Tele-Health Sector Study

"Is Technology The Cure?

Hillary Rodham Clinton's health care reform plan will require new ways of managing patient information automating claims isn't enough."

Information Week, May 10, 1993

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Tele-Health Sector Study

Executive Summary

This National Tele-Health study is a policy and technology analysis of information infrastructure technology and applications (IITA) that are available for use now by the United States health care industry. The study is in support of the United States Department of Energy's "telecommuting study" for the U.S. Congress, a study mandated by the Energy Policy Act of 1992. Research & Planning, Inc. carried out this study in association with Global Telematics, which acted as a subcontractor to Lawrence Berkeley Laboratory. This study reflects the Department's mandate to look beyond reduced commuting by office workers in order to find the social impact of energy-efficient, travel-saving applications of telecommunications for U.S. economic performance and quality of life.

> ***Tele-Health***, defined, *is a vision of the electronic delivery and management of health care services and practices, including electronic support for proactive self-health practices. "Electronic" in "Tele-Health" is the use of voice, data information storage and communications, and computer technology.*

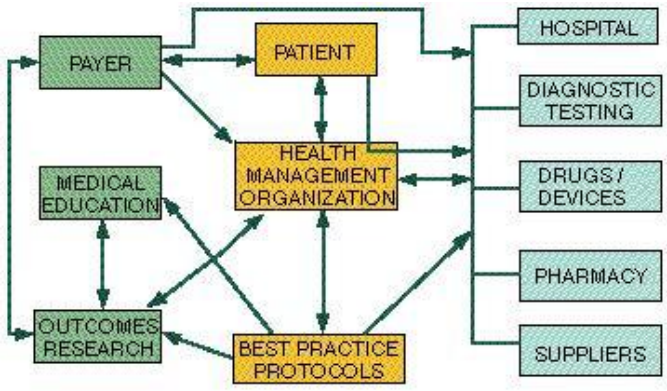
It exists on a networked information infrastructure technology and applications(IITA).

Tele-Health Vision

The **Tele-Health Vision** provides the patient with cost-effective *appropriate* best practice care at the *appropriate* location. The simultaneous movement of the patient through the health care system with timely information flow is essential to success.

The Electronic Medical Record (***EMR***) provides the comprehensive linkages to the components of the Tele-Health network of information flow. Exhibit 1 illustrates this concept as the ***Macro Model of Tele-Health Information Flows***:

EXHIBIT 1



Source: Research & Planning, Inc.

Access to timely and accurate information ensures that the combination of appropriate care at the appropriate location is achieved.

In the matrix shown in Exhibit 2, the lower right-hand quadrant is the highest cost situation: inappropriate care at an inappropriate location; one without the expertise to provide the required treatment.

EXHIBIT 2

	Appropriate location	Inappropriate location
Appropriate care	Optimal	
Inappropriate care		Worst

Source: Research & Planning, Inc.

The patient may get the right care at a location without adequate expertise, the upper right-hand quadrant. Or, the patient may receive inappropriate care at a well-respected facility. Neither of these two situations is optimal.

The optimal situation is the upper left-hand quadrant: the situation that occurs when appropriate care is provided at the appropriate location, one with the expertise to provide the required treatment. When this situation occurs, Tele-Health best practice vision is achieved.

The development of a nationwide networked *electronic medical record* is the priority step in building an effective Tele-Health system of cost-effective, high quality health care.

Benefits of Tele-Health

Even as Tele-Health begins to take shape and gain momentum, the opportunities for annual savings are already being predicted. But, the argument for savings is secondary to the real payoff, as reflected by Workgroup for Electronic Data Interchange(WEDI) and recently retired president of Travelers Insurance Co. Joseph Brophy.

> *"We are going to have good information to make better decisions that will lead to better health."*[1]

Health as percentage of GDP can range from 10-20% of GDP in a decade. According to experts, such as Uwe Reinhardt, approximately 25% of savings could be achieved without any noticeable difference in the quality of health care.[2] Projected out a decade in the future, a savings of over a trillion dollars a year is possible. Even in 1993 health expenditures, savings of 25% on $900 billion would be over $200 billion. Tele-Health through *teleapplication** support for appropriate policy will produce a major contribution to these savings.

*Any application with "tele" in front means "done at a distance."

The June 14, 1993, issue of *Business Week* provides an illustrative example of actual savings through the use of electronic communication:

> *Dr. James Cimino had a problem. To find out if his patient's confusion was a sign of neurological disease, Cimino needed to test the man's spinal fluid. But scheduling a visit to Columbia Presbyterian Hospital was difficult. So he made a note in his computer: Order a spinal tap the next time the patient's chronic heart condition brought him to the New York City hospital's emergency room. Two weeks later, the patient was there. And yes, having read Cimino's note--which was stored with the patient's records in the hospital's computer system--doctors did the spinal tap.*
>
> *The case exemplifies how re-engineering hospital's costs with sophisticated computer networks can help cure one of medicine's worst ills--inefficiency. "Up to 40% of all hospital costs are related to the generation and storage of information, so it makes sense that information technology can improve efficiency," Says Dr. William M. Tierney of Wishard Memorial Hospital in Indianapolis. Wishard now requires doctors to order all drugs and treatments for patients via computer. The system then automatically warns of potential problems, such as allergic reactions or duplicated tests. Doctors tend to make fewer mistakes and order fewer tests. The result: costs per patient are $900 less. "To stay competitive," concludes Tierney, "doctors really have to get into the electronic medium."*

These savings are for direct health cost reductions and do not include the cost of pain, illness, death, loss in work productivity, loss of jobs to foreign countries with lower health costs, loss in exports due to higher prices of United States produced goods due to higher health costs, etc. As Joseph Brophy and others have concluded, these are the real benefits of Tele-Health.

The Tele-Health Impact on Transportation

Tele-Health, through the *teleprocesses* of *teleservice* and *telework* will produce major benefits in high efficiency use of transportation. High efficiency travel will be achieved through the use of current and emerging *teleapplications* for the delivery of health care to remote locations:

1. Telediagnosis
2. Teleconsults
3. Telemonitoring
4. Telespecialties (e.g., surgery, psychiatry, radiology)
5. Telework (e.g., *Electronic Data Interchange* for claims

processing)

Travel miles will be saved in the reduction of low efficiency travel:

1. Unnecessary trips to outpatient clinics/emergency rooms

2. Increased reliance on *teledocumentation*

3. The use of *teleprocess* to manage operations

4. Tele-Health reduction in inappropriate procedures

Tele-Health will increase good travel as a result of the goal to improve the effectiveness of the Tele-Health health care delivery systems:

1. National and regional centers of excellence (e.g., open heart surgery)

2. Community health facilities planning (e.g., Rochester, NY) in which major efforts to lower redundancy through coordination of health facilities will result in some increase in patient and clinician travel due to the decrease in the total number of facilities providing a given specialty in a community.

Whatever the net effect (good minus bad) in vehicle travel miles, this net travel effect will be of minor consequence relative to the $200-500 billion to over a trillion dollars direct annual savings in the next decade plus the indirect benefits (e.g., pain, illness, productivity, jobs) achieved with the effective use of Tele-Health.

Tele-Health has a major role in solving the health care crisis and achieving the health care goals. Through the themes of the vision, benefits, and efficient travel, the Tele-Health Sector Study will develop each of these topics.

Tele-Health Sector Study

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Tele-Health exists on a networked information infrastructure technology and applications (IITA).

Section I Tele-Health Vision

The United States is recognized for its leadership in the health care industry. Life expectancy continues to grow. The United States funds one half of the world's medical research. American physicians have access to the world's best technology.

But as a provider, the country faces a crisis in costs to the economy and the lack of access to appropriate and quality care for increasingly large segments of the population.

The **Tele-Health Vision** provides the patient with cost-effective *appropriate* best practice care at the *appropriate* location. The simultaneous movement of the patient through the health care system with timely information flow is essential to success.

Tele-Health can make a major contribution to United States health care goals:

- Universal access
- Upgrade in quality
- Healthier people
- Lower health care cost as a percentage of GDP

The underlying criteria of the goals require that health care be delivered and measured in *speed, accuracy*, and *efficiency*. Tele-Health contributes to the achievement of these criteria through its vision of enhancing the capability to provide appropriate high quality health care, when, and where it is needed.

The best practice Tele-Health Vision includes the following:

1. *Electronic medical record* of comprehensive family and patient medical history electronically accessible to all medical clinicians (with appropriate security and privacy precautions)

2. National data base of medical information including best practice medicine by illness, medical care costs by illness procedure, drug efficacy, cost, side effects, drug interaction effects

3. Tele-Health support for community planning of health resources (e.g., Rochester, NY practice)

4. Tele-Health support for remote health care:
   a. Diagnostics
   b. Consultation
   c. Monitoring
   d. Rural medicine
   e. Community/urban health care

5. Tele-Health support for research and professional development:

a. Best practice
b. New medical discovery
c. Education and in-service training

Essential to developing the Tele-Health Vision is the ***Electronic Medical Record(EMR).*** The *EMR* provides the vehicle for integrating a patient's medical history with best practice medicine. The result is a match between appropriate care at an appropriate location.

Contrasting the current manual system for record keeping with the *electronic medical record* makes the argument clear. Most people change physicians several times and are unlikely to have all of their medical records in one place. Even if they did, the file would probably be several inches thick. Not only would the file contain the record keeping systems of several care providers (not to mention legibility), but critical information such as the patient's family history, past illnesses, allergies, drug and other treatment therapies are fragmented. Making sense out of such massive and uncoordinated manual data is not only impossible, but also cost prohibitive.

The *EMR* takes data input and distributes it through a relational data base. This data base, immediately updated, is an organized record of cumulative relational data produced, in summary form, of key historical information, chronic and acute illnesses and when they occurred, specific drug and allergic reactions, and any current therapeutic treatment.

The result of timely, well-organized information maximizes the likelihood that the patient receives appropriate care at an appropriate location.

In the matrix shown below in Exhibit 1, the lower right-hand quadrant is the highest cost situation: inappropriate care at an inappropriate location; one without the expertise to provide the required treatment.

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required treatment. When this situation occurs, Tele-Health best practice vision is achieved.

While the full utilization of the EMR will provide a major improvement in the quality of health care, an important concern is confidentiality.

> *"As technology becomes ever more penetrating and intrusive, it becomes possible to gather information with laserlike specificity and spongelike absorbency."*
>
> Gary J. Marx, privacy expert at the University of Colorado

Section II The United States Health Care Crisis

> *"If you don't do something about health care, it's a joke; it is going to bankrupt the country."*
> President Clinton, *Boston Globe*, December 16, 1992

The costs of United States health care are increasing at over twice the rate of growth in GDP. From 6% in 1965, health cost as percentage of GDP in 1993 is estimated at over 14%, over $900 billion. When viewed in comparison to other developed countries, the United States per capita health care expense is 40% greater than Canada, 100% greater than Germany, and 130% greater than Japan.[3]

The United States health care crisis has many measures:

1. High inflation in health care costs

2. Health care costs share of GDP increasing rapidly

3. Lack of coverage/access (particularly for the urban poor, rural areas, elderly, and the uninsured)

4. Evidence of high inefficiency

5. Evidence of a large percent of inappropriate care, errors of omission and commission--with sizable costs in money, pain, sickness, death, and lower work productivity

6. Health care costs increase United States labor costs, thereby driving United States jobs to foreign countries

In a comprehensive review of the literature, an adequate summary of the total cost of the malfunctioning United States health care delivery practices was not found.

Given the current direction of health care, the following scenario, if left unchecked, is likely:

If, health costs increases 10-15%/year (in current dollars)
If, the current dollar GDP increases 5-6%/year,
If, federal, state, local tax revenues increase by the GDP growth rate of 5-6%/year

Then, each year health costs will consume a larger percentage of:

a. family income

b. government spending

c. corporate profits

Causing

a. lower corporate profits

b. smaller real wage increases

c. reduction in government funds available for education and other services

d. slower economic growth

e. increase in use of part-time/temp workers to avoid cost of benefit(further reducing the number of those covered under insurance policies)

f. United States to be disadvantaged in global trade competition

The plight of the urban poor, elderly, and rural population as underserved is well publicized. What is less well known is that curently 71% of the 37 million uninsured are working families above the poverty line. Although most of this group is back on health insurance within six months, the 15% of the country's population that is uninsured has remained static for over the last decade[4] .

As the solutions to the health care crisis are considered, new questions are emerging. The shape of health care will depend upon the answers.

1. Who is entitled to health care, how much, and when?

2. When does formal entry into the system begin and who initiates it?

3. What does local care mean?

4. What constitutes good health care?

5. How does the health care clinician better *see* the patient? Is the office visit a holdover from previous limitations?

6. How can efficient and productive trips to the doctor be defined? Improved self diagnosis supported by networked IT? More extensive networked information technology? A combination?

7. Does *more* insurance mean *better* care? Healthier people? Reduced costs?

8. If more patients use the telephone to ask questions before making an appointment to see the doctor, does the physician get to charge for this service? If not, then why not?

As Tele-Health becomes more integrated into the delivery of health care, current systems will change.

The crisis also extends to the lack of standards for determining appropriate care. The lack of access to self health information and a primary care physician who has a patient's comprehensive *EMR*, causes patients to rely excessively on high cost specialists. Evaluating the best treatment is hard enough for the patient. It is even more difficult when faced with multiple specialists and treatment options.

When Doctors Disagree

One says cut; the other says no

Consumers' Guide to Health Care, May 1993

In another article from the same publication, *Zip Codes & Health Care, Where You Live Affects The Health Care You Receive*[5] highlights the reasons that doctors do things differently:

1. **Practice style**-Some doctors are more aggressive in their use of surgery or high-tech solutions to medical conditions. Others tend to be more conservative, preferring to prescribe medication, rest and lifestyle changes to accomplish similar results.

2. **Resources**-Doctors with access to hospitals with the latest technology are more likely to use the equipment on their patients. Hospitals that purchase expensive equipment are likely to recruit specialists trained with technology and thus more likely to use the technology.

3. **Supply**-Some procedures require hospitals to have highly skilled surgeons on staff. In communities served by hospitals in these fields, studies show area residents are more likely to undergo the procedures.

4. **Money**-Communities heavily populated by residents who are either privately insured or covered by Medicare see higher rates for certain expensive procedures. On the other hand, poorer communities, whose residents are often uninsured, tend to see lower rates.

5. **Community health issues**-Rates can be driven up by legitimate medical problems unique to a particular community. For example, in some communities, doctors may believe air pollution unique to the area causes high rates of asthma.

Although these differences may make sense under the current

structure of health care, what is lacking is a consistent standard of care that ensures the coupling of appropriate health care at the appropriate location. In the current environment, a patient in one community may be three times as likely to receive back surgery as the patient in a neighboring community.

Embedded in the economic crisis of health care is the almost unnoticed travel required to access health care. While vast resources have been invested in the development of research and sophisticated technology to achieve groundbreaking medical accomplishments, accessing health care is becoming geography-dependent, encouraging excessive travel by patients, employees, and industry-related transport. The Tele-Health impact on transportation will be examined in Section IV of this report.

Section III Benefits of Tele-Health

Tele-Health Benefits are found in, but not limited to, each of the United States Health Care goals.

Universal Access-The *tele* in Tele-Health means *at a distance*. The IITA Tele-Health infrastructure means that patients, regardless of where they live, will have access to primary care physicians, specialists, emergency care--appropriate care will no longer be dependent on geography. Sophisticated *teleapplications* are accessible through the Tele-Health infrastructure.

Upgrade in quality-As indicated in the previous section, best practice is often unknown and subject to disagreement. A benefit of Tele-Health is access to *on-line medical literature*, an *outcomes data base*, and by best practice protocol. Through these resources, physicians can determine a course of care through experts who set best practice treatment procedures of patients who match a certain profile. Researchers will benefit from subjects who are in clinical care rather than under artificial situations created for medical discovery.

Healthier people-The combination of universal access and improved access to data results in more accurate information providing people more preventive care through self health or treatment before the deterioration of disease.

Significantly lower health care cost as a percentage of GDP-Health costs have increased from 6 to over 14% of GDP since 1965 and estimates of health costs greater than 20% of GDP have been forecast. These are direct health costs and not the indirect and unmeasured costs of malfunctions in the U.S. health care system such as pain, death, lost work time, needless travel, and lost jobs.

Uwe Reinhardt, Madison Professor of Political Economy at Princeton, has estimated that "We could cut (direct) health spending by 25% without any sacrifice in health." (*Harvard Magazine*, March-April, 1993, p.14).

In 1993 dollars, 25% savings is over $200 billion in *direct* health costs. The R&P comprehensive review of the literature did not find one adequate *direct and indirect estimate of full costs* of malfunctions in United States health care system. R&P work in health care economics over the last two decades leads us to conclude that the total cost of health care problems is close to $500 billion in 1993 dollars.

The *Harvard Magazine* coverage on health issues cited other savings which include the cardiovascular survey described below:

> *The full cost of needless health care can be seen in the study headed by Dr. Graboys, a cardiologist at Brigham and Women's Hospital (in Boston), on the misuse of angiography. In a study of 134 patients who were scheduled to receive*

angiograms, Dr. Graboys and his associates concluded that 80% were inappropriate.

There are direct costs such as reducing even 50% of the million people who receive angiograms each year would save $2.5 billion in direct costs (1,000,000 x .5 x $5,000 direct cost per angiogram).

Invasive questionable cardiovascular surgical procedures are increasing at a rapid rate. Graboys estimates that cardiac surgeons did 180,000 coronary bypass graft operations in 1983; in 1990 there were 380,000 of this procedure.

In 1983, there were 30,000 coronary angioplasty operations (catheter inserted into artery to inflate a balloon to push obstructive material); by 1990 this procedure had increased 9-fold to 285,000 patients.

Much of surgery (e.g., cardiovascular, back) has little scientific evidence of benefit relative to non-invasive options.

> *"Unfortunately, in the case of coronary angioplasty, no reliable data verify its effectiveness as a treatment' to date, says Graboys, no properly randomized or controlled studies have demonstrated that 'putting a balloon in someone's artery is any better for them than medicine, in terms of survival or for preventing a heart attack.' Similarly, for many bypass patients, 'there is no evidence that the surgery improves prognosis over medical management,' he says."*

The most elementary outcomes information is missing for the control of a large percent of direct health expenditures.

Tele-Health provides a major response for greater control of medical practices.

Studies of inefficient paper processing, excessive testing in defensive medicine against malpractice and other direct health care costs have produced estimates of savings for specific partial savings that can be reduced in cost with Tele-Health applications to support specific health policy actions in malpractice, claims processing, and other issues.

Typical of reports on specific inefficiencies is the *Computerworld*, April 26, 1993 article on Electronic Data Inter-change(EDI).

> *"My estimate is that we can probably save using EDI $35 [billion] to $50 billion [annually]." said Brophy, who recently retired from his post as president of Travelers Insurance Co.*

A.D. Little has put together a comprehensive report that suggests an annual saving of $36 billion (see Exhibit 2). It evaluates savings in the areas of Transmission of Patient Care, Clinical

and Diagnostic Information, Electronic Claims Processing, Electronic Data Interchange for Materials Management and other cost reductions.[7]

EXHIBIT 2

Projected Annual Cost Reductions Produced by Tele-Health

			($ millions)	
I	Transmission of Patient Care, Clinical and Diagnostic Information			29,524
	A	Home Health	15,148	
	B	Institutional Care	12,728	
	C	Malpractice	1,281	
	D	Transmission of Images	289	
	E	Provider Communications	78	
II	Electronic Claims Processing			5,620
	A	Provider Benefits	420	
	B	Insurance Company Benefits	5,200	
III	Electronic Data Interchange for Materials Management			639
IV	Video Conferencing			234
	A	Distance Learning	103	
	B	Video Consultation	131	
V	Other Cost Reductions: Work at Home			472
	TOTAL ANNUAL COST REDUCTIONS			**36,489**

Source: A. D. Little, 1992

The study, although it provides a starting place, does not take into considerations some of the other savings realized by Tele-Health.

For instance, malpractice was stated in terms of insurance premium reductions. What it does not include is the $35 billion that has been estimated due to decreased practice of defensive medicine practices (an example of defensive medicine is doctors ordering excessive tests to cover themselves against malpractice suits).

Substantial savings through *telecommuting* can be achieved through restructuring the work of the vast numbers of knowledge workers in the health care industry. *Telecommuting* is work done from home or a decentralized location. Savings will be realized through the use of high-efficiency travel of industry-related transportation (e.g., improved operations management, less courier service due to the reduction of defensive medicine, and improved treatment standards).

Many studies are in the form of pilot predictions based on common industry practices include the following expert and pilot findings:

> Physician referral to self-owned lab radiology vendors *"may cost Americans $40 billion each year in needless and excessive medical treatment."*

"Physicians are unique in our economy-they control both supply and demand."

G. Johnson, William M. Mercer, Inc.

Harvard Medical School Professor Thomas Graboys' finding that *"at least 50% of invasive coronary procedures performed annually in this country are unnecessary."*

Coronary Angioplasty increased from 30,000 in 1987 to 285,000 in 1990. *"To date,"* says Graboys, *"no properly randomized or controlled studies have demonstrated that putting a balloon in someone's artery is any better for them than medicine, in terms of survival or for preventing heart attack."* Similarly, for many bypass patients, *"There is no evidence that the surgery improves prognosis over medical management,"* he says.

Source: *Harvard Magazine,* March-April, 1993

Back office administration accounts for approximately 20% of health care costs. A nation-wide program patterned after The King County Medical Blue Shield could yield as much as a 75% cost reduction by administering insurance claims through electronic claims processing.

Source: *Puget Sound Business Journal*, January 15-21, 1993

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really have to get into the electronic medium."

There has been no broad-based study including both direct and indirect cost savings through Tele-Health at this time. Evidence does, however, point to substantial areas to reduce costs and control spending through Tele-Health.

Section IV Tele-Health Impact on Transportation

Patients generated nearly 2 billion trips to health care facilities in 1990. According to the American Health Association 1991-92 statistics, over 1,840 million of those were trips to outpatient clinics and 192 million trips were to emergency rooms.

When multiplied by the average number of miles[8] required to travel to and from a facility, at least 60 billion vehicle miles were traveled, or 4% of the 1.5 trillion total passenger vehicle miles traveled in 1990.[9]

Estimates as high as 80% of those trips are considered unnecessary, although these estimates merely reflect visits initiated. What is not known is how many visits or telephone contacts were needed but not made.

One study estimates that over 60% of health actions are self-care only.[10] This represents a classic Tele-Health opportunity. Currently, the resources for people to get information and make wise self health decisions is underdeveloped in relation to the development of the rest of the health care system.[11] Better systems for self health diagnostics make the difference between current travel and travel under Tele-Health unknown.

Another important travel factor is how much travel will be altered if people stopped waiting too long to address health problems and diminished the need for expensive, invasive, and painful sickness care services. These expensive services not only mean tens of billions in costs,[12] but also increase the number of visits required to obtain appropriate care.

There are many reasons why people do not obtain health care. Policy, affordability, lack of insurance, and access are the most frequently mentioned reasons.

In the following example, policy dictates that preventive care will not be administered; therefore, what would have been a useful trip was not made.

> *A recently unemployed man in a rural area refuses health care because he cannot afford to pay for the treatment. Besides, the problem "isn't that bad." Even when his doctor offered to work out a payment plan, he refused on the basis on not being a charity case. Two weeks later, the symptom worsened and the man is rushed to the emergency room for treatment. The emergency nature of the problem means that the bill will be covered by Medicaid. Given the limited resources of the rural hospital and the excessive deterioration of his situation, several succeeding trips to a distant medical center are required.*

Under the current model of reactive health care, coverage is

provided when the condition is deemed an emergency. Excessive trips are required *de facto*.

Tele-Health information and decision support systems assume pro-active, preventive care policies that promote the appropriate use of health care. This accomplished, travel to access health care can be evaluated in terms of high and low efficiency travel.

The United States Department of Public Health Bureau of Health Professions reports over 8,300,000 full-time equivalent employees or about 7% of the 1990 labor force associated with the health care industry.[13] While the Bureau of Labor Statistics estimates that 57% of the current 127 million labor force are categorized as information workers,[14] the percentage for the health care industry is probably higher. As discussed in the previous section, there is an opportunity to use *telework* and *telecommuting* to restructure the work force and produce higher levels of high efficiency travel.

As an example, 87,000 of the health care work force are full time equivalent data processing, transcriptionists, and billing clerks.[15] A conservative estimate is that 25% of those can execute their work from home.[16] Benefits include employee time savings by eliminating the commute, flexible hours, improved staff retention, improved productivity, and greater flexibility to adjust staff levels to work volumes. Implied, but not evaluated is how much travel, peak hour congestion and air pollution would be reduced because of fewer commuter trips between the home and office. Part of any calculation should include the impact of non-work related trips at less congested times of day due to flexible hours.

In the following hypothetical situation, travel was decreased and the work of the attending and primary care physician was redesigned by the use of *telecommunications*.

> *An injured patient arrives at the emergency room. The nature of the injury indicates the need for a* ***Teleconference*** *with her primary care physician. The patient's physician is reached at home where the patient's* ***Electronic Medical Record*** *is available on-line through the physician's home-based computer. A treatment plan is developed in accordance with the special needs of the patient. Unnecessary tests are avoided. The patient received timely and accurate treatment.*

Trip reduction occurs with expanded use of Tele-Health applications for home health. A large, and growing larger, population segment is the elderly. Home health terminals are useful to meeting their needs at the time when they need more care and are less likely to be able to afford or travel to receive it.

The pilot program below demonstrates effective home health that reduced the number of low efficiency trips to clinics or emergency rooms. Pilot administrators emphasized, "*While home health terminals should supplement, and redirect patients to appropriate health care, it should not replace the patient/physician relationship.*"[17]

> *The Triage and Education System is a 150 household Harvard Community Health Plan pilot program in Burlington, Massachusetts using home computers to receive medical advice and general health information. Patients answer a series of questions regarding problems and are advised to follow self-care instructions, make appointments at the outpatient center, or go to an emergency center. Patient satisfaction rating after 9 months for program was high for "the accuracy of its contents, usefulness and user friendliness" Visits to the health center dropped 5%.*[18]

Early intervention access ensures that few medical problems become serious and usually results in better care and fewer trips. High efficiency trips are increased when home health education programs redirect patients to the appropriate level of care (e.g., diverting a trip to the emergency room, when a visit to the outpatient clinic or a telephone conversation is preferable, etc.)

Transportation is required to deliver materials and supplies, courier reports (taxis, express mail, etc.), inter-site consultations, emergency calls, and other work and industry-related travel. *Telelogistics* provides an enhanced system for the high efficiency transport of goods and services. The following provides a typical example of excessive materials transport.

> *A high quality digital imaged record is transmitted between two facilities in an urban setting using* ***Teleradiology****. The transmitted image is evaluated and a treatment is established and administered. The original record is immediately taxied from one center to the other.*

Although studies prove that records transmitted through *Teleradiology* provide accurate readings, the need to re-read the original persists as standard operating procedure.[19] Consequently, large numbers of uncoordinated single-item deliveries occur. Best practice protocol will eliminate low efficiency travel as in the above example.

The inordinate costs of health care and limitations of access for underserved populations means that the need for efficient travel gets overlooked. A distinct contribution to efficient travel is available through the evaluation of Tele-Health impact on transportation.

Section V Tele-Health Contribution to United States Health Care Goals

The following vision of best practice Tele-Health is doable cost-effectively with today's information technology.

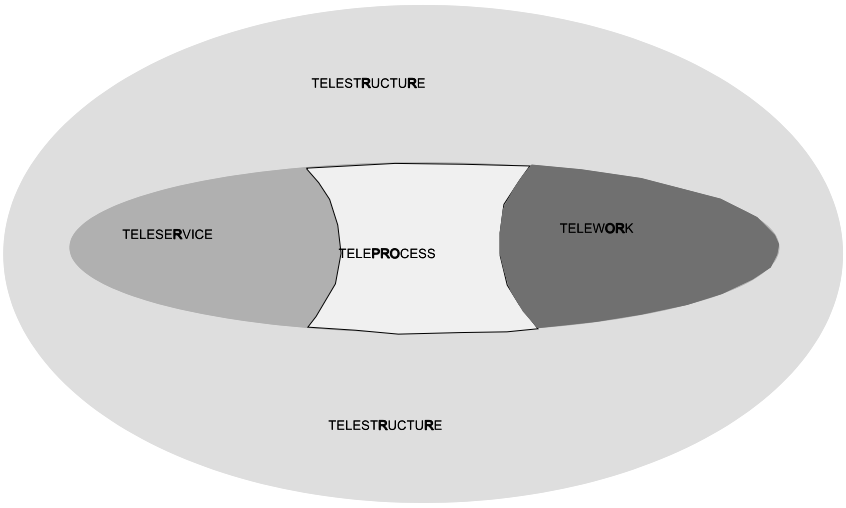
> *It is Tuesday, July 14, October 7, 1997. A man from the East Coast, is visiting friends in western Oregon. He notices a strange rash on his arms. Although he has never had a rash like this, he isn't convinced that it requires a visit to the doctor. He decides to call the publicly supported "Ask a Nurse Program" using a toll-free 800 telephone number. Before actually talking with a nurse, he is prompted by a computerized voice to answer several questions which he answers through his choice of the telephone's numeric key pad or a voice-prompted response system. Within minutes the responses are compiled and a nurse comes to the telephone. Based on his answers, it is her recommendation that he visit the local clinic. Although the nurse is located several hundred miles away, she is able to tell him the location of the nearest physician and makes the appointment for him.*
>
> *When he arrives for the appointment he presents the physician his credit card like* ***Patient Card*** *which, when activated, provides her with the his complete medical history. After examining the rash, she adds the symptoms to his on-line* ***Electronic Medical Record****. Almost immediately, a diagnosis is suggested based on the patient's medical history and the symptoms. Although the physician has some information about the diagnosis, she goes to her office workstation and enters the ORHION (Oregon Health Information Online) system to use a decision-support program to confirm if the diagnosis is reasonable. She then checks the* Medline*, an* ***On-line Medical Literature*** *database, accesses some articles on the disease and requests that they be sent by fax to her office. Using* ***Electronic Mail****, the physician consults with a dermatologist at Oregon Health Sciences University in metropolitan Portland, 200 miles to the northwest, and then orders some blood work.*
>
> *She checks the lab results, again using her workstation, and then connects to an* ***Outcomes Database*** *to see how others in the country with this disease have been treated and what their outcomes have been.*
>
> *The next day the physician calls the patient with a treatment plan. Because she electronically sent a prescription through the drug database, the patient can pick it up at the local pharmacy where he will receive information about the disease, and a good understanding of how the treatment will work. The medical history is automatically updated and the patient card is returned to the patient.*

Inherent in this example is a system of information resources that provides access to both the relevant information about the patient, a suggested diagnosis, and decision support for treatment plans that have rendered the most success. The ability to immediately access the patient's medical history through the e*lectronic medical record* was key to a timely diagnosis. Because a diagnosis was suggested, several costly exploratory tests were averted. The ability to use an *on-line medical literature* data base to learn more about the problem and best practice treatments saved expensive physician time, and allowed the rash to be treated before it spread and became worse, as well as decreasing the likelihood of a malpractice suit.

As a nationwide system capable of providing the underpinnings to solve the health care crisis, Tele-Health is best understood through the context of the ***Telephenomena Model*** (see Exhibit 3). The model rests on a IITA-enabled infrastructure or ***telestructure*** that provides the support for the myriad of services and work which can be assessed through reconfiguring where and how they are produced. In combination, ***telework*** and ***teleservices*** provide the ***teleprocesses***, IITA-enabled marketing, production, logistic, financing, administration, by which new approaches to the various industry segments can be redesigned.

EXHIBIT 3

TELEPHENOMENA



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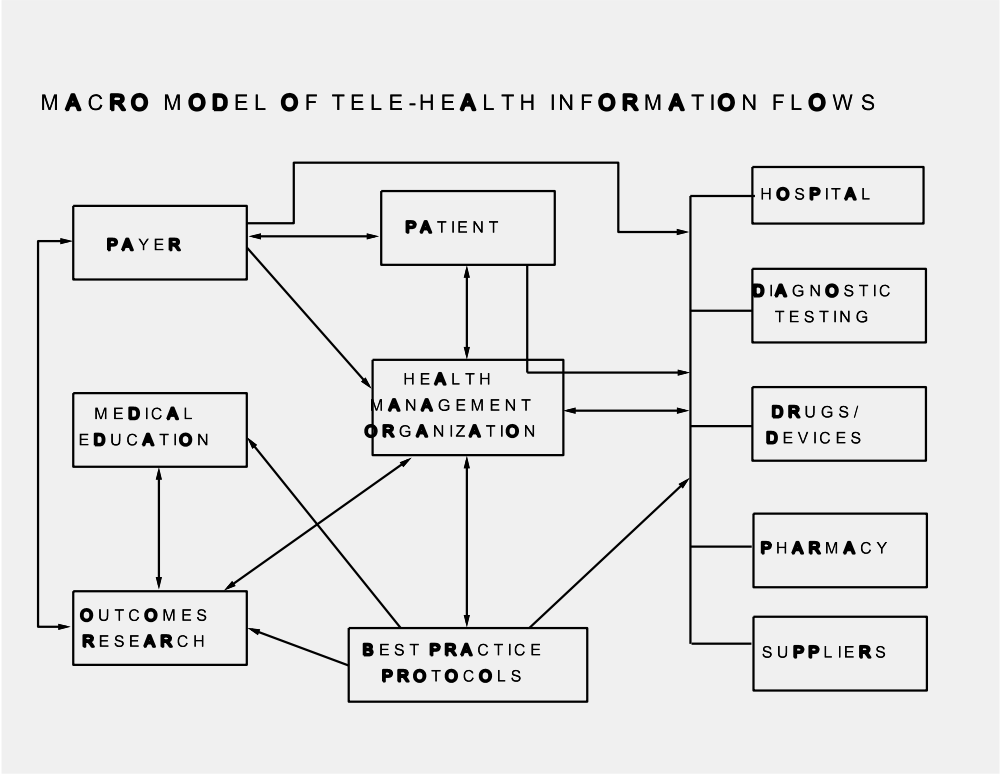
Source: Global Telematics, 1993

Tele-Health, as an outgrowth of the Telephenomena Model, is a set of electronic inter-dependent components in relationship to each other. ***The Macro Model of Tele-Health Information Flows*** illustrates the information flows that provide enhanced data and improved health care.

EXHIBIT 4



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_1993Research & Planning, Inc.

The health management organization is at the center of the model. From this central location, data flows throughout either directly or indirectly to every component of the model. Each component

then acts as a feeder to other components of the flow, eventually making its way back in enhanced form to the health management organization. The data enhances as it moves iteratively throughout the system with increased ability to manage information, discover, innovate, and support cost decisions.

The following examples illustrate some of the professional and ethical dilemmas health care providers face due to the need for the timely, accurate information provided by an electronic medical infrastructure:

> *Medical knowledge is increasing too fast for the physician to stay abreast. Professional publications, as well as the popular press, present findings that are ambiguous and misleading--a perfect environment for the growth of malpractice and host of related costs.*
>
> *The plethora of health insurance providers has created a time consuming labor intensive back-office bureaucracy. Clinicians are being taken away from clinical practice to process paperwork, further increasing the price of health care.*
>
> *Billions are spent in the medical industry for property, plants, and equipment resulting in needless duplication, and often triplication, of services while the lack of meaningful community health planning makes health care out of reach for the urban poor and elderly who reside within blocks of the sophisticated centers.*

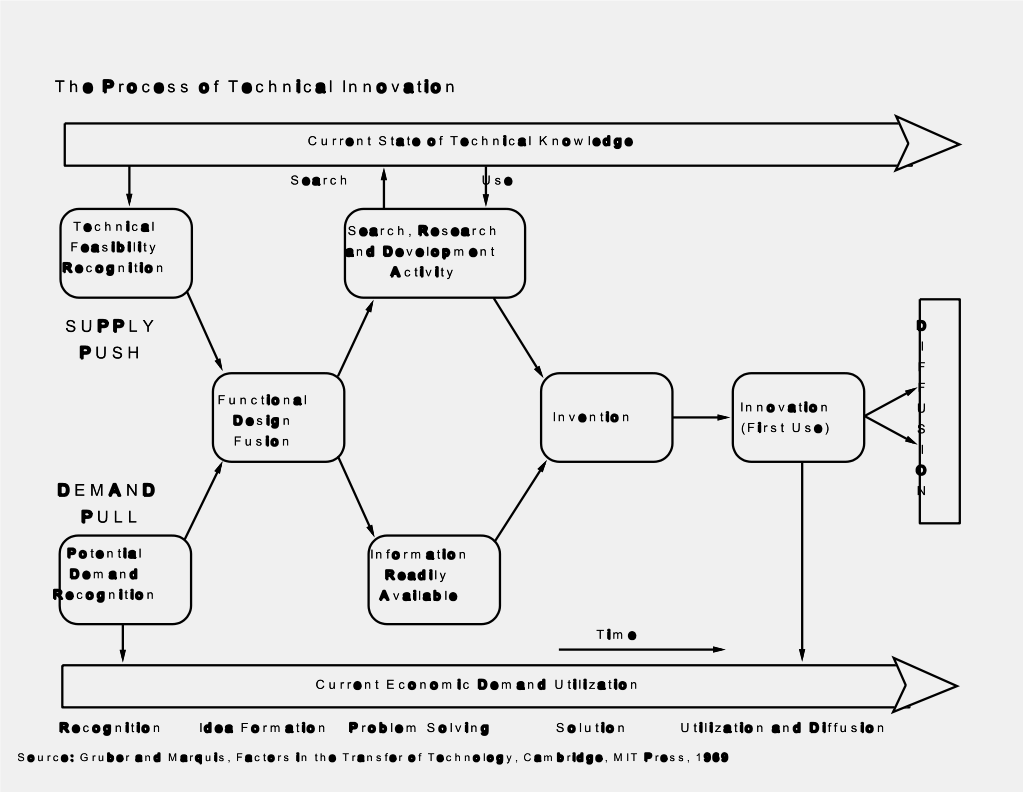
A Tele-Health system enables organizing and forecasting information into proactive preventive care strategies, while simultaneously responding to current demands for effective treatment.

Section VI Forecasting Innovation Through Technology

As the *Macro Model of Tele-Health Information Flows* suggests, Tele-Health is a combination of applications that, when used interactively, provides for a systemic approach to providing and managing health care. The data-building process will improve the ability to forecast innovative Tele-Health applications which will meet the need for high quality, cost-effective medical services. Tele-Health is practiced when unique ***teleapplications*** are invented to solve a broad range of access, financial, educational, clinical, and administrative needs. A list of *Teleapplications* used in this report is in the appendix.

Consider the tenets of the Gruber-Marquis model, ***The Process of Technical Innovation***, as the process for problem solving through the increased use of information technology.

EXHIBIT 5



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The model focuses on ***Demand Pull*** and ***Supply Push*** forces, which when fused, create a ***Vision*** for a future technology solution to a need, which then becomes input to a process of technology advancement and its commercial use.

In the context of this model, the telephone was probably the first Tele-Health application.

> *In the case of medical emergency, the centrally-located telephone operator replaced the messenger sent to seek the*

local doctor. The doctor, when located by the operator, gives some directions(such as boil water) before making the trip to the patient.

Teleconsultation emerged when *supply push* technology, the telephone, was matched with the *demand pull* for emergency care, providing the necessary elements to innovate. By 1959, technology had advanced to the point where the University of Nebraska could use closed-circuit microwave television for medical treatment, *telemedicine* and distance-learning *teleeducation* for professionals in rural locations.[20]

One of the most innovative early programs was a joint project of Lockheed, the National Aeronautics and Space Administration and the United States Public Health Service. It was conceived out of a twofold need to carry out research in using audio and audiovisual *telecommunication* to provide medical *teleservice* to astronauts in space and to provide general medical service (*telemedicine*) to communities on the Papago Indian Reservation in Arizona.[21] About the same time, 1968, Massachusetts General Hospital provided *telepsychiatric* services to the Veterans Affairs Hospital in Bedford, Massachusetts. For some patients, communication by interactive television was easier than contact in the same room.[22]

Teleapplications are currently used in various pilots and projects. More examples are in the appendix.

*The King County Medical Blue Shield (Bellevue, WA) has recently installed an **Electronic Claims Processing** system networking insurers and members of the medical community with the intention of cutting 75% of its existing administrative expenses. The system, which uses existing technology, phone lines and the automated teller machine network, will eventually enable employers to compare physicians and hospitals on price, outcomes, effectiveness and quality.*[23]

*The Joint Underwriting Association of Massachusetts grants 20% a year reduction of malpractice premiums to Massachusetts hospitals who use Kurzweil AI's voice recognition system for enhancing the quality of clinical information into the **Electronic Medical Record System.***[24]

*West Nebraska General Hospital, a 228-bed facility, recognizing the problem of attracting physicians to an isolated region, is using a newly purchased **Teleradiology** system for providing consultation services to smaller hospitals in the region, as a tool for recruiting physicians to the area. They also hope that the **Teleconsulting** program will generate more patient referrals from neighboring hospitals, as well as providing sub-specialty support for smaller hospitals that link into them.*[25]

By linking the high-risk nurseries of two remote urban health care facilities in Detroit the capability for transmitting and reading can be done at a central location. The combined Tele-Health applications, ***Teleradiology*** *and* ***Teleconsulting****, resulted in (1) saving in time and travel by radiologists, (2) a marketing tool for patient recruitment at the tertiary site, and (3) increasing services without increasing labor costs.*[26]

By the year 2000, the baccalaureate degree will be the entry level for professional nursing in Canada. In response, The University of Canada Ottawa School of Nursing is using ***Teleconferencing*** *to provide distance learning aimed at meeting the policy requirements for nurses throughout Ontario. The major advantage of the program is that it provides accessibility to meet the requirement for nurses who would otherwise not be able to pursue studies. Therefore, Canada, will be able to upgrade the standards for nursing without adding to the current nursing shortage.*[27]

The ***Use Categories of Tele-Health Applications*** matrix (Exhibit 6) displays how different categories of need intersect with available Tele-Health *teleapplications*. The categories of use differentiate areas with unique needs. For example, *Rural Areas* face issues of geography, limited economy, and a significantly high rate of chronic illness. In these specific ways their needs are different from the needs of the urban poor where their geography places them ironically near medical centers, yet still underserved.

Another category, back office administration, needs *teleapplications* that provide solutions to compiling, organizing, and disseminating large amounts of information.

For both of these categories, there are several developed or needed *teleapplications* available to solve the problems of these unique industry sectors. Where one category may benefit from several *teleapplications*, others may use fewer to achieve its mission. The matrix can be a useful way to assess and diagnose the needs for a category when planning a Tele-Health strategy.

EXHIBIT 6

USE CATEGORIES OF TELE-HEALTH APPLICATION

APPLICATION	A	B	C	D	E	F	G	H
	Preventive Care	Rural Health Care	Urban Poor	Back Office Admin.	Prescription Support System	Remote Patient Monitoring	Medical Research	Home Care/ Aged
1. Electronic Administration		☿☿☿		☿☿☿				
2. Electronic Claims Processing/Monitoring		☿☿☿		☿☿☿				
3. Electronic Medical Records		☿☿☿		☿☿☿				
4. Electronic Materials Management		☿☿☿		☿☿☿				
5. On-line Medical Literature		☿☿☿						
6. Drug Database		☿☿☿						
7. Outcomes Database and Best Practice Research		☿☿☿						
8. Telecommunications		☿☿☿		☿☿☿				
9. Teleconferencing		☿☿☿						
10. Teleconsultation		☿☿☿						
11. Telediagnosis		☿☿☿						
12. Telemonitoring		☿☿☿						
13. Teleradiology		☿☿☿						

While the model contains several categories of use as well as *teleapplications*, neither list is finite. As new needs arise innovations in Tele-Health applications will emerge to meet those needs. Other *teleapplications* not included here are *telespecialists* such as *telesurgery* and *telepsychiatry*.

Section VII Tele-Health in Rural Areas

Rural America has changed significantly over the last several decades as the population has migrated to urban areas. Nonetheless, the 27% who inhabit non-metropolitan areas are unique and therefore face health care access difficulties that warrant specific attention.

- Rural residents are characterized by low mortality, but relatively high rate of chronic disease
- Injury rate dramatically higher in rural areas (.6 vs. .4 per 1000 residents)
- Rural residents have lower incomes and higher poverty (1 in 6 families lives in poverty)
- Rural residents are less likely than urban residents to have health insurance coverage (18.2% vs. 14.5%)
- Rural physicians utilization is below that of urban residents, while rural residents report more hospital admissions (11.4% vs. 8.7%)
- No single strategy is applicable to all rural areas in the United States, e.g.,

  The West is predominant with low-density frontier counties (6 or fewer persons per square mile)

  Nearly half of the country's rural population resides in the South, where 4 in 10 rural residents are poor, elderly, or both

- Rural areas on average have half as many physicians per 100,000 residents (91 vs. 216)
- Residents in rural farm areas are nearly twice as far from physicians than residents of urban areas[28]

It is a widely held belief that technology has added substantially to health costs. In an effort to minimize technology expenses, capitalizing on economies of scale has lead to the creation of major medical centers that, in turn, increase geography-dependent health care.

The expense of technology has put the costs of modern medicine out of reach for most rural health care facilities causing many of them to close. The lack of technology decreases the

physician's access to key support systems and, therefore, increases professional isolation and diminishing attractiveness of rural practice to most health care professionals.

Simultaneously, while there is a rapidly growing number of physicians, there are too few primary care physicians. In 1963, nearly half the physicians were primary care. By 1986, only 34% were primary care specialists[29]. More medical school graduates choose lucrative specialties to help pay for the soaring price of medical education creating a preponderance of specialties and subspecialties, that are encouraged by reimbursement systems that reward sub specialization.

Rural health care facilities have closed at a steady rate for the past two decades due to a variety of reasons: poor financial management, low occupancy rates, competition from other hospitals, and "outmigration" due to limited services and personal preference, high numbers of uninsured patients, and lack of funding of Medicaid programs[30].

The result is that the rural population faces significant travel to reach health care. Many choose no health care at all until the need for health care moves beyond urgent to crisis, when Medicaid kicks in, and the cost for emergency care soars.

The person living in a metropolitan area is, on average, 20 minutes from a primary care physician and 24 minutes to a secondary care physician. While comparatively, the average for a person categorized as "farm" faces 35 minutes for access to a primary care physician and a 57 minute access for a secondary care specialist may not seem significant,[31] the number is deceiving. Even in relatively well populated rural areas, the lack of a public transportation system and the existence of few local providers to choose from can make it difficult for many rural residents to reach facilities where they can receive appropriate care. The access crisis heightens as rural facilities continue to close.

The compelling advantage of Tele-Health solutions is easily recognized through the following cases.

> *Alpine, Texas is 200 miles from its closest major hospital, the Health Sciences Center in Lubbock. By using compressed video and faxing lab test results, a rural physician and a neo-natal specialist using* ***Telecommunications*** *and* ***Teleconsultation*** *determined treatment for a baby in severe respiratory distress. Employing simple inexpensive Tele-Health applications resulted in*

saving the baby's life.[32]

The Director of Nursing in rural Tidewater, Virginia was concerned about retaining the hospital nursing staff. She feared they would be lured to the cities as the only alternative for a future in their chosen career. She solved the problem by using ***Video-conferencing*** *to provide nursing education. Now the nursing staff receives professional development without traveling long distances. The community hospital benefits by maintaining local occupancy. Retaining the nurses also kept patients in the local hospital maintaining its solvency and contributing to the local economy.*[33]

A physician in rural Georgia examines a 64-year old man complaining of dizziness and headaches. The combination of an elevated blood pressure and the patient's medical history suggests the onset of adult diabetes. The treatment currently known to the physician has some adverse effects. Through the use of ***On-line Medical Literature****, he obtains several relevant articles. He also leaves a message via electronic mail for an endocrinologist. Within a few hours he is able to define a treatment based on the literature search, additional input from the specialist, and his own expertise.*[34]

Each of these cases reflects different kinds of health care needs in rural America and employs a range of Tele-Health from simple to a more sophisticated networked system. Although there are many of these cases and some very impressive pilot programs (see appendix), most of the rural population continue to go underserved.

These programs do, however, hold the promise of achievable solutions through the use of Tele-Health as part of a nation-wide technology infrastructure for providing health care to rural populations. The Gruber-Marquis *Process of Technology Innovation* model demonstrates how the forecasting process works to innovate best practice for application to rural health access issues.

Section VIII Conclusion

As government officials, health care industry leaders, and medical professionals confront the crisis of cost, quality, and access in health care, they must focus on structural change.

An opportunity for massive structural change in how health care is delivered lies in better use of information infrastructure technology and applications. Simply stated, computers and telecommunications are the foundations of a revitalized system for people receiving appropriate health care in appropriate locations.

All of the cost and performance issues identified in the health care reform debate that is gripping America -- all of them -- will yield to electronic means of collecting, processing, storing, and disseminating information. This information includes the know-how that is embodied in the skill of America's health care professionals. Their talents can be made cost-effectively accessible in all geographic locations through IITA. Medical-related applications of the information infrastructure also include self-care, home-care, and better insurance administration, no matter what insurance plan emerges from the reformers. Pieces of a system for affordable United States citizen wellness are already visible and working well on the leading edge of actual practice.

TELERADIOLOGY

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
Essential Access Community Hospital (EACH) - Federal Program R31	Full service hospital that acts as a backup for more limited and remote small hospitals	Residents of rural areas and local primary care physicians				Telecom-munications key to success	Immediate care Reduction in travel	
PACS- viable part of picture archival and comm. systems	Teleradiology applications: home interpretation of images by radiologist on call, but not on duty, centralized reading of images from supporting clinics, outreach facilities, intra-facility rapid transmission		Drew Consultants Inc. (Carlisle, MA)				Travel time savings	
Recruiting Physicians in Western Nebraska 2/5	Providing specialty services through teleradiology	Primary care physicians in rural areas				Nuclear Image Transmission (NITS) transmits nuclear medicine images across telephone lines to NITS with PC	Collected isolation, Reduces isolation Regulation of physician referrals from neighborhood hospitals -- helps cash flow Hospital linking opportunity	Physicians trained in urban areas with lots of specialty back-up not comfortable moving to rural areas
Detroit Medical Center	Teleradiology link to remote sites-ER, off-site nurseries, Children's Hospital of Michigan (CHM) and Hutzel Hospital	Neo-natal care in remote areas	Gammex/ DataSpan (Orchard Park, NY)	$50,000	No increased labor costs Potential to add revenue	Three-screen console to transmit and receive images and text. 300 image disk storage capacity (high resolution images), two 12 inch contrac-monitors (525x525 lines), text screen mouse control, keyboard and image enhancement library, autofocus zoom lens (6:1 max yield, 3:1 line-pair/mm), COHU camera (512 x 512 bit), modem (baud rate 9600), digitizing and transmission = 60-120 seconds per image	Immediate recognition and treatment of severe and abnormal cases Receptivity by non-radiographic physicians at remote sites Physicians accept technology with extra training and user-friendly software Reading at central location saves time traveling to remote sites Marketing tool for patient recruitment for tertiary pediatric centers No increased labor costs Potential to add revenues	Optimal user-friendly software Consistent quality control of film Radiologist burdened with extra time required

TELERADIOLOGY - continued

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
Nevada Rural Health Hospital Project (1988) T7	Restructuring 11 county hospitals to create infra-structure network linkages	Rural patients and primary care physicians in area covering 93,000 square miles		Cost of transmission ($1-2 each)		Transmission through normal telephone lines	Better use of existing facilities Restructuring allowed for guaranteed cash flow	
University of Kansas Medical Center Clinical Compressed-Video Program (1991)	Pilot program provides CME, joint facility meetings, on-going evaluation expansion formal hospitals planned	Subspecialists: - Pediatric cardiology - Endocrinology - Neurology - Surgery - Adult urinology - Oncology - Orthopedics - Psychiatry		$35/hr ($10 after first hour) for trans-mission on greater state-wide private WATTS line		Compressed video	Patient, family, and physician acceptance and high satisfaction reported key State agencies report liability does not increase Reimbursement for both rural provider and consulting physician	Transmission not paid by insurance (yet)

TELECONSULTATION

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
MARS (Medical Access Referral System) (Morgantown, W. VA)	Links rural community to West Virginia University specialists and subspecialists 1,000 phone consultations per month	Rural physicians and patients				Toll-free 24-hour service facsimile machines, (medical records to pharma-ceutical orders to EKG inter-pretation) Electronic bulletin boards on PCs Compressed stable frame video technology to send radio-graphs	Increases access Decrease travel for specialty care	

TELECONFERENCING

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
West Virginia University Mountaineer Doctor Television (MDTV) (in association with MARS) T/7	Goal is to enhance relationships between health care providers in rural areas and specialists at West Virginia University Health Services to permit 24-hour communication	Patients, local physicians and specialists				Two-way audio and video communications network, high capacity (TI) tele-communications	Patient medical consultation Emergency assistance CME programs	
University of Ottawa School of Nursing (Canada) 7/2	Provide college-level courses to RNs toward the Canadian Nurses Association establishing the baccalaureate degree as entry level for professional nursing practice by the year 2000 (1982)	Students in the University of Ottawa B.S. in Nursing program located in remote locations	University Services for Continuing Education	Long distance telephone charges to remote center Transmission of materials back and forth Printing and reprography services Travel for professors and technical personnel Salary for operations staff		Telephone distance education network (telephone, microphones, electronic blackboard, television monitor, transceiver, Sloscan)	Increased inter-university collaboration with the school of medicine Accessibility of university courses to students Teleconferencing relatively inexpensive	Demand is greater than the remote centers can handle Imperfect technology
University of Toronto	Courses in Health Administration					Long-distance telephone lines signal transmission: satellite microwave cable (bulk of telemedicine) Television: self-supporting (fees to cover costs) TV and printer (30 seconds) Telemedicine Canada: expensive, 800 programs with 10 presenters in 1988 Telemedicine Centre at Memorial: 130-site audio network available for 24-hour programming		
Canadian Bar Association	Courses in law & health							
Federal Centre for AIDS	Special programs linking specialists across the country							

TELECONFERENCING - continued

G.D. Searle & Company Tele-Symposium (Continuing medical education)	Promote new use for Cyostec	General practitioners 650 attendees (10% of potential)		Estimated $600 per satellite dish for 46 hospitals		Satellite dishes		
Telemedicine Canada	Transmission of free-hand writing and computer graphics and simultaneous transmission of data	Medical schools, educators and students in remote communities using pre-delivered packages of written materials, slides and video tapes				Specially-adapted PCs and telephones	Interactive education	

ELECTRONIC MEDICAL RECORD

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
Improve delivery of preventive medicine	Number of preventive procedures and complexity of prescribing increases using a database with accurate and reliable information	Members of a rural group practice (10,000 residents in catchment area around Wakefield, Quebec, 35 km north of Ottawa)				Computers: 1983 IBM compatible office computer, 80 megabyte hard disk, 60 megabyte back-up capability Telephone	Hospital ER visits automatically recorded on computer	
Massachusetts General Hospital (Boston)	Remote transmission of high-resolution patient images and records (45MG/second, ~1200 images per day)		NYNEX			Fiber optic network	Immediate interactive discovery	
Children's Hospital (Boston)	Multi-media broad-based service to allow specialists in remote locations to interactively discuss cases using electronic pointers to indicate specific coordinates	Pediatrics/ Radiology	NYNEX			Electronic mail, text-based electronic medical records, voice annotation	Immediate interactive discovery	

ON-LINE MEDICAL LITERATURE

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
Integrated Academic Information Management System (IAIMS) National Library of Medicine	System for managing knowledge and information networking Future phase to link with remote rural areas	Health care professionals in member programs	Grants: AT&T Foundation Apple Computer Digital Equipment Corporation IBM Corp.	Workstation $5,000		Computer networks Voice mail Facsimile Virtual Notebook System (VNS)	Positive and observable impact on research, patient care, and education Success has engendered linkages to and development of emerging health care applications (e.g., Electronic Medical Record)	Shortage of experienced personnel
Georgia Hospitals and Mercer University School of Medicine	Georgia Interactive Network for Medical Information (GaIN): a computer-based clinical medical library for rural areas - 24-hour state-wide network	Half of Georgia's population is federally designated as health-manpower shortages in primary care Primary information access for rural physicians		Remote physicians set up: $1,000 - $16,000 Main operating equipment: $147,750 Remote hospitals: $4,900 (micro-computers, monitor, modem, printer, graphics card)		Links micro-computers with central computer/ minicomputer configuration and peripherals (video display terminals, printers, bar codes, modems)		

TELEMONITORING

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
PERS (1988)	Personal Emergency Response System for home care, respirators and infant apnea monitors	Elderly, infants, home care patients	Lifeline Systems (Waltham, MA) PERSYS (division of Amcest Corp., Roselle, NJ)				Provides remote communication in case of emergency	
American Hospital Association	Trans-telephonic transmission of ECG monitoring from patient's home to hospital (1987)	Out-patients	Survival Technology (Bethesda, MD)	$1,000 per month form 800-telephone line		800- telephone line	Keeps post-heart attack patients out of ICU	
American Hospital Association	Sleep disorder monitoring from home (1988)	Out-patients	Tele-Diagnostic Systems (San Francisco, CA) BioMark, Inc. (Boulder, CO)	Service Cost: $850 instead on $1,200-$1,500 Equipment: portable sender $7000		Sensing	Patients do not need to come into the medical center for all-night sleep monitoring	
Wanderer (1987)	Monitoring device hooked up to Alzheimer's patients and other mentally confused patients	Mentally confused patients	Wander-Guard, Inc. (Lincoln, NE) Patient Security (Chicago, IL) Secure Care (Portland, ME) ICS (Milwaukee, WI)	$1,000-$4,000 per unit sensing device		Sensing	Alerts staff when patients wander outside Frees up staff time/attention	

OUTCOMES RESEARCH/DATABASE

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
Mayo Clinic Outcomes Medical Research T/7	1907 unified medical record 1909 cross-referencing 1919 disease registries 1929 Mayo Clinic proceeding Current: 2000 papers a year written from indexed Mayo Clinic records	Medical researchers, rural physicians				SNOMED ICD-9-CM (of Unified Medical Language System Metathesaurus)	Discovery of new diseases/ treatments Provides greater access for rural physicians	Need for national standards

ELECTRONIC CLAIMS PROCESSING

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
Blue Cross of Conn. 17/3	Electronic claims processing for one million claims linking hospitals and practitioners (1988)	Back office administration	Southern New England Telephone (SNET)/ PROMED (subsid. of BC/BS)		$300,000 decrease in admin. costs per year	Electronic Data Integration (EDI)	Improved relationship with providers and patients Fewer delays in reimbursements with resubmissions of claims	
King County Medical Blue Shield (WA) Laboratory of Pathology (Seattle, WA) The Exchange (regional ATM) 25/1	Reducing health insurance transaction costs (1993)	Network of insurers and members of the medical community	Exclaim (Bellevue, WA)		$6 million in annual savings from $8 million budget ($5 million postage, $2 million incorrect claims, $500,000 related to unnec. phone calls	Telephone lines and computers	Ability to compare physicians and hospitals on price, outcomes, effectiveness, and quality Allows employers to make informed health care decisions	

INTERACTIVE SELF-HEALTH

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
InterPractice Systems/ Harvard Community Health Plan (HCHP) (Boston)	Home health terminals in subscriber's homes - provides guided triage function to recommend actions	Heavy users: elderly, pregnant women, families with young children, lower educated patients	Electronic Data Systems	Focus on clinical - represents 85% of health care costs			Increased patient satisfaction Reduction of unnecessary telephone calls of "worried well"	
Bay Area Health Commission Department of Health and Human Services Berkeley Community Memory Projects SeniorNet	Distribution of public access terminals to provide first-line decision support 24-hours	High risk populations: Blacks, Hispanics, elderly				Audiotex (computer-driven auditory database) Community Services Workstation		Lack of broad distribution Text-based

TELEDIAGNOSIS

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
Kootenai Medical Center (Coeur D'Alene, ID) R/5	Five-hospital consortium aimed at standardizing professional staff commitment to quality and improvement of diagnostic information	Health care professionals in small community hospitals					Increased quality control Coordination of emergency protocols Retention of health care personnel	
Memorial Telemedicine Centre	Electrocardio-gram (ECG) patient wears an electrode-equipped cap that transmits signals to ECG center for interpretation					Electro-cardiogram, television, printer	Patient time Cost savings	

ELECTRONIC MALPRACTICE PREVENTION

Project Sponsor	Activity Scope	Users	Vendor	Costs	Savings	Technology	Benefits	Obstacles
Joint Underwriting Association of Massachusetts 17/3	Malpractice insurance: reduction in premium using enhanced clinical information support, audit physician files (80% complete)	Massachusetts hospitals			20% per year	Voice recognition	Decrease cost of malpractice insurance	
Colorado Physicians National Risk Retention Group Paradyne Insurance Company (Louisville, KY) 17/3	Standardizing order set				2% discounts		Lower cost, fees passed on to consumers	

TELE-HEALTH APPLICATIONS

DEFINITIONS

Electronic Administration: Consolidation and coordination of the vast activities that comprise the record-keeping activities of a particular institution in relationship to other relevant record-keeping systems (e.g., claims processing and medical records)

Electronic Claims Processing/Monitoring: System for health insurers and members of the medical industry - physicians, dentists, laboratories, pharmacies, hospitals, suppliers - to communicate electronically to provide more cross-referenced, cost-effective, less labor-intensive insurance claims processing

Electronic Materials Management: System for just-in-time materials management through accurate and timely reporting of current inventory

Electronic Medical Record: A computerized, consolidated patient medical history information base providing for improved and timely diagnosis, treatment, referral, and preventative care

On-Line Medical Literature: Medical literature accessible through on-line materials search and interconnected literature (e.g., Grateful Med, Medline, MESH, IAIMS, etc.)

Outcomes Research Database: The inclusion of indexed medical papers in a database for the discovery of new diseases and treatments

Patient Card: A wallet-sized patient medical record stored on smart card technology

Teleapplications: Electronic delivery of a variety of services and processes

Telecommunications: The transmission of a broad range of medical information using a variety of information technology

Telecommuting: Working at a remote location (home or specified site) and communicating with the workplace by telephone, personal computer, modem, and/or fax machine

Teleconferencing: A primary application for provider-oriented services such as access to medical education and professional development (includes videoconferencing, video education, and telesymposia)

Teleconsultation: The ability for two health care professionals (often a primary care practitioner in a rural location with a specialist at a major health center) in remote sites to confer on a situation, provide analysis, diagnosis, and

recommendations for treatment

Telediagnosis: Means of diagnosing medical problems through the use of remote diagnostic equipment, Teleradiology, Electronic Medical Records, and Telecommunications

Tele-Health: A vision of the electronic delivery and management of health care services and practices, including electronic support for proactive self-health practices. "Electronic" in "Tele-Health" is the use of voice, data information storage and communications, and computer technology

Telemedicine: Refers to patient-care-oriented clinical diagnostic and therapeutic activities

Telemonitoring: Means of monitoring patients at a remote site (e.g., home) using electronic sensing devices and other technology for observation

Teleprocess: IITA-enabled marketing, production, logistic, financing, administration, for designing new approaches to the various industry segments

Teleradiology: Transmission of images so that a physician in a remote site can "see" the patient or inspect related visual information from a distance

Teleservices: IITA-enabled rearrangements of where services are delivered to customers

Telespecialties: The electronic delivery of health care specialties, e.g., telepsychiatry, telesurgery, etc.

Telestructure: Enabling infrastructure for telework, teleservice, and teleprocess; telecommunications infrastructure and IITA-enabled infrastructure of all kinds

Telework: IITA-enabled rearangements of where workers are located.