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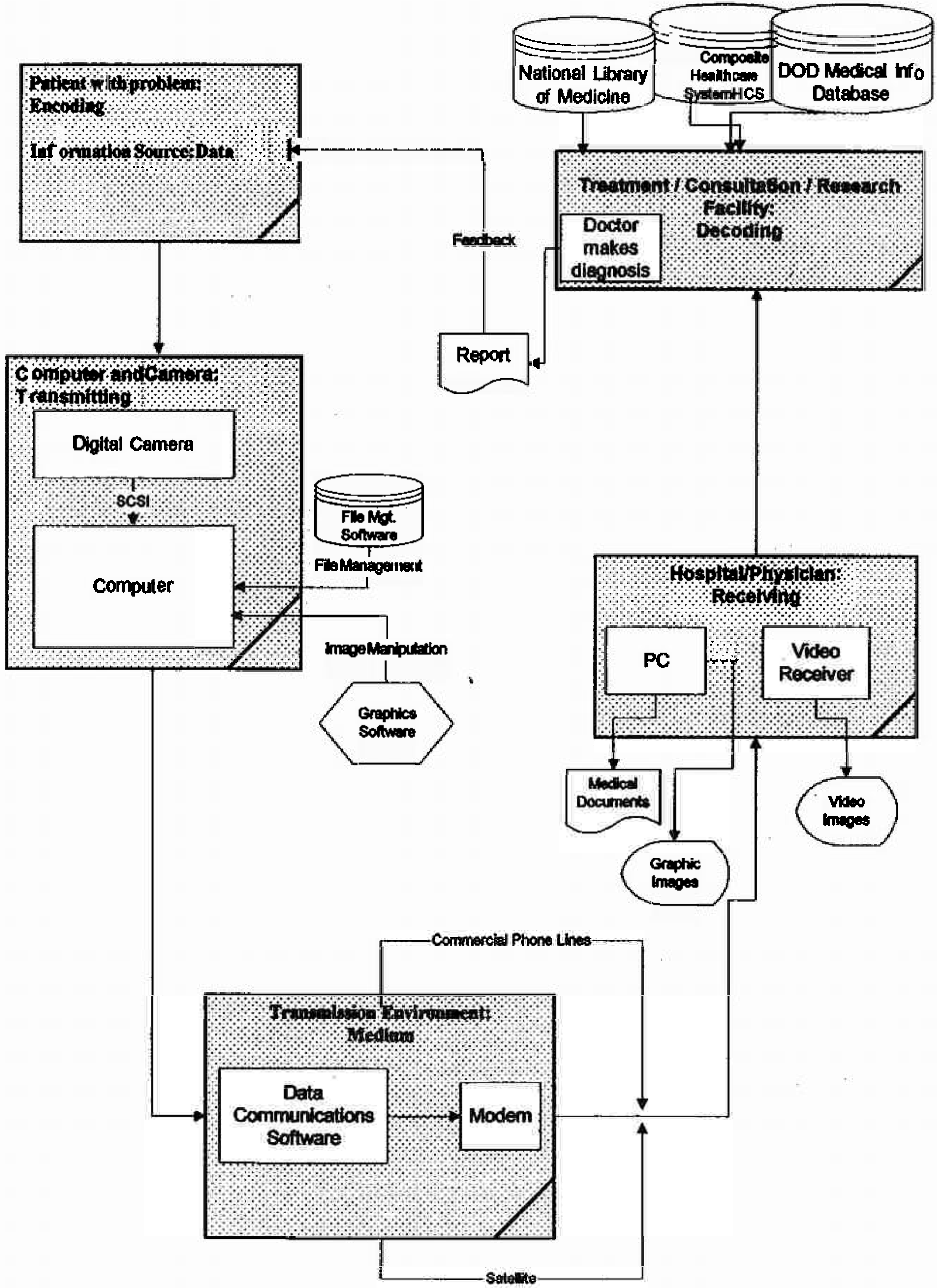

TOPIC: Telemedicine

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1. Chapter 1

1.1 INTRODUCTION: WHAT IS TELEMEDICINE?

"Worldwide, people living in rural and remote areas struggle to gain access to timely, quality specialty medical care. In the U.S., rural areas may have access to a general practitioner but must expend considerable resources (time and money) to seek specialty medical care." [1] Defined broadly, telemedicine uses electronic signals to transfer medical data (i.e. high-resolution photographs, radiological images, sounds, patient records, and videoconferencing) from one site to another. This transfer of medical data may use the Internet, Intranets, PCs, satellites, videoconferencing equipment and telephones. Proponents of telemedicine envision the reduction of resource difficulties by improving access to medical care for populations with sub-standard access to health care.

Health providers in a growing number of medical specialties, including: dermatology, oncology, radiology, surgery, cardiology, psychiatry and home health care, and many more, utilize Telemedicine. A trend nationally is the use of telemedicine in correctional facilities in which time and money for inmate transportation are reduced while safety for health care personnel and the public is increased. Telemedicine is also expected to fine tune the management and allocation of rural health care emergency programs by transmitting images to medical centers for long distance evaluation by the appropriate medical personnel. Telemedicine permits physicians doing clinical research to be linked together despite geographical separation, sharing patient records and diagnostic images. Improvement of medical education for rural physician rotations is made possible by linking several community hospitals together with the sponsoring medical school. Military units, the first group to significantly embrace the telemedicine concept, cite a significant gain in treatment of forces worldwide.

The explosion of information technology advances in biomedicine promises to radically change the way health care is practiced, delivered, taught and learned. These have opened new avenues of research, avenues that 10 years ago we would not have considered possible. New tools for simulation, imaging, and passage of information are changing healthcare as we know it today.

[1] Copyright 1995,1996,1997 Telemedicine Research Center. Telemedicine Information Exchange: http://tie.telemed.org

In short, telemedicine is an appropriate and creative application of technology in the medical environment, a high-tech solution to the universal problem of access to health care. Geographical isolation is no longer an insurmountable obstacle to timely and quality medical care and medical education.

1.2 Statement of the Problem

Telemedicine has arrived in the medical arena and a lot of attention is being paid to the technologically induced advantages it provides. But is advancing technology overshadowing traditional human communication factors? This study will demonstrate that telemedicine is itself a form of communication.

Understandably, the first obstacle for proponents of telemedicine to overcome is resistance by patients and physicians to an alternate method of treatment. Then, because telemedicine is a form of communication, it will benefit all involved to practice effective communication skills to improve the entire process.

1.3 Purpose of the Study

The purpose of the study is to highlight a rapidly growing medical environment, discussing the advantages and disadvantages from a perspective of communication. The study will demonstrate the contribution technology is making to the medical communication process, and to illustrate ways to improve the process by incorporating elements of human communication.

1.4 Need for the Study

1.4.1 To enlighten the general public of this potentially life-saving, medical alternative

1.4.2 To demonstrate the inextricable association of technology in improving communication

1.4.3 To emphasize the need for human communication in an expanding technological environment

1.4.4 To consider improvements for the overall process of telemedicine

1.5 Objectives

I would like to eventually submit this paper to the Telemedicine Information Exchange or other telemedicine organizations for review.

1.6 Definition of Terms

Telemedicine Glossary

A

ADSL (Asymmetric Digital Subscriber Line) Currently under trial in several metropolitan areas. Uses existing copper phone lines. With proper retooling by phone companies, these can supply 6 Mbps downstream delivery of data.

Analog Information (electronic or otherwise) that is created and transmitted as a continuous stream. Waveforms (e.g., on oscilloscopes) are analog. Compare this to digital information generated by computers. Modems are used to convert digital computer data to analog form for sending over standard POTS lines.

Annotation Simultaneous shared annotation of captured (or, less commonly, live video) images allows conference participants to clearly point out the areas in question on an image, and may provide significant instructional value.

B

Bandwidth The capacity of an electronic transmission medium to transmit data per unit of time. The higher the bandwidth, the more data can be transmitted. Typically measured in kilobits or megabits per second (Mbps). Standard telephones are low bandwidth devices (maximum bandwidth = 33.6 Kbps). Cable television uses high bandwidth (up to 140 Mbps).

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. See Mbps, Kbps, byte, bandwidth.
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").

C

Chip An integrated circuit.
Chrominance Hue and saturation (color) on a video monitor.
CODEC - COder/DECoder (also COmpression/DECompression) hardware and/or software used with interactive video systems that converts an analog signal to digital, then compresses it so that lower bandwidth telecommunications lines can be used. The signal is decompressed and converted back to analog output by a compatible CODEC at the receiving end.

D

Digital Information coded in discrete numerical values (bits). Digital data streams are less susceptible to interference than analog data streams. Also, because they are made up of zeros and ones (bits) than can be manipulated and integrated easily with other data streams (voice/video/data).
Digital camera Captures images (still or motion) digitally and does not require analog-to-digital conversion before the image can be transmitted or stored in a computer. The analog-to-digital conversion process (which takes place in CODECs) usually causes some degradation of the image, and a time delay in transmission. Avoiding this step theoretically provides a better, faster image at the receiving end.
Duplex audio Full duplex describes the ability of both ends of a conference to speak and be heard simultaneously (like a regular phone call). Half-duplex audio supports only one site speaking at a time; other speakers will be cut off.

E

Echo cancellation Prevents a system from picking up the sound from its own speakers and transmitting it back to other conference sites. Highly desirable for acceptable audioconferencing.
Encryption A mathematical transposition of a file or data stream so that 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 10 Mbps to 100 Mbps LAN data link protocol.

F

Firewall A computer connected both to the Internet and the local HIN (Hospital Intranet Network) that prevents the passing of Internet traffic 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 from the outside world, and internal, which protect only selected systems. Firewall disadvantages: it restricts information transfer in both directions, and makes file transfer and remote login more difficult

G

Ghosting A motion artifact in monitor displays of compressed video images. As an image moves quickly across the field of view (e.g., an arm waving) it leaves a trail of 'ghost' images that resolve as the movement stops.
Graphic equalizer Allows user to accentuate or de-emphasize selected frequencies within an audio sample. An example is the different 'tuning' for heart and lung sounds in electronic stethoscopes.

Gray scale The levels (shades) of gray that a screen or pixel within a screen can display.
GUI Graphical User Interface.

H

HIS (Hospital Information System) One that supports all hospital functions and activities such as patient records, scheduling, administration, charge-back and billing, and often links to or includes clinical information systems such as an RIS.
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.

I

IATV InterActive TeleVideo or **ITV** Interactive TeleVideo
Image management - Stored image management denotes the ability to sort, arrange, and manipulate stored images into functional groups. Some systems allow the user to store images, but once done they cannot be arranged and are permanently stored in the order in which they were saved. This may be cumbersome.
IMUX (Inverse multiplexer) Re-aggregates split subchannels in a data stream into a single channel. Compare to a **MUX** (Multiplexer) hardware device that *divides* a digital transmission stream into two or more subchannels.
INMARSAT An international global telecommunications satellite network established by government treaty in 1979, with 79 member countries. Land Earth Stations (fixed or portable, even to suitcase-sized) provide links between rural sites and telecom networks.
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-bandwidthsystem).
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.
ISDN (Integrated Services Digital Network) - a low-to-medium speed technology for digital telephony. Usually transmits at 64-128Kbps, although higher speeds are possible.
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

K

Kbps Kilobits (thousands of bits) per second. A typical compressed video clinical interaction is transmitted at 385 Kbps.
KB Kilobyte. 1,024 bits of data.

L

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 10-100Mbps.
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. Currently few institutions are capitalizing on this potential.
Lavaliere A small microphone that is typically clipped to clothing at breast pocket level. May be wired or wireless. Coined from the Duchesse de La Vallière (1644-1710), a mistress of Louis XIV, who wore a jeweled pendant on a chain around her neck.

M

MB Megabytes or millions of bytes.

Mbps Megabits (millions of bits) per second. A typical uncompressed video signal requires 45Mbps (or more) to transmit.

MCU (Multipoint Control Unit, or Conferencing Unit, or Bridge) A device that enables participants at more than two sites to participate in voice or video calls. Contrasts with point-to-point.

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

Modem Access For Remote Diagnostic Support Indicates that a technical support center can call into the system on a separate modem line to perform remote diagnostics.

N

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

Network Interface Connectivity options for the system.

P

PACS (Picture Archiving and Communication System) - an image system that embraces all modalities (X-ray, CT, MR, nuclear medicine, ultrasound) and links users with display workstations over a high speed network to an image server, an archive, printers, and radiology information systems (RISs).

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 bedigital rather than analog.

PIP (Picture In Picture) PIP allows both ends of the videoconference to be viewed simultaneously on a single monitor. Picture in picture swap allows the two-video pictures to change positions so that the local video fills the largest portion of the screen. On some two-monitor systems, PIP allows both live video images to be seen simultaneously on one screen while higher resolution graphic images are seen on the other.

Pixel The smallest unit of a raster display. A picture cell with specific color and/or brightness. The more pixels within an Image has, the more detail, or resolution, it can display.

POTS (Plain Old Telephone System) The analog, public switched telephone network in common use throughout the world. Also known as Public Switched Telephone Network (PSTN). Enables voice phone calls and data transmission of up to 33.6 Kbps, as well as limited videoconferencing.

Primary user interface device Indicates what type of device is used to control the video conferencing system. Hardwired and wireless, keyboard, mouse, and touch-screen options each have advantages and disadvantages. The user should seriously consider in what setting and for what application the system will be used to determine which is the preferred interface.

Printer interface Allows data and images sent or received via the PC to be sent to a printer. This enables reports, images, and data shared in a videoconference to be rendered as hard copy for record keeping and teaching purposes.

R

Real time Sends and receives audio / video / data simultaneously, without more than a fraction of a second delay. Applications that are transmitted within a few seconds are sometimes callednear real time. Compare to store-and-forward.

Resolution The level of detail that can be captured or displayed. For video displays (teleradiology or interactive video) resolution is measured in pixels x lines x bit depth

RIS (Radiology Information System) A specialized system that supports radiology charge capture and billing, storage of patient data, scheduling, and reporting. May be a part of a larger hospital information system

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

S

Spooling As one image or data set is being reviewed, additional images can be received and stored for sequential review without "locking up" the computer.

Store-and-forward Captured audio clips, video clips, still images, or data that is transmitted or received at a later time (sometimes no more than a minute). Email is a store-and-forward system. Enables congruous communication, with the advantage of not needing concurrent participant involvement. Compare to *real time*.

Switch A high-speed bridge that links devices on a network.

T

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).

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

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.

U

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.

V

Videophone Small, stand-alone video appliance with a small camera and circulation, not part of a computer or larger videoconferencing system, that enables interactive audio-video communications over POTS or ISDN.

W

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.

Whiteboard - Shared notebook. The shared whiteboard feature provides the electronic equivalent of an onscreen blackboard. This feature's greatest utility is when a video call is established but the audio portion is not functioning. One can then write a note on the white board for one end to make a phone call to the other to discuss the problem.

1.7 LIMITATIONS

1.7.1 Form ofTelemedicine

While there are three major areas of telemedicine, this discussion will focus on only one. Briefly, the two *excluded* areas are:

- **Aids to decision-making** - As an aid to decision-making, telemedicine includes areas such as remote expert systems that contribute to patient diagnosis or the use of online databases in the actual practice of medicine. This aspect of telemedicine is the oldest in concept. It will not be discussed because it is mostly a technical topic.

- **Remote sensing** - remote sensing consists of the transmittal of patient information, such as electrocardiographic signals, X-RAYS, or patient records, from a remote site to a collaborator in a distant site. It can also include transmittal of grand rounds for medical education purposes or teleconferences for continuing education. This aspect focuses on the medical doctor's abilities to decipher technology and make decisions.

The third form of telemedicine, and the one which will be covered in this discussion, is:

Collaborative arrangements for the real-time management of patients at a distance - Collaborative arrangements consist of using technology to actually allow one practitioner to observe and discuss symptoms with another practitioner, or the patient, who is far away. This aspect probably has the biggest impact on the future oftelemedicine. This aspect requires communication between two human beings at a distance for the purpose of improving mental or physical well being.

1.7.2 Areas Of Collaborative Arrangements To Be Represented In This Document

Collaborative arrangements for the real-time management of patients at a distance employ a wide range of uses, and that range grows continually. However, for the purposes of this study only three areas were chosen to illustrate the advantages and disadvantages of the process, and how it relates to communication. They are:

- Treatment Of Rural Area Patients
- Treatment Of Prisoners
- Treatment In The Military

2. Chapter 2 - Review of Literature

2.1 The Communication Process

This study will demonstrate that telemedicine is a form of communication. The following section outlines basic aspects of human and organizational communication, highlighting a popular communication model as an example.

2.1.1 Human and Organizational Communication

Direct human communication contains two levels:

1. The first level refers to the contents of communication messages,
2. The second level refers to the relationship between communication partners. This relationship has a high impact on how the content of messages is perceived during the communication process.

Communication messages are transmitted verbally, but the perception of these messages is also strongly influenced by a number of *non-verbal* parameters:

- facial expression
- visual contact
- physical contact
- gestures
- posture

Verbal parameters besides the contents of a communication message are melody of speech, gaps within conversations and tone of voice. These also have an impact on the effectiveness of communication. It has become obvious that human face-to-face communication consists of many different elements, which both sides use, on the one hand, to influence their confrere and, on the other hand, to judge the communicative credibility of the confrere. This explains the high effectiveness of direct communications.

Personal communication can be differentiated into the following levels:

- **advocate channels:** People communicate to a body of customers (as in sales to potential buyers).
- **expert channels:** independent experts communicate experience and advice (as doctors to patients, or consultants to clients).
- **social channels:** Word-of-mouth influence takes place within social surroundings (neighbors, friends, co-workers)

Communication problems, caused either by the interference of noise or by the lack of correspondence between the fields of experience, can be solved via a feedback channel. All communication processes are based on this basic principle.[2]

2.1.2 Information Theory

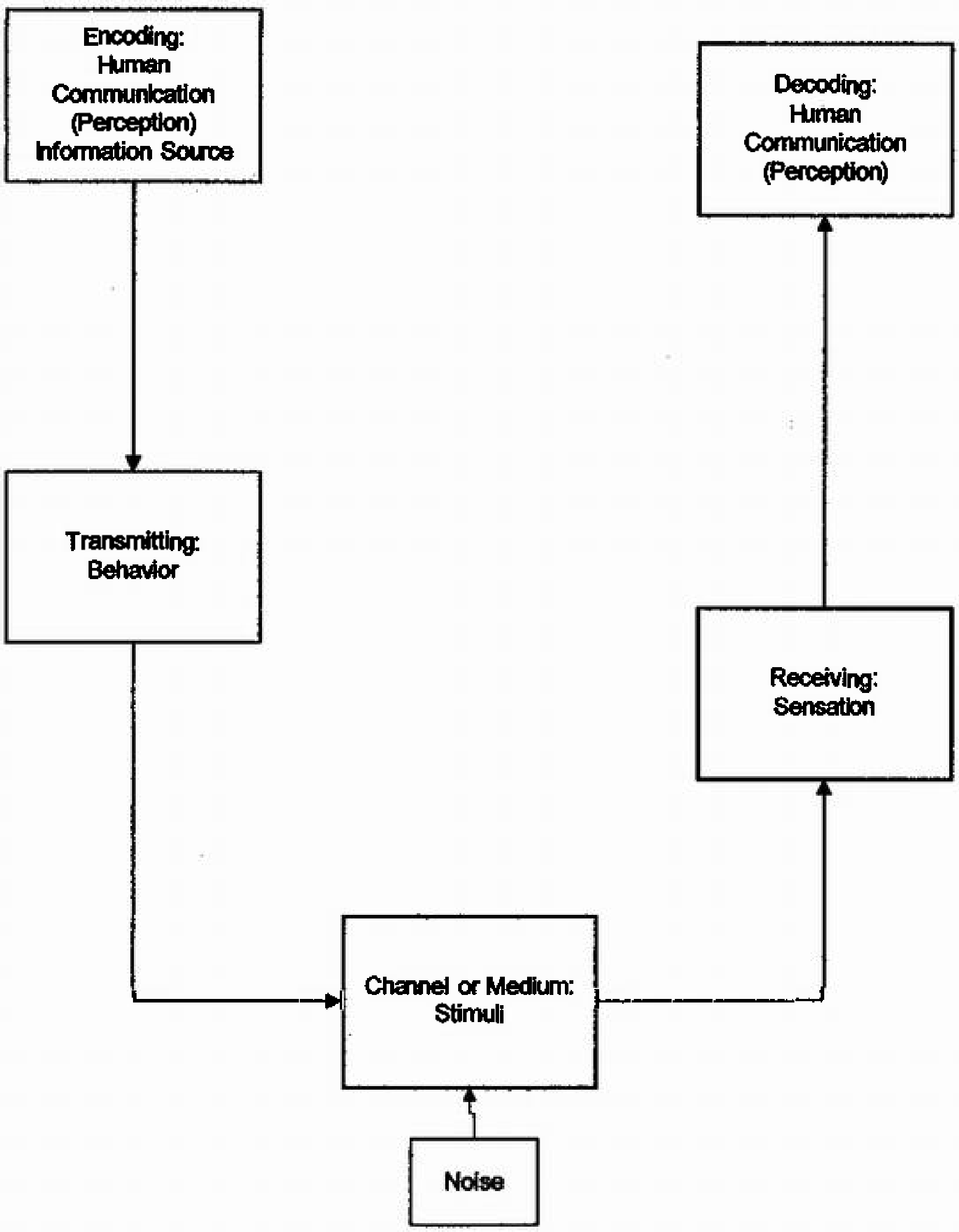
To understand telemedicine as communication, the mechanics can be applied and compared to a well-known communication model. Claude Shannon and Warren Weaver (1949) developed the Information Theory as the prototypical example of a transmissive model of communication: a model that reduces communication to a process of 'transmitting information'. Shannon and Weaver were engineers working for Bell Labs in the 1940's. Their goal was to ensure the maximum efficiency of telephone cables and radio waves. They developed a model of communication intended to assist in developing a mathematical theory of communication. The model led to very useful work in redundancy in language, making information 'measurable', and creating the mathematical study of their information theory. Their work proved valuable for communication engineers in the realm of technical issues like the capacity of various communications channels in 'bits per second'. But for the most part, their work launched a much wider application to human communication laying the groundwork for a variety of other research both in the field of communication theory and communication technology. This model is appropriate in relation to telemedicine, a visibly technical application.

The Information Theory has a fundamental linear assumption[3] where communication is assumed to proceed between a sender and a receiver in a relatively linear fashion. Given the linearity of the information theory, it can be presented in the form of a simple linear diagram (see Appendix item A) that includes the key parts of the theory.

2 Wake Forrest University Department of Communications. http://www.wfu.edu/academic-departments/speech-communication/infot/schemt.html.

3 ibid. Later theorists added a 'feedback loop', but the model remains linear. Feedback enables speakers to adjust their performance to the needs and responses of their audience.

Communication Process Model



The original model consisted of five elements.[4]

Encoding (Information Source) - An information source, which produces a message

Transmission - A transmitter, which encodes the message into signals

Medium- A channel, to which signals are adapted for transmission

Reception - A receiver, which 'decodes' (reconstructs) the message from the signal.

Decoding (Information Destination) - A destination, where the message arrives.

A sixth element: *noise* is a dysfunctional factor. Any interference with the message travelling along the channel (such as 'static' on the telephone or radio) contributes to the effect when the signal received is different from that which was sent.

2.1.3 The Communication Model

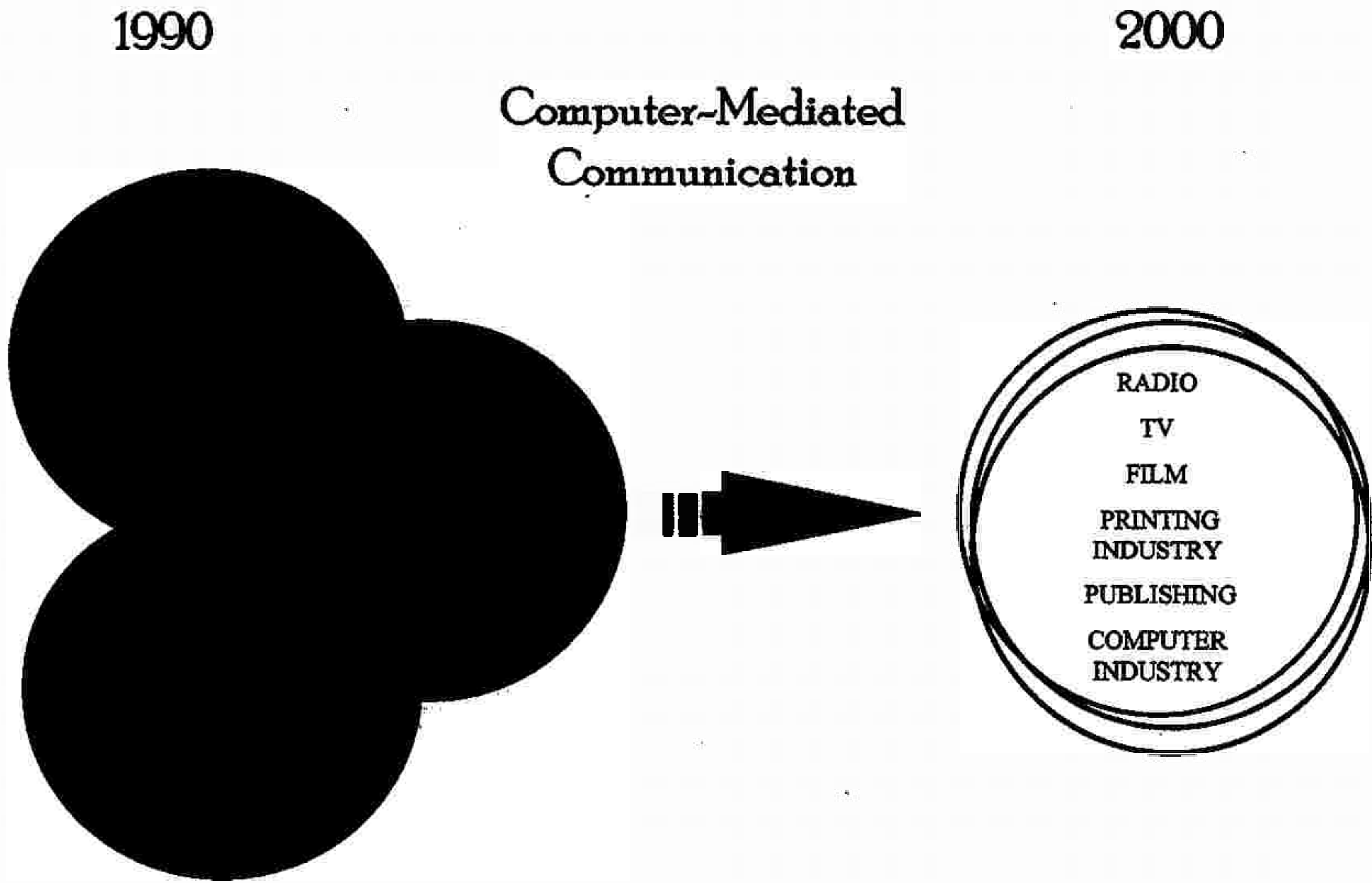
The Diagram in Appendix Item A outlines the basic Communication model as indicated in Section 2.1.2

2.1.4 Technology Is Recognized In The Communication Process

People create, exchange and perceive information using networked communication systems that facilitate encoding, transmitting and decoding messages. This is referred to as **Computer-Mediated Communication (CMC)**. Additionally, **CMC** maintains the ability to store data and messages, which is becoming more and more important within the sector of information technologies. As a consequence of developments in the media sector, a process of drastic changes has begun. Media sectors that were separate in the past are currently being integrated into one *multimedia* sector (see Chart in Appendix Item B). This development will result in multimedia applications with integrated features of computer technology, of communication technology, of music, television, video and of the publishing sector. The nature of information management will reverse. Traditionally, information had been widely spread among a relatively passive audience. But that is no longer the case as customers seek usage of new communication systems to select the information that is important.

[4] Wake Forrest University Department of Communications. http://www.wfu.edu/academic-departments/speech-communication/infot/schem1.html

Computer-Mediated Communication



Computer-Mediated Communication is the process by which people create, exchange and perceive information using networked communication systems, that facilitate encoding, transmitting and decoding messages. Additionally CMC comprises the ability to store data and messages. As a consequence of developments in the media sector, a process of drastic changes has begun. Media sectors that were separate in the past are currently being integrated into one multimedia sector.

2.2 The Telemedicine Process

Using background information from the preceding section (Section 2.1), it can be demonstrated that telemedicine, as a process, is itself a *form* of communication. The communication model is not strictly limited to human processes. It can embody technology. Thus by considering telemedicine as a communication process, associated techniques can be analyzed and improved, and problems can be solved.

The telemedicine process can take several forms. It can consist of a simple "store and forward" method of passing data/images along for a consultation, it can be real-time audio/visual communication with data and images, or it can be a combination of both.

2.2.1 Store And Forward

Generally speaking **store and forward** telemedicine involves the use of computers and telecommunications equipment to provide health care over long distances. It is actually an extension of one of the oldest, simplest, and most popular forms of electronic medical consultation: a telephone conversation between doctor and patient or a medical generalist and a specialist. (But, unlike the telephone, the Food and Drug Administration regulate some aspects of telemedicine.)

> Scenario: A patient needs to see a specialist at a different location. The patient is hooked up to certain digitized electronic equipment based on need. Data and images are manipulated and transmitted through a computer and over telecommunications lines to receiving equipment at another location (hospital, e.g.). The data and images are examined and a consultation occurs. Feedback is provided. The category of this consultation is referred to as "store-and-forward."

The advantage of a store and forward system is that it eliminates the need to have both consulting parties available at the same time. Further, the supporting information technology requirements for this type of system are less demanding and therefore tend to be less expensive. Store and forward networks can support a variety of functions from the simple to the complex. Some aspects of radiology, pathology, and dermatology are especially well suited to the use of store and forward networks. There are, however, limitless possible uses ranging from prescription ordering and refill requests to continuing medical education to patient recall systems.

2.2.2 Interactive Videoconferencing

Another form of telemedicine is **interactive videoconferencing**, also known as interactive television and interactive teleconferencing. Participants can hear and see each other "live" and images of documents and objects can also be exchanged. This technique permits two doctors and a patient to confer simultaneously, even though they are at different sites. For example, a camera in an examining room would enable Dr. A to present the patient to Dr. B . Dr. B, usually a consultant, also in front of a video camera, would offer an opinion. Another widely used technology, two-way **interactive television (IATV)**, is used when a consultation between the patient, primary care provider and specialist is necessary. Videoconferencing equipment at both locations, typically an urban and a rural location, allows a 'real-time' consultation to take place. This means that the patient does not have to travel to an urban area to see a specialist, and in many cases, provides access to specialty care when none has been available previously. This practice of consultation has been found to be advantageous to almost all specialties of medicine including psychiatry, internal medicine, rehabilitation, cardiology, pediatrics, obstetrics, gynecology and many more.

> Scenario: A prisoner in a maximum-security prison needs medical consultation with a specialist. He is placed before a camera of a videoconferencing unit. At another location a doctor is also in front of a videoconferencing camera. The two can have dialog and provide real-time visual input to determine seriousness of the condition. This technique is also deployed at disaster scenes to determine priority of transport.

Live interactive communications can be used for distance learning enabling a rural physician to observe a new surgical procedure, attend or give a lecture without making the trip, or consult with a specialist located at a distant facility, with or without the patient present. It also gives the medical generalist the opportunity to obtain direct information from the specialist, and similarly provide data to the specialist. Recent improvements in digitization and data compression technologies allow transmission of enormous amounts of information needed for video conferencing while using much less bandwidth than previously required thereby reducing operating costs.

The ultimate in telemedicine mediums is a combination of both **store** and **forward** and **interactive videoconferencing.**

> Scenario: An infant born with a heart defect visits a pediatrician and medical director of rural development and telemedicine at a Medical Center. They seek the advice of a cardiologist in a city hundreds of miles away, yet the infant and pediatrician never leave their small town. Instead, using interactive videoconferencing, the cardiologist in the city examines the infant and listens to the heartbeat as a technician in the pediatrician's office holds an instrument similar to a stethoscope against the baby's body. The cardiologist can also view the baby's chest x-ray and electrocardiogram and give real-time diagnosis and consultation by examining the data provided via store-and-forward techniques.

2.2.3 How Telemedicine Fits Into The Information Model

Similar to human communication, telemedicine is a serial process. It can follow the five basic steps of human communication that would be experienced by having the entire experience occur face-to-face in a doctor's office.

Encoding: A patient exists with a problem. That patient has a need. The patient expresses a message, which in fact is information. The message/information encoded is symptoms and data, which must be captured and transmitted. The system of symbols represented by the data is the message the patient is trying to get out.

Transmission: In human communication, message transmission consists of motor-neural impulses originating in the brain and sent to the abdominal muscles, and articulatory organs (i.e. the larynx, the lips, jaw, teeth, tongue and glottis) which all play a part in creating a message. Other inputs that affect messaging in human communication can be temperature, emotions, and physical attributes. Words then capture the transmission. In telemedicine, the motor-neural impulses are replaced with digital images originating from a camera(i.e. the brain) and downloaded(sent) to a computer, which may be ultimately affected by other inputs (e.g. graphics software). Instead of words, telemedicine produces data. it is the data that captures the information to be transmitted.

Medium or Channel: Modes of transmission are numerous in human communication. It can be air accepting the vibrations of sound, or the feel of raised dots on Braille cards, or the vision of drawings on paper, or even understanding physical gestures. These and many more can surround the human communication process. In telemedicine, the medium consists of an electronic environment of hardware and software designed to capture digital communications and pass it along to the receiver via modems powered by satellites or phone lines. Like human communication, the environment can vary.

Reception: The human ear and eye are receivers in human communication. In telemedicine, the receiver is a computer or video receiver accepting the transmission. It processes the digital images and data, emitting the information on a screen or paper.

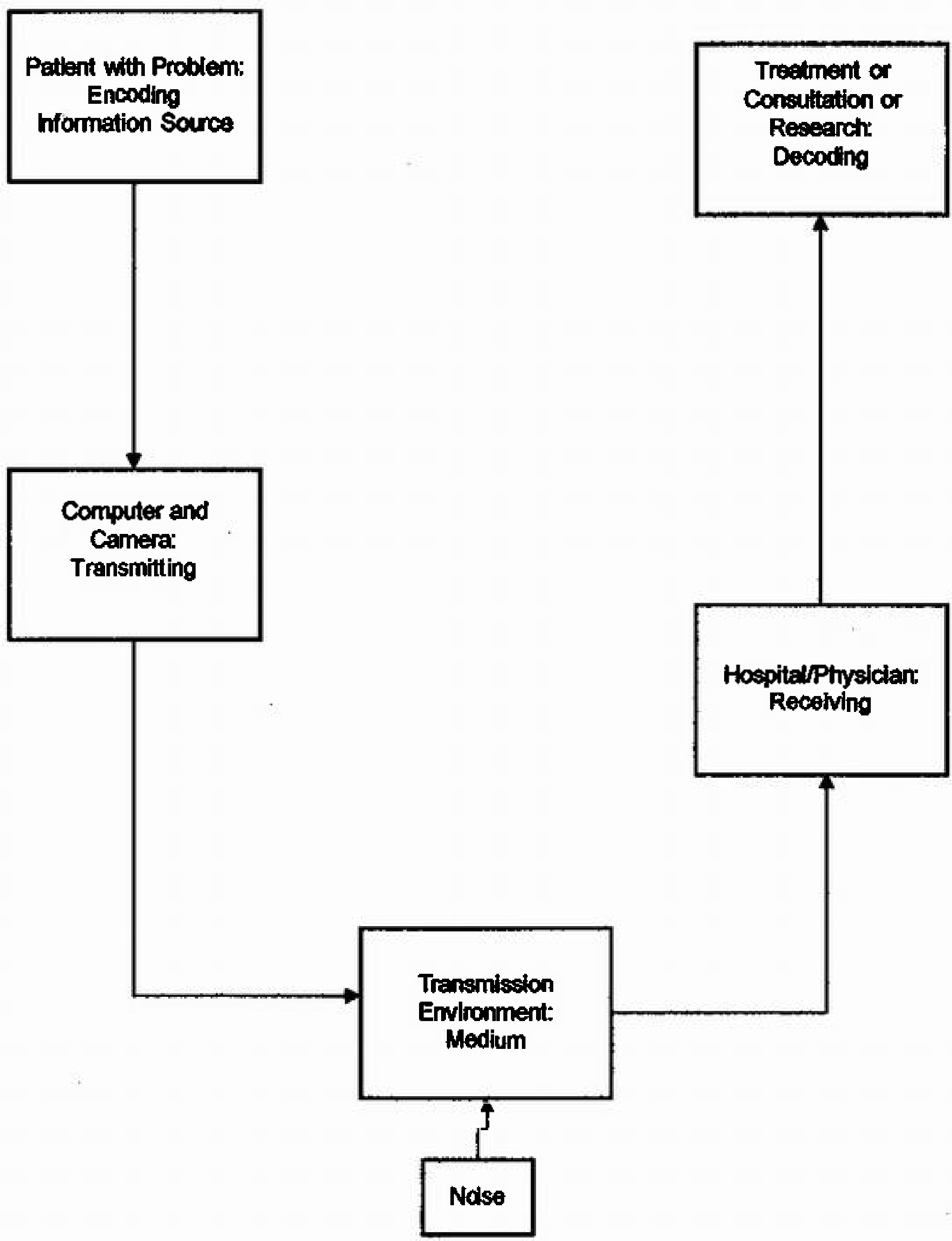
Decoding: The final product of communication is decoding. The brain process what has been transmitted in human communication. Decoding in telemedicine occurs when the data is interpreted and a diagnosis is rendered. Decoding can also be the posting of transmitted information to the database.

Noise: Noise would include any distraction one might experience during a conversation. For the basic telecommunication process, noise would include crackling from the phone lines, distortions of image or conversation, or disruption of service.

2.2.4 Communication Diagram Enhanced With Examples Of Medical Community/Roles

The Diagram in Appendix Item C meshes the medical community roles with those of the basic communication model as explained in Section 2.1.2.

Medical Community Roles



2.3 Communication Problems

Human and organizational communication problems can afflict telemedicine processes as they do ordinary relationships. These problems, when associated with the telemedicine process can not only cause miscommunication, but can have serious impact on the mental and physical well-being of the patient. Some typical communication problems are:

Information Overload by:

- Amount
- Rate
- Complexity

Distortion / Noise

- Semantic
- Physical
- Differentiation Failures[5]

Contextual

- Stereotyping
- Polarization – an inability to see a "middle ground" or gradations. It's an either/or situation. ("Love it or leave it" attitude)
- Neglecting change – inability to accept a notion of change, believing that there is rest, permanence, or constancy.

Ambiguity

In telemedicine, *Information Overload* can be experienced when too much data is provided without proper examination and/or feedback (Amount); more data is supplied prior to or without waiting for the original data to be analyzed (Rate); sending equipment is more sophisticated than the receiving equipment (Complexity). *Distortion/Noise* is evident by static on phone lines, garbled video, unclear pictures, downed computers (Physical); incorrect data in any form (pictures, video, records) needed /supplied for a conference (Contextual); or misinterpretation of procedures in video-conferencing (Semantic). *Differentiation Failures* are clearly demonstrated by misuse or under-utilization of telemedicine facilities (intentional or not) and are explained in depth in the section –"

[5] Haney, William V. Ph.D. Communication & Interpersonal Relations. pp.359-454

Barriers: Attitudinal Barriers. " And, *Ambiguity* can be experienced easily with the complex nature of the telecommunications technology and the jargon that goes along with it. For example, the word "screen" has numerous meanings; from the video screen, to data manipulation for the purposes of filtering, protecting, or selecting; all of which could be misinterpreted when instructions are given.

However, traditional (face-to-face) doctor-patient relationships are subject to other forms of miscommunication that can sabotage treatment, as it can any personal relationship. However, telemedicine can actually minimize some of this danger by automating certain aspects that were previously left only to oral communication. The following are examples of basic miscommunication as cited in "Communication & Interpersonal Relations", by William V. Haney Ph.D.:

- **Intensionally oriented** – People are conditioned by our environment to react *intensionally*. Society customs, traditions, norms, mores, etc are routes which become so ingrained in us that we often fail to see beyond them to the "landscape" we pass through. We tend to be more concerned with the feelings, thoughts, suppositions, beliefs, theories, etc. inside us than with the actuality outside. There is a predisposition to stay on the road, and neglect the landscape around us. It is like putting blinders on or possessing "tunnel-vision ". Intensionally oriented miscommunication in doctor-patient relationships, can be demonstrated when obvious racial, ethnic, educational or sexual prejudices sabotage care as patients choose or refuse physicians based on these criteria. Telemedicine eliminates this aspect by neutralizing (or depersonalizing) predisposition. Data is forwarded without sight or knowledge of recipient.

- **Bypassing**: In bypassing, the speaker speaks, listener listens, but communication "talks past" each. The sender/ receiver (speaker/ listener, writer/ reader, patient/ doctor, doctor/ patient) miss each other with their meanings. The consequence can be unpleasant, unproductive, and even fatal (in reference to medicine). What takes place basically is that there is, either:

    1. apparent agreement when in fact there is underlying disagreement. ...acting on false assurance, or

    2. apparent disagreement when agreement is concealed.

Bypassing occurs because people assume words mean the same to everyone. The misinterpretation occurs when the sender and receiver use :

- same words but say different things – A doctor prescribes medicine for an ailment to be taken *until* the patient returns for a follow-up visit. The patient takes the medicine but feels no improvement so stops taking it, waiting to discuss the failure at the follow-up. However, the medicine has a progressive, cumulative effect so the follow-up is not effective. The doctor and patient miscommunicated the importance of the instructions.

Or, they could use

- different words but are saying the same things - The doctor is looking for "tightness in the chest" as a symptom of a possible heart attack but the patient is saying "pain" in the description of symptoms, thus masking the reality of the situation.

Telemedicine cannot alter all miscommunication events, but the ability to translate the reality of the symptoms into data can reduce the effects of miscommunicating important information. The pure science of telemedicine, technology, can eliminate much erroneous information that previously could only originate with the patient, the patient subject to all fears and prejudices. And despite any needs for physical doctor-patient relationships, the reliability of data can be cited as an improvement to the healing process.

2.4 Telemedicine in Rural Areas

Telemedicine has been proposed to effectively correct the poor distribution of medical expertise in the rural health care delivery system. Through the use of interactive voice and color video telecommunication systems, integrated with biomedical telemetry, health care providers at a tertiary medical hub can examine and treat patients at multiple satellite locations. These locations include rural hospitals, community health clinics, and correctional facilities. By electronically transporting the expertise and state of the art technology of a major medical center to an isolated community, patient care is enhanced significantly. Patients can receive optimal care in their home community, avoiding both the costs and distress of having to travel to a distant hospital. Patients benefit further from receiving continuity of care at the local level. The doctor in the rural site gets assistance with a diagnosis or with planning treatment for a patient. When a physician at the consulting (usually urban) facility sees how critical an issue is, may respond, "I want to see that patient right now ". Information can be transferred from a rural site with limited specialist resources to a specialist site with greater resources.

Physicians can similarly benefit from a reduced sense of professional isolation. Continuing Medical Education is enhanced as physicians are able to directly learn from experts as they work with patients in the natural environment of their community. Rural hospitals and clinics benefit from being able to retain medical professionals who may have left in the past due to feelings of professional isolation.

Pennsylvania, with the largest rural population of any state in the country, has an inadequate supply of medical professionals in rural areas and a distinct disparity between rural and urban populations in respect to the quality, accessibility and cost of health care services. An established telemedicine initiative, PA HealthNet[6] uses telemedicine systems and the Commonwealth's IMUX network to link rural physicians with specialists in tertiary care facilities for purposes of conducting remote patient examinations and consultations. The program can also deliver continuing education to medical professionals in rural areas. Prior to the PA HealthNet project, telemedicine projects had been pursued on a fragmented basis in Pennsylvania and were largely unsuccessful. This was attributable to several factors[7], which are key to the establishment of any rural telemedicine initiative:

- lack of a cost effective communications transport
- limited resources of rural hospitals
- traditional referral patterns and business relationships between secondary and tertiary care facilities
- skepticism of the technology by physicians, and
- the lack of a coordinating entity to promote the use of telecommunications in health care

To facilitate overcoming some of these obstacles and initiate use by physicians in Pennsylvania, the Commonwealth subsidized the program by allowing the participating PA HealthNet sites to use the IMUX free of charge; sites are not charged for any circuit installation costs or for transmission costs.

Telemedicine in rural America is catching on. The first comprehensive survey of rural telemedicine programs, released February 21, 1997 by the Health Resources and Services

6 The Pennsylvania Rural Health Telecommunications Network HealthNet
7 ibid.

Administration (HRSA) via the web (www.hrsa.dhhs.gov/news.htm), identifies telemedicine as a growing but challenging technology that promises expanded specialty health care for rural Americans. The report, *Exploratory Evaluation of Rural Applications of Telemedicine*, highlights rapid expansion of the technology--now in nearly one-third of rural hospitals--but identifies cost and organizational challenges to obtain full utilization. During the two-year study, conducted for the Office of Rural Health Policy, Health Resources and Services Administration, 2,472 rural hospitals were surveyed nationwide, with a 96 percent response[8]. Key findings showed:

- By the end of 1996, nearly 30 percent of rural hospitals used telemedicine to deliver patient care. 18% of respondents were employing teleradiology or some form of telemedicine at the time of the study (1996).
- More than 40 percent of telemedicine programs were in operation one year or less.
- Complex telemedicine networks made up of 28 percent urban metro "hubs" that primarily provide consults and 24 percent rural and 28 percent remote "spokes" that primarily use consults served an average of nine to 13 facilities.
- The most common clinical uses for telemedicine were diagnostic consults, medical data transmissions and management of chronic illnesses.
- Non-clinical applications include continuing health professional education, administrative meetings, and health care demonstrations.
- High costs limit expansion. Less than 25 percent of hub facilities were reimbursed by insurers.

But the concept of telemedicine is not limited to the United States. Rural areas of other countries have taken advantage of the benefits of telemedicine. In Nova Scotia, the TeleHealth Network will connect every hospital in the province by the end of 1998. With 43 sites, the Nova Scotia TeleHealth Network will be one of the largest telemedicine projects in the world and the first to connect all hospitals in an entire health jurisdiction. Telemedicine has provided for continuing medical education at a cost saving to rural physicians over the more traditional visiting professor method. A project included a continuing medical education component with the participation of Dalhousie University, the Cape Breton Healthcare Complex and physicians in Guysborough, Sheet Harbor and North Sydney. The 12 continuing medical education sessions which ran from January to June 1996 fostered team building as a variety of health care providers (physicians, nurses, social workers, etc.) were able to attend.[9] A formal presentation of Nova Scotia's telemedicine pilot project --

8 HRSA Survey Shows Promise and Challenge of Rural Telemedicine (Press Release) February 21, 1997
9 Nova Scotia First in Canada with Province Wide Telemedicine(Press Release) Sept 23, 1997

and its successes -- was presented at a Canadian TeleHealth conference in Quebec April, 1997

2.5 TELEMEDICINE IN PRISONS

An area where telemedicine yields benefits most clearly is in prison systems. The Federal Bureau of Prisons has made telemedicine an advanced part of its medical programs as have several state correctional systems. Despite the use of telemedicine in federal and state prisons, however, Erie County, New York, and Arapahoe County Colorado were the pioneer *county* detention facilities using telemedicine. The University of California Davis Medical Center and the Department of Mental Health in Riverside are developing telemedicine programs within their respective county jail systems. Similar telemedicine programs could be established in detention facilities at all levels from youth detention centers to federal penitentiaries. Nevertheless, it is expected that within 5 years at least half of the larger jails will be using telemedicine to some degree.

Texas Tech University's program to care for inmates in that state is a model to which other states, including Virginia, are looking in creating programs. Prison care accounted for 20 percent of all consults in 1996[10]. Texas Tech University, which manages health care for about 29,500 inmates in West Texas, cites telemedicine as a part of delivering effective, efficient care. Accordingly, telemedicine offers significant "safety, security and cost advantages to correctional facilities" while being able to provide the services of specialists not readily available to incarcerated individuals. As in non-prison institutions, correctional facility managers see telemedicine as able to offer a means of:

- providing appropriate health care evaluation without compromising security,
- reducing costs associated with transport and protection, and
- gaining access to physician specialists and resources unavailable within the prison medical system.

Telemedicine enables a physician to conduct an examination of an inmate from a distance -- just as video court advisement facilitates court appearances from a distance. The inmate is placed in the detention facility's medical exam room, and the physician is located in the hospital "command center" miles away. Nursing staff specifically trained in

10 Zincone LH, Doty E and Balch DC (Winter 1997) Financial analysis of telemedicine in a prison system. Telemedicine Journal 3(4): 247-55.

using the technology facilitate the live televised interaction between the physician and inmate as follows:

- Positioned by the nurse, cameras with close-up capabilities and other diagnostic equipment transfer the necessary information to the physician. The camera can focus on anything from a hair follicle to nodes inside the throat.
- A stethoscope, transmitting to a headset worn by the physician, enables the physician to listen to the patient's heart and lungs.
- Following instructions from the physician, the attending nurse provides information such as whether tender tissue is soft or hard.
- X-rays can also be transmitted from the detention facility to the physician.

The favorable aspect of telemedicine in prisons, is of course, the reduction in costs to taxpayers. For example, based on preliminary data, the DOC (Department of Corrections) for Virginia projects annual savings of approximately $50,000 per facility where the telemedicine program (conducted in conjunction with the University of Virginia) is utilized. These savings should be achieved through reduced security and transportation costs plus savings in costs for ancillary services such as lab and x-ray charges related to the consult.[11]

Inmate and Staff Acceptance

Arapahoe County, Colorado, which accounts for 8.5% of Colorado's prisoners,[12] conducted a survey after the first six weeks of telemedicine in the county correctional facilities there. The survey revealed a number of preferences for telemedicine in the prison systems. Security staff favored telemedicine over traditional programs because of (1) the time saved in the movement of inmates. Both security and health staff recognize telemedicine for (2) reducing the number of outside transports[13], (3) decreasing inmates' non-valid health complaints, (4) increasing the number of inmates with valid medical concerns seen by the physicians, especially specialists, and (5) lessening the risks to the physician[14].

11 Peters, Susan T. and Richard Settimo. "VDOC/UVA Telemedicine Program". Published in *Correct Care*, a publication of the National Commission On Correctional Health Care. August 18, 1997.

12 http://www.state.co.us/gov_dir/DOC_dir/correct.html# Prison Facilities

13 Braly D (1995) Colorado facilities evaluate telemedicine to cut transportation. *Health Managed Tech. 16(2)* : 64.

14 Allen A (1995) Prison telemedicine in Colorado *Telemedicine Today 3(4)* : 26-27.

Officials in both Virginia and Texas say that another motivation for providing as much care as possible in the prisons with the help of communications technology is that doctors, hospitals and patients in the free world often don't enjoy dealing with prisoners.

> *"If you take them to a local hospital or a local doctor's office," ...., "and Grandma Jones is sittin' there and has to sit by a bubba who's in there for molesting children and beating up old women ... and [he] is winking at her and showing her his tattoos -nobody wants that."*[15]

At the Augusta Correctional Center in Craigsville, UVa has installed a part-time primary care prison doctor which would indicate that telemedicine means less hands-on care for inmates. But there is a growing consensus at UVa that the technology will improve care overall. Sandra Murphy, RN, at the Augusta Correctional Center is enthusiastic about the ability to better serve her patients. Ms. Murphy states,

> *"There is better access to medical care because a patient will be seen on a more consistent basis tracking and resolving medical problems more effectively."* [16]

Telemedicine increases communication between the specialty doctor and a prisoner's primary care physician. Some telemedicine equipment, such as otoscopes, which are used to look at the ear drum, give doctors bigger medical images to look at than those provided by scopes found in most doctors' offices, he said. In the past, security logistics surrounding the prisoners leaving the prison, caused officials to be reluctant about allowing them to leave, thus reducing much needed specialty consultation. A number of inmates decline to report for the medical line when their names are called for telemedicine. The observation is that those refusing were not those with valid medical needs, but those who were using medical calls as an opportunity to leave the cellblock.

An inmate survey[17] was conducted 6 weeks after implementing telemedicine in Arapaho County, Colorado where approximately 25 percent of the Arapahoe County inmates requiring medical treatment are diagnosed through telemedicine. Inmates who participated in telemedicine were divided in their opinions. Half indicated that telemedicine did provide the necessary personal interaction for diagnosis and treatment, while the other

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15 Snowbeck, Chris. Staff Writer for Daily Progress. "Success of Texas prison program lures Virginia, other states". 1996

16 Peters, Susan T. and Richard Settimo. "VDOC/UVA Telemedicine Program". Published in *Correct Care*, a publication of the National Commission On Correctional Health Care. August 18, 1997.

17 Not sure

half felt cheated because the physician diagnosed and treated without physically touching them.

2.6 TELEMEDICINE IN THE MILITARY

Within the military health services system, many telemedicine initiatives have moved from the conceptual to operational stage, creating prototypes with which to work. These initiatives are under way at all organizational levels within military medicine and span the spectrum of responsibilities. The Department of Defense first used Telemedicine in Somalia in 1993 to diagnose a severe skin rash.[18] Primetime III is the program supporting the medical operations in Bosnia. [19] In Joint Endeavor, the US instituted for the first time and demonstrated in the field an entire system of telemedicine rather than one or two applications. [20]

One of the most significant health accomplishments sought in the next century by military efforts is the establishment of a global disease surveillance and response capability. With the world no longer divided into sets of loosely aligned and isolated countries, medicine must yield to the interdependencies of growth, trade, development and political stability. The existence of disease in one location can spread quickly to others now that the world is a "global village" without safety barriers. The capabilities of telemedicine can be a key asset to provide early detection, accurate notification, and validation of diagnosis and focused response in an effort to contain an outbreak of disease or epidemic. The infrastructure already exists, but there is much more to be attained. As an agent of change, telemedicine carries significant implications for how military medicine will operate now and in the future, yet the responsibilities of military medicine to provide care wherever and whenever remain the same. The point is that telemedicine is a tool that can be used to improve the delivery of health care. [21]

There is now distributed connectivity among the medical facilities in Bosnia and Hungary, and then with the medical facilities in Germany, followed by several medical centers in the U.S. Facilities most utilized are teleconsultation, digital X-rays, computer

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18 Telemedicine Revolutionizing Medical Care, by MSgt. Merrie Schilter Lowe, "Air Force News Service"
19 Primestar III Telemedicine in Bosnia November 18, 1997 http://206.156.10.15/pages/bosnia/bosniat.html
20 Operation Joint Endeavor, http://www.tatrc.org/global/pt3-5/tsld001.htm
21 "Telemedicine in the Military Health Services System", Speech Delivered to the National Security Industrial Association, June 1996 by LTG Alcide LaNoue, Surgeon General of the Army

tomography and ultrasound transmissions, clinical e-mail, high-resolution still imagery, teledentistry and medical and patient information systems. Military medicine plays a crucial role in overall world health status and obligation can result in rapid deployments to any location without notice. It is the responsibility of the military health services system to prepare deploying troops, educating them about known health threats and immunizations, or providing information regarding self-protective measures, preventive medicine, personal and unit hygiene and sanitation. Once deployed, the medical support force must maintain the health of the troops and provide care when needed.

Telemedicine use benefits the military in the following ways:

1. It enables *safe* care for military forces that are deployed on hazardous missions to various parts of the world.

2. It is *flexible*, allowing adaptation to a changing military thus providing close support to the forces it serves. This enables the increasing participation of U.S. forces in peacekeeping, peacemaking, and humanitarian efforts resulting from the revision of the national security objectives. Military strategies today are focused on assisting with the stabilization of regional conflicts and promoting democracy in developing and recovering countries.

3. It facilitates *uninterrupted* medical treatment despite the ongoing process of base closure and realignment.

4. It provides the *sophisticated* medical services expected whenever and wherever casualties may occur.

Current Military Initiatives

Efforts to produce a computer-based patient record include a project entitled PACMEDNET, (or Pacific Medical Network). Focused in the Pacific, this project is leading to the creation of global, virtual patient records. The goal is to have the capability for a physician to call up the patient's medical history, X-rays and lab results from different sources worldwide and have the required information immediately available – eliminating misfiled, incomplete, or paper records lost in the move. The short-term goal for PACMEDNET is to consolidate patient information and health care resources among the Army, Navy and Air Force and with the Veterans Affairs health care system.[22]

22 ibid.

TRAC2ES [TRANSCOM (U.S. Transportation Command) Regulating and Command and Control Evacuation System] is an important telemedicine initiative that tracks and directs the patients from the point of injury through the evacuation chain to a destination hospital in the United States. This system of communication and teleconsultation will play a significant role in future deployments since there are fewer forward-deployed U.S. forces, and the operational mission may be on the other side of the world. That means longer evacuation distances, and TRAC2ES will assist the aeromedical evacuation team in real-time consultations with specialists on the ground. Patients will receive enhanced care enroute, with complete "visibility" throughout the process. [23]

The daily functioning of the military health services system involves a tremendous number of commands, agencies and staffs worldwide. To improve the routine communications and facilitate the coordination of policy and operational decisions, the military has begun using video teleconferencing as a matter of choice. While retaining the bureaucratic structures and command lines of authority, US military medicine has similarly begun to operate in a more distributed, or network manner. Policy decisions can be made through a corporate process involving surgeons' generals for all branches of the military. Communicating in a timely way throughout the worldwide military health services system has been significantly enhanced through the use of the World Wide Web and the home pages. The Internet has provided the opportunity for real-time sharing of information among the 150,000 people in military health care and with the 8 million beneficiaries, as well as others who are interested in what is happening within the military medical system.

Similarly, there are currently joint initiatives growing among the military, academic and civilian organizations to provide home-based health care. This project will place modules in selected patients' homes, which provide a virtual presence of health care providers within easy reach of the patients. [24]

2.7 The Role Of Physical Presence

A significant amount of telemedicine discussion centers on the importance of the physical presence of the physician or health care specialist and how that presence affects the overall quality of the provided healthcare. When it comes to a decision between needed

23 ibid.
24 Telemedicine Expands Medical Care, by Master Sgt. David P. Masko, Air Force News Service Features

medical treatment versus the "human touch", how does anyone, physician or lay person, qualify an answer? It is unlikely that a patient will pass up telemedicine for no treatment at all. But then is the path heading towards giving the patient no choice? Does it matter? In any relationship, a visit is more desired than a phone call (or a letter), but the phone call can satisfy the need, and the telephone has been an acceptable communication alternative for most of this century. The advantages and disadvantages of physical presence are cited for the reader to make a determination.

2.7.1 Advantages Cited For The Lack Of Physical Presence

There are advantages for patients to be at a distance from their doctors, and some patients will feel freer to speak and less intimidated than in a face-to-face consultation. Others may feel that there is enhanced patient-physician communication, because physicians are less distracted, and because take-home videotapes help patients and their families understand what's happening.[25] It is not coincidental that involving the patient, referring physician, and specialist at the same time improves communication and may improve care. Many patients who have been exposed to telemedicine technology seem to like it. The following are examples cited:

- The environment can be manipulated in a way that could not be done if the doctor and the patient were in the same room. This is particularly useful in psychiatric diagnosis.

  "If he got to the point with a patient that he really felt was crucial in his patient's analysis ... he started to pan the camera in on his face, The doctor's body's getting smaller, his face is getting bigger and bigger until the entire screen is just his face."[26]

  Conversely, when the psychiatrist in this situation felt the consultation was becoming too intense, there is the ability to zoom the camera back and soften the scene. Television directors call this "frame tension", where the emotions of the scene are created by a combination of dialogue and facial expressions, all brought together by the manner in which the scene is taped.

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25 VIEWPOINT: The Acceptability of Telemedicine Among Health-Care Providers and Rural Patients (*Telemedicine Today, v4(3):5-6 1996*)

26 Snowbeck, Chris. Staff Writer for the Daily Progress. "Workstations Allow Doctors to Examine Sick from miles Away". 1997

- Telemedicine interaction can sometimes provide information that might otherwise be "hearsay". At the Medical College of Georgia in Augusta (the hub of one of the nation's most extensive telemedicine programs), asthma specialist Dr. Ned Rupp tries to get pediatric patients and their families to be talkative in front of the medical TV. During one consultation for example, a father and his 11-year-old daughter sat watching two large television monitors in the County Health Department when the doctor (Rupp) suddenly popped onto the screen. "Who's got a new haircut, Dad?", Rupp playfully asked the father at the beginning of the examination. With defenses lowered, the patient relaxes and is more willing to converse. Rupp moves on to ask the child how she was sleeping, whether she was taking her medicines regularly and whether her asthma caused her trouble in school - questions that easily could have been addressed over the telephone, but without the involvement of the patient and the development of a relationship. Later, Rupp will provide feedback on the appearance of the patients and the family at the other end of the telemedicine machine to help people get used to interacting with the TV for future visits. [27]

- Telemedicine can be very effective in picking up peripheral information. Just as telemedicine alters the definition of eye-to-eye contact, it can change what a doctor sees in an examination room. Telemedicine cameras give doctors broader vision, at times, letting him see how parents react to a child's statement as well as the child-patient. It allows a better view than face-to-face because the focus would ordinarily be in one direction, but with televideo, the doctor has the opportunity to get the whole room.

- Some patients seem to respond better to televised medicine than when they meet a doctor in person. David Balch, director of the telemedicine program at East Carolina University in Greenville, North Carolina, said that in one case, a woman who would not accept a diagnosis by two doctors during different face-to-face discussions accepted the same opinion offered by a physician through telemedicine. Balch

[27] VIEWPOINT: The Acceptability of Telemedicine Among Health-Care Providers and Rural Patients (*Telemedicine Today, v.4(3):5-6 1996*)

acknowledges that the cumulative effect of the three opinions as well as the fact that the third doctor practiced at a teaching hospital all could have affected the patient's response.

- ECU already has found that patients with mental illness often feel as if they have more control of the situation when the therapist is not in the room. In the psychiatric arena, some of the younger patients are much more open to the telemedicine doctor than in person. They're used to the culture of TV, and subconsciously, they know they can always turn a TV off or the volume down. Or, as a psychiatrist in Southwest Virginia suggested, "This kind of medium has always been associated with recreation."[28] Whatever the reason, in some instances there is a "perception" that the attention span, the true eye-to-eye contact of patients with physicians over television, seems greater than when the two parties are in the same room. It appears that patients seemed to grant more authority to televised doctors than real ones.

- One of the most unexpected findings is that many patients actually preferred the electronic office visits. Some were more comfortable and less intimidated by the doctor in this setting. One patient's son observed that his father was less intimidated, more self-assured, and better focused than when the physician is physically in the room. It also appears that the televideo reliance on verbal communication may actually make some physicians more communicative and less distracted:

  "There's no "poke/prod/hum, OK" and not tell you what's going on. It's all verbal, so...the doctor [has to] talk, and he's got to listen and explain."[29]

- Patients especially appreciated taking home videotapes of the clinical encounter. The University of Kansas's teleoncology practice employs this practice which has met with great patient enthusiasm.

  "...They're [the doctors] in a hurry and they're using unfamiliar terms and...you're overwhelmed by the whole thing...Having the videotape of my

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28 ibid.

29 Diane Bloom, MPH, Ph.D. Telemedicine Coordinator, U. of North Carolina School of Medicine, Program on Aging. 919-966-5945: dbloom@med.unc.edu With Rebecca Hunter, MEd, and Mark E. Williams, M.D.

session was very helpful. My wife was able to see the videotape directly and have the same understanding even though she wasn't there." [30]

- Patients' health care providers all felt that telemedicine consultations, which typically involved the rural practitioner, the urban specialist, the patient, and sometimes other health care workers involved in the case, were superior to the "linear" style of conventional consultations for participant involvement. As one patient said:

  "If I hadn't participated in this telemedicine session, the consulting physician would have sent a letter to my physician. My physician might have had a short telephone discussion with him and that would have been it. I would not have been a part of that telephone discussion. So my concerns wouldn't have been discussed and I would not have known what their discussion was about." [31]

2.7.2 The Disadvantages Or Issues For Lack Of Physical Presence

Immediately, opponents of telemedicine will cite lack of physical presence as an obstacle to proper medical care. Ideas of human warmth, eye contact, and reassurance, are all aspects individuals have come to expect in doctor patient relationships, but they are the types of aspects the previous section has eliminated as essential. However, there are some obstacles in telemedicine that exist with the absence of one-on-one contact.

2.7.2.1 Technical Difficulties

Telemedicine facilities rely on powerful phone lines that carry anywhere from seven to 800 times as much information as standard lines. In a sense, telemedicine is nothing more than a souped-up telephone call between patient and doctor and subject to the same outages that ordinary phones are susceptible. Some doctors worry that a blurred video image or poor audio transmission could result in the wrong diagnosis. When there is no back-up, the resulting failures are comparable to the doctor not showing up for the appointment.

Microphones placed too close to one another or too far away from the speaker may cause the screeching and yowling of feedback. It may seem obvious, but even experienced people make the mistake of not keeping the microphones away from noise sources in the

30 VIEWPOINT: The Acceptability of Telemedicine Among Health-Care Providers and Rural Patients (*Telemedicine Today, v.4(3):5-6, 1996*)

31 ibid.

room. These may include computer equipment, air conditioning vents, and ringing telephones. Also, table vibrations can cause transmission problems from microphones.

Until technological standards are settled, the difference between good telemedicine and bad telemedicine could come down to whether a health care company spends the proper amount of money on functional equipment. Thus, the precarious balance of a business trying to enhance health care while enhancing the bottom line.

2.7.2.2 Self-Esteem Problems / Shyness/ Image anxiety

Patients and doctors who use telemedicine are learning how to adjust to the changes, but they've also determined there are some cases where telemedicine just isn't a good option. Some physicians believe that patients in the age range of 13 to 21 require a trusting relationship before they will respond, and that relationship needs to be tangible. Others believe a positive self-image is necessary for telemedicine to be successful, and in the above age range particularly, that is not always prevalent. A nurse who runs telemedicine clinics in Waycross, believes teens have trouble with the technology, specifically the videotape, and particularly young women who are self-conscious about their weight.

Skittishness about being televised isn't confined to teens, however. It has been suggested that telemedicine wouldn't work well for gynecological exams. "There are some things you don't want to see on TV. It takes a strong person to be able to show your body like that."[32]

2.7.2.3 Dehumanization

An ancient understanding of medicine associates healing with a physician's assured and assuring touch. Dr. B. Lewis Barnett, retired chairman of family medicine at the University of Virginia, wrote the following in his memoirs:

> *"As a healer, the physician is expected by the patient to touch the body. The first handshake is more than a business or social formality; it's the healer's first penetration into the patient's personal space. ... The handshake symbolizes respect for the individual as a fellow human being, who, though sick, is not viewed as inferior."*

Telemedicine introduces the idea that healing can occur without the healing touch. But not everyone is sold on the theory that the doctor can review and diagnose in a very short time period of time by analyzing data, and *not* conferring (or chatting). Similarly, critics are not convinced that a goal of telemedicine is to supplement, not supplant hands-on care. "Telemedicine [commoditizes, *sic*] the doctor-patient relationship," said Jamie Court, director of the Santa Monica, Calif.-based Consumers for Quality Care. "When patients are viewed through the eyes of a video camera or on a computer screen rather than in person, it's much easier to treat them as numbers." However, telemedicine also brings what can be described as a "paradigm shift" from a world where medical help was always accompanied by human touch to the high-tech silicon caress of modem health care. According to Dr. Max E. Stachura, director of the Center for Telemedicine at the Medical College of Georgia:

> *"We have to keep in mind that there is this thousands-of-years-old mystique that health care is personal-space invasion. We expect it. We demand it, whether it is consciously or subconsciously.... I have to figure out some way to touch you over the distance."*

2.8 Legal And Ethical Issues

Many issues are of particular concern as we move toward an era where technology and health care are inextricably linked. Work is underway to break down the barriers to the advancement of telemedicine by exploring questions such as the following:

- When are health professionals subject to the licensing requirements of a distant state?
- What obligations accompany licensure in another state (e.g., public health reporting requirements, state investigative authority, jurisdiction for suit)?
- What standards govern the confidentiality of telemedicine transmissions? Which state's legal requirements govern the disclosure and retention of the medical records of a patient in another state seen via telemedicine?
- How should payment for telemedicine be structured?
- Should there be unique CPT codes for services provided through telemedicine?
- How can reimbursement be secured from private payers and state programs?

32 Snowbeck, Chris. Staff Writer for the Daily Progress. "Workstations Allow Doctors to Examine Sick from miles Away". 1996

- What telemedicine equipment should be considered a "medical device" subject to FDA regulation?
- What standards have been adopted by professional medical societies on the appropriate uses of telemedicine equipment?
- How can the laws of other countries applicable to telemedicine be determined?

Unfortunately, because of the newness of telemedicine, these concerns are pondered and theorized but solutions have not been universally established to date. It is because of these concerns that telemedicine has not been embraced and utilized to its full extent.

2.9 Technology Used In Telemedicine

2.9.1 Technologies To Deliver TeleHealth And Telemedicine

The fundamental characteristic of information technology is the capture, transfer, and receipt of useful information from one site to another. The basic components include a source (device/terminal), connection to a communication network, and a destination (device/terminal). The two technologies used to transmit information and most commonly referred to in telemedicine are (1) **store and forward** and (2) two-way live, **interactive television (IATV)**.

Store and forward systems provide the ability to capture and store text, audio, static and video images and forward them for review and or consultation by a physician. Technically, store and forward is High Resolution Digital Still (HRDS) Imaging, which consists of taking a clinical image with a digital camera and downloading the image to either a personal computer or laptop. A HRDS image taken with a Kodak DCS 420 camera (for example) is a 4.4-megabyte file. A computerized consult sheet is developed using database management software. This medical record includes essential information for medical consultation such as patient history, physical examination findings, laboratory results and radiological interpretations. The image and related records are placed in a file and transmitted to a "consult manager" through either a Satellite Transceiver, a Switch 56 circuit, or across the plain old telephone system (POTS) lines via a modem. High-speed modem and data-communications software is used to transmit data by terrestrial or satellite communications with a transceiver (a popular choice being a portable International Maritime Satellite known as INMARSAT). The information is either handled directly by a physician or by a consult manager who receives the consult data and image(s) and prepares/updates a patient record, and forwards the record to the appropriate medical specialists for review.

Live interactive systems allow individuals or groups of people in different locations to hold meetings. Interactive videoconferencing is used to support physician teleconsulting typically between one doctor's office and a hospital, a clinic, or another doctor's office. Videoconferencing telephone networks at speeds sufficient for quality videoconferencing can be obtained using ISDN lines. Technically, the supporting communications network must have adequate carrying capacity (bandwidth) to enable the transfer of audio and video signals as well as text and/or image files. A whiteboarding facility will permit doctors or other healthcare professionals to write notes and diagrams in a window on their local machine and have them displayed on the remote machine. A multimedia data exchange capability will allow images to also be transmitted. At the time of teleconsulting, the physicians can show any of the required data items in the whiteboarding mode and view each other through video mode.

The primary component of communications technology related to the delivery of telemedicine services is the carrying capacity, or "bandwidth", needed to transmit a given amount of information within a fixed period of time. The last 15 years have seen the introduction of digital network facilities having a dramatic improvement in the cost and availability of bandwidth. Bandwidth serves as a practical limit to the size, cost, and capability of today's telemedicine systems and can indeed limit the functionality and appeal of many clinical applications. Long distance carriers, regional telephone companies, cellular networks, satellite providers, and cable companies are experiencing the melding of their previously diverse markets into one where they all sell one thing, bandwidth. Health care is a very attractive market for these bandwidth providers where they can help modernize and simplify many of health care's old fashioned paper and labor intensive methods of handling information and data.

There are a number of communication technologies being developed and tested which will expand opportunities for telehealth and telemedicine.

- High bandwidth technologies include asynchronous transfer mode (ATM), satellites, asymmetrical digital subscriber line (ADSL), and cable modems.
- Lower bandwidth technologies begin with standard analog phone lines, and digital networks beginning with integrated services digital network (ISDN).

The chart below illustrates the selection of a communication service, which should be determined by the type(s) of information, the amount of information, and the urgency of the information exchange.[33]

TYPE OF IMAGE		STANDARD PHONE LINE	ISDN PHONE LINE	ADSL T-1*	CABLE**
	(Image Size)	(Analog@ 28.8kbps)	(Digital@ 128kbps)	@ 1.5Mbps	@ 4Mbps
Computed Tomography (CT)	512 x 512 x 8 bits (2.1Mb)	73sec	16 sec	1 sec	<1 sec
X-Ray	2000 x 2000 x 12 bits (48Mb)	27.8 min	6.3min	31 sec	12 sec
Ultrasound video:	30 sec duration (240Mb)	2.3hr	31.3 min	2.6 min	60sec

These figures are for comparison only.
* ADSL and T1 are different systems that have roughly comparable transmission capability. T1 technology can be used with fiber optic or regular phone lines. ADSL is an experimental technology designed to use regular phone lines but not expected to be widely available until 1998.
** Cable modems are expected to be offered widely by cable companies by 1999.

2.9.2 Microphones: simple but critical equipment

There are several types of microphones that can be used for transmission of voice. Omnidirectional microphones pick up sound from all directions offering full room coverage. One microphone can be used for per 2-3 people in a conference setting. It may, however, pick up unwanted background noise or echo. Unidirectional microphones pick up sound directly in front of the microphone offering less room echo but more are needed since it does not offer full room coverage. There is also increased expense since one microphones needed per 1-2 people.

Surface-mount microphones are most common, inexpensive and easy to place. Lavaliere microphones offer an advantage in physician/patient interaction and education as they can be clipped to clothing at breast pocket level leaving hands free to gesture. While there is consistent sound pick-up there is also possible interference with clothing . And, finally there are wireless microphones with no cords or microphone cables to get in the way offering excellent benefits for physician/patient interaction. The distance from the

33 Source: DxNET,LLC

transmitter to the receiver should be less than 100 feet. Obviously, this technology is more expensive.

2.9.3 Technical Standards

Standards represent universally accepted agreements on how to implement technologies, allowing interconnection and communication between devices manufactured by different companies. Standards ensure the ability to exchange information across town, across the country, around the globe. They define how peripherals connect into a personal computer and they describe how information is represented such as the description of clinical procedures and diagnoses. Health Level Seven (HL7), created through the combined efforts of representatives from the medical profession and technologists, is the standard for electronic exchange of health data. HL7 now includes structures for communicating clinical orders, billing information, and patient admission, discharge, transfer, and registration information. The Digital Imaging and Communication in Medicine (DICOM) standard was created in a clinical and technology partnership, defines common formats for data generated by imaging equipment and routine actions that can be performed on images. It also specifies how messages about the data and the processing actions can be exchanged.

2.9.4 The Future

The cable industry is keenly interested in pursuing the opportunities made available by the federal legislation deregulating the communication industry. There are several pilots underway across the nation, related to two-way communications on their networks. The use of cable modems will allow consumers to use the cable network to send information at very high speeds over what has typically been a "receive only" cable television network. One of the attractive uses of cable modems is that they can be used to deliver health information into the home via the Internet. A new service that provides Internet access through the television is known as Web TV, which has been tested extensively in California.

The promise of the cable modems, combined with improving technology, is causing telephone companies to consider the introduction of digital subscriber line (DSL) services. The different types of DSL services may be able to provide low cost, very high speed communications over existing copper facilities.

A third high bandwidth technology that is also gaining significant attention is satellite communications. Direct Broadcast Satellite (DBS) is a system involving communications satellites that transmit television programming signals directly to earth stations located at home or place of business. The business opportunity is very similar to that of the cable companies, a high bandwidth network being matched to bandwidth intensive customer requirements. Technology trends suggest that within the next few years, utilizing technologies made possible by computers and satellites, doctors will routinely perform what are now seen as "miraculous feats." Health care providers will be able to see patients at remote sites, using a desktop workstation or laptop computer in a mobile, wireless configuration.

Included in current and future technology, on land and in space, are developments such as tele-presence surgery, which is surgery performed by a distant physician with the help of a robotic arm. In this world of next generation tools, emergency medical technicians and nurses will resuscitate and operate under the guidance of a surgeon. Even the most gifted medical professionals have natural limits, but the use of technology to capture, expand, and project what they know, what they do, and how they do it, will shape our future. Simple technology will allow physicians to search libraries and download information in a heartbeat enabling them to apply that knowledge to patient care immediately.

2.10 Barriers To Success

Although telemedicine offers many benefits, there are still obstacles to overcome before it becomes part of mainstream medicine. Many barriers to telemedicine are shared with technological infrastructure efforts in other fields.

2.10.1 Technical Barriers

Technical barriers are created by a lack of technical expertise as well as physical connectivity that is needed to perform optimum telemedicine. For example, getting different medical equipment and communications hardware and software to work together can be difficult. It can be frustrating and difficult to put together systems in which the components operate predictably and smoothly together, work in different settings without extensive adaptation, and accommodate replacement components. And when working properly together, the technology may not provide video transmissions of sufficient quality to allow them to render an accurate diagnosis. Many telemedicine projects have been hampered by the lack of appropriate telecommunications technology. Regular telephone lines do not supply adequate bandwidth for most telemedical applications. Most rural areas do not have cable wiring or other kinds of telecommunications access required for more sophisticated uses, so those who can most benefit from telemedicine may not have access to it.

The use of technology often means that things may not run smoothly every time, or at crucial times. There was an incidence when a West Virginia telemedicine program switched to another phone carrier for better support. When auditors from the state licensing board arrived to view the equipment, nothing worked. It was discovered the system operator had to reboot all the computers to make the new phone connection. Similarly, common weather conditions, such as lightning and severe storms, have been known elsewhere to short out all the computers. Obviously this can cause time delays and unwanted interruptions.

2.10.2 Authorization Barriers

Even though *interstate* telemedicine is not a priority for many users or potential users, jurisdictional issues relating to professional licensure and medical liability are generating considerable controversy. Medical licensing is a potential problem even though 38 states have some legislature governing telemedicine.[34] Missouri makes it illegal for a person not licensed as a physician to engage in the practice of medicine across state lines.[35] Because telemedicine can cross state lines, some states could require an out-of-state doctor whose use of telemedicine crosses into their jurisdiction to get a license in their state, even if the doctor's practice is physically located elsewhere. The licensing issue is further complicated by laws some states have passed that prohibit out-of-state physicians from performing telemedicine in their states; they will not allow out-of-state physicians to practice unless licensed in their state.

Since January 1998, 15 states--Alabama, Colorado, Delaware, Florida, Maryland, Michigan, Missouri, Ohio, Pennsylvania, Rhode Island, Tennessee, Vermont, Washington, West Virginia and Wisconsin[36]--introduced bills regarding the out-of-state licensure of physicians, which indicates more attention to the matter.

2.10.3 Financial Barriers

A significant concern for all physicians using telemedicine in any capacity is the refusal of health care reimbursement organizations (e.g., HCFA, Blue Shield, etc.) to

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34 National Conference Of State Legislatures Issue Brief, October 1, 1998

35 State Telemedicine Licensing, published by the American College of Radiology (February 1998).

36 National Conference Of State Legislatures Issue Brief, October 1, 1998

acknowledge telemedical consultations as a reimbursable service. While Medicare and insurance companies pay for diagnostic services such as teleradiology, most do not yet pay for other consultative telemedicine services. [37] Some relief will be experienced with the passage of the federal Balanced Budget Act of 1997. Beginning January 1, 1999, Medicare will pay for teleconsults in health professional shortage areas. By requiring Medicare reimbursement, several states may attempt to address their own initiatives regarding Medicaid reimbursement and telemedicine. [38]The Health Care Financing Administration (HCFA) will reimburse for teleradiology and telepathology, but not specialty consultations for Medicare patients; many private insurers also will not reimburse.

But the financial barriers do not stop at reimbursement. Technology costs money as well, and particularly, it costs to keep up to state-of-the–art equipment. In a period characterized by increased competition, structural realignments, and surpluses of some categories of health profession also, clinicians may see telemedicine as an economic threat.

In rural areas, the telecommunications costs add up for a bigger service area. It is very costly for telecommunications companies to set up infrastructure with few customers to pay the bills.[39] Some states have found ways around the obstacles acquiring other funding such as rural development funds and community development block grants. Some state agencies, like corrections departments, have provided funds in an effort to gain the other benefits from telemedicine. Georgia, Texas, and North Carolina state corrections agencies have provided financial support for telemedicine infrastructure.[40]

Similarly, grants and awards are being designated to help offset initial start up telemedicine costs. For example, The University of Kansas Medical Center's Center on Aging in Kansas City will use its $3,924,300 (1997) HRSA award to help construct a 45,000 square foot model facility that includes telemedicine and education services.[41] In October 1997, HRSA announced the award of $5.2 million in three-year grants to support 18 rural

37 Exploratory Evaluation of Rural Applications of Telemedicine, 1994

38 National Conference Of State Legislatures Issue Brief, October 1, 1998

39 Telemedicine Brings Advances To Rural Locations (USA Today Tech Report) *By The Associated Press* 09/02/97- Updated 12:47 PM ET

40 National Conference Of State Legislatures Issue Brief, October 1, 1998

41 U.S. Department of Health and Human Services, June 24, 1997 Press Release: "HRSA Awards Nearly $12 Million for Health Facilities Serving Children, Women and Older Persons"

telemedicine projects in Arkansas, California, Colorado, Arizona, Illinois, Kentucky, Maine, Minnesota, Missouri, Nebraska, New Mexico, North Carolina, North Dakota, Oklahoma, South Dakota, Tennessee, Washington and Wisconsin.[42] But despite these examples of funding, telemedicine carries significant costs.

2.10.4 Liability Barriers

Medical liability is a serious issue. As an example, a remote specialist who does not perform a hands-on examination could be regarded as delivering less-than-adequate care. Or if compressed digital images are not reconstructed well, causing loss of valuable diagnostic information, a doctor could possibly face a malpractice suit. Fear of malpractice suits is a consideration for all physicians, and more so for physicians practicing telemedicine.

As computer-based patient information systems and databases have increased, the relative weakness of state and federal policies to protect the privacy and confidentiality of personal medical information has stimulated legislative reform proposals, but there has been no action to date. Physicians are concerned for their own liability in dissemination of patient information and the patients themselves are concerned about easy access of their records by those without need or warrant.

2.10.5 Standards Barriers

A difficulty within the military health services system has been the eagerness of many to fashion an information or telemedicine system that will satisfy their particular location or their particular special interest. It is essential to ensure that the systems will operate across the defense networks, that all systems can interact, and that what is developed for use in one scenario can be transported to another without missing a beat. Yet in rural areas reported barriers include lack of clinical standards, scheduling difficulties and time limitations[43]

Moreover, sustainable telemedicine programs require attention to organizational business objectives and strategic plans, which is not always evident in current applications.

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42 U.S. Department of Health and Human Services, October 7, 1997 Press Release: "HRSA Awards $5.2 Million for Rural Telemedicine Grants"

43 HRSA Survey Shows Promise and Challenge of Rural Telemedicine (Press Release) February 21, 1997

2.10.6 Attitudinal Barriers

Probably the most difficult barrier to overcome for successful telemedicine, is that which is caused by human attitudes.

The introduction of new methods, new systems and new ideas frequently gives way to fear and apprehension, which in turn leads to resistance to change. As telemedicine and other ideas become established within health services systems, reluctance is a major impediment. Some physicians today are considered "computer illiterate". Introducing patients to physicians via television and conducting examinations in that environment will take education and the willingness to learn. For any operational medicine to change the way it functions will take investment of resources and efforts that all parties must be ready to make. Business process re-engineering is change, and usually change for the better. It can be successfully accomplished with enlightened leadership, those ready to listen to others who have ideas, to take on the risk of failure and to implement those ideas which prove beneficial and effective.

"Physicians aren't very different from everyone else in the sense that we all tend to resist change," said Dr. William Goodall, director of one of the nation's largest telemedicine programs, which is based at Minneapolis' Allina Health System and includes Dr. Rapp's clinic in the town of Elbow Lake. "We're rapidly moving to a computerized world, but you still hear lots and lots of people with a certain bravado saying, 'Computers, I don't have anything to do with them and I don't want anything to do with them.'[44]

Many folks aren't comfortable learning the new technology. The technology that professionals and patients near an urban or suburban area view as essential can be largely irrelevant to the way doctors practice 50 miles across the state in a more rural area.

There are attitudinal and legal challenges in getting different people and organizational structures to work together. For telemedicine to reach its potential, the effort demands an integrated sharing of technical knowledge across traditional boundaries, between different organizations and departments within organizations. Groups that have felt the need to protect their technology uses in order to maintain a competitive edge are naturally reluctant to change until they see benefits outweighing what they perceive as losses.

44 Snowbeck, Chris. Staff Writer for the Daily Progress. "Workstations Allow Doctors to Examine Sick from miles Away". 1996

3. Chapter Three – Design The Study

Telemedicine is a relatively new concept in medical treatment. While the number of facilities continues to rise significantly each year, experienced telemedical practitioners are not easy to contact for interviews and personal opinions. An informal poll of local physicians demonstrated little knowledge or opinion on the subject. Therefore, this study is designed from a research standpoint accessing studies, reports, and opinions from organizations that have pioneered telemedicine with the goal of increasing medical care and decreasing costs.

The Internet has been an invaluable research tool as it provides information from organizations across the United States, as well as internationally. More organizations are looking to the WEB now to publish papers and reduce mailing costs. It also facilitates global access to information despite any distance. With the use of the Internet, detailed descriptions of telemedicine programs are accessible even though they primarily exist in the military, prisons, and universities across the country and around the world. There are organizations, like the U.S. Department of Defense, that devote entire sections of their homepage to telemedicine with regular updates. Resources also include organizations like the Telemedicine Information Exchange (TIE) in the United States, and The Royal Society of Medicine in the United Kingdom that publish online journals strictly to disseminate information on telemedicine. There are medical and legal offices, like that of Dr. Doug Perednia, and Ardent Fox Associates, respectively, who publish reviews and opinions from the telemedicine division of their practice. The only limitation connected with the research is that data continually changes and becomes updated as more and more organizations get involved with telemedicine.

The increased popularity of telemedicine has also inspired textbooks on the best methods to set up a telemedicine program. These texts are helpful to start-up organizations because they contain lessons learned from the pioneers. The only problem with the textbooks is that the technology is growing so rapidly that suggestions for telecommunications equipment may be outdated before the book is published, no less when the reader gets to it. However, for understanding advantages for telemedicine and citing set-up requirements, textbooks provide sufficient information.

Following a description of telemedicine in this study, it was necessary to relate the concept to communication. The tendency is to view telemedicine as science and technology, when in fact it is a form of communication. Telemedicine is medical telecommunication, which is simply electronic communication. To demonstrate that concept, the simplest communication model was illustrated, compounding the diagram with telemedicine aspects, and then finally illustrating the entire telemedicine process. This reasoning is critical to understanding ways of *improving* the telemedicine process. Obviously, there will be continual technological advances, but an ordinary non-technical participant has a commensurate ability to achieve success with the process.

4. Chapter Four – Summary

Telemedicine is the use of telecommunications for medical diagnosis and patient care. It involves the use of telecommunications technology as a medium for the provision of medical services to sites that are at a distance from the provider. The concept encompasses everything from the use of standard telephone service to high speed, wide bandwidth transmission of digitized signals combined with computers, fiber optics, satellites, and other sophisticated peripheral equipment and software. Telemedicine uses a hybrid of existing technologies, incorporating computers, the Internet, telecommunications, video and electronic medical instruments to deliver healthcare. At a minimum, telemedicine utilizes a sophisticated version of a telephone, which allows audio and still images to be transmitted between a remote site and a full care health facility. It generally encompasses the combination of a handset and video camera at an isolated location, plus a monitor at a hospital or other healthcare facility.

Telemedicine and telehealth is medical technology that has put medical and health resources where they need to be -- near the patient. And despite some resistance, it is here to stay. It will require some getting used to by both physicians and patients, and will require adaptation to doctor-patient relationships. Numerous studies have been conducted, reports written, and recommendations made. Like any technology, telemedicine will grow and change, decrease in price, increase in features, and eventually become more comfortable to be around. But unlike other forms of technical achievement, human communication skills are a very important aspect of telemedicine, and can, in fact, improve the process.

4.1 Telemedicine/Communications Diagram

The Diagram in Appendix Item D demonstrates in detail the specific aspects of telemedicine and how they correlate directly to parts of the communication model in he Information Theory.

4.2 CONCLUSIONS

Telemedicine is a form of communication in and of itself. It is subject to the same processing errors as human or organizational communication and should be monitored appropriately.

Some unexpected attitudes toward telemedicine have been documented [45]:

- Patients report feeling freer to speak and less intimidated
- There is enhanced patient-physician communication, because physicians are less distracted, and because take-home videotapes help patients and their families understand what's happening
- Involving the patient, referring physician, and specialist at the same time improves communication and may improve care.

As use of the system has increased, the level of comfort has risen, resulting in greater acceptance of the technology. Now that Congress has passed the Telecommunications Reform Act, rural education and health care networks will get connectivity rates similar to those charged in urban areas. This will increase the level of acceptance by decreasing costs and increasing the use.

4.3 RECOMMENDATIONS

The following are official recommendations cited by healthcare professionals using telemedicine to improve the quality of healthcare in their organizations.

Significant Recommendations from the California study of 1996.[46]

- Healthcare associations should sponsor educational seminars for their members to provide information relevant to the planning, development, implementation and operation of telemedicine systems

- Specialty medical societies should develop standards for the appropriate use of telemedicine within each clinical discipline, following the lead of the American College of Radiology.

- Medical schools and professional societies involved in providing continuing medical education should develop and implement curricula/programs/courses to ensure that health care professionals are informed enough to make determinations about the appropriate use of telemedicine.

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45 (*Telemedicine Today v.4(3):5-6. 1996*). Diane Bloom, MPH, PhD. Telemedicine Coordinator, U. ofNorth Carolina School of Medicine, Program on Aging

46 California Office of Statewide Health Planning and Development (OSHPD), 1996. http://www.catelehealth.org/

Recommendations from Pennsylvania[47]

(1) Undertake an aggressive marketing campaign promoting the capabilities of the technology. This will help mitigate skepticism among physicians. (2) Include physicians in the process to ensure the telemedicine systems and transmission speeds have been evaluated from a medical perspective. (3) Locate a "champion" at each participating facility who will aggressively push the technology among his/her peers. (4) Make early contact with the appropriate entities involved with reimbursement of health care services (local HCFA representatives, private insurance carriers, the state public welfare agency, etc.). This will be one of the first and most important policy issues you will encounter.[48]

Recommendation from the University of North Carolina program[49]

We feel that the broadcast quality, large-screen image (where participants appear life sized) is especially important in creating the intimacy and immediacy of a face-to-face encounter. This may explain why all of the people who have used the UNC system have been enthusiastic and positive. Whether telemedicine really will turn out to be "the greatest invention since screen wire" (as one impressed 83-year old focus group participant maintained) remains to be seen. Nevertheless, we believe the reactions we have encountered demonstrate the potential oftelemedicine for health care.

Recommendations from Doug Perednia and Ace Allen, M.D.[50]

Doug Perednia, Associate Professor of Dermatology, Oregon Health Sciences University is the founder of not-for-profit organization Association of Telemedicine Service Providers (ATSP), the Telemedicine Research Center- Telemedicine Information Exchange (TIE), and principal physician of a teledermatology practice.

Regardless of the technological possibilities, providers embarking on a telehealth or telemedicine project should:

1. use the lowest cost and most conventional technology that will meet clearly identified needs;
2. make decisions about large scale implementation based on the services to be provided rather than he technology used; and
3. remember that telemedicine systems are simply one more method of providing needed medical services to patients and health care consumers.

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47 The Pennsylvania Rural Health Telecommunications Network HealthNet Report, 1994

48 ibid.

49 (*Telemedicine Today. v.4(3):5-6, 1996*). Diane Bloom, MPH, Ph.D. Telemedicine Coordinator, U. of North Carolina School of Medicine, Program on Aging

50 ATSP Home Page: http://atsp.org/basics/regFrame.html

5. Appendix Items

Communication Diagrams

Appendix A – Information Theory

(See Section 2.1.2)

Appendix B – Computer-Mediated Communication (CMC)

(See Section 2.1.4)

Appendix C – Roles of medical community in relation to communication

(See Section 2.2.4)

Appendix D – Telemedicine details in correlation to the Information Theory model

(See Section 4.1)

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6.4 Reports

6.4.1 California Office of Statewide Health Planning and Development (OSHPD), 1996.

The Project is an effort by the health care community to coordinate the energies and desires of various stakeholders to employ telemedicine to address five areas of concern within California: access to care, quality of care, healthcare costs, resource allocation and professional education.

Upon accepting this challenge, the Planning Committee spent eighteen months studying telemedicine technologies and programs, envisioning the rewards and benefits for California's citizens, eliciting input from a broad spectrum of community representatives and successfuly supporting legislation (SB1665 and SB2098) to remove some of the significant regulatory barriers to telemedicine.

For online access to the full report go to http://www.catelehealth.org/

6.4.2 Exploratory Evaluation of Rural Applications of Telemedicine, 1994

Report of The Pennsylvania Rural Health Telecommunications Network citing 9 Pennsylvania institutions using telemedicine practices, which were verified by on-site visitation/demonstration, reviewing medical records of referring and consulting physicians, interviewing patients, and interviewing health care instructors/students.

Contact: George J. White, Governor's Office of Administration/Bureau of Automated Technology Management, Automated Technology Policy Manager
Five Technology Park
Harrisburg, Pennsylvania 17110-2913

6.4.3 American Medical Association Report, 1996

The AMA issued a report on "The Promotion of Quality Telemedicine" prepared jointly by the AMA Council on Medical Education and the Council on Medical Service. The councils issued a second joint report at the AMA's interim meeting in December 1996. Recommendations were made for Licensing and practice of telemedicine.

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Published by the American College of Radiology. Detailing state legislative initiatives for telemedicine

6.4.5 National Conference Of State Legislatures Issue Brief, October 1, 1998

Published by Marla Rothouse, Esq. Detailing funding for infrastructure, legislature, reimbursement, miscellaneous studies, overview of telemedicine initiatives by states.
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6.4.6 A Health Telematics Policy In Support Of WHO's Health-For-All Strategy For Global Health Development

December 11-17, 1997 Geneva, Switzerland
The World Health Organization (WHO) convened an international Group Consultation on WHO's Telemedicine Policy in relation to the Development of the Health-for-All Strategy in the 21st Century from, in order to:

- advise it on the development of a health telematics policy
- examination of both the benefits and risks of the use of these technologies, and
- propose action for integration health telematics in the overall policy and strategy for the attainment of health for all in the 21st century.

For a detailed description of the report go to - http: //www.who.ch//
or contact: Philippe Stroot, Media Relations, Health Communications and Public Relations, WHO, Geneva. Tel. (41 22) 791 2535, fax (41 22) 7914858. E-mail strootp@who.ch

6.5 Press Releases

6.5.1 U.S. Department of Health and Human Services (6/24/97)

June 24, 1997
"HRSAAwards Nearly $12 Million for Health Facilities Serving Children, Women and Older Persons"

6.5.2 U.S. Department of Health and Human Services (10/7/98)

October 7, 1997
"HRSA Awards $5.2 Million for Rural Telemedicine Grants"

6.5.3 World Health Organization (12/23/97)

December 23, 1997
"Telehealth And Telemedecine Will Henceforth Be Part Of The Strategy For Health For All"

6.5.4 World Health Organization (9/16/97)

September 16, 1997
"Who Director-General Highlights Potential Of Telemedicine"

6.5.5 Nova Scotia Department of Health (9/23/97)

Sept. 23, 1997
"Nova Scotia First In Canada With Province Wide Telemedicine"