REPORT OF THE SECRETARY OF TECHNOLOGY
PREPARED BY THE DEPARTMENT OF TECHNOLOGY PLANNING

A JOINT STUDY TO ESTABLISH GUIDELINES FOR ENSURING COMPATIBILITY AMONG TELEMEDICINE EQUIPMENT

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

HOUSE DOCUMENT NO. 18

COMMONWEALTH OF VIRGINIA
RICHMOND
2000

COMMONWEALTH of VIRGINIA

Office of the Governor

James S. Gilmore, III
Governor

Donald W. Upson
Secretary of Technology

November 15, 1999

The Honorable James S. Gilmore, III
Governor of Virginia and
The General Assembly of Virginia

Dear Governor Gilmore and Members of the General Assembly:

House Joint Resolution 683 (1999) requested the Secretary of Technology to develop guidelines for ensuring compatibility among telemedicine equipment operated by state agencies and other affected entities.

The study was conducted by the Department of Technology Planning, at my request, in cooperation with the Secretary of Health and Human Resources and other affected state agencies and entities. Also, as directed in the Resolution, the study report was submitted on October 8, 1999, to the Joint Commission on Health Care.

In reviewing the current usage of technology (telecommunications, hardware, and software) in support of telemedicine/telehealth (TM/TH), the HJR 683 Study Team has concluded that the existing suite of standards (listed in Appendix C) is sufficient at the current time to provide the consistency and connectivity necessary to support the practice of TM/TH in the Commonwealth. What is currently missing in terms of standards, in the Study Team's opinion, are applications standards—i.e., what is the agreed-upon minimum bandwidth necessary to support a specific use of TM/TH (e.g., teleradiology, telemental health, etc.)? The Study Team believes that further, near-term efforts in TM/TH standardization should be focused on such applications standards. The Study Team also believes that any mechanism set up to deal with such applications standards should also be capable of addressing changes or additions in the current technical standards that will inevitably need to be considered as technology continues to change.

I am pleased to submit to you ***A Joint Study to Establish Guidelines for Ensuring Compatibility Among Telemedicine Equipment***.

Sincerely,

Donald W. Upson
Secretary of Technology

Enclosure
C: The Honorable Claude A. Allen

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PREFACE

BACKGROUND

House Joint Resolution 683 (HJR 683) was agreed to by the General Assembly in February, 1999. HJR 683 calls for the Secretary of Technology, in cooperation with the Secretary of Health and Human Resources and other state agencies and organizations, to develop guidelines to ensure compatibility, where possible, among the equipment purchased by state agencies, and others involved in telemedicine. The Resolution cites state agencies and teaching hospitals involved in telemedicine initiatives including, but not limited to:

- Department of Corrections;
- Eastern Virginia Medical School;
- Medical College of Hampton Roads;
- Virginia Commonwealth University's Medical College of Virginia;
- University of Virginia Health Sciences Center;
- Department of Mental Health, Mental Retardation, and Substances Abuse Services; and
- Virginia Department of Health.

The Secretary of Technology assigned the Department of Technology Planning (DTP) to conduct this study. DTP was formerly the Council on Information Management. Murray D. Rosenberg of DTP was assigned as the Study Team Leader. Invitations were extended to 20 organizations for a meeting that was held on August 5, 1999, to form a Study Team to initiate work on a report to comply with the mandate of HJR 683. The attendees were invited based on the Resolution or known previous involvement in telemedicine activities. It was immediately noted at the meeting on August 5th that an earlier meeting was held independently on July 6, 1999 with somewhat similar goals and attendees at Virginia Commonwealth University.

The August 5th meeting pointed to a very important aspect of addressing telemedicine/telehealth (TM/TH) issues in Virginia. There are many different interests in the Commonwealth pursuing goals in TM/TH. Some of the groups are meeting jointly, while others act independently. Some of the goals being pursued are unique, while others are redundant. The implementation of the various collaborative recommendations in this Study Report should provide a mechanism to coordinate much of the efforts in TM/TH and should lead to state contracts for many services.

The outcome of both meetings produced results that indicated the scope of this study would be more beneficial to those involved in TM/TH if additional areas were covered beyond the "guidelines for ensuring compatibility among telemedicine equipment." Accordingly, other TM/TH-related topics building on previous state studies are also updated in this report.

ACKNOWLEDGEMENTS

The editor of this report thanks the members of the Study Team for their efforts in completion of this document. A special thank you is extended to those who provided additional valuable input and support in preparation of this report:

- Ron Allison and Henry Smith of The Appal-Link Network, Cumberland Mountain Community Services;
- Dorothy Boland and Stephanie Saccone of the Department of Information Technology;
- Carol Hampton and Kelly Jones-Fisk of Virginia Commonwealth University's Medical College of Virginia

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EXECUTIVE SUMMARY

House Joint Resolution 683 (HJR 683) was agreed to by the General Assembly in February, 1999. HJR 683 calls for the Secretary of Technology, in cooperation with the Secretary of Health and Human Resources and other state agencies and organizations, to develop guidelines to ensure compatibility, where possible, among the equipment purchased by state agencies, and others involved in telemedicine.

The Secretary of Technology assigned the Department of Technology Planning (DTP) to conduct this study. DTP was formerly the Council on Information Management. Murray D. Rosenberg of DTP was assigned as the Study Team Leader. Invitations were extended to 20 organizations for a meeting that was held on August 5, 1999, to form a Study Team to initiate work on a report to comply with the mandate of HJR 683 (see APPENDIX A). In addition to the charge of HJR 683, the Study Team addressed other topics. Based on the consensus of those at this meeting, the topics to be covered were to be of a wider scope than the original charge of HJR 683 and should be included in the Study Report. These topics included:

- The charge of HJR 683 -- "to develop guidelines for ensuring compatibility among telemedicine equipment operated by state agencies and other affected entities;"
- The need for a "catalog" of telemedicine/telehealth (TM/TH) projects or programs throughout the Commonwealth;
- The need for a greatly improved communication mechanism for dialogs among practitioners of-- and parties interested in -- TM/TH;
- Establishing and maintaining a listing of existing technical standards in TM/TH telecommunications, with related hardware and software standards also are of interest;
- Determining TM/TH functional standards, *i.e.*, which bandwidth is best suited for a particular service or mode of operation; and
- The need to reduce redundant or overlapping TM/TH efforts. Many agencies and departments are pursuing the same or similar objectives, unknown to each other. Statewide contracts for TM/TH related hardware and software are also a priority, with inter-operability of such hardware and software being an essential requirement.

There are many definitions offered for "telemedicine." One states it involves "the use of modern information technology, especially two-way interactive audio/video telecommunications, computers, and telemetry, to deliver health services to remote patients and to facilitate information exchange between primary care physicians and specialists at some distances from each other." Rather than the traditional face-to-face structure, health care professional to patient, telemedicine (TM) allows the separation of the two by a physical distance, with services provided via an electronic linkage. <u>Thus, telemedicine or, more broadly, telehealth (TH) offers one of the most significant and dramatic changes in the practice of health care that has been seen in the United States since its founding in 1776.</u> In doing so it offers for those requiring health care many more opportunities for superior care, especially in inner city and rural areas. In addition, it offers a mechanism to ameliorate the delivery of medical care by centralization of items such as telecommunications, education, equipment use, *etc.* TM/TH is an area where public and private benefits converge.

Based on the stated vision of the Governor and the Secretary of Technology for the role of information technology in the Commonwealth for continued economic development, TM/TH can be a significant tool. For example, the availability of tertiary-level medical consultations can make rural areas more desirable for business development. The Governor's Commission on Information Technology's report (May 12, 1999) entitled, *Toward a Statewide Investment Strategy: Leveraging Information Technology for Regional Growth,* makes it is clear that TM/TH and its development are in the best interests of the Commonwealth.

CONCLUSIONS

There is no question that TM/TH is better, in terms of reduced costs and delivery of improved services, than it was ten years ago, and it is still improving. It is accepted quite well by the consumers, although less so by health providers. Consequently, the questions facing TM/TH involve not whether it can be done but rather who is willing to make investments in it and where they will be made. The goal of those involved in seeking solutions must be to insure that an affordable telecommunications network, with interoperable software and hardware is in place, and that the true merits and cost benefits of TM/TH are attained in the most appropriate manner.

RECOMMENDATIONS

- ***Recommendation Number One*: Take a broad approach to facilitating TM/TH at the state level, as the following recommendations proposed by the Study Team indicate.**

- ***Recommendation Number Two*: Establish a TM/TH Work Group under the Secretary of Technology's Council on Technology Services (COTS). This TM/TH Work Group would be charged with providing a focal point for TM/TH technology planning:**
    - **The TM/TH Work Group would initiate and enhance statewide information exchange among the various state agencies and departments, and any interested parties;**
    - **The TM/TH Work Group would be responsible for overseeing the development of any proposed TM/TH standards and the recommendation of same for subsequent promulgation by the Secretary of Technology; and**
    - **The TM/TH Work Group also would act to:**
        - **Maintain an updated common source, or "catalog," of the many and varied projects/programs underway in TM/TH in Virginia (see APPENDIX B);**
        - **Maintain a listing of all known standards (see APPENDIX C); and**
        - **Develop a Web-based database on TM/TH programs/projects and research underway throughout the United States.**

  - The TM/TH Work Group should provide leadership in seeking funds for rural and inter-city TM/TH projects to overcome the high cost of the "start-up" for telecommunications linkages, hardware, and software.

- *Recommendation Number Three*: Maintain an enhanced TM/TH Web-site.
  - The recently created TM/TH Web-site, initially set up for Study Team use by the Department of Information Technology (DIT), should be maintained and enhanced on an ongoing basis. The Virginia Information Providers Network (VIPNet) should be considered as the possible longer-term host for this site.
  - The Department of Technology Planning (DTP) should maintain appropriate links to the TM/TH Web-site.

- *Recommendation Number Four*: Create a formal Telecommunications Technical Task Force (TTTF).
  - The TTTF will meet as needed to review any existing standards in such areas as: telecommunications, hardware, or software. TTTF would make technical recommendations on establishing standards as needed, *e.g.*, setting a bandwidth for a given application; and
  - The membership of the TTTF should include representatives from all involved sectors: medical, academic, state/local agencies, and TM/TH equipment/services vendors.

- *Recommendation Number Five:* The TM/TH Work Group should advise the Department of Information Technology on the TM/TH related equipment and services that are appropriate candidates for statewide contracts to enhance the process.

- *Recommendation Number Six*: Establish a liaison between the TM/TH Work Group and the Federal agencies sponsoring TM/TH initiatives for input to Virginia's TM/TH projects.

- *Recommendation Number Seven*: Consider authorization of additional TM/TH studies by the Joint Commission on Health Care to address the following:
  - The potential for the adoption of a standardized medical record/data system;
  - A comprehensive analysis of costs and benefits to establish quantifiable returns;
  - Other barriers/impediments, *e.g.*, lack of interstate reciprocity for practitioner licenses, infrastructure costs, third-party reimbursement for video consultations, malpractice liability.

SECTION ONE

INTRODUCTION

What is Telemedicine?

Rather than the traditional face-to-face structure, health care professional to patient, telemedicine (TM) separates the two by a physical distance, with services provided via an electronic linkage. Thus, telemedicine or, more broadly, telehealth (TH) offers one of the most significant and dramatic changes in the practice of health care that has been seen in the United States since its founding in 1776. "Collectively, the public and private sectors have funded hundreds of projects that could improve, and perhaps change significantly, how health care is provided in the future." (General Accounting Office, 1997). In doing so, TM/TH offers for those requiring health care many more opportunities for superior care, especially in inner city and rural areas. In addition, it offers a mechanism to ameliorate the delivery of medical care by centralization of items such as telecommunications, education, equipment use, *etc.* TM/TH is an area where public and private benefits converge. Many anecdotal examples demonstrate how it could improve access to and delivery of quality medical care.

Americans were first broadly exposed to TM without the realization that they were observing an entirely new mechanism of health care delivery. This occurred in the space program when our first astronauts flew in space. To monitor their health status, astronauts were wired with electrodes on their bodies to observe physiological parameters from space to the Mission Control Center in Houston, Texas.

Key Definitions

There are many definitions offered for "telemedicine." Bashshur (Bashshur, *et. al.*, p. 9, 1997) defines telemedicine as involving "the use of modern information technology, especially two-way interactive audio/video telecommunications, computers, and telemetry, to deliver health services to remote patients and to facilitate information exchange between primary care physicians and specialists at some distances from each other."

An earlier report from the Commonwealth of Virginia (House of Delegates Document Number 31, 1997) defined telemedicine as "the use of telecommunications technology to deliver health care services and health professions education from a central site to distant areas." It further stated it is "the practice of health care delivery, diagnosis, consultation, treatment, transfer of medical data and education using 'store and forward' systems such as image transfer and interactive video, video, and data communications."

Further, a federal agency (Health Care Financing Administration, 1999) that has much involvement with telemedicine states, "telemedicine is generally described as the use of communications equipment to link health care practitioners in different locations" as it covers "Medicaid and telemedicine." With these three definitions, the TM/TH spectrum is covered.

What is Telehealth?

Telehealth (TH) has a broader health care systems meaning than telemedicine and includes all aspects of the latter. Telehealth includes non-clinical applications, such as family and consumer support meetings, civil hearings, case conferences, and prevention and education, that are included in this study. A telehealth system generally uses interactive telecommunications technology to integrate a comprehensive array of health care services within a region of related organizations. These networks distribute scarce health resources into areas of shortage, while integrating service components, such as outpatient and inpatient services, into a more connected system, (Smith, H. A. and Allison, R. A., 1998). Thus, The Office for the Advancement of Telehealth defines it as "the use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional-related education, public health research, and health administration. (Office for the Advancement of Telehealth, United States, 1998). The Health Resources and Services Administration's (HRSA) Office of Rural Health Policy turned its telehealth functions over to a specialized agency, the new Office for the Advancement of Telehealth (OAT). Included in OAT's definition are:

- Telepsychiatry;
- Telemental health;
- Teleradiology;
- Telecardiology;
- Tele-echocardiogram;
- Teledermatology;
- Tele-ophthalmology;
- Telementoring;
- Teledentistry;
- Telerobotic health;
- Tele-ultrasound;
- Teleneurology;
- Telepresence surgery;
- Tele-education; *etc.*

What are the Issues in Applying Telemedicine/Telehealth Today?

This study will deal with the title subject: "establish guidelines for ensuring compatibility among telemedicine equipment through inter-operability for hardware and software." At the same time, as the research into this subject has uncovered, there is the need for a wider scope to deal with the issues involved in the current environment:

- Improving communications among the many parties involved in TM/TH;
- Providing a source of the varied activities (projects/programs) in the TM/TH field;
- Listing all known standards; and
- Listing any additional needed standards.

If these needs can be addressed, a reduction in current redundant or overlapping efforts can be made.

Some of the issues that are being faced by organizations interested in TM/TH are:

- Providing funds to overcome the high cost of the "start-up" for telecommunications linkages, hardware, and software.

- Seeking partnerships with federal agencies such as the Department of Defense and others to share what they have learned and to exchange the technology they have developed. Between 1994 and 1996, a General Accounting Office (GAO) report has cited nine federal departments and independent agencies as having spent at least $646,000,000 on TM/TH.

- Initiating comprehensive studies of costs and benefits to move the promise of telemedicine from the largely unquantified to a quantifiable state.

- Providing leadership to overcome legal, regulatory, financial, technical, and cultural barriers facing health care providers that hamper the expansion of these services. Some barriers, *e.g.*, lack of interstate reciprocity for practitioner licenses, infrastructure costs, third-party reimbursement for video consultations, malpractice liability are too broad and have implications too far-reaching for any one sector (government, providers, insurers) to address. Thus, collaborative efforts are required.

- Making the necessary telecommunications infrastructure in rural areas both available and affordable.

- Insuring consistent and continuing cooperation among the involved organizations as there is no overall federal or state strategy to maximize the value of investments in TM/TH.

There is no question that telemedicine is better, in terms of reduced costs and delivery of improved services, than it was ten years ago, and it is still improving. Consequently, the questions facing TM/TH involve not whether it can be done but rather who is willing to make investments in it and where they will be made. The goal of those involved in seeking solutions must be to insure that an affordable telecommunications network, with interoperable software and hardware, is in place, and the true merits and cost benefits are attained in the most appropriate manner.

Based on the stated vision of the Governor and the Secretary of Technology for the role of information technology in the Commonwealth for continued economic development, telemedicine/telehealth can be a significant tool. For example, the availability of tertiary-level medical consultations can make rural areas more desirable for business development. The Governor's Commission on Information Technology's report (May 12, 1999) entitled, *Toward a Statewide Investment Strategy: Leveraging Information Technology for Regional Growth*, makes it clear that TM/TH and its development are clearly in the best interests of the Commonwealth.

SECTION TWO

HISTORICAL OVERVIEW AND RECENT DEVELOPMENTS

The Early Beginnings

The history of telemedicine/telehealth, which started almost 50 years ago, contains documentation sufficient for the publication of many large books. The major element in any of these efforts has been the funding supplied initially by the federal and later state governments to one, or a combination of, a federal medical center, university medical center, private non-profit health care system, or a public health system for direct application or research purposes. Since the publications and examples are extremely numerous in telemedicine/telehealth (TM/TH), telemental health will be used as it exemplifies one of the best documented fields and is of direct interest in this study. Smith and Allison (*Op. cit.*) have provided an excellent overview of the field with numerous references in their document. This section will provide a condensed version of that work. Some examples of the early efforts were:

- The first documented use of technology for medical/health provision in the field occurred in 1920 at Haukeland Hospital in Norway where radio links were established to provide health care support services to ships at sea.
- As if gazing through a crystal ball, the April 1924 issue of *Radio News* contained a drawing of a physician and his young patient connected over a radio that contained a small television screen. It would be another five years before television was invented.
- In 1957, a radiologist, Albert Jutras, documented telemedicine's first application in Montreal, Canada.
- The space program and the need to monitor the health of astronauts in the remotest of environments have made telemedicine possible.

Nebraska's Pioneering Efforts

- The work at the Nebraska Psychiatric Institute (NPI) in the early 50's was the first in the field of mental health.
- In 1954, the University of Nebraska designed a simple one-way closed circuit system using black and white televisions for lectures and instructional purposes. The first and primary application for years to come would be as a teaching tool.
- In 1955, the National Institute of Mental Health (NIMH) provided funding to establish an interactive audio link connecting NPI and seven hospitals in Nebraska, Iowa, North Dakota, and South Dakota. This network consisted of 1278 miles of closed circuit telephone lines, all routed through Omaha. The primary use of this system was to broadcast the NPI's weekly visiting lecturer series to the rest of the network. Participants could ask questions to the lecturer in Omaha, which for the first time involved audience interaction with the site of origin.
- In 1959, with additional funds from NIMH, the first audio-visual interactive system was developed on the University of Nebraska (UN) campus, again using closed circuit technology. Its primary application continued to be for teaching.

- In 1961, the experimental project at UN cited above led to the first interactive psychiatric consultation.
- In 1964, based on the success of continued testing, NPI received an additional grant to develop and test a system utilizing a new technology called microwave. Picture and sound could originate from multiple locations at any project site.

New Hampshire's "User-Friendly" Technology

- In 1968, NIMH funded a project to develop a closed circuit link utilizing two microwave relay stations between the Department of Psychiatry at Dartmouth Medical School and a rural hospital in Claremont, New Hampshire. For the first time highly trained technicians were not needed. Program staff, with limited technical training, could now operate these more "user friendly" systems.

Massachusetts' More Effective Communication

- In 1968, a project linking two sites in Massachusetts was the first to report the use of major technological enhancements in video equipment: a type of microwave bi-directional television transmission, equipped with remote camera control. The consulting psychiatrist could pan, zoom, and focus the camera located at the remote site. This control greatly added to the psychiatrist's ability to observe physical and emotional nuances without invading the patient's personal space. For the first time, technology was more effective than the established "best practice" model.

More Recent Developments

The inauguration of telemedicine's third generation began in the late 80's. Two major factors contributed to this rejuvenation:

- The greater availability of federal and state funding after a decade of reduced funding, along with greater recognition of needs on the state level; and

- The rapid advancement of computer and communications technology, helping to create a favorable environment to begin investigation of potential applications of the emerging technologies.

These developments, together with new applications in corrections, in-home health services, managed care, etc. spurred applications in the telemental health field, which, in turn, has rapidly advanced the issue of reimbursement, - the single most formidable barrier to the future development of this technology. Currently, the public and private sectors have funded hundreds of TM/TH projects in over 40 states, (General Accounting Office, February 1997). The following examples are more recent, including a more detailed discussion of a Virginia program.

A Large, Local Application -- Virginia's Appal-Link Network

- The Appal-Link Network is a means of improving access to psychiatric care in rural and remote areas of southwest Virginia. Funded as a demonstration project through the Office of Rural Health Policy, it began operations in February, 1995.
- Cumberland Mountain Community Services Board (CSB) in Cedar Bluff, the grant administrator, and Southwest Virginia Mental Health Institute in Marion, began providing clinical and support services to the clients of Cumberland Mountain while in the facility and following discharge. Dickenson County CSB joined the network within weeks, creating the first telepsychiatry network in Virginia and one of only six in the nation dedicated to testing telecommunication technology to deliver mental health services at a distance. This totally interactive system utilizes compressed video and audio transmission over high speed enhanced telephone lines. All clinical trials and interviews operate at a minimum of 384 kbps to achieve the required quality of video transmission.
- The Appal-Link network expanded over the next two years, encompassing all of the Institute's service area. Planning District One CSB in Big Stone Gap, Highlands CSB in Abingdon, Mount Rogers CSB in Wytheville and New River Valley CSB in Blacksburg joined the original network.
- Additional sites and specialty services have been added since the original consortium began operations. Blue Ridge CSB provides highly specialized services to the deaf and hard-of-hearing mentally ill population throughout the entire network. In addition, classes in American Sign Language (ASL) are available to both clients and providers over the network to better deal with the needs of this population.
- The Laurels, a regional alcohol and drug treatment program serving seven counties in extreme southwest Virginia, became the network's ninth site. The Laurels also accepts Temporary Detention Orders (TDOs) from the judicial system in an effort to minimize the use of inpatient beds.
- Cumberland Mountain is developing another unique application in conjunction with the Kluge Children's Rehabilitation Center at the University of Virginia Medical School. This highly specialized children's treatment center will work directly with the Southwest Virginia CSB's infant intervention programs to provide critical services to infants with birth defects and developmental delays who were traveling as much as five hours to receive these life-sustaining services. The length of the service area is over 300 miles. The severe shortage of occupational, speech and other developmental therapists can be minimized with this technology.
- After the fourth full year of operation, the Appal-Link Network provided services to 778 different clients involved in 2,391 medication review appointments with psychiatrists. Currently, 75-80 active clinics continue to be followed via the network for medication management. Overall, 3,502 client contacts occurred during the four-year reporting period.

Oregon's RODEO NET

- The first of the third generation projects in the field of mental health was RODEO NET, a group of nine community mental health programs that make up the Eastern Oregon Human Services Consortium. The vision was to use telecommunications technology to deliver mental health information and services to the point of need.

The University of Kansas Medical Center (KUMC)/Menninger Center for Telepsychiatry

- In the early 90's, the KUMC began studying possible solutions to the challenge of rural access to health care. One of the findings led to the implementation of a statewide interactive telemedicine network providing clinical and educational services for residents throughout the state of Kansas. Residents at more than twenty sites have access to the more than 200 specialists at KUMC.

The Eastern Montana Telemedicine Network

- The Eastern Montana Telemedicine Network (EMTN) began as a cooperative effort in 1993 among health care providers to research the potentials of utilizing two way interactive video conferencing technology to provide medical and mental health services throughout the region. EMTN has continued to expand its eleven-site network providing a variety of applications making it one of the most comprehensive networks in the nation.

Northern Arizona Regional Behavioral Health Authority (NARBHA)

- NARBHA offers a unique approach to the concept of managed care. Inherent in its philosophy is the inevitable "rationing and denial of health care services." NARBHA is attempting to balance these two previously opposing concepts by developing a telemental health network to provide mental health services to the remote areas of Northern Arizona.

VideoLink of St. Peter's (Montana)

- This project (formerly Southwest Montana Telepsychiatry Network) began operation in early 1995, with the primary mission "to improve access and quality of mental health services and education through the use of an integrated system of communication technology and collaboration of provider resources." The network encompasses a twelve-county, 28,509 sq. mile area with a population of 190,000. The population to psychiatrist ratio is 30,000 to 1.

SECTION THREE

THE TECHNOLOGY AND TERMINOLOGY: TELECOMMUNICATIONS

The great majority of the material in this section is excerpted with the permission of the authors, H. A. Smith and R. A. Allison, from their draft report: *Telemental Health: Delivering Mental Health Care at a Distance (1998).* Draft document pending publication by Center for Mental Health Services, Health Resources & Services Administration, Office of Rural Health Policy. Rockville, MD.

Existing Telecommunication Standards

APPENDIX C provides a compilation of telemedicine/telehealth (TM/TH) telecommunication standards currently in use. These standards provide specifications for videoconferencing, asynchronous transmission mode (ATM), Integrated Services Digital Network (ISDN), and Ethernet and Token Ring packet networks for local area network (LAN) operation.

Establishing a Telemedicine/Telehealth System

It is recognized that the utilization of interactive telecommunications technology for TM/TH care access and enhancement is now fairly widespread in the United States, with numerous projects underway or in development. There are variations not only in the types of service applications developed, but also in the ways in which these projects are organized to carry out these applications, as well as in the equipment and network transmission systems used. There are also variations in the focus of the TM/TH network, whether in a university medical center, a private non-profit health care system or a public health system. Interactive telecommunications technology can be employed in many different ways. This section examines the technology and organizational and clinical characteristics for establishing a successful TM/TH program.

The Tools of Telecommunications Technology - The Concept of Presence

It has been demonstrated with consumer satisfaction studies that participants in TM/TH services find such services beneficial and acceptable alternatives for traditional face-to-face approaches. What is it that makes interactive telecommunications technology more useful than telephone consultation or conference calls, and the next best thing to being there in person? In order to understand these effects, it is important to discuss the concept of "presence" as it applies to theories of communication. "Presence" helps us understand the utility of interactive telecommunications, and helps to explain the importance of adequate higher bandwidth transmissions in some situations. It is the catalyst in all communications media.

The existence of this psychological phenomenon is clearly felt when individuals are exposed to interactive networks for the first time as participants. It is the reason that they do not feel that they are "talking to the television" when they are participating in an interactive video mediated encounter. Ongoing conscious awareness of "presence" allows planners to manipulate system design and settings to enhance its effects, (Lombard, M. and Ditton, T., 1997). "Presence" can be defined as "the perceptual illusion that a mediated experience is not mediated." That is to say, it feels very close to a "real and actual experience" that individuals are a part of, rather than just an observer. State-of-the-art interactive videoconferencing is designed to give the users a mediated experience that seems to incorporate them in a natural immediate direct and real encounter. The attempt to extend all presence enhancing factors to their highest order results in what is becoming commonly referred to as "virtual reality."

Presence as a Function of Bandwidth

Low bandwidth systems still maintain the presence enhancing quality of interactivity under certain conditions. When there is a basic conversation between what is sometimes referred to as "talking heads," low bandwidth systems may work well. However, the speed at which these systems can adjust to changes of input from cameras and microphones is noticeably slow, with a resulting feeling of being out of synchronization with the other communicator. Therefore, TM/TH applications provided over low bandwidth systems (less than 384 Kbps), in which the communicators can limit their movements, will still preserve a working level of presence. Higher bandwidth interactive telecommunications systems, with their higher order of presence, would seem indicated for applications which require close and accurate observation of neurological indicators, subtle changes in affect, or the inclusion of motion as part of the application. The accurate assessment of an involuntary movement disorder seems logically to require at least a 384 Kbps transmission of the data to be examined.

The transmission of American Sign Language for the deaf and hard-of-hearing population is based on the accurate perception of constantly changing data from hand and finger movements by each communicator. Without research to answer this question, the higher bandwidth system, capable of faster adjustments to users inputs and generating a higher level of presence, would seem to be the logical and preferred choice for this application.

Obtaining Presence: Telecommunications Equipment

If the product of an interactive telecommunications network is the creation of presence, then it is produced by the use of equipment, software, and transmission systems. There are as many possible variations of telecommunications equipment and transmission systems as there are TM/TH applications. The equipment used should be from a reliable and recognized manufacturer, with a demonstrated history of proven successful implementation at a number of projects. The development of standardized data compression algorithms by equipment manufacturers has fortunately resulted in connection compatibility between equipment. Therefore, networks with different equipment can complete video connections.

Equipment used by telemental health projects varies from inexpensive low bandwidth 128 Kbps desktop systems to dual large monitor boardroom systems, capable of transmitting at a full T-1 bandwidth of 1,532 Kbps. Costs of these systems also vary from the low end of less than $2,000 to close to $50,000 at the high level. However, equipment prices have been declining to an affordable level of around $12,000 for a large monitor desktop system capable of 384 Kbps transmission and operating software compatible with the network's existing equipment. Equipment costs are no longer prohibitive to TM/TH expansion. A project might be considered cost effective if a location can join the network for less than what it costs to purchase an automobile to transport mental health consumers to distant service providers, thereby greatly reducing travel expenses. However, like purchasing an automobile, it is not just the initial cost of the vehicle for which programs must budget. By far one of the great limitations of the use and expansion of TM/TH is the initial cost of the equipment to link to a transmission network, such as Net.Work.Virginia.

A test of the interconnectivity of TM/TH networks divided by great distances across the country has been completed. It was done to answer the question: Have the national long distance telephone service carriers been able to work out videoconferencing calling protocols? Why? In the recent past, connections were prevented or made extremely difficult between networks using different long distance service carriers. However, video connections now have been established from Virginia to similar projects, located in Kansas, Montana, and Oregon, and Arizona. It was in 1996 that the Appal-Link Project was unable to connect to another intrastate network in Virginia, due to differences in long distance carriers. The implication of this successful test is important, because it means that connections can be established between any dial-up networks in the country in order to provide or receive consultation and training.

Transmission: Being in Two Places at Once

The evolution of data compression software allows the sending of more video and audio information more quickly over existing copper telephone lines requiring higher speed computer processors with adequate memory storage capacity. This device is commonly referred to as the "codec" (coder/decoder). The "codec" converts the analog signal from the camera and microphone inputs to a digital signal, using sophisticated software programs for data compression transmission over some type of telephone line based service, having access to the long distance telephone network.

The "codec" passes the digitalized, coded, and compressed signal through a telephone network device, known as an inverse multiplexer, and referred to by technicians as the "IMUX." This device divides the signal to be transmitted over the total number of available ISDN channels employed in the connection. After the IMUX at the distant site combines the split data channels into one data stream, the other system's "codec" decodes this signal and presents the visual and auditory information to the participants through the analogy expression of images and sound. The higher the data bandwidth employed (the wider the "pipe") the more data that can be moved more quickly in order to upgrade changes in the visual and auditory inputs. Thus, a single ISDN line connection of 128 Kbps produces a poorer, less naturally appearing image with more "echoes and artifacts" than a three ISDN connection of 384 Kbps. At lower bandwidths movement within quadrants "read" by the "codec" from the camera input cannot be corrected quickly enough, since the "pipe" is smaller and more restricted, just as a garden hose moves less water than a fire hose. On the other hand, one would not use a fire hose to water the garden. Obviously, the cost for three ISDN circuits is approximately three times the cost of a single circuit. The problem then becomes trying to find the most cost effective transmission bandwidth, while not unduly compromising the efficacy of the application. If cost was not a factor, one would want the maximum available bandwidth, such as obtained with a full T-1 connection of 1,532 Kbps, resulting in the most realistic video quality and the greatest degree of presence. Many medically based telemedicine applications, such as teledermatology and tele-ophthalmology, require such high levels of transmission acuity in order to make accurate diagnoses. Others, such as consulting on pediatric cardiac echocardiograms, are being done on two ISDN lines at 256 Kbps.

Bandwidth: More or Less

There are several telemental health projects currently testing the use of low bandwidth transmission systems to provide mental health care directly into the consumer's home or into a nursing home or group home. The Menninger Center has several projects underway. The advantage of these low bandwidth systems is their affordability; however, they are only deployed in populous areas (where carriers have a revenue stream) rather than in rural, less populated areas where they are needed.

A POTS system (plain old telephone service, a term used by the telephone companies) can allow consumers to receive much needed home based mental health services, whereas before they received no service whatsoever. As this is being written, Public Switched Telecommunications Networks (PSTN) are replacing POTS. In telemental health debates the question frequently arises as to whether it is better to provide low bandwidth, what some may consider "poorer quality," telemental health care, or no care at all. The answer is "yes," if the recipients of services are not being harmed, and if projects can demonstrate some improved outcome. Further testing and research will help answer these questions.

Resolving Cost versus Quality

Most currently active telemental health projects have resolved the low cost/lower video quality versus high cost/higher quality by compromising at a mid-point of 384 Kbps bandwidth transmission. In a survey conducted by the Association of Telemedicine Service Providers, 384 Kbps or higher was the bandwidth used for mental health specialties at eleven of fifteen projects.

It is fair to say that there is a noticeable and persisting perception of lesser video quality by participants, who have experienced videoconferencing at 128 Kbps compared to 384 Kbps, when these participants have been exposed to the higher bandwidth transmissions. However, it also appears that there is a lesser noticeable decline in presence enhancing characteristics when bandwidth is reduced from 762 Kbps to 384 Kbps. Staffs who have experienced both bandwidths have not reported a discernible difference, when the transmission is reduced to 384 Kbps. The cost difference, on the other hand, is great between all three bandwidths.

Telemental health participants in their first exposure to compressed videoconferencing complain of the noticeable disappointing quality of the transmitted images caused by "echoes and artifacts" even if the transmission was at a moderately high bandwidth of more than 384 Kbps. Comments are made of the "jerky motion" and occasional lack of full synchronization of voice with video. When people watch television at 1,532 Kbps (the equivalent of three T-1 channels), they are accustomed to seeing broadcast quality full motion transmissions without any of these distractions. There is a similar expectation of the uninitiated when experiencing a compressed videoconference.

However, an interesting experience occurs. Over a short time period, some process happens which trains the "mind's eye" to be less aware of these differences, which then become less noticeable, unless there is a technical difficulty which degrades presence further. Staff, with many hours of exposure to compressed videoconferencing, are surprised when "first timers" in the same room make disparaging comments about the video quality, as if they actually have not seen the same thing. Videoconferencing experience in itself over time at any consistent bandwidth seems to lead towards some noticeable enhancement of presence, merely from the length of exposure itself. Whether this is a predictable and measurable condition that is bandwidth specific is unknown at this time.

The Study Team's Evaluation

In reviewing the current usage of technology (telecommunications, hardware, and software) in support of TM/TH, the HJR 683 Study Team has concluded that the existing suite of standards (as per APPENDIX C) is sufficient at the current time to provide the consistency and connectivity necessary to support the practice of TM/TH in the Commonwealth. What is currently missing in terms of standards, in the Study Team's opinion, are applications standards—i.e., what is the agreed-upon minimum bandwidth necessary to support a specific use of TM/TH (teleradiology, telemental health, etc.)? The Study Team believes that further, near-term efforts in TM/TH standardization should be focused on such applications standards. The Study Team also believes that any mechanism set up to deal with such applications standards should also be capable of addressing changes or additions in the current technical standards that will inevitably need to be considered as technology continues to change.

SECTION FOUR

IMPEDIMENTS / BARRIERS

The impediments or barriers below are derived from the cited document (House of Delegates Document Number 31, Commonwealth of Virginia, 1997. *Barriers to the Implementation of Telemedicine in Virginia*). Of the eight listed impediments developed at that time, it appears that five issues are still real barriers: Issues 1, 2, 3, 4, and 5. Issues 6, 7, and 8 would appear to have been or are being resolved within this timeframe. A recent article, entitled "Policy Lag Slows Telemedicine Growth" (Government Technology's *Executive News,* 1999), states, "Yet the practice of such futuristic medicine is not the norm. Issues such as medical licensure, liability and health-insurance reimbursements muddle the field of telemedicine, where technology is moving faster than the policy to support it."

VIRGINIA ISSUE 1. Reimbursement for Telemedicine/Telehealth (TM/TH) Services

This issue is probably the major factor influencing the use of TM/TH in Virginia. It is likely that third party payers are waiting for the Health Care Financing Administration (HCFA) to establish a clearer policy. What has HCFA (Health Care Financing Administration, 1999) said thus far? Any Medicaid reimbursement, including those for telemedicine applications, must satisfy the Federal requirements of efficiency, economy, and quality of care. With this in mind, states are encouraged to "use the flexibility inherent in Federal law to create innovative payment methodologies." Currently, 14 states are receiving Medicaid reimbursement, including Virginia for some TM/TH procedures, with an additional four developing plans.

The 1997 *Barriers to the Implementation of Telemedicine in Virginia* report states: "Reimbursement policies adopted by the Health Care Financing Administration (HCFA) of the Federal Department of Health and Human Services (HHS) directly influence state health care programs and exert considerable influence on private insurers. HCFA has not established a national telemedicine policy for Medicaid and, consequently reimbursement policies for telemedicine services by HCFA, private insurers, and state Medicaid programs are currently limited and inconsistent."

VIRGINIA ISSUE 2. Acceptance of Telemedicine/Telehealth

It appears that a large number of physicians in Virginia and nationwide **are still unwilling to become involved in TM/TH due to the lack of scientific validation** of specific aspects **in the broad spectrum of applications making up the field** of TM/TH. As of mid-1999, the Health Care Financing Administration has not formally defined telemedicine for the Medicaid program, and the Federal Medicaid law does not recognize telemedicine as a distinct service. However, "Medicaid reimbursement is available, at the State's option, as a cost effective alternative." On the other hand, it appears the patients are quite willing to accept this practice, especially in rural areas.

VIRGINIA ISSUE 3. Licensure and Credentialing

Each state regulates the practice of medicine within its boundaries. The "rules" are not exactly the same among the states; thus interstate practice is not feasible at this time. HCFA, through the Federal Medicaid guidelines, requires all providers to practice within the scope of their state practice act. Some states have legislation allowing TM/TH across state lines, *i.e.*, the provider in a state that is different from the patient, only if the provider has a license in the state where the patient resides. Any current federal restrictions or requirements are binding on the provision of TM/TH under current federal law.

VIRGINIA ISSUE 4. Legal and Malpractice Liability

This impediment applies to each state and is related to the licensure and credentialing issue. The question of which jurisdiction's liability laws are to be paramount in an interstate litigation must be settled by future statute or ruling.

VIRGINIA ISSUE 5. Confidentiality of Patient Records

Each state faces this issue due to the two main elements in the confidentiality issue: HIPPA and cryptography (the subject of cryptography is covered as APPENDIX D). The privacy of a patient's medical records enters the TM/TH discussion as such records may be transmitted electronically. Why is this a major issue then, when perhaps it should not be? Regulations in the Health Insurance Portability and Accountability Act (HIPPA) developed by the Health Care Financing Administration (HCFA) of the Department of Health and Human Services (HHS) implement the administrative requirements of Health Insurance Portability and Accountability Act. This legislation (Joint Healthcare Information Technology Alliance, 1999) deals in part with patient records confidentiality and the security issues related to the electronic (and Internet) transmission of such information. For TM/TH to work effectively data, *e.g.*, X-rays, information (a patient's medical history), *etc.*, must be transported over distance via some form of electronic transfer and be kept confidential. This transfer potentially introduces the element of encryption of data/information into the discussion.

Health Insurance Portability and Accountability Act

Key provisions of this act are as follows:

- HIPPA's stated purpose is to improve the Medicare/Medicaid programs, other Federal health programs, and private health programs by simplifying the administration of the system and to enable the efficient electronic transmission of certain health information by the establishment of standards.

- HIPPA: eliminates the current problems that exist due to non-standardized identifiers, *e.g.*, a single health care provider having different numbers for each program and multiple billing numbers within the same program complicates the claims submission process; makes exchanging health care data less costly and less complex because it will create a single and unique provider identifier; and enhances the ability to identify fraud and abuse in the health care programs and industry.

- HIPPA defines a number of standard terms and makes any standard applicable to all health plans, all health care clearinghouses, and any health care providers that transmit any health information in electronic form about Medicare and Medicaid transactions.

- HIPPA provisions supersede contrary state laws.

- HIPPA defines electronic transmissions as including transmission's using any media, even when the transmission is physically moved from one location to another using magnetic tape, disk, or CD media. Transmissions over the Internet, extranets, leased lines, dial-up lines, and private networks are all included.

An observation made by one of the HJR 683 Study Team members raises a point that is, perhaps, overlooked (Private Communication, D. Boland, Department of Information Technology to M. Rosenberg, 1999). Many patient records are routinely transferred by the facsimile process from one provider to another. If this meets the criteria for maintaining patient privacy, and apparently it does, then TM/TH transmissions meet the same criteria since it uses the same conduit. An example that is legally acceptable is the transfer of an individual's prison records, that could include medical records, being distributed routinely via facsimile transmission using the same lines as used for TM/TH. In fact, TM/TH transmissions "are more secure than faxing because fax uses standard analog voice grade transmission lines. Telemedicine uses digitized lines, which may or may not be switched, and are more secure." That notwithstanding, the essential question arises: Where does the responsibility lie for their security- - with the physician(s) or with the transmitting linkage?

R. Allison, the Project Administrator for the very successful Appal-Link Network in Virginia discussed earlier, raises a similar point on the question of confidentiality as an impediment (Private Communication, R. Allison to M. Rosenberg, 1999). He observes that this issue is raised by those who are unfamiliar with the telecommunications technology employed in networks such as he administers. He feels that the networks are often more confidential than the telephone or Internet linkages. Why? "Data compression and de-compression software transmitting over multiple telephone lines would require expensive and highly advanced equipment that the average person or even a major university does not possess." The Appal-Link Network "has been informed by knowledgeable sources that it would take an organization at the level of the CIA to intercept these videocalls being made over telephone circuits...and put them together into a video format." Further, Allison states, "It's a question of motivation. Why would someone want to go to great expense and time to intercept a call that has no commercial value? These TM/TH sessions are very dull to the average person. Confidentiality is a much exaggerated issue."

VIRGINIA ISSUE 6. Telecommunication Regulation

This is becoming a non-factor in Virginia with increasing access to various telecommunication modes. Virtually the entire state now has some form of access suitable for TM/TH, particularly through Net.Work.Virginia.

VIRGINIA ISSUE 7. Telecommunications Costs

As with Issue 6, Net.Work.Virginia and telecommunications competition is changing the picture for TM/TH. Such change favors more usage of TM/TH as costs fall.

VIRGINIA ISSUE 8. Infrastructure Planning and Development

The Commonwealth is fortunate to have an available network -- Net.Work.Virginia that is already being used for high bandwidth transmissions. The competitive procurement of a new statewide telecommunications network, COVANET, currently being conducted by the Department of Information Technology, will continue to expand the bandwidth possibilities available to state and local agencies.

ADDITIONAL IMPEDIMENTS/BARRIERS

Overall Cost (A Federal Issue)

The estimated cost for all services provided by the Department of Health and Human Services (HHS) for TM/TH is not an insignificant one. A 1997 report from the HHS Secretary, Donna Shalala, to the Vice President, Albert Gore, places the five-year cost from 1999 through 2003 at $2.7 billion dollars.

The HHS Secretary's report further raises the concerns for a broad implementation of coverage "despite telemedicine's vast potential to reduce barriers to quality health care." Those concerns are listed:

- Scientific determination of safe and effective applications (VIRGINIA ISSUE 2);
- Absence of published standards (VIRGINIA ISSUE 2);
- Extent to which current payment methods can accommodate telemedicine (VIRGINIA ISSUE 1);
- Potential over-utilization without needed controls (a federal issue);
- Increased financial liability for beneficiaries (a federal issue); and
- Impact on Medicare Trust Fund (a federal issue).

SECTION FIVE

CONCLUSIONS AND RECOMMENDATIONS

General Conclusions

Telemedicine and telehealth programs and projects have the potential to revolutionize the way health care is delivered in a manner not previously seen in this nation. The increased interest in telemedicine/telehealth (TM/TH) technology has resulted in widespread applications throughout the United States. Collectively, the Department of Defense (the largest individual spender), other federal agencies, *e.g.*, the National Aeronautics and Space Administration and the Department of Health and Human Services, state governments, and the private sectors have already invested hundreds of millions of dollars on numerous TM/TH programs and projects, mostly in individual (departmental/agency) ventures, but less frequently on collaboratory ventures. Such projects range from long-term research efforts exploring robotic or telepresence surgery to developmental programs at medical facilities where some clinical application, e.g., teledentistry is actually practiced. Among the most common current clinical applications are teleradiology and telemental health.

Successful expansion and sustainment of TM/TH will require resolution of many legal, regulatory, financial, technical, and cultural barriers/impediments. Some of the more critical barriers/impediments on both the national and statewide levels--licensure, credentialing, and infrastructure costs--are too broad and have implications too far-reaching for any single sector (public, providers, or insurers) to address. On the other hand, some barriers/impediments--physician acceptance, redundancy in project planning, and lack of collaborative efforts--can be overcome at the state level with planning, management, education and use of information technology tools.

As assigned in the Resolution for HJR 683 this study was to deal with the title subject: "establish guidelines for ensuring compatibility among telemedicine equipment through inter-operability for hardware and software." The Study Team has concluded, however, that inter-operability for hardware and software is not the major TM/TH issue. Connectivity (via telecommunications) for hardware and software is one supporting component of TM/TH in which significant progress has been achieved. Guidelines or standards have been established for the key components of telecommunications technology necessary to support TM/TH applications. What remains to be standardized is agreement on the bandwidth (i.e., quality of transmission) required for specific TM/TH applications (teleradiology, telemental health, etc.). The Study Team believes, however, that there are additional, complementary areas for collaboration that can assist in facilitating the expansion and consistent application of TM/TH across the Commonwealth. These additional collaboration opportunities are addressed in the study recommendations below.

Specific Conclusions And Recommendations

Conclusion: Lack of any form of a centralized TM/TH planning function at the state level appears to have created a vacuum that leaves TM/TH activities driven by many varied interests. Such uncoordinated efforts can be costly and cause difficulties in making progress in terms of purchasing, funding, and timely implementation of specific TM/TH projects.

- *Recommendation Number One*: **Take a broad approach to facilitating TM/TH at the state level, as the following recommendations below proposed by the Study Team indicate.**

Conclusion: There is a need for an improved, universally-available information exchange mechanism for use by TM/TH practitioners and interested parties in the Commonwealth. Based on the research performed for this Study Report, there is also a need to support such an exchange mechanism with a central source of published data/information for the Commonwealth's TM/TH efforts.

- *Recommendation Number Two*: **A number of the Commonwealth's departments and agencies and others interested in TM/TH have recently met to discuss technology issues of common interest, however, there is a lack of an ongoing mechanism to coordinate these efforts.**
    - **To overcome this barrier, there is the need to establish a TM/TH Work Group under the Secretary of Technology's Council on Technology Services (COTS). Under the Secretary, COTS has become the focal point for multi-agency and state/local collaborative technology activities. This COTS TM/TH Work Group (henceforth called the TM/TH Work Group) would be charged with providing a focal point for TM/TH technology planning.**
    - **The TM/TH Work Group would initiate and enhance statewide information exchange among the various state agencies and departments, and any interested parties. Discussions at the Study Team's August 1999 meeting indicated that such consistent communications among the many interested groups have been difficult to achieve in the past.**
    - **The TM/TH Work Group would be responsible for overseeing the development of any proposed TM/TH standards and the recommendation of same to COTS for subsequent promulgation by the Secretary of Technology.**
    - **Additionally, the TM/TH Work Group would act to:**
        - **Maintain an updated common source, or "catalog," of the many and varied projects/programs underway in TM/TH in Virginia (see APPENDIX B for the initial efforts towards establishing this catalog); this catalog should become part of the recently established TM/TH Web site;**
        - **Maintain a listing of all known standards, building on the initial efforts documented in APPENDIX C;**
        - **Develop and/or list any additional standards, as deemed appropriate; and**
        - **Develop a Web-based database on TM/TH programs/projects and research underway throughout the United States. The database would include both publicly-funded (federal or state) as well as privately-funded projects. The TM/TH Work Group could develop this concept in concert with library personnel at the state's medical schools' libraries. Such an**

effort would become part of the recently established TM/TH Web-site.

- **The TM/TH Work Group should provide leadership in seeking funds for rural and inter-city TM/TH projects to overcome the high cost of the "start-up" for telecommunications linkages, hardware, and software.**

Conclusion: To meet needs of Recommendation Number Two, the need for a common source for TM/TH project and program data/information can be overcome by building on efforts already underway.

- *Recommendation Number Three*:
  - **The functionality of the recently created TM/TH Web-site, initially set up for Study Team use by the Department of Information Technology (DIT), should be maintained and enhanced on an ongoing basis. This site provides an easily accessible source of TM/TH information for any interested party for the near term. The Virginia Information Providers Network (VIPNet) should be considered as the possible longer-term host for this site.**
  - **The Department of Technology Planning (DTP) should maintain appropriate links to the TM/TH Web-site as part of its planned Web-based "Best Practices Center."**

Conclusion: To satisfy the need identified by the Study Team to define appropriate bandwidths for specific TM/TH applications, and to initiate efforts to develop any other TM/TH standards that may be needed in the future, a technical task force should be organized.

- *Recommendation Number Four*:
  - **Formalize the existing Telecommunications Technical Task Force or TTTF (reported herein as the July 5th Meeting Group) and have it report to the TM/TH Work Group.**
  - **The TTTF will meet as needed to review any existing standards in such areas as: telecommunications, hardware, or software. TTTF would make technical recommendations on establishing standards as needed, *e.g.*, setting a bandwidth for a given application.**
  - **The current membership of the TTTF should be increased to include representatives from all involved sectors: medical, academic, state/local agencies, and TM/TH equipment/services vendors.**
  - **TTTF would serve as a conduit to effect any needed standardization studies. If such studies require funding, TTTF would request funds through the TM/TH Work Group, who would make the necessary recommendations.**

Conclusion: There is a significant need to reduce the numerous, redundant technology procurement efforts that currently take place in the TM/TH sector. As was amply indicated in Study Team discussions, four different state agencies/departments were proceeding with their individual Requests for Proposals (RFPs) for a similar service at the same time as the Department of Information Technology was negotiating a state-wide contract for the same type of service.

- *Recommendation Number Five:* **The TM/TH Work Group should advise the Department of Information Technology on the TM/TH related equipment and services that are appropriate candidates for statewide contracts. Information on the status of TM/TH related procurements should be posted on or linked with the TM/TH Web site.**

Conclusion: The research for this Study Report amply has recorded the numerous programs and projects in the TM/TH field being undertaken by various departments and agencies of the federal government. Seeking partnerships with federal agencies such as the Department of Defense and others to share what they have learned and to exchange the technology they have developed would prove beneficial. Between 1994 and 1996, the General Accounting Office (GAO) issued a report stating that nine federal departments and independent agencies had spent at least $646,000,000 on TM/TH. To reduce redundant efforts and to gain any knowledge from these studies, an effort should be made to seek liaison with the various federal TM/TH groups.

- *Recommendation Number Six*:
  - **The TM/TH Work Group should seek to establish a liaison with the Federal agencies sponsoring TM/TH initiatives, particularly the Department of Defense, for input to Virginia's TM/TH projects.**
  - **The TM/TH Work Group should seek to exchange information with such sponsoring agencies or offer to serve as a test-bed for new technology for Virginia to foster future collaborative partnerships.**

Conclusion: There is an apparent need, based on the research performed for this Study Report, to continue to address several of the impediments to implementing TM/TH noted in Section 4. The Study Team considers these remaining impediments to be more significant barriers to the use of TM/TH than the technology-related issues identified herein.

- *Recommendation Number Seven*: **The Joint Commission on Health Care should consider authorizing additional studies to address the following:**
  - **The potential for the adoption of a standardized medical record/data system with the appropriate representation from within the Commonwealth's medical, insurance, legal, and public/nonprofit agency sectors.**
  - **A comprehensive analysis of costs and benefits of TM/TH, in order to move discussions of potential dividends from TM/TH from generalities to quantifiable returns.**
  - **Other TM/TH barriers/impediments, *e.g.*, lack of interstate reciprocity for practitioner licenses, infrastructure costs, third-party reimbursement for video consultations, malpractice liability.**

APPENDICES

APPENDIX A

HOUSE JOINT RESOLUTION NO. 683

Requesting the Secretary of Technology, in cooperation with the Secretary of Health and Human Resources and other affected state agencies and entities, to develop guidelines for ensuring compatibility among telemedicine equipment operated by state agencies and other affected entities.

Agreed to by the House of Delegates, February 7, 1999
Agreed to by the Senate, February 23, 1999

WHEREAS, telemedicine is defined as the use of telecommunications technology to deliver health care services and health professions education to sites that are distant from the host site or educator; and

WHEREAS, telemedicine has increased access to health care, particularly for residents of remote areas requiring subspecialty services; and

WHEREAS, a number of state agencies and teaching hospitals are now involved in telemedicine initiatives including, but not limited to, the Department of Corrections, the Eastern Virginia Medical School, the Medical College of Hampton Roads, the Medical College of Virginia, the University of Virginia Health Sciences Center, the Department of Mental Health, Mental Retardation and Substance Abuse Services, and the State Department of Health; and

WHEREAS, the technology for telemedicine services is changing rapidly; and

WHEREAS, the equipment purchased for telemedicine represents a significant investment; and

WHEREAS, telemedicine offers the opportunity for cooperation among a number of state agencies in serving the health care and health professions education needs of Virginians; and

WHEREAS, the Governor has recently appointed a Secretary of Technology; now, therefore, be it

RESOLVED by the House of Delegates, the Senate concurring, That the Secretary of Technology, in cooperation with the Secretary of Health and Human Resources and other affected state agencies and entities, be requested to develop guidelines to ensure compatibility, to the extent feasible, among the telemedicine equipment purchased by state agencies and entities involved in telemedicine.

All agencies of the Commonwealth shall provide assistance to the Secretary of Technology, upon request.

The Secretary of Technology's findings and recommendations shall be submitted to the Joint Commission on Health Care prior to October 1, 1999, and shall be submitted to the Governor and the 2000 Session of the General Assembly as provided in the procedures of the Division of Legislative Automated Systems for the processing of legislative documents.

APPENDIX B

CATALOG OF TELEMEDICINE / TELEHEALTH PROGRAMS / PROJECTS IN VIRGINIA

Agency / Institution, Program / Project Name, Location (s)	*Equipment Used*	*Telecommun-ications & Protocols*	*Date Installed*	*Purpose or Comments*	*Contact (Name & Telephone No.)*
<u>VCU - SOM</u> Blackstone Powhatan Other sites on *ad hoc* basis	V-Tel Media Max Promptus Oasis Promptus Hotlink Intel Proshare 8x8 videophones	T1 H.320 4 ISDN/H.320 Ethernet LAN/ISDN POTS ATM to Health Dept.	07/95 11/97 06/98 06/98	Used for distance education & patient consultations R&D, R&D (homehealth)	Kelly Jones-Fisk 804-828-2821 Carol Hampton 804-828-6594
<u>VCU - SOM</u> Dept. of Surgery NASA Comm. Space Ctr. - Medical Informatics & Tech. Apps. Consort. (MITAC)	Pic Tel Intel Team Station CuSeeMe Inperson MBONE (TBS) Netmeeting	Various Bandwidths H.320 H.323 H.324 ISDN 3 BRI	Start 7/99	A NASA commercial Space center for medical informatics & technologies. Consultations & distance learning on internat'l scale	Charles Doarn 804-827-1022
<u>DOC</u> (installed) Powhatan UVA Atmore Rd Augusta Staunton Coffeewood Buckingham Dillwyn <u>DOC</u> (proposed) MCV Fluvanna	MMS Housecall Zydacron V-Tel Media Max (at PCC only) as of May, 1999 on hold until	ISDN (5 BRI) H.320 may be ATM H.323 Raytheon-VitelNet		Patient consultations	Fred Schilling 804-674-3282 Angelo Cisternino 804-674-3542

Deerfield Greensville Sussex II Haynesville Nottoway Lunenburg Brunswick Mechlenburg Red Onion Wallens Ridg	decision is made regarding statewide telecommun-ications issues				
<u>*VDH*</u> VDH (Rich.) Lancaster C. Danville Scott C.	VitelNet Raytheon Radvision (Gateway)	ATM H.323 & H.320 via Gateway H.323 & H.320 via Gateway H.323 & H.320 via Gateway		Equipment is supposed to be delivered & installed by 7/26/99	Tim Dunk 804-786-7580 Chip Reed Ken White
<u>*UVA*</u> DOC sites SWVA sites: Castlewood Clinic Vansant Lee Co. H. Norton Hos Augusta Hlth. Ctr. Winchester Med Cen	MMS Housecall VitelNet V-Tel	ISDN/H.320 ATM/H.323 Network Virginia	XX/96		Gene Sullivan 804-924-5470 Rich Settimo 804-924-5470
<u>*SWVAHEC*</u> Abingdon		ATM - Network VA ISDN T1	XX/98	every classrm connected to every option	Rachel Fowlkes 540-469-4009
<u>*RAHEC*</u> TECC	3 Rivers Health District (King William, Lancaster, Westmoreland)			ATM proposed H.323	Pat Rodriguez 804-493-0818
<u>*Southside VA Community College*</u> (VCCS)	V-Tel	Net.Work.Virginia			
<u>*DEPT. OF MENTAL HEALTH*</u> *(VA)*	Proshare	ISDN (128K)			

APPAL-LINK	V-Tel T2000	T1 PRI lines			Henry Smith Sheri Hall 540-783-1200
Eastern Va Med. School (EVMS) - 17 sites in SE Va.	Cal. Microwave MR-23CX PicTel Sys. 4000 VSI Omega videoconf. sys.	Dual Trans. Modes /Videoconf. @ 128K/384K Dist. educ. for profession.	07/98	Eastern Virginia TM Netwk-EVTN 12-15 broadcasts /month	Don Combs 757-446-6090

APPENDIX C

EXISTING TELECOMMUNICATIONS STANDARDS

The majority of equipment vendors support the following telemedicine/telehealth telecommunications standards.

H.320	H.261	H.221	H.242	H.230	G.711
G.722	G.728	H.243	H.281	H.323	

H.320 is a suite of specifications, which defines how videoconferencing systems communicate over circuit-switched media such as ISDN, fractional T-1, or switched 56K lines.

- H.261 is an essential component of H.320. It is the video-compression algorithm which defines two video resolutions—CIF (Common Intermediate Format or 352 pixels per line by 288 lines per image) and QCIF (Quarter Common Intermediate Format or 176-by-144)
- H.261 also includes three audio "codecs" designed to handle a broad range of applications:
    - G.711 uses 64K of bandwidth to provide telephone quality audio (3KHz)
    - G.722 is a higher quality algorithm which produces 7.5 KHz of audio but uses up to 64K of bandwidth
    - G.728 provides near telephone audio requiring 16K of bandwidth
- H.310 and H.321 adapt H.320 to the next generation topologies such as ATM and broadband ISDN
    - H.321 provides maximum backward capability by retaining H.320's overall structure and components such as H.261
    - H.310 adds ISO's MPEG-2 video compression algorithm which will provide HDTV-class video quality.
- H.322 enhances H.320 for networks that guarantee Quality of Service (QoS) for isochronous traffic such as real-time video.
- H.323 extends H.320 to Ethernet, Token Ring, and other packet-switched networks that don't guarantee QoS. [QoS is usually found in higher bandwidth (384 K >)]. It supports point-to-point and multi-point operations. H.323 includes video codec H.261 and audio codec G.711; also H.320, H.324 and components such as H.263,

G.722, G.723, and G.728. QoS will be addressed by central gatekeeper component that lets LAN administrators manage video traffic on a backbone. QoS defines LAN and H.320 gateway which will allow any H.323 node to interoperate with H.320 products.

- H.324 brings H.320-like video to analog POTS telephone lines. It can incorporate H.261 video encoding but will probably use H.263, which is a scalable version of H.261 which adds Sub-QCIF (SQCIF or 128-by-96). Because of H.263's efficient design, it may produce frame rates similar to today's ISDN systems.

- T.120 is a document-conferencing specification that allows users to share information. It permits "data-only" sessions without video if desired. It also allows multi-point meetings that include different transmission media. Mandatory components include MFT and shared whiteboard.

APPENDIX D

CRYPTOGRAPHY: THE STUDY OF ENCRYPTION

There are two kinds of cryptosystems: symmetric and asymmetric. Symmetric (also called conventional or secret key) cryptosystems use the same key (the *secret* key) to encrypt and decrypt a message, while asymmetric (also called the public key) cryptosystems use two keys (the *public* key) to encrypt a message and a different key (the *private* key) to decrypt it.

Symmetric cryptosystems have a problem: how do you transport the secret key from the sender to the recipient securely and in a tamperproof fashion? If you could send the secret key securely, you wouldn't need the symmetric cryptosystem in the first place (because you would simply use that same secure channel to send your message). Frequently, trusted couriers are used as a solution to this problem. Another, more efficient and reliable solution is a public key cryptosystem.

Symmetric vs. Asymmetric Cryptography

Symmetric ciphers require both the sender and the recipient to have the same key. This key is used by the sender to encrypt the data, and again by the recipient to decrypt the data. The problem here is getting the sender and recipient to share the key. Asymmetric ciphers are much more flexible from a key management perspective. Each user has a pair of keys: a public key and a private key. Messages encrypted with one key can only be decrypted by the other key. The public key can be published widely while the private key is kept secret. For example, if Alice wishes to send Bob some secrets, she simply finds and verifies Bob's *public* key, encrypts her message with it, and mails it off to Bob. When Bob gets the message, he uses his *private* key to decrypt it. Verification of public keys is an important step. Failure to verify that the public key really does belong to Bob leaves open the possibility that Alice is using a key whose associated private key is in the hands of an unauthorized user. Technically, symmetric ciphers are much slower than their asymmetric counterparts. In addition, key sizes generally must be much larger.

For many users of computer-based cryptosystems, preserving the contents of a message is as important as protecting its secrecy. Damage caused by tampering can often be worse than damage caused by disclosure. For example, it may be disquieting to discover that a hacker has read the contents of your funds-transfer authorization, but it's a disaster for him to change the transfer destination to his own account. Encryption by itself does not protect a message from tampering. In fact, there are several techniques for changing the contents of an encrypted message without ever figuring out the encryption key. If the integrity of your messages is important, don't rely on just secrecy to protect them.

Key Sizes (Number of Combinations Possible)

Even if a cipher is secure against analytical attacks, it will be vulnerable to brute-force attacks if the key is too small. In a brute-force attack, the attacker simply tries every possible key combination until the right one is found. How long this takes depends on the size of the key and the amount of processing power available. Thus, to secure data, one must consider how long it should remain secure and how much computing power an attacker can use. Today, 56 bit keys are becoming obsolete with 128 bit keys the standard. With the tremendous increases in computing power, cryptosystems which were once considered secure are now vulnerable to brute-force attacks. RSA Laboratories, a commercial leader in the field, has sponsored a series of contests starting in 1997, collectively known as the *Secret Key Challenge*. The strongest code was broken each time in the annual "contest" much to the consternation of the financial industry, the military, and others looking to this tool to protect and/or preserve secrecy. The "RC5" code with 56 bits fell victim to brute force attacks, as well as the financial industry's workhorse, "DES." At 56 bits, the keys used for "DES" are just too small to stand up to a dedicated attacker. It's noteworthy that both of the groups that broke the 56 bit "DES"-encrypted message did so with essentially no outside funding. More recently, this "Challenge" has led to similar groups breaking 128 bits codes in 1998 and a concerted effort in 1999 saw a group joining forces for a massive computer assault on a 256 bit code that they broke after many hours of continuous processing.

Keys versus Passphrases

A key is not the same thing as a passphrase or password. In order to resist attack, all possible keys must be equally probable. If some keys are more likely to be used than others, then an attacker can use this information to reduce the work needed to break the cipher. Essentially, the key must be random. However, a passphrase generally needs to be easy to remember, so it has significantly less randomness than its length suggests. For example, a 20-letter English phrase, rather than having 20 x 8 = 160 bits of randomness, only has about 20 x 2 = 40 bits of randomness. Therefore, most cryptographic software will convert a passphrase into a key through a process called hashing or key initialization. Cryptosystems that use a password directly as a key should be avoided, as well as a system that doesn't permit generation of "your" own keys, *e.g.*, the vendor sends keys in the mail, or keys are embedded in the copy of the purchased software.

Implementation Environment

Other factors that can influence the relative security of a product are related to its environment. For example, in software-based encryption packages, is there any plain text that's written to disk (perhaps in temporary files)? What about operating systems that have the ability to swap processes out of memory on to disk? When something to be encrypted has its plain text counterpart deleted, is the extent of its deletion a standard removal of its name from the directory contents, or has it been written over? If it's been written over, how well has it been written over? Is that level of security an issue? Are cryptographic keys stored on a multi-user machine? If so, the likelihood of having keys illicitly accessed is much higher. It's important to consider such things when trying to decide how secure something must be.

APPENDIX E

GLOSSARY OF TERMINOLOGY

The following is a list of terms with which anyone involved in an interactive telecommunications network can used to solve the wide usage of technical jargon, whether they are involved in telemedicine or telehealth.

ACCESS CONTROL. Protection against unauthorized access to a computer network. A less restrictive tool than a firewall. Using access controls, a HIN will check its access control list to see if a computer requesting service from the outside world is permitted to use that service. See also encryption.

ACR-NEMA. American College of Radiology and the National Equipment Manufacturers Association. They have jointly developed standards for teleradiology practice. For CT, MRI, ultrasound, nuclear medicine, digital fluoroscopy: images must be scanned at 500 pixel x 500 line resolution by 8 bit depth (256 gray scale) or better; for diagnostic X-rays: 2,000 x 2,000 ("2K by 2K") by 12 bit depth (4,096 gray scale).

ALGORITHM. A mathematically based software program used to compress large volumes of video and audio data, in order to maximize the effectiveness of lower bandwidth systems. These systems have made modern telephone line based interactive telecommunication networks possible. Within the past five years, telecommunication equipment manufacturers have standardized algorithms in order for different systems to engage in videoconferencing.

ANALOG. An older form of information transmission relying on a continuous stream of data. Most video cameras and many telephones are analog based, requiring some type of conversion device to communicate with digital based systems, such as computers.

BANDWIDTH. The greater the bandwidth (the larger the pipe), the greater the amount of information or data which can be transmitted in a measured time period. Bandwidth is usually measured in kilobits or megabits per second (Kbps, or Mbps). Higher levels of bandwidth allow more video and audio data to be transmitted quickly enough to capture movement, with less "jerkiness."

BASIC RATE INTERFACE (BRI ISDN circuits). A 128 Kbps digital telephone line circuit, using two 64 Kbps channels. A 384 Kbps bandwidth can be obtained by combining three BRI circuits. See also ISDN and PRI.

BIT. BInary digiT. The basic 0-1 unit of information used by computers for information entry, storage, and transmission. Data rates in telecommunications are often referred to in bits (abbreviated 'b') per second.

BOARDROOM VIDEOCONFERENCING SYSTEM. A full feature system with large, usually dual monitors and multiple microphones, allowing groups to comfortably engage in a videoconference. These are the "Cadillac" of videoconferencing systems, and maybe either built into the room, or mounted in large cabinets to roll (with difficulty) to other rooms. These are the most experience systems. See Desktop System.

BRIDGE. A multipoint control device which connects more than two sites simultaneously. Usually too expensive for a small network to operate, bridging services can be obtained through long distance telephone companies and system integrators. Every network will have a need for multipoint meetings at some time.

BYTE. Each data character, such as the letter A, is composed of 8 bits, called a "byte" (abbreviated "B"). Units of storage are often referred to in terms of the number of bytes (e.g., a "100 MB hard drive").

CHIP. An integrated circuit.

CODEC (also referred to as Coder/Decoder). A device consisting of a computer and software allowing analog data to be converted to a digital format for compression. The compressed digital signal can be transmitted over telephone lines at lower bandwidths with less loss of needed information. A similar CODEC at the receiving site decompresses the signal and converts it back to analog format for display on a monitor.

CSU/DSU. Channel Service Unit / Data Service Unit. A hardware device that is needed to terminate a high-speed telecommunications connection. It is inserted between the telemedicine system (i.e., CODEC) and the communications line. It conditions and strengthens the signal, and supports the necessary link protocols, for transmission of data from LANs, video systems, and other applications over leased or switched communications lines (T1, fractional T1, leased or switched 56, ISDN).

DEDICATED NETWORK. A fixed telephone line connection, using a fraction of a T-1 circuit. There is a monthly access charge, which can range from $1,500 to$2,000, but no usage expense. Some networks are required to operate these connections, when dial-up telephone technology, such as ISDN, is not available.

DESKTOP VIDEOCONFERENCING SYSTEM. Using a desktop personal computer and videoconferencing software, these systems use computer monitors to provide a high quality video image. These systems are now capable of 384 Kbps transmission and are "best buys" for the money. Like automobiles, videoconferencing systems run from the ornate to the basic transportation. The service needs and financial support of the network dictate the equipment needed.

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DIAL-UP NETWORK. Sometimes referred to as a switched access dial-up network. Charges for usage are like a long distance telephone call, with only the time used charged. Charges are based on the length of the connection and the number of channels used. In a dedicated network there is a fixed monthly cost, but no usage charges. ISDN connections are dial-up.

DICOM. Digital Imaging and Communications in Medicine. An industry standard for connection of, and communication among, medical imaging devices. The most recent iteration is DICOM 3.

DIGITAL TECHNOLOGY. A coded form of data transmission, using numerical values assigned to bits of information. These bits of data can be mathematically manipulated, compressed, and packaged with other digital signals being transmitted over the same data stream. Software programs can detect and sort out these coded bundles for display.

DUPLEX AUDIO. Full duplex describes the ability of both ends of a conference to speak and be heard simultaneously (like a regular telephone call). Half duplex audio supports only one site speaking at a time; other speakers will be cut off.

ENCRYPTION. A mathematical transposition of a file or data stream so it cannot be deciphered at the receiving end without the proper key. Encryption is a security feature that assures that only the parties who are supposed to be participating in a video conference or data transfer are able to do so. This has not been an essential feature for telemedicine systems, but with the growing concern about patient privacy in telemedicine networks it may become one.

ETHERNET. A 10Mbps to 100 Mbps LAN data link protocol.

FIREWALL. A computer connected both to the Internet and the local HIN that prevents the passing of Internet traffic, in the form of IP packets, to the internal hospital network. Provides an added layer of protection against 'hackers'. There are two kinds of firewalls: external, which protect all hospital systems form the outside world, and internal, which protect only selected systems. Firewall disadvantages: it restricts information transfer in both directions, and makes file transfer (ftp) and telnet (remote login) more difficult.

FRAME RELAY. A service that supports data rates in the range of 56 Kbps to 1.54 Mbps. The Frame Relay circuit often comes in different levels of committed information rates (CIR). A 1.54 Mbps Frame Relay circuit with a 768 Kbps CIR would indicate that you would never drop below 768 Kbps transmission capability, and could burst up to 1.54 Mbps.

H.26, H.256, H.324, H.263, H.242, *etc.* (see ITU-T, video format, standards)

HOME PAGE. The first screen of a URL, which usually introduces the host organization and provides pointers to other pages within the web site.

HOT LINK. Hypertext link. A highlighted word, phrase, or graphic within an Internet document that, when selected, automatically links to another site (URL) on the Internet.

HTML. HyperText Markup Language. A simple computer language used for formatting and presentation of Internet hypermedia documents. It is used to embed hypertext links ("hot links") into documents.

HUB. Provides a cost-effective single point of connection to the network for workstations and other devices.

HYPERTEXT LINK. See hot link, html.

IEC. (IXC) InterExchange Carrier. The long distance companies in the U.S. that provide inter-

LATA telephony services. *e.g.*, Sprint, AT&T, MCI. See LEC.

IMUX. Inverse multiplexer. Re-aggregates split subchannels in a data stream into a single channel. See ISDN.

INTEGRATOR. A vendor that uses retail parts from other manufacturers to produce a product that other vendors might make and assemble within the company. See VAR, OEM.

INTERFACE. How the system enables information to be accessed and modified. A graphical user interface (GUI) is typically simple to use, with mouse controlled point-and-click onscreen icons. See primary user interface.

INTERNET. A loose aggregation of thousands of computer networks forming an enormous worldwide WAN (although some would not use the term WAN for this generally low-bandwidth system).

INTRANET. A "private Internet" that employs TCP/IP communications protocols used over the Internet. The Intranet may be linked to the public Internet through a tightly managed, controlled gateway.

IP. See TCP/IP.

ISDN. Integrated Services Digital Network, a low-to-medium speed technology for digital telephony. Usually transmits at 64-128Kbps, although higher speeds are possible. ISDN is broken into 64 Kbps bearer channels (B-channels) and 16 Kbps data channels (D-channels). Basic Rate Interface (BRI) generally provides a 128 Kbps data rate ("2B+D"), while Primary Rate Interface (PRI) can provide up to 1.54 Mbps (the equivalent of a T1 circuit). To combine channels to provide a virtual circuit at greater than the basic 64 Kbps an inverse multiplexer may be needed.

ISO. International Standardization Organization. Establishes and coordinates worldwide standards for electronic information exchange.

ISP. Internet Service Provider. The local, regional, or national (AOL, CompuServe, etc.) company that provides dial-up connections to the Internet, as well as hosting of home pages

ITU-T STANDARDS. International Telecommunications Union. Founded in 1865 as a telegraphy standards body. Now a United Nations agency. **H series** (videoconferencing): H.320 defines how the whole H series works together & contains instructions for ISDN and some G (audio) algorithms as well; H.323 are LAN standards; H.324 permits video, voice, and data over a single analog phone line; H.261 is a video compression protocol for dissimilar CODECs; H.230 for multipoint control; H.263 is a video coding interface subset of H.324 and supports html; H.723 is a dual speech coder that transmits at 6.4 and 5.3 Kbps; H.242 is an audio conference setup and termination protocol. **T.120 series**: image capture, annotation, and transfer in videoconferences. **G series** (G.721, G.722, and G.728): audioconferencing.

INVERSE MULTIPLEXER or IMUX. A device which receives and combines a stream of data coming in from multiple telephone circuits into a single channel of data. The opposite of a MUX or Multiplexer. Usually these devices are combined into one unit to accomplish either task as needed.

ISDN. Integrated Services Digital Network. A more recent telephone line based technology, which allows for higher bandwidth transmission than plain of telephone service (POTS). A typical ISDN telephone circuit, referred to as a Basic Rate Interface (BRI) provides 128 Kbps, using two 64 Kbps channels. A Primary Rate Interface (PRI) using 12 circuits can deliver 1,536 Kbps, the equivalent of a T-1 circuit.

JPEG. Joint Photographic Experts Group. This international group, a joint effort of the ISO and TSS, has developed standards for still image compression. Motion JPEG applies JPEG compression to each frame of a video clip.

KBPS (Kbps). Kilobits per second. A measure of bandwidth in thousands of bits per second. The most frequently used bandwidth in telemental health networks is 384 Kbps.

KB. Kilobyte. 1,024 bits of data.

LAN. Local Area Network . A computer network linking computers, printers, servers, and other equipment within an enterprise. Can support audio, video, and data exchange. Typically runs at 10-100 Mbps.

LAN CONNECTIVITY. The ability to connect the video system to a LAN within the health care facility. This can allow access to and sharing of patient records, test reports, demographics, etc. during a videoconference.

LATA. Local Access and Transport Area. The local access telephone exchange area, within which telephone calls are not long distance. Once an ITV network has to cross LATA's to connect to a desired site the usage rates for these connections increases significantly.

LEASED LINE. Private line. A point-to-point connection that is logically similar to two cans tied together with a dedicated piece of string. You pay for the sole use of the circuit and the price does not vary as a function of usage, as with switched lines.

LEC. Local Exchange Company. The local telephone office that bridges between the long-distance carrier and the customer site. May be part of an RBOC or an independent telephone company. See LATA, IEC.

LOCAL AREA NETWORK. See LAN.

MB (Mb). Megabytes or millions of bytes.

MBPS (Mbps). Megabits per second. A measure of bandwidth in millions of bits per second. Some telemedicine networks need this level of transmission, for example to transmit x-rays. In the case of telemental health networks, which involve what is commonly referred to as "talking heads" any transmission higher than 384 Kbps is considered high. Network transmission expenses are exponentially directly related to bandwidth. A full T-1 bandwidth (1,536 Kbps) cost approximately 10 times a BRI connection (128 Kbps).

MODEM. Modulator/Demodulator. Enables transmission of digital data (by transforming it to and from analog waveforms) over standard analog telephone lines and cable video systems.

MPEG. Moving Picture Experts Group. A group of standards for compression and storage of motion video. MPEG-1 provides images of 240 lines x 360 pixels/line, digital transfer rates up to 1.5 Mbps, and compression ratios of about 100:1. MPEG-2 provides a higher quality picture - 720 horizontal lines x 480 vertical lines (pixels/line).

MULTIPLEXER. "MUX." A hardware device that divides a digital transmission stream into two or more subchannels. This can be done by frequency division (splitting the single band into multiple narrower bands) or by time division (allotting a common channel to several different transmitting devices one at a time). Compare IMUX.

MULTIPOINT CONTROL UNIT or MCU. Commonly referred to as a "Bridge." This devise allows more than two sites to be electronically connected in a "multipoint meeting." See Bridge.

MULTIPOINT VIDEOCONFERENCE. An interactive videoconference of three or more sites usually arranged by a bridging service. These meetings are often audio switched. The site with the speaking person is seen by all participating sites. Switching is very quickly performed, and these meetings can be very productive, saving travel time.

NETWORK. An assortment of electronic devices (computers, printers, scanners, etc.) connected (by wires or wireless) for mutual exchange of digital information.

OC3. A high-speed digital transmission capability of 155 Mbps. Compare T1, ISDN.

OEM. Original equipment manufacturer. Compare VAR, integrator.

PBX. Private Branch eXchange. A telephone switch, typically located at the customer site, connected to the public telephone network, but operated by the customer. PBXs may be digital rather than analog.

PC. Personal (or desktop) Computer. Generally, but not necessarily, IBM-compatible (as opposed to an Apple Inc., "Macintosh").

PERIPHERAL DEVICES. Attachments to videoconferencing systems to augment their communications or medical capabilities. Examples include: electronic stethoscopes, oto-/ophthalmoscopes, dermascopes, graphic stands, and scanners.

PIXEL. The smallest unit of a raster displays. A picture cell with specific color and/or brightness. The more pixels an image has, the more detail, or resolution, it can display. The pixel size in a high-end computer monitor's screen (a "1K x 1K monitor") is approximately 0.28 x 0.28 mm. The pixel size for diagnostic teleradiology monitors ("2K x 2K") is much smaller than this.

POTS. Plain Old Telephone System. The common analog based public telephone system, which allows slow speed data transmission up 56 Kbps. This is the basic service supplying standard single line telephones, telephone lines, and access to the public switched network. Being replaced by Public Switched Telecommunications Networks.

PSTN. See Public Switched Telecommunications Networks.

PUBLIC SWITCHED TELECOMMUNICATIONS NETWORKS. Public Switched Telecommunications Networks are replacing Plain Old Telephone System (POTS). This refers to any common carrier that provides circuit switching between public users on a worldwide basis, *e.g.*, AT&T Long Distance Service, MCI, Sprint, or even Telex, MCI's Execunet.

RAID. Redundant Array of Inexpensive Disks. Any of six arrangements of conventional disk drives to increase data transmission speed and reliability, and better assure safe backup.

RBOC. "R-BOCK." Regional Bell Operating Company. The "Bell" companies (SW Bell, PacBell, Nynex/Bell Atlantic, Bell South, Ameritech, US West, Pacific Telesis) that were the result of the AT&T breakup of the 1970s. See LEC.

RJ-11 JACK. The connector jack used for standard telephone and FAX lines.

ROUTER. A device which routes data to the segment of the network it was meant to go to, rather than be broadcast to all segments.

SWITCHED LINE OR NETWORK. A telecommunications option that operates like a dial-up telephone line (which is, in fact, a switched line-as are ISDN, ATM, switched 56). There is often a usage charge for switched services, particularly for long distance connections such as telephone lines. Compare to leased line, where the connection is continuously open and charges are usually on a flat, monthly rate.

SWITCHED 56. A dial-up 56 Kbps digital line, billed at a monthly rate + cost/minute, as with a regular POTS phone line

T1. A leased T1 line, marketed and serviced by LECs, that provides 1.544 Mbps data rate (in N. America; the European T1 provides 2.048 Mbps). T1 is available almost everywhere, and can be fractionated. Fractional T1 services are less expensive than full T1. Typical interactive video-mediated telemedicine programs transmit video images at "1/4 T1" rates (384 Kbps).

T.120. A standard for audio and graphics exchange, supporting higher resolutions and pointing and annotation (which the H.320 standard does not).

TCP/IP. Transmission Control Protocol / Internet Protocol. The most popular open-standard protocols used in data networks today. The Internet Protocol is used to route packets of data on a network.

TELCO. Telephone Company.

TELEHEALTH. See **"Telemedicine."**

TELEMEDICINE. The provision of health care and education over a distance, using telecommunications technology.

TELEMEDICINE NETWORK. Typically, an integrated regional health care system, providing an array of services at a distance using advanced telecommunication technologies.

TELEMENTAL HEALTH NETWORK. An integrated regional mental health care system aligned through interactive telecommunications technology. These networks distribute scarce mental health resources into areas of personnel shortage, while integrating service components into a more connected system of care.

TRANSMISSION RATE. Amount of information / unit of time that a technology such as a regular (POTS) or digital (ISDN or T1) phone line, satellite or wireless technology, or local area network (LAN) can transmit. A typical POTS-based modem can transmit 33.6 thousand bits (Kbps) of information/second.

TSS. Telecommunications Standardization Sector of the ITU.

TWISTED PAIR. A pair of copper wires that have been twisted to minimize electronic interference. Standard telephone wire.

URL. Universal Resource Locator. The World Wide Web address (typically in the form: http://www.name_of_site) of an Internet home page or other document.

VAR. Value Added Reseller. Adds functionality to product(s) from OEM(s). Compare integrator.

WAN. Wide Area Network. Wider in geographic scope than a LAN. Provides digital communications (voice / video / data) over switched (ISDN, switched 56) or unswitched (fractional T1, T1) networks. Some consider commercial dial-up networks (America OnLine, the Internet) to be WANs.

WIDE AREA NETWORK. See WAN.

APPENDIX F

BIBLIOGRAPHY

Allison, R. A. to Rosenberg, M. D. 1999: Personal communication.

Bashshur, R.L., Sanders, J.H., and Shannon, G.W. (ed.). *Telemedicine: Theory and Practice.* Springfield, IL. Charles C. Thomas Publisher, 1997.

Boland, D. to Rosenberg, M. D. 1999: Personal Communication,

Curtin, M. *Snake Oil Warning Signs: Encryption Software to Avoid.* 1998. See at: http://www.interhack.net/people/cmcurtin/snake-oil-faq.html

General Accounting Office (United States). February, 1997. *Telemedicine: Federal Strategy is Needed to Guide Investments.* Report Number GAO/NSAID/HEHS-97-67. See at: http://www.access.gpo.gov/su_docs/aces160.shtml (key "HEHS-97-67" in the Report Number Field.

Government Technology's Executive News. "Policy Lag Slows Telemedicine Growth." Page 4. August 26, 1999.

Governor's Commission on Information Technology (Virginia), Report and Recommendation of the. *Toward a Statewide Investment Strategy: Leveraging Information Technology for Regional Growth.* May 12, 1999. See at: http://www.sotech.state.va.us/gcoit/gcmeet2.htm

Health Care Financing Administration (United States). 1999. *Medicaid and Telemedicine.* See at: http://medicare.hcfa.gov/medicare.telemed.htm

Health Insurance Portability and Accountability Act of 1996. Published in *The Federal Register*, June 16, 1998. See at: http://www.access.gpo.gov/su_docs

House of Delegates Document Number 31 (Commonwealth of Virginia). 1997. *Barriers to the Implementation of Telemedicine in Virginia.* A Report of the Council on Information Management (now the Department of Technology Planning).

Joint Healthcare Information Technology Alliance (JHITA). July 6, 1999. See at: http://www.jhita.org/admsimp.htm.

Lombard, M. and Ditton, T. "At the Heart of It All: The Concept of Presence." *Journal of Computer-Mediated Communication.* 3 (2) September 1997. University of Southern California Press.

Office for the Advancement of Telehealth (United States). 1998. See at: http://telehealth.hrsa.gov/welcome.htm

Shalala, D. E. to Gore, A. Jr. December 4, 1997. Report required by Section 192 of the Health Insurance Portability and Accountability Act of 1996 (HIPAA).

Smith, H. A. and Allison, R. A. 1998. *Telemental Health: Delivering Mental Health Care at a Distance.* Draft report pending publication by Center for Mental Health Services, Health Resources & Services Administration, Office of Rural Health Policy. Rockville, MD.