done that do not necessarily fall into a formal job description.
- Administrator - a large number of individual's schedules need to be coordinated in order for the telemedicine assessments to occur.

Diagnosis and treatment

The diagnosis and treatment recommendations were found to be the same in 22/23 (96%) cases. No studies were found in the literature to which the results could be directly compared. Studies have compared the results from standardized psychiatric screening tests conducted by two psychiatrists and found a correlation of 0.89 (Folstein et al., 1975). Studies have also compared telemedicine to face-to-face interviews for the delivery of standardized psychiatric screening tests (Ball et al,

1993), and for standardized rating scales (Baer et al., 1995). Correlational values in these studies ranged from 0.89 to 0.99. Based upon these figures, and taking into account that five psychiatrists were involved in the project, the diagnostic agreement in this study was high. Possible reasons for the high level of agreement include: all psychiatrists were trained at the same institution, all had received fellowship training by the same individual, and their level of experience with the telemedicine system was similar.

The level of diagnostic confidence with the Primary, Axis 4 and Axis 5 diagnoses was very similar independent of how the assessment was conducted and was not found to be statistically different. This was unexpected as it had been anticipated that the psychiatrists level of confidence would be significantly less when using telemedicine system compared to face-to-face assessments as found by McLaren et al., (1996). A possible reason for this difference may be because the videoconferencing system used in (McLaren et al., 1996) produced a smaller, lower quality, video image compared to this study and was monochrome versus color.

Psychiatrist satisfaction

Overall, child psychiatrists were satisfied with the telemedicine system. All five said it was "an acceptable alternative" to a face-to-face assessment and that it "did not interfere with making a diagnosis". Four out of five said it was "just as effective" as a face-to-face assessment and the fifth said it was "almost as effective". Even though the majority said telemedicine assessments were just as effective as face-to-face assessments, all five psychiatrists still said they "preferred" to assess a patient face-to-

face. This seems to indicate that psychiatrists like to see a patient in person if given the choice, but do not need to see the patient in person in order to make the diagnosis.

Parent satisfaction

The majority of parents were "satisfied" or "very satisfied" with the telemedicine system. Like psychiatrists, when asked explicitly which assessment they "preferred", most parents selected the face-to-face assessment. Unlike psychiatrists, their responses to the satisfaction questions did not statistically favor the face-to-face assessment, but were neutral. In fact, none of the satisfaction questions were statistically different from each other. These findings correlate with results from other telepsychiatry studies that have found that patients are more likely to accept and be satisfied with telemedicine interviews than physicians (Dongier et al., 1986), (McLaren et al., 1996).

The calculated p values for parents' responses to satisfaction questions 5 and 6, (e.g. 0.0327, 0.0312) were very close to the p value set for significance (e.g. 0.025). If a one-sided test had been used (and the critical p value was 0.05, not 0.025) the results would have been significant. In this case, these results were classified as showing a trend towards significance. If a larger sample had been used, the results may have been significant.

Since some parents said they would not want to use the telemedicine system again (2/23), it implies that not all patients may be suited to the technology. One parent's comment sums this concept up well, "I wouldn't want to use it again, but it

might be OK for another person". Studies need to be done to determine if there are certain types of patients that should not be expected to use telemedicine systems.

The comment by two parents that they had difficulty communicating with one child psychiatrist because of her accent is noteworthy because it was only mentioned after telemedicine assessments. No comments regarding her accent were recorded after any of her face-to-face assessments. It is possible that the telemedicine system made her accent more difficult to understand. The psychiatrist had been born in India, but trained in Canada.

Patient satisfaction

Children were very positive towards the telemedicine system, 16/17 "liked" using the system and 5/17 preferred it compared to seeing the doctor in person. This is in contrast to psychiatrists and parents who almost unanimously prefer to have an assessment done face-to-face. It is hypothesized that some children prefer the telemedicine assessments because they are intimidated when the doctor is in the same room. It is also possible that children who have grown up using computers and playing video games are also more comfortable with the technology than adults. These results support the results from Dwyer (1973), a descriptive study, that found that some schizophrenics, children and adolescents preferred the telemedicine interviews to face-to-face interviews.

Statistical significance versus clinical significance

One of the difficult areas in biomedical statistics is to determine what level of statistical significance is relevant clinically. Even if there is a statistical difference, it may not impact the clinical situation. In this study, the psychiatrists stated they preferred to conduct an assessment face-to-face and all five satisfaction questions were statistically significant favoring face-to-face assessments. However, the psychiatrists also said the telemedicine assessment was an acceptable alternative to a face-to-face assessment and did not interfere with making a diagnosis. There is obviously a difference between what psychiatrists "want or like" and what is "needed". Further research needs to be conducted to determine what level of statistical significance correlates with different clinical outcomes.

CONCLUSIONS

Overall, the Child Telepsychiatry Project met all of its objectives and was considered a success by the project participants. The only negative point was that the final sample size was lower than anticipated. The following conclusions can be made from the project:

1) Child psychiatric assessments can be conducted using a PC-based telemedicine system linked using six digital telephone lines, e.g. 336 kbps.
2) Five child psychiatrists became familiar with the telemedicine system and by the end of the study were comfortable using the system. Their responses indicated that they became more positive toward the telemedicine system after having used it.
3) When the same patient is assessed by one child psychiatrist face-to-face and by another child psychiatrist using a telemedicine system they make the same diagnosis and treatment recommendations 96% of the time.
4) Psychiatrists prefer to conduct child psychiatric assessments face-to-face, but stated that telemedicine assessments were an "acceptable alternative" and the technology did not interfere with making a diagnosis.
5) The majority of parents preferred to have their children assessed face-to-face, but stated that they would use the telemedicine system again and would choose to use the system instead of travelling a long distance.

6) The majority of patients "liked" using the telemedicine system. Approximately 1/3 of the children preferred the telemedicine assessment, 1/3 preferred the face-to-face assessment and 1/3 had no preference.

Future Research

Based upon the positive results from Phase 1, the Janeway Children's Foundation agreed to fund Phase 2 of the Child Telepsychiatry Project. Phase 2 will involve setting-up and evaluating a telemedicine system that links child and adolescent psychiatrists at the Janeway Child Health Centre in St. John's, to patients and their parents located at Western Memorial Regional Hospital in Corner Brook, 670 km away across the island. The study will include a cost analysis and a descriptive evaluation of participant satisfaction with the system. The telemedicine system will also be demonstrated and promoted to other health care professionals at both institutions. It is hoped that if Phase 2 of the Child Telepsychiatry Project is successful, it will continue on indefinitely as a service.

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APPENDICES Page

APPENDIX A – CHILD TELEPSYCHIATRY PROJECT QUESTIONNAIRES

The data for the Child Telepsychiatry Project came from the questionnaires on the following pages.

Note - The space that would normally follow many of the questions (to write in the response) has been deleted in order save space.

The questionnaires were delivered according to the following schedule:

A) The child psychiatrists will fill out:

- Pre-Project Questionnaire before the study begins.
- DTS (Diagnosis, Treatment and Satisfaction) Questionnaire after a face-to-face or telemedicine assessment.
- Technology Evaluation Questionnaire after a telemedicine assessment only.
- Post-Project Questionnaire at the end of the study after all the Phase 1 interviews have been completed.

B) The parent will fill out:

- Parent Satisfaction Questionnaire after a face-to-face or telemedicine assessment.
- Parent Comparison Questionnaire after the second assessment.

C) The patient* will fill out:

- Patient Satisfaction Questionnaire after a face-to-face or telemedicine assessment.
- Patient Comparison Questionnaire after the second assessment.

*Patients age 4-11 years completed Patient Satisfaction / Comparison Questionnaire A. Patients age 12-16 years will fill out Patient Satisfaction / Comparison Questionnaire B.

PRE-PROJECT QUESTIONNAIRE

Date:

Code:

This questionnaire is to be filled out by a child psychiatrist before commencing the Child Telepsychiatry Project.

Please answer the following.

1) Age:

2) Sex (circle one): Male Female

3a) Name of medical school attended:

3b) Year of graduation:

First residency

Second residency

4a) Location of residency program:

b) Type of residency:

c) Year of completion:

5a) Location of child psychiatry fellowship:

b) Year of completion:

6) Location(s) and years in child psychiatry practice:

Location:

Years in practice:

7) Number of years in practice before starting child psychiatry (leave blank if not relevant)

a) Type of practice (e.g. general practice / psychiatry) :

b) Number of years:

Please circle your answer to the following questions.

8) Do you own any of the following?

a) a television? YES NO

b) a video machine i.e. VCR? YES NO

c) a video camera? YES NO

d) a computer? YES NO

e) computer CD-ROM player? YES NO

9) How comfortable are you with using electronic equipment in general?

1. **Very Comfortable**
2. **Moderately Comfortable**
3. **Moderately Uncomfortable**
4. **Very uncomfortable**

10) How comfortable are you with using computers?

1. **Very Comfortable**
2. **Moderately Comfortable**
3. **Moderately Uncomfortable**
4. **Very Uncomfortable**

11) How much experience have you had with videoconferencing equipment?

1. **None**
2. **Some**, please describe:
3. **Extensive**, please describe:

12) How comfortable do you expect you will be using the videoconferencing equipment?

1. **Very Comfortable**
2. **.Moderately Comfortable**
3. **Moderately Uncomfortable**
4. **Very Uncomfortable**

Please circle your answer to the following question.

13) Compared to a face-to-face psychiatric assessment, how effective do you think the videoconferencing system will be?

1. **Significantly More Effective**
2. **More Effective**
3. **Just As Effective**
4. **A Little Less Effective**
5. **Significantly Less Effective**

14) If you feel that the videoconferencing system will be more or less effective than a face to face assessment, please describe why (if you felt it would be the same, please leave blank).

15) What is your greatest concern with using the videoconferencing system for child psychiatric assessments?

16) What do you think are the potential benefits to telepsychiatry? (list more if necessary)

1.
2.
3.
4.

17) What do you think are the potential barriers to telepsychiatry? (list more if necessary)

1.
2.
3.
4.

DTS QUESTIONNAIRE

Date:

Code:

This questionnaire is to be filled out by a child psychiatrist after a face-to-face or telepsychiatry assessment. Please dictate your assessment as per normal. This should include the history, your assessment of the mental status of the patient, and recommended therapy.

PART A - DIAGNOSIS

The following questions will ask you to classify the patients diagnosis according to **DSM IV**, e.g. **AXIS 1, AXIS 2** etc. If the patient does not have any pathology for a category, please write in N/A i.e. not applicable.

1) What is your **AXIS 1** diagnosis e.g. Clinical syndrome?

a) Primary Dx:

b) Differential Dx

c) Concurrent Dx:

3) How confident are you with your primary **AXIS 1** diagnosis? (please circle a star)

0 100%

Not confident at all Extremely confident

4a) What is your **AXIS 2** diagnosis? (e.g. Personality / developmental disorder)

b) Differential diagnoses (you may write up to three)

5) How confident are you with your **AXIS 2** diagnosis? (please circle a star)

0	100%
Not confident at all	Extremely confident

6) What is your **AXIS 3** diagnosis, e.g. physical disabilities? (If none write N/A)

7) What is your **AXIS 4** impression e.g. severity of psychosocial stress? Please circle a number on the scale.

0	6
none	Severe

8) What is your **AXIS 5** impression, e.g. global assessment of functioning?
Please circle a number, using the GAF scale

1	9
very poor	excellent

9) How confident are you that the equipment enabled you to pick up on the cues that you felt were important in making the diagnosis? (please circle a star)

0	100%
not confident at all	Extremely confident

PART B - PATIENT MANAGEMENT

Please circle your answers to the following questions:

10) Does this patient require another session for assessment by a child psychiatrist? **YES NO**

11a) Does this patient require follow-up with a child psychiatrist? **YES NO**

If **YES**, how soon i.e. 6 months, a year?_____

b) Do you feel that this patient requires comprehensive treatment by a child psychiatrist? (requires specialist intervention) **YES NO**

12) Does this patient require admission to the Janeway for treatment ? **YES NO**

13) Do you think this patient can be treated in the community if the services are available? (e.g. treated by local health care professional?) **YES NO**

14) What treatment would you recommend? (i.e. medications/dosages, other treatment)

15a) Would you recommend any further investigations? **YES NO**

b) If **YES**, please list

16a) Would you recommend involving other disciplines, e.g. social work. **YES NO**

b) If **YES**, please list

17a) Would you recommend that this patient be assessed by another physician, e.g. non-psychiatrist? **YES NO**

b) If **YES**, please state the type of specialist recommended

PART C - SATISFACTION WITH THE INTERVIEW PROCESS

Please circle your answer to the following questions.

18) How well do you think the interview went?

1. **Very Well**
2. **Moderately Well**
3. **Moderately Poorly**
4. **Very Poorly**

19) How well were you able to communicate with the patient and parent?

1. **Very Well**
2. **Moderately Well**
3. **Moderately Poorly**
4. **Very Poorly**

20) How well do you think the patient and parent were able to understand you?

1. **Very Well**
2. **Moderately Well**
3. **Moderately Poorly**
4. **Very Poorly**

21a) Did you have any difficulties during the interview? (Other than technical difficulties) **YES** **NO**

b) If **YES**, please describe

22a) Was there anything you would have liked to have changed / improved? **YES** **NO**

b) If **YES**, please describe:

Other comments:

TECHNOLOGY EVALUATION QUESTIONNAIRE

Date:

Code:

This questionnaire is to be completed by a child psychiatrist after a telepsychiatry assessment.

Please answer the following questions

1a) Did you have any problems with the equipment? **YES** **NO**

b) If **YES**, please describe

2a) Did the problem interfere with your ability to assess the patient? **YES** **NO**

b) If **YES**, please describe

3) What do you think could be done to prevent this problem in the future?

4) Any other recommendations?

POST-PROJECT QUESTIONNAIRE

Date:

Code:

This questionnaire is to be filled out by a child psychiatrist after all assessments have been completed.

Please circle the number of your answer.

1) How comfortable were you using the videoconferencing equipment?

1. **Very Comfortable**
2. **Moderately Comfortable**
3. **Moderately Uncomfortable**
4. **Very Uncomfortable**

2) How easy was if for you to use the telemedicine system?

1. **Very Easy**
2. **Moderately Easy**
3. **Moderately Difficult**
4. **Very Difficult**

3) How easy do you think it would be to teach other physicians how to learn how to use videoconferencing?

1. **Very Easy**
2. **Moderately Easy**
3. **Moderately Difficult**
4. **Very Difficult**

4) Compared to a face-to-face assessment, how effective do you think the videoconferencing equipment is in its ability to allow you to do a psychiatric assessment?

1. **Significantly More Effective**
2. **A Little More Effective**
3. **Just As Effective**
4. **A Little Less Effective**
5. **Significantly Less Effective**

5) Which mode did you prefer to conduct your interview?

1. **Face-To-Face**
2. **Telemedicine Interview**
3. **No Preference**

6) Do you think videoconferencing provides an acceptable alternative to a face-to-face assessment, e.g. is it good enough? **YES** **NO**

7a) Would you use telemedicine to do assessments in the future? **YES** **NO**

b) If **NO**, what would have to change for you to use it?

8a) Are there particular psychiatric illnesses / conditions that you feel cannot be assessed adequately using telemedicine? **YES** **NO**

b) If **YES**, Please describe.

9) Was there anything that you would have liked to have done in the telepsychiatry interview that you could not because you were not there in person?

10) Having used telemedicine, what is your greatest concern with using videoconferencing equipment for child psychiatric assessments?

11) Did you feel that videoconferencing equipment hindered you in anyway from making a diagnosis? Please describe: **YES** **NO**

12) How could the telemedicine assessment process be improved?

13) What do you think are the potential benefits to telepsychiatry? (list more if necessary)

14) What do you think are the potential barriers to telepsychiatry? (list more if necessary)

Other Comments:

PARENT SATISFACTION QUESTIONNAIRE

Date:

Code:

This questionnaire is to be completed by the parent (or guardian).

PART A - DEMOGRAPHICS

Please answer the following questions.

1) Where do you live?

_____

(City/town)

2) Your child's age in years: _____

3) Your child's sex (circle one): **MALE FEMALE**

4a) Has your child seen a psychiatrist in the past? (circle one) **YES NO**

b) If **YES**, please write in the month and year:

_____

PART B - SATISFACTION WITH THE INTERVIEW PROCESS

Please circle the number that represents your answer.

6) How comfortable were you were during the interview?

1. **Very Comfortable**
2. **Somewhat Comfortable**
3. **Somewhat Uncomfortable**
4. **Very Uncomfortable**

7) How easy was it for you to talk to the psychiatrist?

1. **Very Easy**
2. **Somewhat Easy**
3. **Somewhat Difficult**
4. **Very Difficult**

8) How easy was it for you to understand the psychiatrist?

1. **Very Easy**
2. **Somewhat Easy**
3. **Somewhat Difficult**
4. **Very Difficult**

9) How easy do you think it was for your child to talk to the psychiatrist?

1. **Very Easy**
2. **Somewhat Easy**
3. **Somewhat Difficult**
4. **Very Difficult**

10) How often were you able to tell the psychiatrist everything you wanted?

1. **Almost Always**
2. **Often**
2. **About Half The Time**
3. **Infrequently**
4. **Almost Never**

11) How helpful do you think the interview was?

1. **Very Helpful**
2. **Somewhat Helpful**
3. **Somewhat Unhelpful**
4. **Very Unhelpful**

Other Comments:

PARENT COMPARISON QUESTIONAIRRE

Date:

Code:

This questionnaire is to be filled out by a parent (or guardian) after both interviews have been completed.

Please circle the number that represents your answer.

1a) Which interview did you prefer? (circle your answer)

1. **The Television Interview**
2. **The Face-To-Face**
3. **No Difference**

b) If you liked one interview better than the other, please describe why?

2) Did you like one interview more than the other because of the personality of the psychiatrist? **YES NO**

3) How would you compare the television interview to the face-to-face interview?

1. **Much Better**
2. **A Bit Better**
3. **About The Same**
4. **Not As Good**
5. **Much Worse**

4) Would you prefer to see a child psychiatrist in person?

1. **Yes**
2. **No**
3. **Doesn't Matter**

5a) Was there anything you did not like about the television interview? **YES NO**

b) If **YES**, please describe

6a) Was there anything that you did not say or do during the television interview because you were not in the same room as the psychiatrist? (circle one) **YES NO**

If **YES**, what were you unable to say or do

7a) Would you use telemedicine again? **YES NO**

b) If **NO**, what would have to change for you to use it again?

8) If you lived a long distance from St. John's, would you prefer to have a television interview instead of traveling into St. John's to see a doctor? **YES NO**

9) Do you think telemedicine should be paid for by the government? **YES NO**

PATIENT SATISFACTION QUESTIONNAIRE A

Date:

Code:

This questionnaire is to be filled out by children ages 4-12, after either a face-to-face or telepsychiatry interview. The research assistant will ask the questions.

---

1) How old is the child?: _____

2) Male or Female: M/F

3) Did you like talking to the doctor?

YES NO

4) Could you understand the doctor?

YES NO

5a) Did you have any problems talking to the doctor? **YES NO**

b) If YES, please describe

_____

Other comments:

PATIENT COMPARISON QUESTIONNAIRE A

Date:

Code:

This questionnaire is to be filled out by a patient ages 4-12 after both interviews have been completed. The research assistant will ask the questions.

Please answer the questions.

1) Did you like using the television to talk to the doctor? **YES** **NO**

2) Which interview did you like better:

1. **The One Done By Television**
2. **The One Where The Doctor Was In The Same Room**
3. **Liked Both The Same**

3) If you had to see the doctor again, would you like to see him / her:

1) On Television

2) In Person

3) Does Not Matter

Other Comments:

PATIENT SATISFACTION QUESTIONNAIRE B

Date:

Code:

This questionnaire is to be filled out by a patient ages 12-16, after either a face-to-face or a telepsychiatry interview. The research assistant will ask the questions.

---

1) What is your age? (please print your answer): _____

2) What is your sex? (please circle one) **MALE FEMALE**

3) How comfortable were you were during the interview? (circle a number)

1. **Very Comfortable**
2. **Somewhat Comfortable**
3. **Somewhat Uncomfortable**
4. **Very Uncomfortable**

4) How easy was it for you to talk to the psychiatrist?

1. **Very Easy**
2. **Somewhat Easy**
3. **Somewhat Difficult**
4. **Very Difficult**

5) How easy was it for you to understand the psychiatrist?

1. **Very Easy**
2. **Somewhat Easy**
3. **Somewhat Difficult**
4. **Very Difficult**

6) How often do you think the psychiatrist was able to understand you?

1. **Almost Always**
2. **Often**
2. **About Half The Time**
3. **Infrequently**
4. **Almost Never**

7) How helpful do you think the interview was?

1. **Very Helpful**
2. **Somewhat Helpful**
3. **Somewhat Unhelpful**
4. **Very Unhelpful**

Other Comments: (i.e. child's perception of the equipment, etc.)

PATIENT COMPARISON QUESTIONNAIRE B

Date:

Code:

This questionnaire is to be filled out by patients age 12-16 years, after both interviews have been completed. The research assistant will ask the questions.

Please circle the number that represents your answer.

1) How much did you like using the television to talk to the psychiatrist?

1. **Very Much**
2. **Somewhat**
3. **Not Very Much**
4. **Very Little**

2a) Which interview did you like better?

1. **The Television Interview**
2. **The Face-To-Face Interview**
3. **No Difference**

b) If you liked one interview more than the other, please describe why?

3a) Would you use the television system again? **YES** **NO**

b) If **NO**, what would have to change for you to use it?

4a) Was there anything that you could not say or do because you had to use the television system? **YES** **NO**

b) If **YES**, please describe what you could not say or do:

5) How would you compare the television interview to the face-to-face interview?

1. **Much better**
2. **A Bit Better**
3. **About The Same**
4. **A Bit Worse**
5. **Much Worse**

6) Would you prefer to see a child psychiatrist in person?

1. **Yes**
2. **No**
3. **Doesn't Matter**

7a) Was there anything you did not like about the television interview? **YES** **NO**

b) If **YES**, please describe:

8) If you lived a long distance from St. John's, would you prefer to have a television interview instead of traveling into St. John's to see a doctor? **YES** **NO**

Other Comments: (i.e. child's perception of the equipment, etc.)

APPENDIX B – Telemedicine Technology Chosen

The equipment chosen was a portable PC-based videoconferencing unit. The telecommunications link chosen was six digital telephone lines (336 kbps). The reasons for choosing these technologies were:

- The literature and intuitive reasoning supported the need for interactive audiovisual communication for psychiatric assessments.
- PC-based technology could provide interactive audiovisual communication at a lower cost than dedicated room-based videoconferencing systems.
- There was no room at the Janeway hospital that could be dedicated solely for videoconferencing therefore the equipment had to be portable.
- Because of the telecommunications infrastructure in the province, if the project was going to link another site outside of St. John's, it was necessary to go from ISDN lines to switched-56 lines.
- A bandwidth of six digital lines was decided upon as this was consistent with the literature. It was felt that it would be prudent to err on the side of higher quality, even though it was more expensive. If needed, this bandwidth could be reduced in the future.

Technology chosen

The initial survey revealed that a variety of telemedicine technologies were being used to conduct telemedicine activities. The telemedicine technology has been divided into two parts, 1) end unit technology and, 2) the telecommunications link. Each part will be discussed separately. The end unit technology is the hardware / software / peripherals used by the user to capture, send, receive and view the information. The telecommunications link is the medium the information is transmitted over, e.g. telephone lines. The telecommunications link can be further categorized.

End Unit Technology

End unit technologies include: the simple telephone, picturephones, personal computers (running a variety of different software programs), videoconferencing systems, specialized teleradiology workstations (based on a computer or server), specialized telepathology workstations, and a variety of peripheral devices (e.g. ENT scopes, electronic stethoscope, document camera). Videoconferencing systems and PCs will be described in detail, as a PC-based videoconferencing system was chosen for the study.

Videoconferencing systems allow individuals in different locations to see and talk to each other in real time. This has many benefits, e.g. individuals no longer have to travel in order to meet and this saves time and money. This has resulted in videoconferencing becoming increasingly popular especially among the corporate sector. Health care professionals recognized the potential of videoconferencing technology in medicine and in the late 1980's and early 90's, a number of sites began to investigate using videoconferencing systems for clinical consultations. (Note – interactive television systems had been used much earlier but were based on analog technology). Dedicated room-based videoconferencing systems are expensive, approximately $60,000 - 100,000 per site. Diagnostic teleradiology systems adhering to the American Radiology Associations standards are even more expensive, due to the need to display very high resolution images (e.g. 2000 x 2000 pixels x 10 bit grey scale for a chest x-ray) and transfer large amounts of information. In 1995, the first PC-based videoconferencing systems running over digital telephone lines became

commercially available. They were much less expensive than the room based systems, (approximately $30,000 - 40,000 / site), were portable, and had similar audio and video quality (when running at 1/4 T1). As costs fall and the telecommunications infrastructure expands, PC-based videoconferencing systems will eventually allow desktop videoconferencing to become the norm.

Telecommunications Link

There are many different ways to link individuals located in different locations together using telecommunications technology. Telecommunications link can be described in a number of ways: a) type of link, e.g. medium, b) bandwidth, c) analog versus digital, d) dedicated vs. dial-up, e) synchronous (live) versus non-synchronous (store and forward), f) site to site vs. multi-point. Each of these categories will be described.

A) Medium

There are many types of telecommunications medium including telephone lines (twisted pair), fiber optic cable, coaxial cable, Ethernet, radiowave (including: microwave, cellular, satellite).

B) Bandwidth

Bandwidth can be likened to a pipe. The larger the bandwidth, the larger the

pipe. Analog systems measure bandwidth in Hz (cycles per second), while digital systems measure bandwidth by the amount of information sent in one second, kbps (kilobits per second).

C) Analog versus digital

Historically all telephone lines were designed to and carried analog information, e.g. voice. Most telephone networks in urban centres however have been upgraded to provide digital services. The advantages of converting information to a digital signal before transmitting is: 1) it does not degrade as easily, e.g. audio sounds clearer, 2) any type of information (sounds, data, still image, video) can be converted to digital form and sent over the same line simultaneously and 3) it can be compressed so that the signal takes up less bandwidth or less "pipe space". The most common types of digital telephone lines are ISDN (integrated services digital network) and switched-56. Both are ideal for transmitting digital information. The difference between ISDN and switched-56 is that one ISDN channel has a bandwidth of 64 kbps, whereas a switched-56 line has 56 kbps. Another benefit of digital telephone lines is that they can be added together to create larger bandwidths. For example, six ISDN channels could be added together to create a useable bandwidth of 384 kbps. This is also called ¼ T1. Adding lines together requires additional equipment, e.g. inverse multiplexor (or immux). The inverse multiplexor is required at both ends and simply divides the outgoing signal into the required number of lines or brings together all the incoming lines.

The literature indicates that most active telepsychiatry sites used telecommunications bandwidths ranging from 256 - 384 kbps (Allen et al, 1994) (Brown, 1995). However, recent studies have provided evidence to support the use of lower bandwidths, e.g. 128 kbps for some mental health disorders in adults (Zarate et al., 1997). For difficult psychiatric cases, e.g. for schizophrenic patients that have movement disorders or for patients (e.g. children) that move around a lot during an interview, higher bandwidths ,e.g. 1/4 T1, are recommended.

Telephone lines used as an example

Telephone lines will be used as an example since they were the medium chosen for the study. All telephone lines are not the same. The type of telephone lines used by most people are called POTS (plain old telephone service). Physically these telephone lines are made of twisted pair copper wires. POTS lines were originally designed to carry analog information, e.g. voice, however they can also be used to transmit digital information. For example, digital information is transmitted when you use a modem to link your computer to the Internet. The problem with POTS lines is that they have a small bandwidth. The information is sent and received slowly. Most modems in mid-1997 were capable of transmission speeds of 19.2 - 32 kbps. Even these speeds are usually not reached because of traffic or noise on the line. Although it is possible to use modem-linked computers for interactive audiovisual communication, the video and sound quality was is poor, (e.g. small picture size, low resolution and refreshed slowly) and therefore unacceptable for consultative purposes.

D) Dial up versus dedicated lines

Another characteristic of a telecommunications link is whether it is dial-up or dedicated. Dial-up means that you dial a specific number(s) when you want to use the line and you only pay for the line when you use it. Dedicated means that only select sites are on the network and consequently these are the only sites that can communicate with each other. With dedicated lines you do not have to dial a number however the network operator needs to be informed which sites on the network want to be linked together and when. Each site pays a set rate to be part of the network and pays even if they do not use the network. The major advantage of a dedicated network is that the cost is spread out over a number of users, and if the network is used a lot it is probably less expensive than paying for multiply dial-up calls. Most telemedicine programs use dial-up services or are moving to them. An analogy is that dedicated networks are like railroads and only specific sites have access. Dial-up services are like trucks that can move from any site to another as needed.

E) Synchronous versus non-synchronous

Telecommunications links can be synchronous (also called "live" or "real-time") or asynchronous (also called "store-and-forward" or "off-line"). Synchronous links allow you to interact like you would in a face to face situation; it is possible to immediately respond to the person, e.g. interrupt if you want. Asynchronous links do not let you interact in real-time, there is always a delay between when the information

sent and the response. The length of the delay can vary. The best example of asynchronous transmission is email. If you send an email message to a friend, it may be a day or more before you get a response. However, if your friend is on their computer the same time that you are, they may respond to your message in a few seconds. In either case, there is a delay. Obviously, the shorter the delay the more it becomes like a synchronous or "real-time" link.

F) Point-to-point versus multi-point

The final characteristic of a telecommunications link is whether it allows you to connect two sites together (point-to-point) or multiple sites at the same time (multi-point). Multi-point links are becoming increasingly popular. To have a multi-point videoconference, all sites need to be connected on a videobridge. Most video bridges are voice activated so that whoever is talking is the person who seen and heard by everyone else. At the present time, there is a limit to the number of sites that can be connected together due to technical and logistical problems.

Another type of communications link that more and more people are using is a LAN (local area network). Usually a LAN is an Ethernet based network. Ethernet uses a special type of cable and protocols that facilitates approximately 10 Mbps communication rate. When multiple users are on the link, the transmission rate slows down.

APPENDIX C - CONSENT FORMS

Faculty of Medicine
Memorial University of Newfoundland
St. John's, Newfoundland A1B 3V6

CONSENT TO PARTICIPATE IN BIO-MEDICAL RESEARCH

TITLE: Child Telepsychiatry Project

PRINCIPAL INVESTIGATOR(S): Drs. Rod Elford, Max House

SPONSOR: Not applicable

You and your child (or ward) have been asked to participate in a research study. Participation in this study is entirely voluntary. You may decide not to participate or may withdraw from the study at any time without affecting your normal treatment.

The investigators will maintain confidentiality of information concerning your participation. If at any time during the study you have any problems or questions, you can contact the person named at the end of this form.

Purpose of the Study

The purpose of this study is to compare if an interview done by a child psychiatrist using telemedicine is as good as an interview done in person e.g. face-to-face. The telemedicine system in this project will allow you to see and talk to a psychiatrist over a television and he/she will be able to see and talk to you.

Specifically, it will link a child psychiatrist in one room at the Janeway Child Health Centre to you and your child who are located in a different room. The electronic connection between you and the psychiatrist is completely confidential i.e. no one else can tap into it.

If you agree to participate in this study, you and your child will be interviewed by the child psychiatrist using the telemedicine system i.e. over the television, on the first day. The next day, you and your child will be interviewed by a different child psychiatrist in the normal way i.e. face-to-face. After each interview, you will be asked to fill out questionnaires so we can get your impressions about the interviews. Half of the participants will have a face-to-face interview first and the television interview second, whereas the other half of the participants will have the interviews in the reverse order.

The only inconvenience to you and your child, is that you will have two interviews instead of one. Each interview is approximately two hours long so it means you will have to commit two extra hours of your time. Also, you will have to complete a questionnaire after each interview. The time needed to do this is approximately 15 minutes for each questionnaire. Any extra expenses you have because of your involvement in the study e.g. bus / taxi fare, babysitting, will be reimbursed at a reasonable rate.

Alternative Treatments

If you decide not to participate in this study, your child will be assessed and treated in the normal manner i.e. face-to-face. Deciding not to participate in the study will have no negative consequences on the standard of care your child will receives.

Your signature on this form indicates that you have understood to your satisfaction the information regarding your participation in the research project and

agree to participate as a subject. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities.

I, _____, the undersigned, agree to my participation and the participation of _____ (my child, ward, relative) in the research study described.

My questions have been answered and I understand what is involved in the study. I realize that participation is voluntary and that there is no guarantee that I will benefit from my involvement. I acknowledge that a copy of this consent form has been given to me.

_____ _____

(Signature of Participant) (Date)

If Appropriate:

_____

(Signature of Minor Participant) (Age _____)

To be signed by investigator:

To the best of my ability I have fully explained to the subject the nature of this research study. I have invited questions and provided answers. I believe that the subject understands the implications and voluntary nature of the study.

_____ _____

(Signature of Investigator / research assistant) (Date)

If you have any questions please contact the following person:

Name _____ Phone Number _____

APPENDIX D - CHILD TELEPSYCHIATRY PROJECT BUDGET

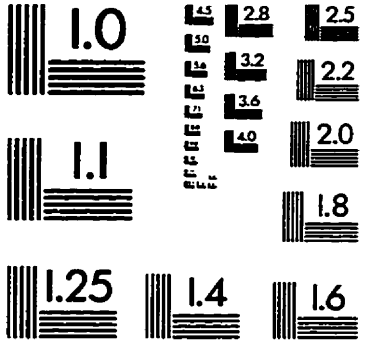
Description	Projected	Actual
Telemedicine equipment (lease)	10 000	10 000
Equipment installation and maintenance	8 000	8 000
Secretarial time and office supplies	3 000	3 000
Administrative costs	3 000	3 000
Reimbursement of patient expenses	1 000	48
Part-time research assistant (4 months)	10 000	8 646
contingency	3 000	3 852
Total	38 000	36 546

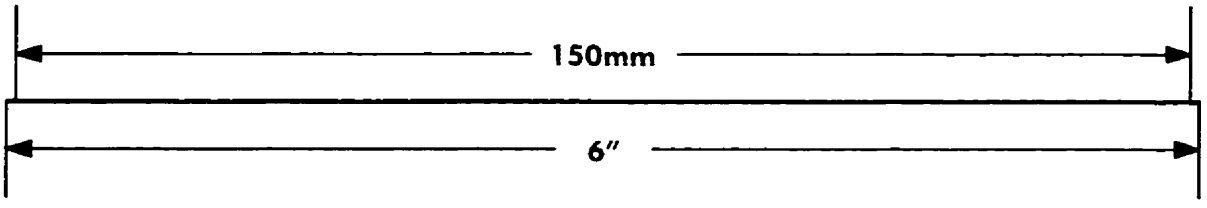
Projected budget for Phase 1	38 000
Actual cost of Phase 1	36 546
Surplus (Carry over to Phase 2)	1 454

APPENDIX E - PROJECT SCHEDULE

Month	Description of tasks
June. - Aug. '96	Preliminary set-up phase
Sept. - Dec. '96	In-hospital testing (data collection - 4 months)*
Dec. '96 - Jan. '97	Data analysis
Feb. '97 - July '97	Write-up

*The first consultation took place on September 16, 1996 and the last consultation on December 12, 1996.





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