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# MILITARY TELEMEDICINE: A STATUS REPORT

## Introduction

From the perspective of the Military Health Services Systems (MHSS), telemedicine — the integration of telecommunications, information management and advanced diagnostics — is the embodiment of both a great opportunity and an equally difficult challenge.

At first glance, it is clear that telemedicine is at least a partial solution to some of military medicine's most pressing problems. Many serious analysts believe that telemedicine will expand the geographical reach of medical consultations — that it will be an important tool in enhancing the quality of care and will decrease the resources needed to deliver both combat and peacetime health care. Very few technologies offer such a broad range of potentially powerful benefits.

On the other hand, it is also true that few real-world applications of telemedicine have delivered cost-effective care with better clinical outcomes that its proponents have forecast. Telemedicine is a technology that is in its early life cycle. Although technical standards have developed rapidly for teleradiology, the standards and operating procedures needed to effectively employ telemedicine over the broad range of other clinical applications are still immature. Consequently, investments in telemedicine are still risky.

Despite these risks, as the Information Age progresses toward the 21st century, telemedicine is likely to develop into an important clinical tool. As the Army Medical Department crafts strategic responses to the driving forces that are revolutionizing both combat and peacetime health care, it will be increasingly forced to fully understand how telecommunications, advanced diagnostics and information technologies can be used to enhance the execution of its varied missions.

The U.S. military has established an unchallenged position as a world-class leader in telemedicine research. As we move into the next century, the Army Medical Department must leverage this research advantage and develop streamlined, integrated processes that link well-conceived clinical requirements with advanced technology rapid prototyping, testing, acquisition and total-package fielding of telemedicine systems and reengineered medical practices.

## What is Telemedicine?

In the defining article on the subject, "Telemedicine Technology and Clinical Applications," two of the field's top practitioners and analysts, Dr. Douglas Perednia and Dr. Ace Allen, described telemedicine as "the use of electronic signals to transfer information from one site to another . . . to provide medical information and services."[1]

Telemedicine networks are characterized by a clinical application — what service or medical information is being provided — and the transmission modality — how the service or medical information is being provided. The number of clinical applications of telemedicine is expanding rapidly. Today they include teleradiology, telepathology, teledermatology, telecardiology, teleneurology, teledentistry, telepsychiatry, teleophthamology, teleoncology, telesurgical mentoring, telemedicine-supported renal dialysis, physician-based primary care support, remote home health monitoring, trauma support, and access to interactive medical knowledgebases, practice guidelines and continuing medical education.

Telemedicine programs use a wide variety of transmission, networking and telecommunications modalities. For example, contingency support military networks are robust, and have been designed to support forward-deployed troops in remote geographical areas with real-time, multipoint, two-way, collaborative multimedia medical information on a worldwide basis. These networks require high-bandwidth satellite and terrestrial land line support, interactive videoteleconferencing, Frame Relay Wide Area Networking (WAN), Ethernet Local Area Networking (LAN), Internet access and sophisticated medical informatics support. These military applications have been perhaps the most technologically complex telemedicine projects attempted to date.

Less robust and less expensive telemedicine solutions are suitable for most other clinical requirements. Typical systems use lower-bandwidth telecommunications and rely on store-and-forward (e-mail with attachments) rather than real-time, interactive videoteleconferencing to satisfy the clinical user requirement. In the final analysis, it all depends on matching the technology to the budget and to the clinical needs of particular users along the axis of cost, quality and access to care.

Accordingly, a broad definition of telemedicine is the use of clinically relevant procedural protocols and technology to transmit and use computerized patient record data, output from point-of-care diagnostic devices, store-and-forward still and/or interactive video images, continuing medical education knowledgebases, medical decision support guidelines and collaborative groupware applications over telecommunications internetworks to improve the access to care, decrease the cost of care and enhance the quality of care.

### History of Telemedicine

Though current digitally enhanced telemedicine technologies are early in their developmental life cycles, telemedicine techniques have been under development for more than 30 years. The first telemedicine project took place in 1959 when C. L. Wittson and his colleagues at the University of Nebraska College of Medicine used microwave to connect the Nebraska Psychiatry Institute to the state mental hospital 112 miles away.[2]

During the 1970s and into the 1980s, various aspects of telemedicine were tested in projects throughout the United States and Canada.[3] These early telemedicine programs were primarily demonstration projects funded by various government agencies. The objective of many of these programs was to establish the feasibility of telemedicine.

With the exception of one program in Canada, none of these projects have survived as self-supporting activities.[4] Although the equipment was reasonably effective at transmitting the information needed for most cases and users were generally satisfied, when external funding was withdrawn the programs were not economically viable and ceased operations. This recent history clearly illustrates the importance of justifying telemedicine programs from the perspective of linking investments to well-understood user requirements, and of conducting prospective cost-benefit analysis.

Since 1990, the cost/performance ratios of advanced medical diagnostics, information technology and telecommunications modalities have improved dramatically. This has changed the potential risk/reward equations for new telemedicine program starts and, along with emerging health care financial pressures, has sparked a renewed interest in initiating telemedicine projects.

For example, in fiscal year 1995 over $100 million was devoted to telemedicine research and development at state and federal government levels. More than a dozen federal agencies, ranging from the Department of Defense and NASA to the Departments of Commerce and Health and Human Services, are devoting significant resources to exploring the potential use of these technologies to improve access to care, to decrease the cost of delivering care and to improve the quality of medical decisionmaking.[5]

The states have been equally active. There are telemedicine programs in Alaska, California, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Massachusetts, Montana, Michigan, Minnesota, Montana, Nebraska, Nevada, New York, North Carolina, North Dakota, Oklahoma, Oregon, Pennsylvania, South Dakota, Virginia, Texas, Washington and West Virginia.[6]

The U.S. military is an aggressive developer of telemedicine applications. The services have pursued deployable telemedicine applications to support combat operations and are spearheading the development of filmless medical diagnostic and imaging systems (teleradiology) in military hospitals around the world. Additional initiatives are integrating telemedicine into oceangoing vessels and studying options for supporting strategic aeromedical evacuation with in-flight telemedicine linkages. The Department of Defense is also aggressively implementing automated patient information systems and is a leading proponent of research, through the Defense Advanced Research Projects Agency (DARPA), of medical applications of remote monitoring, 3D Visualization, Image Guided Medical Procedures, Telepresence and Virtual Reality.

This level of interest in the United States has also been paralleled by increased interest in telemedicine in Europe, Asia, Canada, Australia and Africa. As a result, telemedicine has become an international focus of intense clinical interest across the globe.

For the second time in as many decades, telemedicine development is at a significant, if not critical, juncture. Although it has achieved a limited momentum by virtue of widespread interest and support from both public and private sectors, it faces several formidable barriers to optimal implementation.[7]

These include regulatory barriers to interstate telemedicine in the civilian health care system, the lack of reimbursement for telemedicine services, liability concerns and lack of documented technical and clinical standards. Fortunately, military applications of telemedicine enjoy relative immunity from most of these obstacles, with the exception of lack of standards. As a result, the nation has looked to the military to be an important part of the effort to develop these technologies, not only to benefit those eligible for military health care, but more broadly as a test bed to explore and develop potential civilian applications.

### Telemedicine — A Revolution in Military Medical Affairs?

A careful analysis of history illustrates that new technologies can have a profound impact on military operations. Gunpowder, machine guns, tanks and precision-guided munitions redefined the art and science of war in their eras. Military scholars refer to these technology-driven turning points as revolutions in military affairs (RMAs). RMAs force military leaders to reexamine their strategic framework and challenge their long-accepted doctrine, training, organizational structure and tactics in light of new operational realities.

The surge of new information technologies into contemporary military organizations signals the advent of another historic RMA. The Army is being forced to commit increasing levels of managerial attention to how it will integrate computers, telecommunications and advanced "third wave" technologies into mission-critical work processes. These new technologies will provide the Army of the 21st century with the ability to coordinate very complex, time-sensitive, high-tempo operations across the spectrum of combat and peacetime operations.

While the military is in the midst of an information-driven RMA, the nation's health care delivery systems are simultaneously experiencing a historic revolution of another sort. In response to tighter restrictions on revenue growth, the decreasing ability of providers to raise prices and political pressure to find savings in federal health care accounts, health care providers are being forced to develop new strategic approaches for the future. In essence, health care is now faced with its own transition into the post-industrial Information Age.

As a result, both civilian and military medical organizations are rapidly evolving into vertically and horizontally integrated managed care systems. These managed care networks exhibit an unconcealed rush to cut costs, to deliver health care services in new, more efficient ways and to open new markets and geographical areas to high-quality health care.[8]

In the Military Health Services System these pressures have led to the three-year effort to configure peacetime health care into a military managed care system called TRICARE. In 1995, these changes in military strategy and health care delivery led Headquarters, Department of the Army to approve the Mission Needs Statement (MNS) for MC$^4$ (Medical Communications for Combat Casualty Care).

As recognized in U.S. Army Medical Command's Task Force Mercury report (the seminal 1996 Army study on this subject), both TRICARE and MC$^4$ exemplify what is at the heart of this revolution in military medical affairs — that is, that the lifeblood of these managed care systems is evolving clinical information systems that can perform multimedia data acquisition, information processing and distribution to enable better coordinated health care, in lower cost settings unconstrained by geographical restrictions.[9]

The technologies that enable coordinated care between separated sites are what we generally consider telemedicine. The strategic intent of military telemedicine is to ultimately integrate advanced diagnostics, therapeutic devices, computerized patient records, interactive medical knowledgebases and high-bandwidth telecommunications into unified, clinically powerful managed care systems that extend the continuum of care from the frontline medic to the continental United States-based regional medical center. Because of these simultaneous RMAs in military and medical strategy, it is clear why the development of telemedicine, and more broadly all forms of medical informatics, have emerged as top priorities of the Army Medical Department.

## Clinical Applications

The full spectrum of telemedicine technologies is wide-ranging. The technologies begin with sensing devices, including high-definition still and video cameras, electronic microscopes, stethoscopes, ophthalmoscopes, otoscopes, dermascopes and imaging devices that can capture and transmit text, visual and sound images.

An array of telecommunications technologies transmit information over low-bandwidth standard telephone lines, high-speed, wide-bandwidth dedicated telephone lines or satellites. Computers, sophisticated peripheral equipment and software are then used to manage and enhance the delivery of the patient information and images.[10]

Telemedicine, as an operating concept, integrates diagnostic technologies, medical information management resources and telecommunications into a unified, clinically useful system. For example, real-time patient vital signs, medical records, and automated treatment plan transmissions (low-bandwidth data) can be combined with interactive video (moderate-bandwidth data) and high-resolution radiological images (high-bandwidth data) to deliver to the desktop computer of a remotely located physician a fully integrated medical presence.

The intent of this technology integration is to provide the caregiver with access to the full universe of relevant patient and reference medical information, in real time or in delayed, store-and-forward mode. A well-conceived telemedicine system provides not only information pushed to the caregiver by standard clinical reports, records and interactive video, but also the ability to pull, on demand, additional information from the patient's past medical history or advisory information that resides in any medical decision support system.

The technologies known collectively as telemedicine vary widely in their levels of technical maturity, and consequently in the degree to which the technology precisely matches the clinical user's requirements. In many cases, because telemedicine applications are relatively new the clinical requirement and the technology needed to satisfy it are not yet well understood. This is an important focus of many of the current research projects.[11]

Today's telemedicine programs are just beginning to explore the full potential of integrated telemedicine applications. Most programs limit their focus to one or two of the potential applications that telemedicine can provide. Many programs focus only on video applications for remote consultation or on still-image transmission between sites. A few, though, are beginning to experiment with integrated systems that combine patient point-of-care data capture, automated medical records and expert medical decision support systems in addition to the remote video and still image capability.[12]

Among the medical specialties that are currently supported in telemedicine programs are emergency medical care, general internal medicine, cardiology, radiology, pathology, dermatology, oncology, neurology, obstetrics, orthopedics, pediatrics, otolaryngology, public health and psychiatry.[13]

As noted earlier, the component of the telemedicine industry which is most mature is teleradiology. Over the past decade, manufacturers of teleradiology devices, the American College of Radiologists and researchers have engaged in the sometimes difficult process of defining, documenting and monitoring compliance with clinical and technical standards.

As a result, teleradiology has begun to find widespread clinical and economic acceptance. By analyzing how the teleradiology community has managed to progress more rapidly than other telemedicine applications, astute observers may be able to project some of the cost and quality enhancements that will accrue to telemedicine more broadly in the future.[14]

For example, by 1995 more than 7,000 teleradiology systems had been sold. At the time there were 15 interfacility teleradiology programs servicing more than 90 remote sites in North America alone. These 15 programs interpreted over 20,000 radiology studies in 1994.[15]

Teleradiology is functioning in programs ranging from systems in large general hospitals[16] to systems linking teaching hospitals and family medicine centers,[17] and military applications that have involved field units in the Persian Gulf War,[18] Somalia, Haiti, Croatia[19] and Bosnia.[20] In 1996 the contingency Deployable Radiology developed to support troops in Bosnia transmitted over 6,000 radiological images for study and analysis by military radiologists located in Hungary and Germany.

Additional research must continue within the MHSS to develop the standards that are now commonplace in teleradiology to the same level in other clinical applications of telemedicine. Interactive video and high-resolution still image transmission technical requirements must be optimized to satisfy the clinical requirements of the physicians, nurses and medics that will use them.

Standards must also be developed for the medical informatics support required to utilize computerized patient records and remote physiological monitors as part of the integrated telepresence physicians need to fully participate in care at a distance. With well-understood standards based on quality research and development, it is more likely that the wide range of potential benefits that telemedicine has to offer will become available more rapidly.

Without a continued commitment of resources devoted to this important research and development effort, the danger still exists that the necessary seed funds for the development, deployment and testing of telemedicine may be reduced or withdrawn before its true merit has been fully demonstrated.

**Policy Developments in Telemedicine**

In the past year, a number of national and state organizations have sought to influence telemedicine development. They include the American Medical Association (AMA), the Food and Drug Administration (FDA), the Physician Insurers Association of America, the California legislature, the American Telemedicine Association, the Federation of State Medical Boards, the Federal Communications Commission (FCC), the American Medical Informatics Association, the National Institutes of Health, the Federal Joint Working Group on Telemedicine and various congressional committees and individual congressmen.

The AMA has articulated its position on the issue of interstate licensure of physicians providing telemedicine services. Simultaneously the Federation of State Medical Boards and the American Telemedicine Association have put forward their model for licensure legislation.

The Physicians Insurance Association of America recently published a white paper on telemedicine liability. The California legislature has issued a landmark telehealth bill that addresses both reimbursement policy and interstate licensing.

The National Institutes of Health has just awarded 18 contracts to leading research universities and commercial entities such as Science Applications International Corporation (SAIC) and BDM International. The purpose of the funding is to explore the cost effectiveness of telemedicine in multiple clinical applications and to determine future requirements to protect patient data security and confidentiality.

From the regulatory perspective both the FCC, in relation to the recently passed Telecommunications Act of 1996, and the FDA, in relation to medical decision support software, are both developing new regulatory guidance. The American Medical Informatics Association has also offered a model proposal to tailor the level of regulation of medical software based on the level of patient risk and physician involvement.

Finally, in early 1997, a new group has emerged — the Association of Telemedicine Service Providers. This group's mission is to provide advocacy and resources for the industry's advancement and policy development.[21]

The one conclusion that can be drawn from all this activity is clear: Telemedicine is an area of intense and dynamic interest to an increasingly diverse and powerful set of stakeholders.

## Conclusion

The Military Health Services System is responsible for the comprehensive care of the uniformed active duty military and their dependents, military retirees and their dependents, the survivors of retirees and other eligible government officials.[22] The MHSS is no longer a right-sized system. It is too small to directly provide care for all of its growing number of entitled beneficiaries.[23] Over the years, demographic changes have significantly increased the number and type of health care providers and facilities required.[24]

In response to these budgetary and demographic pressures, the Department of Defense recently adopted a new approach to peacetime health care delivery called TRICARE. TRICARE is a capitated-payment, managed care program designed to control costs, improve quality and ensure system access to all its beneficiaries. This is a dramatic shift from previous military financing and delivery models. It parallels the dramatic changes taking place in civilian health care and signals an openness by the Department of Defense to reexamine the core processes of its health care system.

As mentioned earlier in this paper, the military is also developing new processes to exploit telemedicine in support of combat and peacekeeping missions worldwide. With the combination of its peacetime and combat missions, the MHSS faces unique, complex and fundamental issues. The defining issues are driven by both the demographics of its peacetime beneficiary population and the changing nature of its national security mission.

TRICARE and recent combat health service support developments are fundamental changes in how health care is delivered. They are responses to major changes in the external environment that influence these systems. As such, they are good candidates for a reengineering approach to integrating telemedicine into existing health care delivery processes.

Over the last five years, data compression, fiber optics, advanced communication networks and communications satellites have developed sufficiently to provide the backbone for the accurate transmission of medical data. In concert with high-speed computing, software innovations and decreasing technology costs, the field of telemedicine is moving closer to becoming a technically feasible solution to many of the combat and peacetime challenges facing military health care delivery.[25]

However, shortcomings still exist in the development of technical standards to guide the applications of telemedicine in the broad range of clinical applications for which it will eventually be useful. Continued support of telemedicine research and development is important.

Approaches to telemedicine applications in support of the managed care requirements of TRICARE would benefit health care's migration to a patient-centered approach to medical care.

Developments in combat medical support would be important advances in the provision of trauma care not only for the military, but for the wider civilian health care delivery system.

The military, because of its relative immunity to the obstacles that hinder the widespread development of telemedicine in the civilian sector, has a unique, if not historic, responsibility to develop these technologies to the benefit of military health care beneficiaries and for the nation as a whole. The unique context of contemporary military medicine positions our armed forces to make a singular contribution to the development of the Information Age health care delivery infrastructure.

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## Endnotes


[1] Douglas Perednia, M.D., and Ace Allen, M.D., "Telemedicine Technology and Clinical Applications," *Journal of the American Medical Association*, vol. 273, no. 6, February 1995, p. 483.

[2] C. L. Wittson, D. C. Affleck and V. Johnson, "Two Television Group Therapy," *Mental Hospital*, vol. 12, November 1961.

[3] Rashid Bashshur, Ph.D., "A Proposed Model for Evaluating Telemedicine," in L. Parker and C. Olgren (eds.), *Teleconference and Interactive Medicine* (Madison, Wis.: University of Wisconsin, 1980), pp. 211-219; M. Karinch, *Telemedicine: What the Future Holds When You're Ill* (Far Hills, N.J.: New Horizon Press, 1994).

[4] Perednia and Allen, p. 483.

[5] *Ibid.*

[6] Telemedicine Information Exchange (TIE), Internet-accessible online research site *http://www.tie.telemed.org* (Telemedicine Research Center, Portland, Oreg.).

[7] Dena Puskin, Ph.D., and Jay Sanders, M.D., "Telemedicine Infrastructure Development," *Journal of Medical Systems*, vol. 19, no. 2, 1995, p. 125.

[8] S. Willliams and P. Torrens, *Introduction to Health Services* (Albany: Delmar, 1993).

[9] Task Force Mercury, *Recommendations for Reengineering Army Medical Department (AMEDD) Information Management for the 21st Century* (Fort Sam Houston, Tex.: U.S. Army Medical Command, July 1996).

[10] James Grigsby, Ph.D., et al., *Literature Review and Analytic Framework, Report 1: Analysis of Expansion of Access to Care Through Use of Telemedicine and Mobile Health Services* (Denver: Center for Health Policy Research, 1993).

[11] Seong Ki Mun,Ph.D., *Akamai Network for Diagnosis, Treatment and Management to Support Telepresence: Annual Report* (Washington, D.C.: Georgetown University, 1996).

[12] TIE, *http://www.tie.telemed.org.*

[13] *Ibid.*

[14] E. Ridley, "PACS Centers Achieve Widespread Acceptance," *Diagnostic Imaging*, September 1994.

[15] Perednia and Allen, p. 485.

[16] N. Hickey, J. Robertson and M. Coristine, "Integrated Radiologic Information System: Radiology Multimedia Communication System," *Thoracic Imaging*, vol. 5, 1990, pp. 77-84.

[17] Edmund Franken, Ph.D., et al., "Teleradiology for a Family Practice Center," *Journal of the American Medical Association*, vol. 261, 1989, pp. 3014-3015.

[18] Michael Cawthon, M.D., et al., "Preliminary Assessment of Computed Tomography and Satellite Teleradiology from Operation Desert Storm," *Investigative Radiology*, vol. 26, 1991, pp. 854-857; Lt. Col. (Dr.) Edward Gomez, USA, "Global Telemedicine," *Medical Electronics*, June 1994.

[19] Karinch, *Telemedicine: What the Future Holds When You're Ill.*

[20] Lt. Col. (Dr.) Dean Calcagni, USA, et al., "Operation Joint Endeavor in Bosnia: Telemedicine Systems and Case Reports," *Telemedicine Journal*, vol. 2, no. 3, 1996, pp. 211-224.

[21] Deborah Dakins, Editorial Comment, *Telemedicine Today*, March 1997.

[22] M. Potter, "Military dependent care during World War II," *Military Medicine*, vol. 155, no. 2, 1990, pp. 45-47.

[23] U.S. Department of Defense, Office of Program Analysis and Evaluation (OPAE), *The Economics of Sizing the Military Medical Establishment* (Washington, D.C.: DoD, 1994).

[24] Col. Douglas Braendel, USA Ret., "A Managed Care Model for the Military Departments" (senior service college fellowship project, Office of Prepaid Health Care, Health Care Financing and Human Services) (Washington, D.C.: Department of Health and Human Services, 1990).

[25] James Grigsby, Ph.D., et al., *Analysis of Expansion of Access to Care Through Use of Telemedicine and Mobile Health Services, Report 3: Telemedicine Policy: Quality Assurance, Utilization Review, and Coverage* (Denver: Center for Health Policy Research, 1994).

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