

# Creating Telemedicine-Based Medical Networks for Rural and Frontier Areas



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## F O R E W O R D

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On behalf of the IBM Center for The Business of Government, we are pleased to present this report, “Creating Telemedicine-Based Medical Networks for Rural and Frontier Areas,” by Dr. Leonard P. Graziplene, president of the non-profit group, The Center for Rural Resurgence.

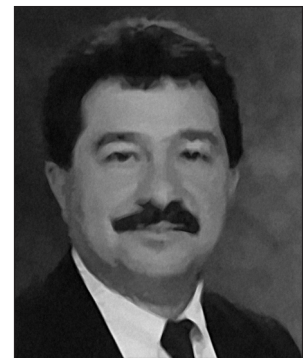
To date, telemedicine has largely been seen as futuristic. Well, the future is here. Advances in sensor technology, wireless networks, mobile monitoring devices, and telecommunications have all made it possible to address the increasingly dire shortage of health care professionals in rural areas. There are approximately 60 million Americans living in rural or frontier areas, and the average age of physicians practicing in these areas is over 55 years old. In fact, in over one-quarter of the counties in the United States, there are no practicing physicians.

The recently passed American Recovery and Reinvestment Act provides funding to support a telemedicine infrastructure for rural areas. It also provides funding to support wellness initiatives, which are important ways to reduce the demand for emergency medical treatment. In his report, Dr. Graziplene offers a three part approach that can leverage these Recovery Act initiatives to respond to the health care crisis in rural and frontier areas. This approach includes:

- Expanding the use of telemedicine
- Better managing care for chronic disease patients via the use of the medical home concept
- Investing in Ka band satellites to ensure affordable, pervasive, and dependable network connectivity for both telemedicine devices and a medical home network

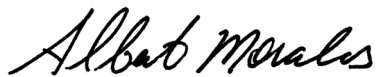


Albert Morales

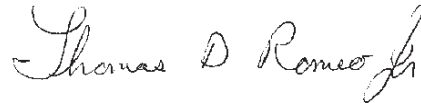


Tom Romeo

This report, notes Dr. Graziplene, “presents an action plan that describes the deployment of new technologies to address the needs of these medically underserved areas.” It, and a related IBM Center report, “The Role and Use of Wireless Technology in the Management and Monitoring of Chronic Diseases,” by Elie Geisler and Nilmini Wickramasinghe, should be useful guideposts for government leaders now engaged in improving health care in America.



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## EXECUTIVE SUMMARY

In spite of the United States spending more on health care than any other country in the world, the nation ranks poorly on many health indicators when compared to other advanced countries. There are actions that need to be taken to correct these problems. The areas facing the most growing disparities in the provision of health care are rural and frontier America. This report presents an action plan that describes the deployment of new technologies to address the needs of these medically underserved areas.

### The Use of Telemedicine Networks in Rural and Frontier Areas

The use of proprietary telemedicine networks operating over telecommunications links shows considerable promise for alleviating the poor state of health care in rural and frontier areas. Telemedicine has been in use for several decades, but it has been only recently that its functionality and use has begun to gain widespread support. Telemedicine monitoring equipment is becoming smaller and easier to use. At the same time there has been a growing body of evidence demonstrating that telemedicine reduces costs, saves time, is convenient, and contributes to a better quality of life for patients.

Our level of health care would be enhanced if we take telemedicine to a higher level and begin to realize its full potential. The following trends now make it more feasible to dramatically increase the use telemedicine in rural and frontier areas:

- Advances in sensor technology
- More efficient wireless networks
- Mobile monitoring

- Advanced telecommunications
- An increased commitment to bring about improvements in rural health care

### Focusing on the Areas of Greatest Need: Health Care in Rural and Frontier Areas

Health care is most deficient in rural and frontier areas where hospitals and primary care physicians are disappearing and not being replaced. This has left most of these areas without adequate medical care. If this condition is to be remedied, there must be more treatment centers connected to the broader medical community, and above all, a network that can efficiently tie them together.

One promising approach to responding to this need is the creation of a medical home network administered by primary care physicians and linked to specialists, hospitals, and information centers by a satellite based telemedicine network. The concept of a medical home has intensified in recent years. The medical home concept is a patient-centered approach to health care, which has recently received attention as a strategy to improve access to quality health care for more Americans at lower cost. It offers an excellent opportunity to improve health care delivery in rural and frontier areas.

Specific roles that a medical home can assume include prevention, self help, supervision, motivation, monitoring, early health literacy, personal health record keeping, more contact with centers of excellence, and advocacy interventions. This approach also promises to eliminate gaps in coverage, find



and treat problems more quickly, and bring about better outcomes. The technologies that can provide improved health care to the medical home are telemedicine and state-of-the-art satellite telecommunications, which can be woven together into networks.

## Selecting the Best Telecommunications Vehicle

Telemedicine operates over a wide range of telecommunications systems. Up until recently, most telemedicine interventions were enabled using telephone lines. Cable modem and DSL are widely used for telemedicine in densely populated areas and, where care is concentrated in very small areas, WiFi and WiMax have also been used for this purpose. Unfortunately, it is just too expensive and impractical for these technologies to be extended into sparsely populated areas. Consequently, none can be counted on to serve as a telecommunications carrier for telemedicine networks in rural areas.

Aside from the telephone, there is only one other telecommunications technology that is capable of reaching all corners of rural and frontier America. That technology is Ka band satellites, which possess such a long list of excellent features that there is little doubt that they should become the carrier of choice to extend the range and benefits of telemedicine. If it weren't for the fact that medical data and information should ideally be proprietary, the Internet could be counted upon to do more to expand the range of telemedicine.

## Recommendations

A plan of action based on the following recommendations will substantially improve health care in rural and frontier areas and bring about the elimination of those communities designated as medically underserved. The net result of these actions will be significant cost reductions, better management of chronic conditions, and a much higher level of care.

**Recommendation One: Create a separate stand-alone satellite network to provide telemedicine services to rural and frontier areas.** This represents the most efficient and cost effective way to ensure the provision of adequate health care in areas that are today medically underserved. It represents high bandwidth and the ability to link up effortlessly with medical centers throughout the world.

**Recommendation Two: Create a medical home network as part of the new system to provide telemedicine to rural and frontier communities.** The medical home network should have emergency treatment capabilities.

Health care must be properly managed, and the best way to do this in remote areas is by the establishment of strategically placed administrative and care centers run by primary care physicians. They will enable closer monitoring of patients, and when necessary, direct them to appropriate specialist care centers in a more timely manner.

**Recommendation Three: Provide additional training on the use of telemedicine networks to the medical profession.** Patient demands on physicians are so great that there is seldom time left to learn and become proficient in the use of the latest technologies that will substantially improve health care. The benefits of telemedicine will be more fully understood and then used to the fullest if physicians are trained in its value and use.

**Recommendation Four: Support telemedicine networks with funds from private and government sources.** The cost of health care is increasing annually at a rate that far exceeds inflation. Unless we come up with more funds, or else substantially change the way in which we financially support health care, we will not be able to adequately address all patient needs. More funding is required, and unless we are prepared to increase taxes to fund socialized medicine, more funding will have to come from the private sector.

**Recommendation Five: Add a retail consumer component to the proposed telemedicine network.** One way to relieve the growing cost of health care and many of its poor outcomes is to make it possible for individuals to afford and pay for some of their own care. Individuals should be able to purchase part of their medical products and services in the same way they go to a store and purchase consumer goods.

**Recommendation Six: Grant physicians throughout the United States licenses to practice in telemedicine networks.** There are currently many legal restrictions in place that make it difficult, if not impossible, for physicians from different states to practice electronically in other states. These barriers

are counterproductive and make it unnecessarily difficult to bring health care to medically underserved rural areas. Some physicians already have this right, so extending the privilege to all physicians shouldn't be that complicated.

**Recommendation Seven: Do not restrict insurance reimbursements for telemedicine services.** One thing that will substantially make health care more affordable is to find ways to reduce costs without negatively impacting the quality of service. Telemedicine has been shown to be a less expensive way to treat many patients. This means it is in the financial best interest of health care insurers to make reimbursements for services delivered in this manner rather than continuing to pay for traditionally provided, but more expensive, services.

# Introduction: The Importance of Focusing on Rural and Frontier Medically Underserved Areas

In recent years, there has been a series of developments which now make it crucial to pursue new approaches to delivering health care to rural and frontier underserved areas:

- There are now fewer rural hospitals and primary care physicians in those areas, and it is likely their numbers will shrink even more in the years ahead.
- The increasing availability of new telemedicine networks with equipment which is smaller, wireless, and more portable.
- Telecommunications technology now makes it possible for telemedicine to be extended into every geographic area, no matter how remote.
- The increased interest in international networks where the best of care and treatment may come from many different parts of the world.

## Factors Contributing to the Need for Better Health Care in Rural and Frontier Areas

Medically underserved areas of the United States are suffering from the absence of the latest and best care that our nation's health care system can provide. There are several factors which have contributed to the need to now better serve these areas.

### Factor One: Widespread Poverty and Ill Health

The rural population of the U.S. suffers from low per capita income, widespread poverty, and bad health practices. Almost one in three adults living in rural America is in poor to fair health, and the number of traumatic injuries that occur there are very high. Emergency medical service is particularly tenuous for residents of these areas. Unfortunately, because

this care may take a very long time to be delivered, too many people die because of the delay. In some rural counties there are so few doctors that increasingly more care is now being provided by physician assistants, nurses, and paramedics.<sup>1</sup>

With medical care so inconvenient to receive, and distances to physicians and hospitals so great in many cases, it is not surprising that an abnormally large number of rural residents are afflicted with chronic illnesses. The situation is made worse where there are no public transportation services, since this can have a negative effect on poorer individuals being able to get to medical care facilities.

### Factor Two: Health Care Personnel Shortages

Geographically, rural and frontier America constitute the greatest portion of land mass in our country. There are approximately 60 million people who reside in these sparsely populated areas; 9 million of whom live in frontier areas. This is a significant number of people when one realizes that it is higher than the total populations of some of the largest European countries—namely, the United Kingdom, France, and Italy.

There is a shortage of health care professionals in rural areas. Several years ago it was pointed out that the average age of physicians practicing in these areas was over 55, and that most would soon be retiring. This would not be alarming if young doctors were there to replace them. However, this is not the case. Recent medical school graduates, especially women, prefer to practice in suburban or urban areas. Those who do move to rural areas often suffer from professional isolation and a diminished quality of life.<sup>2</sup>

### Factor Three: Vast Areas with Low Populations

Rural areas where the population density is less than six persons per square mile have been designated as frontier areas. There are currently 3,141 counties in the U.S., and 940 of them are classified as frontier counties. About 9 million people live in these counties, which encompass more than half the land area of the U.S. There are very few health care services found there, and none in as many as 78 counties. Twenty years ago, there were only 123 doctors still practicing in rural frontier counties.<sup>3</sup> Today it is closer to zero, and this has compelled many of these counties to rely almost exclusively on physician assistants and advanced nurse practitioners for their health care. All attempts to entice physicians to practice in frontier counties usually fail because of a weak economic base to support suitable medical care.

Because there are often so few physicians in rural and frontier communities there is a huge burden on those who are there to provide 24 hour on-call coverage. It is difficult for primary care physicians to earn a decent income in these areas because so many of their patients have no health insurance or are on Medicare and Medicaid. It is understandable that most physicians don't want to spend their life underpaid and out of the mainstream of their profession. Consequently, rural areas are very likely to be served by foreign physicians who have come to this country under special J-1 visas. Even under this arrangement, almost 75 percent of rural counties have been designated as medically underserved areas. What is worse is the fact that some 166 rural counties with 10,000 or more residents have no primary care physician.<sup>4</sup>

### Factor Four: Declining Number of Rural and Frontier Hospitals

Rural and frontier hospitals are disappearing, and those that remain usually are unable to afford up-to-date technologies.<sup>5</sup> To make matters worse, most rural hospitals suffer from insufficient funds and high numbers of patients without health insurance. These tend to be covered by low Medicaid payments. Consequently, it is becoming questionable whether most rural hospitals can survive in the future. Those remaining typically have fewer than 100 beds. This has resulted in a drastic change in the way in which rural hospitals operate, and their disappearance is troubling because, in spite of their deficiencies, they represent much-needed places for treatment.

## How to Respond to the Health Care Crisis in Rural and Frontier Areas

Since highly trained health care personnel prefer not to practice in rural and frontier areas and the hospitals found there are unable to afford all the necessary and latest state-of-the-art medical equipment, there is now only one way that most of the gaps and serious deficiencies can be addressed and overcome in an effective and efficient manner.

The strategy to be pursued represents a model consisting of three key components which, if put together, hold the promise to more effectively provide health care to rural and frontier areas. The three components are:

- **Telemedicine.** Expertise and care from distant locations are going to have to be exported to rural and frontier areas electronically. Shifting much of the health care in rural and frontier areas to telemedicine networks represents a realistic way to deal with this challenge. In the words of one expert, "Today, in the health care industry, communications is the business and patient care is the service."<sup>6</sup> If communications is the business, it must then be factored into all the strategies that are crafted to improve care in these medically underserved areas.
- **Medical home.** While it is possible to fill in the vast spaces of medical deficiencies in rural and frontier areas electronically, there still must be a certain level of physical presence of health care personnel and facilities to provide oversight and care. Before any suitable strategies can be crafted to address and alleviate the problems found in medically underserved areas, there has to be an adequate number of nodes, hubs, and gateways to integrate the entire rural and frontier population into well defined orbits of care. The missing link to provide improved health care in rural and frontier areas is a medical home network.
- **Satellite.** One of the major sources of aggravation for cell phone users when the service was first introduced was "dead cells" where transmission and reception were unavailable. As the technology matured, very few of these unserviceable areas exist any longer. This has contributed to the swift growth in the customer base now using cell phones. While the erection of

more towers helped alleviate this problem, it was the use of satellites that basically solved it. Today the entire telephone service of many countries operates exclusively on satellites. Because of the current availability of Ka band satellites, there no longer have to be any pockets of medically underserved areas. By incorporating these satellites into telemedicine networks we can now provide a level of health care that is omnipresent and consistent throughout the country.

The remainder of this report discusses each of the three components for improving health care to rural and frontier areas. The final section presents recommendations on implementation of the three components to address the current health crisis in rural and frontier areas.

# Improving Health Care in Rural and Frontier Areas: The Use of Telemedicine

## Increasing the Role of Telemedicine

A considerable amount of evidence is building that the increased use of the latest technologies and wireless communications has become the key to delivering health care effectively to patients in rural and frontier areas.<sup>7</sup> When you add to this the fact that so many people are surfing the web to search on a global basis for the latest medical information, it is only a matter of time before a critical mass of people are convinced of the value and importance of the role of telemedicine in monitoring, treating, and curing health problems.

Telemedicine is the application of clinical medicine where medical information is transferred by telecommunications networks for the purpose of consulting, examination and performing remote medical procedures. Twenty years ago, people were reluctant to entrust important activities in their lives to electronic technologies. However, as more people become familiar with and use the Internet, e-mail, and cellular telephones, there will likely be less hesitancy to rely upon telemedicine for fast reliable health care. Telemedicine based networks have been shown to greatly facilitate bringing patients under a doctor's care, help find problems faster, reduce response time, and cut down on the number of trips to specialists.<sup>8</sup>

In 1980, the average visit to a physician at their office lasted 20 minutes. Today, it averages only about seven minutes.<sup>9</sup> If this trend continues, one wonders whether anything less than seven minutes will be enough time for a thorough medical visit. From the patient's perspective, is it that much more important for them to disrupt their entire day and often travel great distances in inclement weather to

have such a short personal consult? Many of these visits could be handled through telemedicine just as effectively. Telemedicine allows physicians to take better care of patients, and at the same time, it enables patients to take a much more active and effective role in caring for themselves. Telemedicine networks are not only becoming more useful for routine medical purposes, but could also serve a dual purpose of becoming a critical link in bringing help to individuals devastated by a mass casualty event.<sup>10</sup>

## The Benefits of Telemedicine

In its brief history, telemedicine is responsible for significant improvements in health care. Examples include:

- **Specialist Care.** Telemedicine is being used to reduce waiting lists and speed up access to specialists. One of its most important benefits has been the improved linkage of the specialist to rural based general practitioners. Specialists have stated that if telemedicine was widely utilized, only a small percentage of patients would actually have to come to their office for an initial face-to-face consultation.
- **Mobility.** There are many conditions that make it difficult for both physicians and patients to be in the same place at the same time. Weather, transportation problems, and other pressing matters can all interfere with normally scheduled appointments. In these cases, telemedicine has proved to be an attractive option.
- **Remote Care.** As wireless access improves, telemedicine should become even more functional in the future. Right now, the main barrier to wider use of telemedicine is not in its features,

## The Capabilities of Telemedicine

More health care personnel are awakening to the fact that telemedicine represents an expanding and practical way for practitioners to deliver health care services. Even though a physician may not personally visit a patient in their home, they can easily monitor and assist many residing in remote sites simultaneously using telemedicine.<sup>11</sup> There is growing evidence to substantiate the fact that telemedicine applications and services do a good job of delivering diagnostic, consultative, and treatment services to patients. Most of this service is currently being used to monitor chronically ill patients. This is an excellent application because it is estimated that as much as 80 percent of all health care costs are attributable to this group of patients.<sup>12</sup>

The features associated with telemedicine are winning the support of the medical profession because they are able to target and reach populations that are not easy to serve. The technology allows physicians to take better care of patients, and at the same time it enables patients to take a much more active and effective role in caring for themselves.

Improvements in medical care have accelerated as a result of telemedicine's ability to treat many patients at a distance rather than in an expensive hospital setting. The following significant improvements are now being realized from the increased use of telemedicine:

- The availability of a highly reliable delivery system
- Improved access to specialty care
- Sharing of high cost technology
- Upgraded emergency medical services
- An improvement in administrative support systems
- A reduction in unnecessary duplication of services
- Easier diagnostic consultations
- More widespread medical data transmission
- Better management of chronic illness
- Expanded health professional education
- More extensive administrative coordination
- Greater number of health care demonstrations
- In-home and mobile monitoring of chronically ill patients
- Remote medical consultations
- More patient health inquiries
- Ease on making prescription drug renewals
- Swifter diagnostic test results by regional laboratories
- A reduction in health care costs
- An improvement in treatment regimens
- Facilitation of earlier interventions
- Creation of better communication links to the broader medical community
- More preventive medicine initiatives
- Achievement of more favorable medical outcomes
- Better oversight and stricter monitoring of targeted patient status
- Conversion of patient record keeping to digital formats
- Closer monitoring and encouragement of patients to engage in healthy practices<sup>13</sup>

but much rather lack of knowledge over how to utilize the technology.

- **Long-Term Care.** Many patients are being spared long-term care in medical facilities since more of their problems can now be addressed with telemedicine and they can remain at home.

Telemedicine will become an even more valuable tool in the future as wireless and mobile access improves. When it first gained prominence, telemedicine was limited by cumbersome equipment, a lack of reimbursement fees, and credentialing limitations imposed by the states. Some barriers to wider use of telemedicine are now being removed, and as the technology miniaturizes and becomes wireless, its appeal is growing.

## The Uses of Telemedicine

Telemedicine is now capable of providing superior services to traditional medical practices and has been shown to be an excellent time saver for:

- Initial evaluation of patients, triage decisions, and pre-transfer arrangements
- Medical and surgical follow-up and medication checks
- Supervision and consultation for primary care encounters in sites where a physician is not available
- Routine consultations and second opinions based on history, physical examination findings, and available test data
- Transmission and interpretation of diagnostic images

- Extended diagnostic workup or short term management of self-limited conditions
- Management of chronic diseases and conditions requiring a specialist who is not readily available locally
- Swift transmission of medical data
- Public health, preventive medicine and patient education applications<sup>14</sup>

Telemedicine is not limited in scope to only a few medical disciplines. Its range of applications includes many different medical specialties. It has already been used extensively in the areas of emergency medicine, primary care, cardiology, orthopedics, general surgery, general medicine, pulmonary care, psychiatry, pediatrics, oncology, dermatology, and radiology.<sup>15</sup>

### Growth in the Use of Telemedicine

Telemedicine has quickly become an important tool in enabling state-of-the-art medical methods and techniques to be communicated and utilized worldwide. The ability to provide medical service at a distance with telemedicine networks will assuredly help more people to live a longer and more productive life.

There are now over 200 telemedicine networks involving more than 2,000 medical institutions across the United States. Recently the Federal Communications Commission awarded grants to substantially increase this number. Sixty-nine new

networks will soon be constructed in 42 states and three U.S. territories under the Rural Health Care Pilot Program.<sup>16</sup>

The application of this technology in Georgia and California is typical of the remarkable advances that have been realized. For example, patients in 39 rural Georgia counties can now visit local health presentation centers to remotely consult with 75 specialists in fields such as dermatology, cardiology, and pediatric medicine. The program plans to provide access to a presentation center within 30 miles of every rural patient that lacks specialty care. Additional payments are made to physicians who use the remote centers.<sup>17</sup> In yet another example, the California Telehealth Network is connecting 319 health care sites across the state as part of a three year pilot program to help patients in rural areas access health care providers.<sup>18</sup>

In the federal government, the Department of Veterans Affairs (VA) has made significant progress in the use of telemedicine for veterans' care. VA has found that by caring for patients at home, mortality rates are reduced and fewer patients have to go to nursing homes.<sup>19</sup> VA started its national home telehealth program in 2003 with the intent of taking care of patients with chronic conditions. The program is growing rapidly, as evidenced by the fact that in 2003 it treated 2,000 patients, grew to 31,570 by 2007, and had reached 36,000 patients by December 2008.<sup>20</sup>

### The International Growth of Telemedicine

The increased use of telemedicine is not something that is occurring only in the U.S. There has also been a rapid growth of medical networking in other parts of the world. For example, Malaysia now has a fully operational telemedicine network for remote areas. It was the first virtual private network of its kind in the world with nationwide coverage. The network enables patients to access care from 37 spokes (clinics, medical centers, and district hospitals) that are connected to four hub hospitals. In this way patients can confer with physicians using computers that transmit video, voice, and data for diagnosis and treatment. The network eliminates the inconvenience of forcing patients to spend great amounts of time traveling and waiting for second opinions and follow-ups. To ensure confidentiality all information is encrypted.<sup>21</sup>

During the planning stages of constructing new telemedicine networks it should be noted that all medical issues are now international rather than only domestic in scope. As a result it is becoming increasingly important to be able to network with the world health care community and share state-of-the-art information. One example of this initiative is the approach being taken by the Ohio Telehealth Video Resource Center to provide links between the state's higher education system and health care organizations. They plan to soon become a global hub for online medical education and videoconferencing and make clinical care available to interested parties around the world. The World Bank is helping with funding because they see this as a way to provide educational and clinical help to physicians in other countries.<sup>22</sup>



# Reimbursement Issues Impacting Telemedicine

By Aaron T. Steele

Reimbursement has consistently been cited as a significant barrier to the widespread adoption of telemedicine (Dixon et al., 2008; Hersh et al., 2006). Medicare and insurance companies have moved incrementally in changing reimbursement policies for telemedicine and remote monitoring services. Future expansion of electronic health records may provide higher quality data on telemedicine, which will assist in determining future telemedicine reimbursement policy.

A 2006 study for the Agency for Healthcare Research and Quality provided examples of the concerns surrounding telemedicine reimbursement. The study highlighted gaps in high quality evidence on telemedicine use, and concerns that fee-for-service could provide incentives for reimbursable types of care instead of the best quality of care (Hersh et al., 2006). The study noted the need for ongoing research on the efficacy of telemedicine in the health care setting (Hersh et al., 2006).

A 2008 study found that although patients and insurers pay few of the costs, they benefit from quality improvements and cost savings from telemedicine (Litan, 2008). This study recommended a “fee-for-health” approach in which insurance reimbursement policies recognized the value of services that technologies, such as remote monitoring, provide (Litan, 2008).

Federal reimbursement policy changes for telemedicine are proceeding incrementally. The American Telemedicine Association noted the following recent federal telemedicine reimbursement policy changes (ATA, 2009):

- New entities were added as originating sites for payment of telehealth services in H.R. 6331, the Medicare Improvements for Patients and Providers Act of 2008. These entities include hospital-based or critical access hospital-based renal dialysis centers (including satellites), skilled nursing facilities, and community mental health centers.
- U.S. Centers for Medicare & Medicaid Services approved telemedicine reimbursements for skilled nursing facilities.
- Draft Legislation in H.R. 2068, the Medicare Telehealth Enhancement Act, could possibly expand Medicare coverage, expand store-and-forward telemedicine, allow use of telemedicine for Medicare-covered providers, and supports certain grant programs.

The potential expansion of electronic health records may offer improved methods to evaluate the efficacy of telemedicine. A key factor will be having standardized, high quality data about telemedicine workload and clinical outcomes across health care settings. This information could then be used to assist policy makers to examine and decide appropriate telemedicine reimbursement policies.

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## The Cost of Telemedicine

One of the most pressing problems with the provision of health care is the high costs associated with its delivery. Today, health care is both labor intensive and expensive. Currently one out of every eight jobs in the U.S. is in the health care industry, making it the largest employer in the country.<sup>23</sup> Not only are these numbers staggering, but they also reflect how much money the industry has drawn to itself. For example, nine of the 10 highest paid professions in America are health care specialists.<sup>24</sup> By comparison, the average French doctor earns just \$55,000 per year, while in the U.S., primary care physicians earn an average of \$146,000 and specialists earn an average of \$271,000.<sup>25</sup> In Germany, the purchasing power of a physician's income is now about 20 percent that of a U.S. physician.<sup>26</sup>

The failure of the health care industry to control costs has put it on the brink of a financial meltdown. Since the 1980s, costs have been raising at annual rates that exceed the increase in wages by a factor of three or more to one in any given year. Telemedicine offers a real opportunity for cost savings in our national health care system.

As the volume of telemedicine equipment grows, its costs have come down. However, there is still some distance to go before we reach the threshold of saturation. Presently, for example, the cost for telemedicine software and equipment to monitor 1,000 patients for respiration rate, heart rhythm regularity, and body temperature, along with a distress alarm, is about \$250,000. From a business perspective, these costs represent a tax write-off over a five year period of time. So even though the initial costs may seem steep, during the same five year period the revenue stream generated from the use of the equipment should not only represent cost savings but also a profit.

As a result of telemedicine's ability to treat many patients at a distance rather than in an expensive hospital setting, the financial savings for medical care are likely to be substantial. Like all aspects of health care today, cost is a major limiting factor for greater use of telemedicine. However, if just 10 percent of traditional home care visits were substituted with telemedicine home care, a savings of \$1.5 billion would occur annually.<sup>27</sup> One recent study has projected that remote monitoring alone could

reduce health care expenditures by \$197 billion over the next 25 years as a result of using this method to track the vital signs of patients.<sup>28</sup> As far back as 1997, it was pointed out that the cost of a typical telemedicine visit was only \$30, as contrasted with a home health care visit cost of \$74, a nursing home cost per day of \$100, and hospital inpatient costs of \$820 per day.<sup>29</sup> The savings are likely even more pronounced today.

## Factors That Have Held Telemedicine Back

Telemedicine has been gaining support for the past 10 years, but has not yet had a huge impact on health care delivery. The reasons for the failure to realize its potential can be attributed to the following:

- The equipment has been too large and cumbersome to use.
- Insurers have been reluctant to make reimbursements for its use.
- Physicians often say that they are unable to identify their needs for telemedicine because they do not know what the technologies can do.
- Some physicians refrain from its use because it is seen as too time consuming and a threat to their business.
- The rate of diffusion. Every new technology takes a different amount of time before it gains widespread acceptance. For example, it took the telephone over 40 years from the time it was invented before it became a mass market technology. Until telemedicine is seen as a useful consumer product/service, its rate of acceptability remains unclear.

The costs and benefits that can be achieved through wider use of telemedicine are enough to make it the preferred tool for a medical home network to improve care in medically underserved rural and frontier areas.

# Improving Health Care in Rural and Frontier Areas: The Use of the Medical Home Concept

A second key component of improving health care in rural and frontier areas is better management of care. In order to provide a higher level of health care in rural and frontier areas, there has to be a focal point around which to build a network of medical services. This focal point can be a medical home. A medical home is a place where continual care that is managed and coordinated by a personal physician with the right tools takes place and leads to better health outcomes.

The need for a medical home network is related to the closure of rural hospitals. Rural hospitals are being shut down for economic reasons. As they disappear, an increasing number of rural and frontier residents and travelers are put at greater medical risk. Today, there are approximately 6,000 beds in the roughly four dozen rural hospitals in New York State (including VA hospitals).<sup>30</sup> Persons in need of attention can't always get to a distant urban medical center for treatment in a timely manner. Reasons for difficulty getting to hospitals include weather, transportation, the suddenness of injury, and the availability of first responders. As rural hospitals disappear, it should not mean that the availability of treatment also disappears. A medical home can fill much of the increasing gaps in service to rural and frontier areas.

## The Key Role of a Medical Home Network In Rural and Frontier Areas

### The Idea Behind a Medical Home

Health care dollars are going to have to be redistributed in such a way that they will reduce the need for costly procedures, services, and hospitalization. This can be done by creating monitoring groups or a

medical home that have as their mission the attainment and maintenance of the optimal health of their members. These show great promise and have recently gained favor among medical planners. Some people currently experience something like this concept if they are enrolled in an HMO. However, most people are only loosely tethered to the health care system: usually through their primary care physician, if they have one.

The control and management of a medical home will ideally be entrusted to a group of primary care physicians assisted by a wide range of other practitioners. Among these would be physician assistants, nurse practitioners, nurses, social workers, mentors, a logistics staff, technology experts, and network personnel. In order to assure close supervision of patients, a medical home would be the center for remote wireless monitoring, expanded networking, close ties to centers of information, and an expanded advocacy role. Under this arrangement every aspect of an individual's health and well-being would be dealt with promptly and efficiently.

According to the American Academy of Family Physicians and several other primary care medical organizations, the key characteristics of a patient-centered medical home include the following:

- A personal relationship with a physician
- A team approach
- Comprehensive care
- Coordination of care
- Quality and safety
- Expanded access to care
- Added value<sup>31</sup>

However, there is one barrier that stands in the way of this model being widely adopted in rural and frontier areas any time soon. It has to do with the availability and qualifications of medical personnel to administer a medical home.

## The Challenge of Staffing a Medical Home Network

### Responding to a Shortage of Primary Care Physicians

A medical home network will operate best in rural and frontier areas if they are under the jurisdiction of primary care physicians. Unfortunately, the trend in recent years has been for primary care physicians to abandon these regions. Consequently, before a strong case can be made for introducing this form of much needed relief, it must first be known if there will be enough qualified personnel to properly staff a medical home to adequately cover everyone living in designated underserved areas.

Primary care physicians (PCPs) are quickly losing their grasp on the core of health care, especially in rural and frontier areas. This is a very serious matter because they have always been the foundation of our health care system. Ideally, primary care should be available everywhere 24 hours a day, seven days a week, every day of the year. However, this is not happening because there are currently too many impediments to keep the number of PCPs at levels needed to provide a sufficient level of basic care in rural and frontier areas. Older PCPs are retiring in huge numbers and young doctors are not replacing them. Recent graduates prefer to specialize rather than become PCPs.

The number of medical students entering family practice training dropped by 50 percent between 1997 and 2005. One reason why this is happening is because young doctors do not want to live and work in areas far removed from colleagues and which are devoid of amenities that give them the quality of life they prefer. Another factor can be traced to income. The median income of specialists in the U.S. is now about twice that of PCPs, and rapidly increasing.<sup>32</sup> Since primary care and family medicine practitioners continue to decline in numbers in rural and frontier areas, this trend will either have to be reversed or else they will have to be replaced by technology, other health care workers,

disease specific clinics, direct access to specialists, and international care.<sup>33</sup>

### Finding Substitutes for Primary Care Physicians

Primary care has been shown to reduce health costs and to improve quality in almost every developed country in the world, and for that reason is worth retaining in some form—especially to service a medical home.<sup>34</sup> Even though the number of PCPs is declining there are trained personnel who are filling their role. These include foreign medical graduates and graduates of osteopathic medical schools. Another growing source of talent is the approximately 2,000 doctor of nursing students enrolled in programs nationwide, an increase of over 1,000 in just two years.<sup>35</sup>

Some might argue that these substitutes possess fewer qualifications than PCPs, but with the availability of medical technology to assist them, they should be able to function proficiently and professionally on their patient's behalf. If one accepts this premise, it should be possible to operate a medical home in rural areas under the administration of these alternate medical personnel when PCPs are not available.

The problem of not having enough qualified PCPs will most likely be resolved over the Internet and through medical networks. According to Kaiser Permanente Medical Group, they expect that by 2020, half of the medical care provided by their group will be over the Internet.<sup>36</sup> It would not be surprising if most of the other half, especially in rural areas, would be covered by other forms of technology which link a medical home to the broader medical community.

Bringing patients under the close supervision of a medical home will also improve the likelihood that much-needed prevention programs could be introduced. Success in this area would go a long way toward relieving many of the pressures now being felt in our health care system.

## The Role of a Medical Home

As discussed in this report, one way to improve conditions in rural and frontier areas is to introduce the medical home concept that functions as part of a network that connects these facilities and their patients to the broader medical community. The medical home model shifts the care delivery paradigm from today's traditional, episodic acute care approach to one that requires physicians to reach out and manage more directly their patient's health care.

A medical home can fulfill the following roles in the proposed telemedicine health care network for rural and frontier area.

### Providing Available Medical Information

In the medical home model, primary care physicians play an important role in directing their patients to health care information web sites where they can learn at their own pace, and instruct patients as to what they can do in cooperation with their doctors. Between 10,000 and 15,000 health care-related web sites currently exist. This information was once the exclusive domain of the physician, but now the same information is available to everyone. This has brought about a new relationship between physicians and patients. Years ago, the physician was the authority and the patient was passive in their treatment. Now, physicians and patients act as a team to treat medical problems. At times, however, when physicians talk to a patient about a serious health problem, it is likely that the patient will remember very little from the conversation. The ability to search medical databases now enables patients to ask questions and get information that was once hard to get without access to a medical library.

### Coordinating Personal Medical Information

In recent months, there has been increased attention to using information technology to make it easier to access and share health care records of patients. The idea is to increase the use of computer technology to improve patient safety and to facilitate quick, reliable and secure access to information about patients that promotes faster and more accurate treatments throughout the health care system. It should not be very long before a nationwide health information network is put into place which enables health care

personnel to access up-to-date Electronic Health Records (EHR) on patients. The advantage to patients is the fact that it would help eliminate medical errors and bring about improvements in such tasks as the tracking of chronic disease management.<sup>37</sup>

A medical home will help drive and coordinate the implementation of this record keeping service. However, a medical home could go one step further and issue smart cards to all of its members. This is something that has proved to be highly successful in Europe. Each patient would be given a smart card to assist in cutting through red tape, qualifications for treatment, inoculation records, basic personal characteristics such as blood types and allergies, and medical histories. With a smart card, information could be plugged into a system to facilitate accurate treatment of an individual, even if they were unconscious and unable to provide this vital information. To protect the identity of the individual, cards would be encrypted.<sup>38</sup> The use of smart cards is long overdue and should become part of all efforts to improve the flow and accuracy of patient information.

### Increasing Contact with Centers of Excellence

Physicians seldom have the time necessary to keep up with advances in their respective fields and would greatly benefit from being able to quickly access the latest and most pertinent information on a specific subject by directing inquiries to centers of excellence. As it is now, the most relied upon sources of information are often pharmaceutical and medical supplies salespersons who have a vested interest in promoting their own product lines.

In order to function at the highest levels of efficiency, a medical home should be linked to a wide range of centers of information excellence. This would enable them to log on to the latest state-of-the-art information on specific medical issues and problems. What they would receive from these centers is detailed information on innovative activities and technologies, opportunities to communicate with leading practitioners in learning networks, and directions on how to support and implement medical innovations in the medical home.<sup>39</sup> The

information obtained would greatly enhance the knowledge base of the medical home and improve referrals to specialists. A connection to centers of excellence, like the Agency for Healthcare Research & Quality's Health Care Innovations Exchange or the Centers for Disease Control and Prevention (CDC), for example, would shed immediate light on just about every medical issue with which the medical home might have to deal. There is no longer any reason for medical practitioners to be distanced from the most updated medical information from anywhere in the world that would result in better outcomes for their patients.

Certain neglected patients too would benefit from better ties with centers of excellence, especially those who are suffering from rare afflictions. For example, there are estimated to be only a few thousand individuals in the U.S. who are afflicted with the Ehlers-Danlos Syndrome, a rarely encountered breakdown of connective tissues. It is difficult for them to receive proper care, and information about their ailment is fragmented around the world.

The causes and treatment of diseases such as Ehlers-Danlos Syndrome might be better understood if physicians unfamiliar with this affliction could effortlessly access a network or converse with a center of excellence for information and treatment recommendations. However, it will require special features in order to have the greatest impact on the improvement of health care in these areas. It starts with how telemedicine resources are incorporated into networks. The key lies with selecting the best telecommunications system to bring all the component parts together, which is discussed in the next section.

# Improving Health Care in Rural and Frontier Areas: The Use of Satellite Technology

A third key component of improving health care in rural and frontier areas is the creation of satellite networks to provide telemedicine capabilities. Telemedicine can function with a wide range of delivery systems. However, some are unavailable, and still others are unsuitable for rural and frontier areas because of their limited range. A review of these network links will reveal their limitations and make clear why they are not the answer. (See “Other Options to Satellites” below.)

The use of state-of-the-art satellites has not been given the attention it deserves when considering the construction of medical networks. However, as the need for improving health care in rural and frontier areas intensifies and the importance of bringing the international medical community together in the years ahead grows, satellite networks are now the best option for facilitating the flow and sharing of medical expertise and information.

## Other Options to Satellites

There are many broadband technologies that can play a role in bringing about improvements in rural health care. These are typically integrated with local networks that primarily rely on the Internet, but in order to deliver better care to rural regions it will be necessary to create a network of networks to seek assistance and import care from even greater distances.<sup>40</sup> The options for doing so are limited:

- **DSL** is not a viable option because the achievable data rate weakens as the distance from the central office grows longer.
- **Cable Internet** coverage in the U.S. has largely reached its limit of economical coverage and will probably never be extended further into rural and frontier areas.
- **FiOS** would be an excellent option, but its availability in rural and frontier areas should not be expected for many years, if ever.
- **A WiMax network** is impractical because unless there is very flat terrain, it is unable to deliver its microwave signal the twenty-plus miles it is supposed to generate from its tower. This, coupled with the fact that the technology has run into very high implementation costs and standards impediments, makes it unlikely that it has an immediate future in rural areas.<sup>41</sup>
- **WiFi** is another wireless technology, but its effective range of only about 300 feet quickly eliminates it as an option for rural areas. The same holds true for a local multipoint distribution service (LMDS), which only has a three to five mile range of transmission.

Another future option is based on the eventual consolidation of G cellular telephony with the Internet, which will result in international mobility, or 4G.<sup>42</sup> When this happens, the technology may very well have a wide-scale presence in rural and frontier areas. The third generation of wireless technology is now in place and it was recently reported that the mobile operator Zain has started a service in Ghana with the launching of the first 3.5G wireless network in Africa outside South Africa.<sup>43</sup> It will be years before 4G becomes operational, so what we are faced with is the ambition to expand telemedicine services to remote regions with relatively few telecommunications options to do the job effectively and efficiently. What it comes down to is the realization that the best telecommunications technology for a rural telemedicine network is satellite.

The ability to effectively provide coverage and service at a wide range of subscriber density is one of the outstanding qualities of satellite. Satellite broadband removes much of the uptake distribution risk by economically covering large geographic areas. This enables operators and service providers to address a large market with relatively little upfront investment. We are now able to uplink signals from mobile terminals, and this has important implications for telemedicine, especially during times of disaster. It is not that difficult to perceive the benefit of enabling HDTV uplinks from mobile satellite terminals, especially where high quality video is required for proper medical treatment. High speed interactive satellite communications are capable of providing access to health care services for patients, irrespective of where they are located. Where many sites need to be connected simultaneously through a common network, satellite has proved to be an ideal solution.

Every corner of the world can now benefit from the melding of telemedicine technologies and satellite networking. As a current example, through a satellite connection to a 24 hour emergency medical center in the U.S., doctors in the middle of the South Atlantic are now able to send and receive encrypted images and confer with specialists at any time.<sup>44</sup> Based on this example, linkages anywhere in the U.S. should now be a simple matter to accomplish. There is little doubt that mobile wireless telemedicine networks would operate best if satellite technology was used as the transmission vehicle.

Some of the most appealing features of the use of satellites to serve sparsely populated rural and frontier areas include:

- Making possible instant access to broadband services, particularly in remote areas where telecommunications links are poor or non-existent
- Enabling swift response in disaster situations where speed is critical and providing a powerful and relatively inexpensive video link between multiple users
- Affordability
- Proven, reliable communication<sup>45</sup>

## Advantages of Ka Band Satellite

Over the last several years, the large satellite companies have put satellites into orbit with all of the features necessary to service a national telemedicine network. These satellites are operating in the Ka band, which offers the following advantages:

- **High bandwidth.** A Ka band satellite can deliver service at gigabits-per-second rates.
- **Cost.** A satellite network can be built to cover large geographic areas for much less than terrestrial options.
- **Untethered communications.** Users can enjoy untethered mobile communications anywhere within the footprints of the satellite.
- **Simple network topology.** Compared with mesh interconnection models of the terrestrial Internet, GEO satellite networks have much simpler delivery paths.
- **Broadcast/multicast.** Satellite networks are naturally attractive for broadcast/multicast applications. By contrast, multicast in a mesh interconnection network requires complicated multicast routing.
- **Direct link.** Ka band inter-satellite links will allow a user to connect with medical facilities and telemedicine providers throughout the world with a single direct satellite link.
- **Price structure.** Users will be offered bit rate on demand and they will only pay for the time that they use a link.
- **Connectivity.** Last mile connectivity can be filled in easily by satellites.<sup>46</sup>

Ka band satellites represent a technology that has built in safeguards to ensure continuous functionality. Its many spot beams can easily be redirected to areas of intensified need, or if one spot beam fails another can quickly be shifted to take its place. Only in the unlikely event that an entire satellite failed would there be the need for a back up system. In that case redundant alternatives would have to be readily available. These could take the form of ISDN, the Internet, or 3G telephony. Historically, satellites have proved to be equally, if not more, reliable than cable, DSL, or any other transmission vehicle.



## U.S. Military Experience with Satellite Technology to Provide Telemedicine Services

By Aaron T. Steele

The U.S. Military has extensive experience with the use of satellite communications to offer telemedicine services in remote areas during military deployments. During the 1990s, communications satellites were used by the U.S. Army in Bosnia to link field hospitals and clinics in remote areas to military hospitals in Germany and the United States. This project, referred to as Primetime III, enabled deployed military physicians to use the satellite link to transmit radiographs and diagnostic images, conduct video conferences, access a computerized medical record system, pharmacy services, lab results, medical logistics, online clinical information, and communicate via e-mail (Garshnek and Burkle, 1999).

Throughout this decade, the use of satellite communications has continued as a key enabler of telemedicine services for field hospitals and clinics deployed in remote areas of Afghanistan and Iraq. Teleradiology (the transmission of radiographs and digital images for remote interpretation) has been one of the largest applications, along with secure e-mail consults, teledermatology, ocular consults, and telepathology (Lilie, 2005).

Some of the key lessons learned with telemedicine during the Iraq and Afghanistan deployments have been the need for a telehealth consultation program and standardized multimedia medical records (Lilie, 2005). Recently, the Department of Defense (DoD) established Centers of Excellence, such as the National Center for Telehealth and Technology. The mission of the National Center focuses on developing, evaluating and deploying telehealth technologies and focusing resources on urgent clinical needs such as psychological health and traumatic brain injury. The DoD's Centers of Excellence partner other organizations within Department of Defense, the Department of Veterans Affairs and a national network of military and civilian agencies. The experience and lessons that the military has learned may offer insights to other health care systems now considering the use of satellite technology to offer telemedicine services in rural and frontier areas.

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The most useful feature of future telemedicine networks in rural areas is going to be mobile wireless technology. Toward this end, there is nothing now, or on the horizon, that promises to be able to compete with what Ka band satellite systems do to enable mobile wireless connectivity. It currently may be the best option for linking all of the health care components in rural and frontier America, as well as throughout the world, into one highly efficient international network for dealing with medical issues.

## Costs and Functionality of Satellite Networking

Satellite will be essential to configure broadband services with the performance required to support

the mission critical applications needed by the health care industry at a cost that is a fraction of currently available service. Telemedicine networks that run on a Ka band satellite system can benefit from the operational and logical simplicity of having voice transmission and numerous other data applications managed by a single service provider.

Satellite has already demonstrated a wide range of benefits even in regions where wired infrastructure is available and inexpensive to acquire. However, where wired broadband lacks service quality or is unavailable because of costs, Ka band satellite provides a solution that is less expensive and less risky to deploy than hard-wired options. Furthermore, it is highly efficient since all customers can commu-

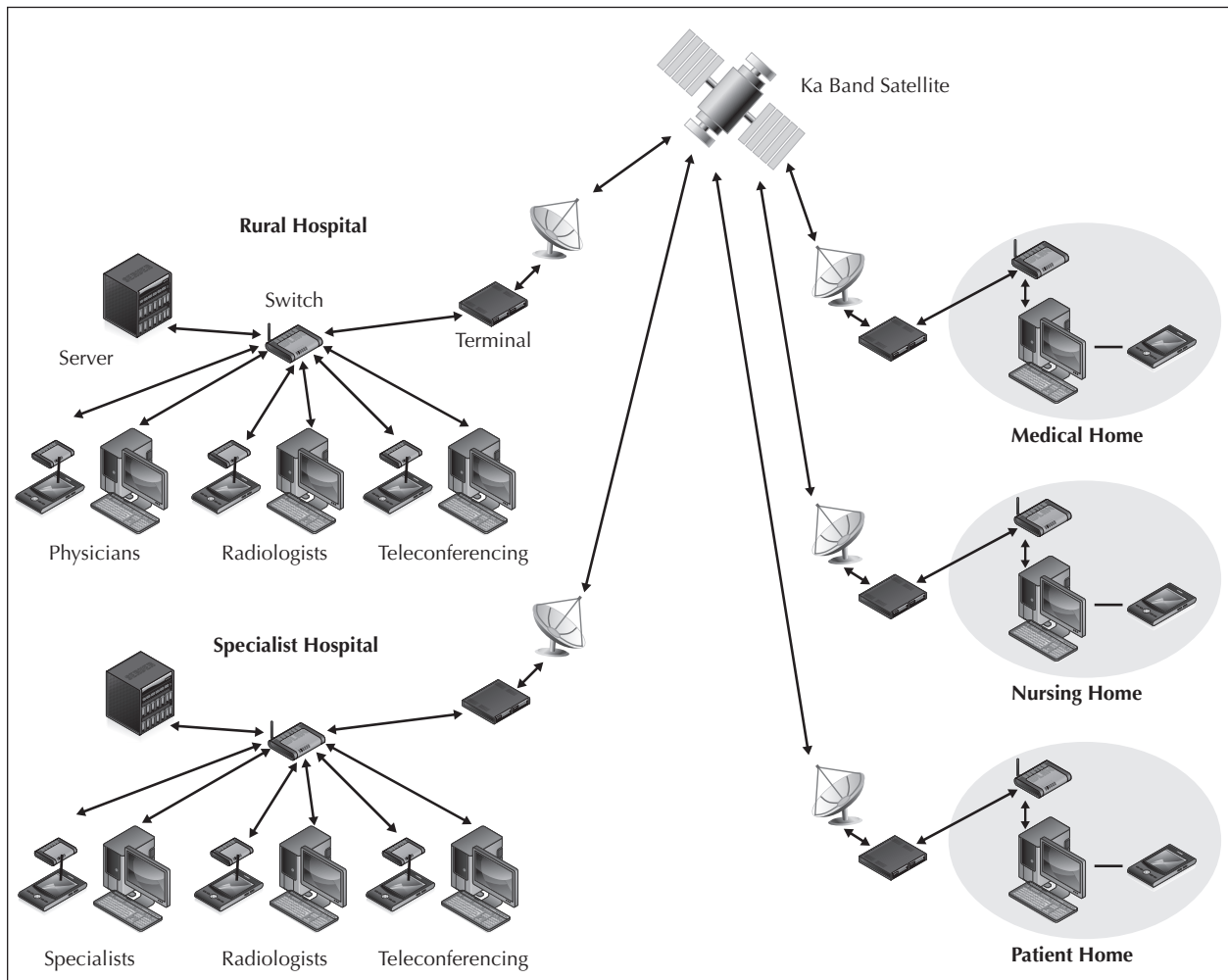
nicate and exchange information on an equal basis.

Not too many years ago, satellites would not have been a suitable option for telemedicine networking because of their relatively weak signal. The C band, which was prevalent until the mid 1980s, necessitated having at least a 10-foot dish to receive signals and the further away one was located from the center of the footprint of the signal the greater the size of the dish needed. To make matters worse, uplinking could only be accomplished using equipment that cost in the neighborhood of a half million dollars. The introduction of the Ku band opened the door to using satellites in telemedicine because their more powerful signal required much smaller receivers, which were given the name VSAT (Very Small Aperture Terminals), that averaged around 30 inches in diameter. However, each transponder on these satellites represented somewhat different strengths

and their signal was, for the most part, fixed on the more heavily populated areas of the country. Uplinking in this band was just about as expensive as it was with the C band, so two way communication was still largely missing.

With the introduction of the much more powerful Ka band satellites early in the 2000s, along with their spot beam capability, signal strength can be focused where it is needed most and the size of dishes to receive the signal have grown much smaller. More importantly, the Ka band can easily handle two way communications and it is this feature which makes it so adaptable to telemedicine networking. Furthermore, both fixed and portable Ka band VSATs can operate on either AC or DC current. This makes this technology particularly well suited for use in rural and frontier areas. For the sake of clarity, a typical Ka band configuration using spot beams and VSATs is outlined in Figure 1.

**Figure 1: Ka Band Telemedicine Configuration: Multipoint-to-Multipoint System**



A satellite based telemedicine network will result in low monthly service costs. Because of the high gain provided by the spot beams of the Ka band, greater volumes of data can be transmitted in a given amount of frequency allocation. At peak bandwidths the Ka band can service 200,000 users at the same rate. Cost for coverage is low due to satellite's ability to service a large area. This means satellite will always offer coverage at a lower cost than hard-wired systems. It becomes significantly competitive at five sites, and benefits increase in direct proportion to the number of sites that are added to a network.<sup>47</sup> Another option for lowering monthly costs of a satellite-based system may be to allow states, localities, and other users to share the cost of the system by allowing it to be used for other purposes. For example, it could be used for educational; or commercial TV coverage, or for the collection of population health data such as biosurveillance, disease registries, etc.

Even if satellites are not utilized in a primary network, they are an excellent choice for backup connection in the event primary earth links are disrupted. Even more importantly, satellite networks can be set up as dedicated networks and offer an alternative that is clear of the clutter and fragile nature of the Internet. The use of satellite enables connectivity for dispersed sites through a common carrier, thus eliminating the need for multiple, often disparate, service contracts and bills. Even more importantly, satellite supplies a common grade of service that is uniformly available to all sites so that applications run transparently and seamlessly.<sup>48</sup>

The connection at one location can also be shared with a wired-to-wireless router, which would make this service very cost effective in nursing homes. Downloads and uploads are very fast and will handle most applications.<sup>49</sup> Individuals who wish to secure service would pay roughly \$450-\$650 for equipment, and monthly service runs between \$49 and \$95, depending on upload speeds. The cost is higher than DSL and cable, but in areas where these are not available, the extra cost will be justified in many ways. For example, in telemedicine applications the costs of the satellite service will more than make up for the inconvenience and expected higher price of gasoline to regularly drive to health care facilities. Another benefit of the Ka band network is one that permits customers to take advantage of Voice over IP (VoIP) and use the Internet to make phone

calls inexpensively to anywhere in the world. This will be very important in the future as more medical treatments originate from other parts of the globe.<sup>50</sup>

The use of Ka band satellites in medicine is not something new. For example, the technology has been successfully used for robotic surgery both domestically and internationally for the past decade.<sup>51</sup> It is also being used in the business side of health care for many applications, such as inventory management by the pharmaceutical industry,<sup>52</sup> and for the past five years the health care industry throughout Europe has been using satellites regularly in conjunction with telemedicine to extend the range of medical services to even the most remote areas of the continent.<sup>53</sup> The delivery of improved health care using telemedicine and satellites has also been successfully utilized in India in recent years.<sup>54</sup>

# Making It Happen: Improving Health Care Services in Rural and Frontier Areas

## Recommendations on Creating a Telemedicine Network

### **Recommendation One: Create a separate stand-alone satellite network to provide telemedicine services to rural and frontier areas.**

There are now literally thousands of telemedicine networks already in place in the U.S. Their size and capabilities vary considerably. In a sense, what we have been doing with existing networks in rural areas is narrowly defining and building medical communications links from the bottom up by gradually linking rural hospitals together, and in turn, linking them to larger urban medical facilities. This process has been driven by federal grants that are competitive, but this initiative does not go far enough. It is possible that some of the poorest hospitals in greatest need of help have no grant-writing capabilities and consequently are not considered for an award.

All areas, no matter how remote or poor, must be reached. These gaps in service could be eliminated if all the telemedicine networks that have been built to date were consolidated or, better yet, a single stand-alone national telemedicine network was built. In addition to being able to cover all of rural and frontier America more efficiently, a network of this nature would assure greater confidentiality and operational capabilities. While some experts believe security on the open internet has evolved to the point where it is secure, public perceptions seem to be more in line with a stand-alone network approach.

Most telemedicine networks today usually commingle their services with many other services, usually over the Internet. The military does just the opposite. Because of the importance and confidential nature of their mission, they set up proprietary networks to

handle their communications needs. The networks they have constructed are highly efficient, reliable, confidential, global in nature, and seldom break down. The time has come to follow their lead and do the same with health care. Rather than continue with piecemeal efforts based on different technologies, it would be more fiscally prudent and efficient to put a large telemedicine network in place that can link every area and sector of our country under one system. Existing networks could remain functional and be made compatible with the larger system. The most important advantage of this arrangement rests with the fact that we would have a network that controls all nodes, hubs and gateways and bring them together under one system of operability. Whole pockets of medically underserved areas would quickly be upgraded to full service if a large proprietary telemedicine network operating over a Ka band satellite network was put into place.

There has been some concern expressed about satellite networking being able to ensure HIPAA privacy compliance and confidentiality. However, this should not be a major concern. Telemedicine was addressed in the original HIPAA bill which was passed in 2000, and as far as confidentiality is concerned, the transmission of health data over satellite is just as secure as electronic banking using similar telecommunication networks.

Another challenge is ensuring compatibility of any rural telemedicine network with the emerging Nationwide Health Information Network (NHIN). NHIN is patient-centric, not centered on geographic areas. According to the Department of Health and Human Services, NHIN is being developed to provide a secure, nationwide, interoperable health information infrastructure that will connect providers,

consumers, and others involved in supporting health and healthcare. This critical part of the national health IT agenda will enable health information to follow the consumer, be available for clinical decision making, and support appropriate use of healthcare information beyond direct patient care so as to improve health. Any rural or frontier network would need to be able to share standards and data with a broader national network in order to maximize the usefulness of networks, such as NIHN, to patients, since they could be referred for treatment in non-rural areas.

**Recommendation Two: Create a medical home network as part of the new system to provide telemedicine to rural and frontier communities. The medical home network should have emergency treatment capabilities.**

For a proprietary telemedicine network to work well, there must be more strategically located treatment centers in rural and frontier America. Health care problems can be divided into two onset categories:

- Gradual
- Immediate

Those that are gradual in nature can be diagnosed over a period of time, and arrangements made in an orderly fashion to have the problem treated at a hospital or intermittently through periodic planned interventions. In cases such as these, monitoring the condition of patients who are chronically ill, or following an operation through telemedicine hookups with a hospital and/or specialists works well, especially for those who reside in rural areas and may find it difficult to travel on a regular basis for check-ups. Gradual onset medical issues, therefore, may not require the presence of a hospital in a rural area.

Immediate problems, however, like accidents and heart attacks, require care quickly and the distance the patient is from a health care center equipped and staffed to provide emergency treatment can become a critical factor for survival. For this reason, it becomes necessary for a telemedicine network to be able to assure promptness of treatment as well as monitoring and continuous care.

Unless treatment centers can be reached in a reasonable amount of time and are strategically placed to deal with medical problems that are

unpredictable and occur at random locations, the network would not serve the full purpose for which it was intended. The most cost effective way to increase the number of treatment centers in rural and frontier America is to incorporate them into a medical home. This would mean expanding the role of the medical home and equipping them with the capability to stabilize patients until they could be transported to trauma centers. It would also mean that the medical home would have to be staffed 24 hours per day and have strong links to regional trauma centers and swift transport services. While a combination of rural hospitals and a medical home might lack the staff to provide optimum treatment for all problems, the immediate assistance that can be imported over a network would go far to supplement weak areas and bring about favorable outcomes.

**Recommendation Three: Provide additional training on the use of telemedicine networks to the medical profession.**

Most medical personnel are either unaware of what improvements can be achieved through telemedicine or else have a very limited understanding of telemedicine and telecommunications. This would all change for the better if initiatives were taken to educate physicians and health care administrators on the merits of utilizing telemedicine networks more fully. The federal government can play an important role in making this happen if it focused a small grants program to support conferences on this subject and made more funds available to bring the right parties together. If this was done, it is likely that resistance would be diminished and more physicians would get a better idea of how telemedicine could benefit their practice. By bringing hospitals administrators, physicians, telemedicine providers, and telecommunications companies together, a great deal of progress will be achieved.

## **Recommendations on Financing the Proposed Network**

**Recommendation Four: Support telemedicine networks with funds from private and government sources.**

In spite of the fact there have been countless cases of saving money and gaining efficiency through the use of telemedicine, it is uncertain where the money

to underwrite the more extensive use of this technology will come from. As it is now, health care costs are growing at twice the rate of inflation, and this would make it difficult to justify the building of more infrastructure.<sup>57</sup>

So far it has been the federal government that has underwritten the construction of most telemedicine networks through grants to not-for-profit organizations. We have grown accustomed to having government fund medical initiatives and make up for financial deficiencies. However, in the case of building a proprietary telemedicine network, it is unlikely that the government will assume most of the costs. They are already hard-pressed to commit money to assist a wide spectrum of failed and distressed sectors of our economy. The construction of the proposed telemedicine network is going to require engineering skills and huge sums of money. For this reason, it is reasonable and necessary for private sector involvement.

As the country struggles to get out of its current economic downturn, stimulus money is being made available to support critical industries. Almost \$8 billion is earmarked for the wider provision of broadband in rural areas. This in itself is a good initiative, but too much emphasis is being placed on wired technologies that can economically only reach small pockets of concentrated populations. It would be more advantageous to allocate some of these monies to satellite, which can reach even the remotest areas. More importantly, this would greatly assist the construction of the proposed satellite based telemedicine networks.

The way government and private sector companies might work together and complement each other is not that complicated. Under current economic conditions it should be entrepreneurs, much like the early railroad builders, who are given the task of raising the money to construct the large proprietary telemedicine network advocated in this report. Because of the importance and necessity of the project they could easily generate the required funds through an initial public offering (IPO). The federal and state governments, at the same time, could play an important role by granting tax credits to those who build and service the network and those who purchase the telemedicine monitoring equipment.

They could also help by selling bonds to underwrite certain features of the network. If this approach doesn't work, the backup plan would be to find ways for utility companies to fund construction of the network. Irrespective of who constructs the network, there will have to be a suitable revenue stream to amortize costs and pay for maintenance.

The revenues to support the ongoing operation of the network will come from a medical home network, patients, insurance companies, hospitals, and to a certain extent, governments. The network would not be owned by any of these customers, but much rather each would pay a service fee. This arrangement would be somewhat similar to paying DirecTV or a cable system \$55 or more a month for entertainment to be delivered to one's home TV.

The less expensive applications costs related to telemedicine for such things as satellite dishes, portable imaging equipment, or video monitors, will most likely be paid for by patients and insurance companies. Those without insurance would have their service paid for by Medicaid. Some relief of costs could be realized if, by being closely monitored through a network on a regular basis, some patients could become participants in unobtrusive medical trials, in which case some or all of the fees for participation could be shared by the insurer.

#### **Recommendation Five: Add a retail consumer component to the proposed telemedicine network.**

Much of the proposed service would be adequately supported through insurance reimbursement, but on the other hand in the beginning some of it might have to be paid for by patients. OnStar charges just a little over \$200 a year, including tax, to monitor the vital components of an automobile, and it is likely that a similar medical monitoring system could function by charging somewhere near this amount. This raises an important question. Would a sufficient number of patients be willing to pay this amount for personal health monitoring?

In a recent study conducted by The Center for Aging Services Technologies (CAST) to determine how baby boomers think about using technology to deliver health care, it was found that 90 percent of the participants were willing to pay \$50 or more per

month out of pocket for technology that would meet their needs to stay healthy and independent. Over 50 percent were willing to spend \$100 or more a month.<sup>58</sup>

Taking a cue from cellular telephones, once the value of telemedicine monitoring is understood, people will most likely be willing to purchase monitoring equipment and service much like they buy any other consumer item. Eventually, as this service is sought by a mass market of consumers, prices will come down and increasingly more people will be able to afford this protection.

## Recommendations to Change Laws and Regulations Governing Telemedicine

### **Recommendation Six: Grant physicians throughout the United States licenses to practice in telemedicine networks.**

One barrier to greater use of telemedicine has been the difficulty of getting physicians licensed across State lines. Most physicians today can only practice in one state. However, practicing across state lines is already permitted for many medical and health professionals employed by federal agencies, namely, the Department of Veterans Affairs, the Indian Health Service, and the military.

In order for a national telemedicine network to work at optimum efficiency in all areas of the U.S., these restrictive licensing rules must be relaxed or eliminated. It appears this matter is gaining attention because some states have recently introduced legislation that would permit physicians from throughout the U.S. to practice in their state over telemedicine networks.

### **Recommendation Seven: Do not restrict insurance reimbursements for telemedicine services.**

Since it has been proven that telemedicine is a cost saver, insurers should drop their reluctance to issue reimbursements for its use. The government too should be more supportive by clearing the way for telemedicine consults to be adequately covered for Medicare and Medicaid recipients. In the same way it was shown that teleconferencing using satellite technology was a significant cost saver when introduced during the 1980s, the evidence now supports the fact

that the widespread use of telemedicine-based satellite networks in rural and frontier areas will similarly bring about major reductions in health care expenses.

Sending health care personnel to a patient's residence to help manage a chronic condition as compared with doing the same over a telemedicine link has consistently revealed that the latter option results in significant cost savings. This fact alone should be a sufficient enough incentive to encourage insurance companies to drop their reluctance to make reimbursements for telemedicine services.

# Appendix I: Configuring the Network

## Building on Existing Models

In Europe, a great deal has already been done to create different types of proprietary telemedicine networks to service the medical needs of several countries. In brief, they include the GALENOS project, which was the first satellite based European network for telemedicine that connected over a dozen clinics in six countries; the DELTASS project, a satellite-based system for telemedical support during times of disaster emergency; and the EMISPHER ([www.emispher.org](http://www.emispher.org)) project, which provides equal access to quality medical care for most of the Mediterranean countries in Europe.<sup>59</sup>

Successful telemedicine initiatives have already been taken to address areas where special medical care is required. Building on what has already been learned from these three initiatives is a good starting point for constructing large scale telemedicine networks in the U.S. There will, however, be different challenges to reach this goal in the U.S. For one thing, the U.S. is a vast nation with huge sparsely populated areas; something you don't find in most parts of Europe. In addition, most of Europe has universal health care that is supported by the government and this means they provide the funding for telemedicine initiatives

## Network Topologies

Many rural hospitals are now linked to each other to form a network. These connections are forming what should turn out to be a much larger full scale telemedicine network. What is now required is the creation of a medical home network and their linkage to this larger network of hospitals. Following this, the next step is to link the rural hospital network to a national health care network. Once this has been

accomplished, the much needed national proprietary telemedicine network would become a reality. However, for this to operate efficiently the architecture of the network must be carefully worked out, and there must be compatibilities between and among all nodes, hubs, and gateways.

The topology of the proposed telemedicine network should be a combination of point-to-multipoint and multipoint-to-multipoint configurations. Tentatively, a medical home would require a mesh or multipoint-to-multipoint topology, but hospitals might be able to operate effectively using a star, or point-to-multipoint, topology. This, of course, is subject to change based on the capabilities and needs of the various nodes, hubs, and gateways. However, for the sake of functionality, a mesh topology is the better all-around choice because it would enable two way communications between and among patients, primary care physicians, specialists, hospitals, centers of excellence, and information centers.

Since cost considerations are so important, any opportunity to save money to construct a telemedicine network should be thoroughly considered. Fortunately, some are taking shape. There would be economies of scale realized, for example, if the type of network proposed in this report could be integrated with Hughes Network Systems' Inter-Governmental Crisis Network (IGCN). It is going to be used by government agencies during times of large scale crisis and is based on the same Ka band satellite systems being advocated for the telemedicine network in this report. It offers many advantages. Among these are the ability to mitigate rain fade, superior bandwidth capabilities (uplinks of up to 2 Mbps and downlinks of up to 8 Mbps), and security against a cyber attack. This last feature is



critical because a cyber attack is capable of bringing our entire health care system to a halt.

A detailed diagram of the topologies needed in the telemedicine and crisis networks is a complicated and extensive undertaking and will be determined by a great number of unique considerations pertinent to different applications and locations.

## Appendix II: Sensors—A Driving Force

During the past 10 years telemedicine equipment has become much smaller, more efficient, less expensive and perhaps most importantly, mobile and wireless. The proposed telemedicine network will become more highly useful to the extent patients who are connected to the system, and not bedridden, are able to be monitored remotely while they are engaged in normal daily activities.

As it is now, most telemedicine systems rely on wires to connect patients in their homes. This may be better than being wired in a hospital, but it still poses an inconvenience for the patient. The fixed or stationary nature of the equipment may be one reason why telemedicine has been so slow to gain widespread acceptance and use.

In the not too distant future, sensors will either be implanted within the body of patients or else be carried on one's person unobtrusively much like a cell phone. All sensors would have to be able to transmit and receive signals over the network and whenever medical attention was needed a person would quickly be connected to the healthcare infrastructure. These types of sensors will soon be available and when they are they will be the driving force to make the proposed telemedicine network a necessary and indispensable part of healthcare in rural and frontier areas.

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