ANNUAL REPORT
(Sans Financials)

NASA COMMERCIAL SPACE CENTER
COOPERATIVE AGREEMENT
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VIRGINIA COMMONWEALTH UNIVERSITY
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EXECUTIVE SUMMARY

This report represents a compilation of the Medical Informatics and Technology Applications Consortium's (MITAC) accomplishments during the period, November 1, 1999 – October 31, 2000. The last 12 months have seen a tremendous amount of activity and scientific endeavor. Activities include investment in emerging technologies through collaborative partnerships, evaluation and validation of technology in environments such as Devon Island, Canada; Moscow, Russia; Dominican Republic; and Ecuador.

The MITAC is happy to report that it is robust and moving forward to fulfill its mission as directed by NASA. This mission of boldly exploring and expanding the concepts of telemedicine and telehealth are moving along splendidly.

MITAC accomplishments include, continued development and sustainment of international telemedicine activities with several countries, the evaluation of emerging technologies that show promise in enhancing the delivery of health care both in space and terrestrially, the creation and conduct of an international course on the applications of telecommunications and information systems to health care, and ongoing didactic interchange on multidisciplinary medical subject matter. The MITAC has worked closely with NASA to revise the Agency's strategic plan for telemedicine and telehealth. In addition, MITAC worked closely with NASA to develop telemedicine plans for Ukraine and Romania.

An integral part of the MITAC vision, as well as an important facet of NASA's interest, is the application of telemedicine technologies in the educational process. This process, characterized by an international focus, is applicable in K-12 as well as up through graduate school. Strengthening the knowledge and abilities of those less fortunate or without the resident expertise is a highly desirable trait for telemedicine.

The MITAC is happy to report that matching funds for the past 12 months are $2.6 M. This represents a leverage of 1.3:1. These commitments are both cash contribution and in-kind support from Virginia Commonwealth University (VCU), Yale University School of Medicine and industrial affiliates such as Tyco – US Surgical Corporation, and Compaq Computers. Interaction with industry continues as MITAC explores collaborative research with companies like Microsoft Corporation.

ACKNOWLEDGEMENTS

The work conducted during the 4th year of the MITAC's operation could not have been accomplished without the dedication and perseverance of faculty and staff in the Department of Surgery at VCU. This team of professionals is to be commended for their accomplishments and their efforts in making the MITAC a success.

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ANNUAL REPORT

INTRODUCTION

Since the MITAC relocated to VCU in July 1999, it has continued to fulfill the expectation set forth by NASA as stated in the cooperative agreement as well as assigned tasks and close interaction with NASA. The MITAC has had a tremendously successful year in supporting the evaluation and validation of telemedicine systems and technologies. Much of MITAC's work has been focused on implementing international test beds and supporting NASA's telemedicine needs.

MITAC works in a very collegial and interactive way with NASA Johnson Space Center (JSC) and NASA Headquarters (HQ) in meeting the agency's needs with respect to telemedicine activities, which are over and above those conducted in direct support of space flight.

The MITAC's vision is

"Explore new technologies in medical informatics and health care delivery systems that will revolutionize health care in space and on earth."

The MITAC's mission statement is to

Establish partnerships with academic, industrial, and governmental entities dedicated to:

- *The improvement of health care through the use of space science and technology;*
- *The maintenance of U.S. competitive lead in commercial applications of medical informatics and telemedicine;*
- *The development and application of innovative technologies that can be embraced by human space flight; and*
- *The integration of communications, information systems, and electromechanical interfaces between patient and health care team.*

The goals that will enable the vision and mission are

- *To establish partnerships with academia, industry and other government agencies to leverage technology and broaden the concepts of telemedicine and medical informatics as well as develop novel technologies in the sensors, transmitters, effectors, and process simulators;*
- *Evaluate technologies, process, algorithms, and protocols in international and domestic test-beds; and*
- *Shepherd these technologies into products, services, and processes in terrestrial and space medicine.*

STRATEGIC DIRECTION

In consideration of meeting the Agency's needs and implementing its strategies with regard to telemedicine and telehealth, the MITAC has focused its efforts on several activities, including international telemedicine test beds, process simulation for education and commercial development of MITAC-derived technologies.

MITAC works closely with HQ and JSC to review and implement appropriate processes for enhancing the delivery of health care for potential applications in space flight as well as to meet NASA's expectations. To effectively meet the Agency's needs, the MITAC has established and fostered a strong relationship with JSC.

Guidance provided by the board of directors, science advisors, and the Scientific Director, has provided strategic direction with a focus on medical informatics, telemedicine, and distance learning. A key strategy of the MITAC is to establish partnerships with industry. Industrial partners include emerging biotechnology investors and clinical research consolidators who are at the forefront of the disciplines of telemedicine, telehealth, and medical informatics. Several strategies have been developed, whereby the MITAC will utilize the Virginia Biotechnology Research Park as an incubator for transferring technologies into commercial products. These products will be of great value in applications of telemedicine and distance learning.

STRATEGIC ALLIANCES

MITAC has developed alliances with academia and industry to foster and promulgate knowledge and technological innovation for medical informatics, telemedicine, and telehealth. These alliances are strengthened by both cash contributions and donation of hardware. These financial and non-financial contributions are important to the success of any CSC. Our partners believe in the vision and mission of the MITAC and believe that its efforts are about the future of medicine.

The principle organizations that are affiliates with the MITAC include the following corporate entities: Tyco-U.S. Surgical; Compaq Computers; QRS, Inc.; Virginia Biotechnology Research Park; and Computer Motion. During the past 6 months, MITAC has been exploring a collaborative relationship with Microsoft Corporation. This is very promising.

Academic institutions with which MITAC has collaborated include: Yale University School of Medicine; the East-West Space Science Center (EWSSC) at the University of Maryland; the University of New Mexico, Florida Atlantic University; Massachusetts Institute of Technology; Moscow State University (Space Biomedical Center for Training and Research); and Moscow State University of Medicine and Dentistry.

In addition, the MITAC has interacted with the ministries of health of Ecuador, Jamaica, Dominican Republic, Kosova, Turkey, and Armenia. Collaborative activities are also ongoing with several national and international organizations. These include the Telemedicine and Advance Technology Research Center (TATRC) – the US Army's telemedicine effort; National Library of Medicine; Applied Physics Laboratory; National Science Foundation; Defense Advanced Research Projects Agency; Office of Telehealth, Department of Health and Human Services; Arctic Council, Department of State; the G-8, Subproject 4; Diagnostica Center in Yerevan, Armenia; National Space Agency of Ukraine; Centre National d'Etudes Spatiales (CNES); Institut de Médecine et de Physiologie Spatiales (MEDES); Zil Hospital in Moscow; Tana, Ltd. in Moscow; and the National Information Learning Center – Republic of Georgia.

ADMINISTRATION AND ORGANIZATION

Interaction with NASA

The MITAC interacts regularly with personnel from the NASA HQ Office of Life and Microgravity Sciences and Applications (OLMSA), the NASA HQ Office of the Chief Health and Medical Officer, JSC, and Marshall Space Flight Center (MSFC). This interaction is based on a

strong relationship and is further strengthened by a commitment from within the Agency and MITAC to work closely together to support mutually beneficial endeavors.

Throughout the year NASA has requested information from the MITAC. This information includes reports of performance metrics and input for the NASA Administrator's speeches and congressional testimony in support of the Space Product Development office at MSFC and the CSC Program. In addition, several tasks have been assigned to the MITAC by OLMSA and the Contracting Officers' Technical Representative (COTR) at JSC. Those task directed from OLMSA are coordinated with the COTR. These tasks included (1) preparation of a new version of NASA's Strategic Plan for Telemedicine; (2) a telemedicine support plan for Romania (NASA Administrators' request); (3) telemedicine support for Ukraine; (4) telemedicine as a tool for responding to humanitarian needs; (5) white papers on home health care and disaster response; and (6) a summary of telemedicine activities in Alaska. In all cases the MITAC has worked closely with NASA to respond in a timely fashion to these requests and actions.

MITAC initiated the development of an updated inventory of telemedicine activities across NASA field centers. It is hoped that this inventory will be completed in early 2001.

MITAC has worked closely with JSC to organize and sponsor two discipline specific symposia at JSC to support medical operations' needs. One was focused on Medical Informatics: Infrastructure for Space Medicine and the second was on Ultrasound: Applications and Implications in Human Space Flight. Both symposia were well attended by national experts in these disciplines as well as the customer base at JSC (key Medical Operations Personnel). Each of these symposia resulted in a report with recommendations and findings. These reports have been distributed to symposia participants and key NASA officials. The reports are also available at www.meditac.com/documents/.

MITAC is represented on the joint working group of NASA, MITAC, and TATRC. This group has met on several occasions during the year to explore commonality and potential collaboration. Mr. Doarn serves on this working group.

In November 1999, Dr. Merrell, Mr. Doarn, and Dr. Sanders participated in the JSC-lead "Strategic Planning Meeting for Telemedicine in Space Flight." This resulted in a formal report with recommendations and a manuscript. This manuscript is being published in an upcoming issue of the Telemedicine Journal *(see Publications section of this report).*

MITAC coordinates all of its activities and responses with the COTR at JSC. The COTR throughout most of the year has been Dr. Samuel L. Pool. JSC recently notified the MITAC that Dr. James Logan will serves at the COTR for MITAC beginning mid October 2000.

NASA has been well represented at the MITAC board meetings.

Management Approach

The MITAC is under the direction of Dr. Ronald C. Merrell who serves as the Director and the Principal Investigator. The MITAC is located within the Department of Surgery of MCV campus of VCU. Mr. Charles R. Doarn performs day-to-day operations of the MITAC and interactions with NASA. Mr. Doarn serves as the Executive Director and Co-Principal Investigator of the MITAC. Figure 1 highlights the MITAC's organizational structure.

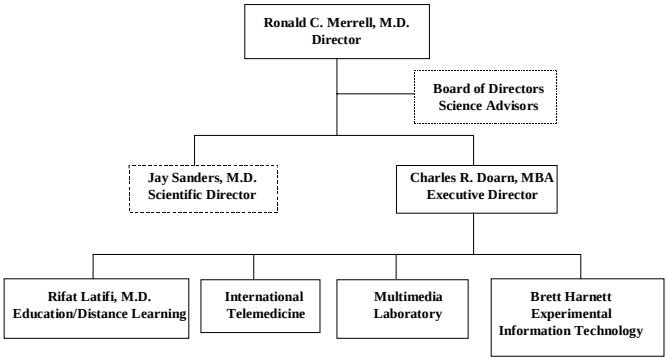


Figure 1. MITAC Organizational Chart

The appropriate offices and services of VCU provide the necessary support for financial and contractual support through ongoing interaction with MITAC management.

Scientific Direction

Since July 1, 1999, MITAC has maintained a contractual relationship with The Global Telemedicine Group (TGTG) on behalf of Dr. Jay Sanders to serve as Scientific Director. Dr. Sanders brings a breadth of knowledge and capability to the MITAC team. His role as Scientific Director is to provide guidance with respect to scientific direction and review of technology that should be pursued. In addition, Dr. Sanders evaluates those organizations – industry, academia, and government – that are involved in medical informatics and telemedicine and establish partnerships with them. A key responsibility in creating strategic alliances is to obtain funding to leverage MITAC resources.

Dr. Sanders has been involved in the following activities in support of the MITAC and its mission:

1) Organization and conduct of two symposia at JSC. One on medical informatics and one on ultrasound.

2) Interaction with the Department of Defense and TATRC to determine unique needs and potential collaborations in adapting technologies to meet these needs.

3) Participation in all MITAC board meetings and interaction with MITAC management in planning activities and developing strategies for success.

4) Attendance and participation in telemedicine conferences, domestically and internationally.

5) Initiation and development of a relationship with Dr. Howard Champion to develop new tools for training and teaching in trauma surgery that have potential applications in astronaut training.

6) Exploration of an opportunity to have Worldwide Healthcare Division of EDS collaborate as an affiliate with MITAC.

7) Establishment of a company, imMEDiate Care that is focused on developing and distributing telemedicine or health care kiosks. This company is one of the initial five that will come out of MITAC.

8) Worked closely with MITAC to further the commercial concepts of telemedicine and further promulgate the idea of a contract research organization with a specific focus on telemedicine technologies and tools.

Board of Directors

The MITAC established a board to provide advice and guidance to the MITAC on technological innovation and current philosophy in the disciplines, in which the MITAC is involved. The MITAC board of directors and science advisors, chaired by Dr. Ronald Merrell, represents academic, industrial and governmental organizations that share a common vision and ideas in medical informatics and telemedicine (see Table 1). Those members who serve as science advisors do so based on the circumstances of their employment.

During the past 12 months the board has met twice, once in January 2000 and once in August 2000. Summary reports of this meeting have been published and distributed. They are also available on the MITAC web site (www.meditac.com). These meetings provided an opportunity for MITAC management to present its accomplishments and its operating plans. Plans for November 1, 2000 to October 31, 2001 were presented to the board in August, where they were endorsed. The detailed plans for the operation of the MITAC for this period are highlighted in the November 1, 2000 to October 31, 2001 MITAC Business and Operating Plan. This document was baselined and distributed to NASA in early November 2000.

Name	Affiliation	Status
Carlos Babini	Infomedix	Board Member
Irwin Birnbaum	Yale University School of Medicine	Board Member
David Borer	MIT	Board Member
James Cimino, MD	Columbia Presbyterian	Board Member
Bernard Harris, MD	Spacehab	Board Member
TBD*	Tyco – USSC	Board Member
Donald Lindberg, Ph.D.	National Library of Medicine	Board Member
Robert Mattauch, Ph.D.	VCU Dept. of Engineering	Board Member
Maj. General John Parker	TATRC – Ft. Detrick	Science Advisor
Vincent Piscane, Ph.D.	Applied Physics Lab	Board Member
Dena Puskin, Ph.D.	Office of Telehealth, HHS	Board Member
Raold Sagdeev, Ph.D.	EWSSC – University of Maryland	Board Member
Brig. General Klause Schafer	US Air Force – Langley AFB	Science Advisor
Steve Schendel, MD	Stanford University	Board Member
Robert Skunda	Virginia Biotechnology Park	Board Member
Yulun Wang, Ph.D.	Computer Motion, Inc.	Board Member

Table 1. Board of Directors/Science Advisors

Note: *This has been the president of USSC. The incumbent recently changed. MITAC is awaiting confirmation.

FACILITIES

The MITAC facilities (office and laboratory space) remain in Sanger Hall on the MCV campus of VCU. The laboratory is equipped with state-of-the-art computer systems and telecommunication to support computer networks as well as video-teleconferencing using Internet Protocol (IP) and Integrated Services Digital Network (ISDN). These links provide a unique opportunity to interact and participate in a wide range of telemedicine and distance learning activities throughout the world. MITAC also has utilized other

resources on the campus of VCU as necessary. These include teaching facilities and other laboratories.

EDUCATION

Education has been an integral part of the MITAC's activity during the year. MITAC personnel have been involved in giving a number of lectures abroad, teaching an honors course at VCU, and conducting telemedicine training in the MITAC laboratories. A telemedicine course has been created and is being validated. A web-based Continuing Medical Education (CME) program has been developed and is being evaluated and validated. A series of educational exchanges have been made between the MITAC and sites in Armenia and Russia.

The Department of Surgery's grand rounds, held weekly, have been archived on the MITAC web site www.meditac.com/education. The archiving of these lectures utilizes video streaming with Real Player. This permits the viewer to go online and see the lecture in its entirety including synchronized graphics, anytime, anywhere in the world.

This same technology has been incorporated into the MITAC lecture series conducted with various medical institutions in Russia, Ukraine, and Armenia. This series is located at www.meditac.com/education. These lectures cover a wide spectrum of medical topics delivered to students and medical professionals around the globe. Discussions and question and answer sessions are held weekly on the MITAC multi-point H.323 videoconference server.

In addition, MITAC and VCU have been participants in the NASA HQ Occupational Health seminars, which are conducted across the NASA centers as well as sites in France and Russia.

MITAC, the VCU Department of Surgery and the School of Engineering conducted a seminar series entitled 'Engineering the Future of Medicine'. This symposium was captured on video and is available at www.meditac.com and on CD.

Currency of knowledge is vitally important to maintaining skills. The integration of communications into the education process provides unique opportunities for faculty and students from around the world to participate in educational courses in a variety of disciplines. Lectures and grand rounds are formatted using exciting new technologies on the Internet. These technologies include video streaming, Web-based training and CD ROMs. Educational material can be viewed throughout the world and enhances our ability to transition our knowledge to students of all ages. These same technologies can be easily adapted for enhancing training of astronauts during flight on long duration missions. These technologies have been evaluated and validated and will become the basis for a spin 'out' company from MITAC.

MITAC is involved in a number of educational endeavors. These include training students in telemedicine. Mr. Charles Doarn, MITAC Executive Director is teaching an honors course in telemedicine in the fall semester 2000 at VCU. Additional interaction includes medical students from Ecuador,

Armenia, the Republic of Georgia and physicians and computer specialists who are participating in the NASA-sponsored East-West Space Science Center (EWSSC) at the University of Maryland.

Telemedicine Course

The MITAC telemedicine course has been completed and is being evaluated and validated. The syllabus includes material on the concepts and principles of telemedicine, real-time and store-and-forward applications, as well as the principles of Internet and World Wide Web applications.

Student participation in this course has included physicians and computer specialists from the EWSSC, representing Russia, Armenia, Ukraine, Georgia, Uzbekistan, and Kyrgystan, and medical students from Ecuador. A total of 9 individuals have participated in the course.

The format of the course incorporates the use of the Web, didactic lectures, hands on laboratory work and independent study.

SUMMARY OF ACTIVITIES

MITAC staff has been involved in a number of activities as they have been broadly defined in the original scope of work. These activities range from developing and conducting educational materials both in a structured course and across the Internet to working with other organizations to further develop, evaluate, validate and promulgate technologies that can support telemedicine, distance learning, and health care. In addition, a number of MITAC's activities are international in nature. Many of these activities are being conducted internationally with countries such as Russia, Armenia, Dominican Republic, Canada and Ecuador. The activities of the past 12 months are highlighted below.

Telemedicine at VCU

VCU has a robust telemedicine program that supports clinical care and distance education to remote clinics in rural Virginia and to the Powhatan Correctional Facility. MITAC has interacted with this group to provide technical support and guidance.

Disaster Response

Although MITAC was not a major player in the Operation Strong Angel project in Hawaii in June of 2000, it provided guidance and input to NASA and other participants in the planning stages of this project. In addition, MITAC personnel have explored opportunities for integrating telemedicine technologies in disaster response. This includes landmine victims and refugees from disaster or war. These activities have been highlighted under the test bed section of this report by country. A white paper on the integration and application of telemedicine in disaster response was provided to NASA HQ Chief Medical Officer.

Conference Support

MITAC participated in and/or co-sponsored several scientific conferences during this reporting period. In several instances, MITAC gave presentations or participated as panel chairs (see Table 2).

Meeting	Location	Purpose	Date
Arctic Council – US State Department	Washington, DC	Exhibitor	Nov 99
G-8 Subproject 4	London, England	Participant	Nov 99
2nd Conference on the Development of Technology in Medicine – University of Virginia	Charlottesville, VA	Presenter	Nov 99
NASA Tech 2009	Miami Beach, FL	Presenter	Nov 99
NASA Strategic Planning Workshop	Houston, TX	Participants	Dec 99
Telecon West	Anahiem, CA	Attendees	Dec 99
Telemedicine Conference in Russia	Moscow, Russia	Presenter	Dec 99
ATA Industry Briefing	Washington, DC	Presenter	Dec 99
Medicine Meets Virtual Reality	Newport Beach, CA	Presenter	Jan 00
Distributed Medical Intelligence	Crested Butte, CO	Panel Chair, Presenters	Mar 00
Richmond Colloquium	Richmond, VA	Presenter	Mar 00
Symposia on Medical Informatics	Houston, TX	Organizer	Mar 00
World Congress on Telemedicine	Toulouse, France	Presenter	Mar 00
Telemedicine 2000	Houston, TX	Presenter, Moderator	Apr 00
G-8 Subproject 4 Summary Meeting	Berlin, Germany	Presenter	Apr 00
Virginia Congressional Delegation	Richmond, VA	Presenter	Apr 00
Telemedicine on the Threshold of the 21st Century: Rendering of Urgent Assistance Seminar	Moscow, Russia	Presenter	May 00
American Telemedicine Assocation	Phoenix, AZ	Panel, Presenter	May 00
Aerospace Medical Association	Houston, TX	Participant	May 00
Advanced Informatics in Medicine Initiative	Belfast, Ireland	Presenter	Jun 00
Cybermedicine: Virtual Collaborative Clinic	Alburquerque, NM	Presenter	Jun 00
SURA-Health Sciences Workshop	Atlanta, GA	Presenter	Jul 00
Symposia on Ultrasound	Houston, TX	Organizer	Jul 00
Surgical Conference in Kosova	Prishtina, Kosova	Presenter	Sep 00
Smart Systems 2000	Houston, TX	Presenter	Sep 00
International Society for Telemedicine	Montreal, Canada	Panel Chair, Presenters	Oct 00
Inspection Day 2000	Houston, TX	Exhibitor	Nov 00

Table 2. Conferences with MITAC participation

Interaction with Industry

MITAC interacts with a number of industrial affiliates. Some of these have donated money and some have purchased services or expertise. These interactions are covered through affiliation agreements.

MITAC's largest affiliate is *Tyco - US Surgical (USS)* provides funds to MITAC through contractual relationships with VCU. The primary focus of this activity is to support two Centers of Excellence. These centers are located at Yale University and VCU. The Endo-Laparoscopic Surgery Center at Yale is under the direction of Dr. James Rosser. This activity is focused on several areas (1) explore innovative ways of instruction utilizing state of the art technologies; (2) establish a model center; and (3) establish educational course work to enhance quality of service and evaluate distance learning technologies. Two additional activities involved Dr. Spyros Condos and Dr. Richard Satava. Their activities were focused on animate facilities for teaching advanced surgical techniques using the latest technologies in minimally invasive surgery and review and provide insight on advanced technologies.

The Minimally Invasive Surgery Center at VCU is under the direction of Dr. Eric DeMaria. The MIS Center promotes the advancement of patient care through research and development of

technology and procedures. The center enhances health care delivery, diagnosis and treatment through collaboration, integration and patient education. In addition, the MIS is integrating telemedicine into its activities using state-of-the-art video imaging and storage, computer, and telecommunications technology. Clinical practice guidelines and credentialing guidelines are two additional areas of focus.

Knowledge Systems International (KSI), Inc. is an organization that initially approached one of the NASA Technology Transfer centers to explore acquisition of telemedicine technology. KSI was directed towards the MITAC to continue this exploration. KSI, Inc. has since licensed the Telecollaboration on Line Database (TOLD) to support a telemedicine project in partnership with IBM and AT&T using multicasting. Although this activity has been slow in starting it has strong potential in that there is revenue stream back to the University for the licensing of the technology.

VCU has worked closely with an organization known as *QualKids, Inc.* to develop a Web-based medical content focused on pediatric medicine. MITAC was approached by QualKids, Inc. to develop surgery content to be hosted on their web site. MITAC worked with the Department of Surgery to provide this content and was paid a fee for doing so.

Early in 2000, MITAC personnel met with research personnel from *Microsoft Corporation* to explore collaborations. This interaction has been further promulgated through several visits to the Microsoft Research campus in Redmond, WA. Although the outcome has not been finalized, the MITAC will be working closely with Microsoft Research in the area of telemedicine in the coming year.

Interaction with Academia

MITAC has established relationships with several academic institutions to support its overall activities in telemedicine, medical informatics and distance learning. In some cases these relationships are contractual but they are all collegial as MITAC builds a community of scholars.

The *University of Maryland* hosts the NASA-sponsored East-West Space Science Center (EWSSC). EWSSC interacts with the MITAC through partnership on the MITAC board and through telemedicine training. EWSSC fellows visit the MITAC for 1-2 weeks of telemedicine training. In addition, MITAC has worked closely with EWSSC to provide the telemedicine component for the business plan development of the MedSat project.

As the original host university for the MITAC, *Yale University School of Medicine* continues to work with the MITAC to support telemedicine and distance learning as well as evaluation of telemedicine technologies, processes and procedures in places like Greece and the intensive care unit. Yale is also represented on the MITAC board.

During the past year, a relationship has been explored with Department of Preventive Medicine and Community Health at the *University of Texas Medical Branch* (UTMB) in Galveston. This relationship would involve the visit of medical residents to VCU and MITAC to receiving training in telemedicine. As of this report date the final agreements have not been completed.

The *Massachusetts Institute of Technology* (MIT) Media Laboratory works with the MITAC. A senior member of the Media Lab participates in the MITAC board. Although a formal arrangement does not exist, the MITAC interacts with the Media Lab through discussions and visits.

The *Johns Hopkins University* Applied Physics Lab works closely with the MITAC through membership in the MITAC board and participation in discipline specific seminars.

During the past year, a relationship has been explored with Department of Surgery at *Stanford University*. This relationship would involve the visit of medical residents to VCU and MITAC to receiving training in telemedicine. As of this report date the final agreements have not been completed. In addition, the Stanford Biocomputation Center interacts with the MITAC through board membership.

The MITAC interacts with two Russian Medical Schools. Lomonosov Moscow State University, which hosts the Space Biomedical Center for Training and Research and the Moscow State Medical & Dental University (MSMUD). The interaction is based on exploring distance learning, joint research, evaluation of telemedicine technologies and joint publications.

Test Beds

Telemedicine in Ecuador

During the past several years MITAC has worked closely with Ministry of Health in Ecuador and the Cinterandes Foundation to develop a telemedicine test bed in both mobile surgical services and in remote regions. In the past year, Dr. Ronald Merrell demonstrated laparoscopic techniques in gall bladder removal to surgeons at VCU via the Internet. Despite being a 10-hour drive from the nearest major city, a portable telemedicine system, existing phone lines and a local Internet connection provided access to physicians at VCU. In addition to this connection, a system has been installed to permit local surgeons to collaborate from Cuenca to the outlying areas within Ecuador. Physicians are now able to view patient records and talk directly to the patients from an ordinary desktop computer and explain symptoms or complications that may be encountered days prior to an actual operating procedure. A customized Spanish electronic medical record has been developed and is in place to collect validation data on these events. For most of the year a MITAC person was on site in Ecuador supporting the training of personnel and collection of data.

A clinical site in Taisha, located in the eastern part of Ecuador, was selected as a remote site to further evaluate the integration of telemedicine in the health care delivery system. The population of this remote village does not have access to the same quality of care as in larger areas. People living in outlying areas may have to walk nearly 12 hours to Taisha to obtain medical care. Integration of telemedicine would be an excellent adjunct to health care in this environment.

Telemedicine efforts in Ecuador continue. The goals of the current project are (1) continue using telemedicine as a preoperative and post-operative tool for assessing patients; (2) expand the use of telemedicine beyond surgery so the population in Taisha may receive enhanced medical advice without leaving their village; (3) develop a more efficient means of storing medical information – an electronic medical record-on a given patient so that transfer of information may be done more easily and reliably; (4) create an electronic means of expanding the knowledge of indigenous medicines and treatments, *i.e.* prepare an electronic medical record or database; and (5) continue to

train personnel at the Foundation and in Taisha so enough that they become self-sufficient with regard to teleconferencing and transferring data (images, medical records, etc) to and from remote areas in Ecuador.

Devon Island

MITAC worked closely with JSC and ARC to support the Mars Arctic Research Station (MARS) activity on Devon Island in July 2000. The goal was to transmit in (artificially-delayed) real time the vital signs from two 'terranauts' (individuals who acted as earthbound astronauts) and served as 'physiologic ciphers'. In 1998 and 1999, a more rudimentary system was demonstrated from Mt. Everest. Wireless telemedicine was conducted by porting vital signs of two individuals located near Haughton Crater (Devon Island) who served as terranauts to the Web and then to wireless, hand held device such as the Palm Pilot in Richmond. The project at Devon Island showed that current technologies could be used to affordably transmit and distribute a patient's vitals signs to a variety of platforms. This activity was conducted in nominal monitoring and simulated medical emergency using wireless technologies and the Internet. This has tremendous value to home health care. MITAC's activities in the coming year and its relationship with Microsoft will be based on the concepts evaluated in this test bed.

International Activities in Telemedicine

G-8 Subproject 4 Global Healthcare Applications

For the past 4 years, MITAC has served as the lead U.S. clinical site for telemedicine in support of the G-8, Subproject 4 (SP-4) initiative on the inoperability of telemedicine systems. G-8 is the seven democratic (G-7) nations plus Russia. The Scientific Director for MITAC, Dr. Jay Sanders, has served as the U.S. representative to this group. MITAC personnel have participated in several of the G-8, SP-4 meetings held in London, England; Toulouse, France; and Berlin, Germany. A final report was written and submitted to the Ministers of Health the G-8 countries. Mr. Doarn and Dr. Sanders are principle authors of this report. The final report was also presented to the G-8 Conference on Health Care in Berlin, Germany. It has also been submitted to the Telemedicine Journal for publications. In the U.S., the report was provided to the Secretary for Health and Human Services, Dr. Donna Shalala.

One of the follow activities of the G-8 has been the International Multipoint Project of Advanced Communication in Telemedicine (IMPACT). The main purpose of IMPACT is to have the G-8 member countries and others participate in telemedicine, telehealth, and distance learning activities. IMPACT lectures continue in breast cancer research and trauma through as series of a videoconference between the MITAC; Regensburg, Germany; and Montreal, Canada.

MITAC personnel are working closely with G-8 representatives in Regensburg, Germany to develop standards for supporting telemedicine. These standards are on the interoperatibility of telemedicine systems. These are currently being prepared for publication.

Armenia

Interaction between MITAC and the Diagnostica Center, located in Yerevan continues. These activities are principally regular communications that further develop and promulgate technologies in telemedicine, medical informatics and distance learning. Telemedicine experts from Armenia have visited the MITAC laboratories and educational content is exchanged through the established network.

Dominican Republic

VCU surgeons have established an organization called Operation Helping Hands (OHH). OHH supports surgery missions to various countries and have discussed with MITAC the opportunity of integrating telemedicine into its activities. In March 2000, a surgical team departed for a mission to provide surgery and medical care at the Hospital of Samana, Dominican Republic. Test beds such as this allow us to fully assess the feasibility of sending live images over low-bandwidth connections with today's H.323 video conferencing applications like CuSeeMe, NetMeeting, etc. using both local POTS and portable satellite communications. The team was connected by a point-to-point method and multipoint server via the Internet. This enabled patients to be monitored from a remote clinic, (in this case VCU) for diagnosis of the patient. Once the data was collected from the patient to populate a database, a collaborating surgeon shared database tools and whiteboards during a live videoconference.

During videoconferences, live images of surgical procedures such as a laparoscopic cholecystectomy were transmitted in real time so that physicians at VCU were able to view and identify structures within the abdomen as well as make recommendations on “where to cut” using the whiteboard feature. Because of the integration of standards-based protocols, a physician from anywhere in the world would have been able to participate in this scenario with as little as a dialup connection to the Internet.

France

Through direction from NASA HQ, MITAC has established a collaborative relationship with Institut de Médecine et de Physiologie Spatiales (MEDES). MEDES is affiliated with the French Space Agency, Centre National d’Etudes Spatiales (CNES). This relationship was solidified by a memorandum of understanding between MITAC and MEDES. In addition, MITAC interact with the Telemedicine Institute in Toulouse, France.

The collaboration between MITAC and MEDES has been tied to a performance target in the OLMSA FY00 Performance Plan. This target was to establish a telemedicine relationship between MEDES and NASA to explore collaborative research in telemedicine.

MITAC established a relationship with MEDES through a memorandum of understanding with a focus in the following areas:

1) Explore technologies that might be adapted and integrated into home health care. Candidate technologies include personal status monitoring for patients who have illness or injuries such as neurological disorders or cardiovascular disease. Global positioning system (GPS) also will be integrated into these candidate technologies. MITAC will develop a common protocol for gathering data. This standard protocol will be utilized to collect data from a variety of sources. Simple communication protocols will be the foundation of data exchange.

2) Foster an infrastructure for education exchange. Multimedia tools will be made available through the Web and as a stand-alone CD-Rom. Materials would be shared through licensing agreements and each organization will market their educational material as commercial products through the appropriate mechanisms.

3) Agree to explore the establishment of a Telemedicine Service Organization that would serve the medical needs of these travelers. This will be accomplished through a panel of consultants, located in each respective country, U.S. and France. A traveler would solicit guidance from a counselor in the country they are visiting. The counselor serves as a liaison who would connect the patient with their doctor in the their home country via some communications modality.

4) MEDES agreed to work with the MITAC in exploring collaborations with the organization, with Doctors Without Borders, to provide technical assistance in integrating medical informatics capabilities into their efforts.

Jamaica

As reported in the interim report to NASA in April 2000, MITAC has developed a potential collaboration in Jamaica for conducting telemedicine between VCU and clinical sites in Jamaica. There is tremendous interest in how telemedicine can be integrated into the health care system of Jamaica. Computer equipment was donated to this activity through an individual here in the Richmond area. These computers were outfitted with software and small cameras to support videoconferencing and installed in a hospital in Montego Bay, Jamaica. MITAC is ready to evaluate the potential of telemedicine and distance learning in Jamaica, however, the project has not moved forward.

Kosovo

In January 2000, the Dean of the School of Medicine, University of Prishtina, Prishtina, Kosova visited VCU and signed a memorandum of understanding with MITAC to explore collaborative activities in telemedicine and distance learning. In follow-up, MITAC representatives visited the Surgical Hospital at the University of Prishtina in February 2000. There are numerous issues in the war-torn region including lack of specialty talent, equipment, supplies and communications. MITAC personnel engaged in surgical procedures, education and technology assessment. Information gathering on the affects of landmine victims was also initiated.

Subsequently, a site visit to Kosova was conducted by MITAC personnel to perform a needs assessment. This involved the review of the communications infrastructure and to determine what knowledge of telemedicine existed and how it might be integrated into the health care delivery

system. The concepts discussed in Kosova and presentations by MITAC personnel at international meetings have resulted in the formation of the Kosova Telemedicine Association and full endorsement by the European Community about the further development of the concept 'Kosova Virtual e-Hosptial'.

Republic of Georgia

MITAC' relationship with the National Information Learning Center (NILC) in Tblisi, Georgia continues. Regular scheduled videoconferences are held between MITAC and NILC to discuss collaborations in telemedicine and distance learning.

Romania

MITAC was tasked with developing a telemedicine plan for supporting telemedicine for Romania. MITAC provided input to a NASA Headquarters response to a request from the Ambassador of Romania regarding an interest in developing and integrating telemedicine into health care in Romania. The principle interests were to assist in providing a basis for a mobile breast-imaging vehicle linked to a hub in Bucharest via the Internet and comprehensive training in telemedicine. The MITAC proposal was integrated into a memorandum of understanding between NASA and the Romanian Government.

Russia

The stature of telemedicine in Russia is robust and is a direct result of the space program. Many of the commercial activities that are now underway are based on the experiences from the NASA led 'spacebridge' projects. The MITAC continues to work closely with several organizations in Russia.

Space Biomedical Center

The Space Biomedical Center (SBC) for Training and Research, initiated by NASA in 1995, has become self-sufficient. MITAC personnel continue to work closely with the SBC to assist in developing commercialization plans to make the transition from funded activities to self-sustainment. MITAC has worked closely with the SBC to develop modifications to the Telecollaboration on Line Database (TOLD), a Web-based telemedicine tool.

In addition, Dr. Merrell and Mr. Doarn have worked closely with the SBC to prepare manuscripts for publications. Those that have been completed are highlighted in the Publication section of this report. The following are still under consideration: (1) Telemedicine as a Training Course; (2) Internet Applications for the Organization of Telemedicine Consultation Service; (3) Development of Telemedicine Service System in Russia; (4) Experience of the Telemedicine Development in Russian Regions; (5) Business Plan of the Establishment of Telemedicine in Russia; and (6) Concerning the Establishment of the Telemedicine System for the International Space Station.

TANA, Ltd.

TANA, Ltd. is a commercial telemedicine company in Moscow that has worked closely with the Russian medical community in the commercializing telemedicine in Russia. MITAC has developed a working relationship with them to explore potential collaborations in telemedicine services and technology.

ZIL Hospital

The ZIL Hospital has an interest in telemedicine and how it can be integrated into the delivery of health care, principally how clinical cases can be exchanged between Russian patients and U.S. clinical experts. Regular video-teleconferencing continues with ZIL Hospital. The focus of this relationship is commercial telemedicine activities and distance learning in Russia. The clinical cases incorporate Web-based tools like TOLD. Telemedicine practice guidelines and pricing policies have been made available to them.

Moscow State University of Medicine and Dentistry

Formerly known as the Moscow Medical Stomatological Institute, the MSUMD has developed a relationship between one of its affiliated teaching hospitals Railway Hospital #3 in Moscow and the MITAC to explore distance learning technologies and enhance the educational process. Medical students and residents at the Russian site interact with their peers at VCU. In addition, use of telemedicine consultations using store-and-forward via the TOLD as well as interactive consultations at lower bandwidth are being explored.

Turkey

The integration of telecommunications and information systems in disaster response and for rehabilitation for land mine victims has tremendous possibilities. To further develop this concept, MITAC sent a technical team to Turkey with the Physicians for Peace (Norfolk, VA), to assemble a multimedia course on land mine victim rehabilitation. Most of southeastern Turkey is heavily contaminated with land mines; and victims that survive often lose one or more limbs. The Physicians for Peace mission consisted of surgeons and prosthetists to fit victims with much needed prosthetic devices. MITAC efforts focused on developing an onsite multimedia curriculum that could be used to enhance land mine relief efforts anywhere in the world.

Ukraine

Through a task order from the NASA COTR, MITAC was asked to develop a plan, outlining how MITAC would work with NASA in developing a telemedicine capability within the Ukraine. This was in response to interaction between the U.S. Department of State, NASA, NSAU and the Science and Technology Council of Ukraine.

MITAC provided input into several documents 1) letter agreement between NASA and NSAU and 2) a complete rewrite of NSAU's proposal to NASA, and 3)a preliminary review of Ukrainian Telemedicine Proposals. It is MITAC's understanding that telemedicine was not one of the activities that received a high priority from the Ukrainian side. Therefore, MITAC will not be supporting telemedicine activities in Ukraine unless directed to by NASA.

Technology Development

Telecollaboration On Line Database

The Telecollaboration on Line Database (TOLD) is a Web-based telemedicine consultation service. It was originally developed as the Spacebridge to Russia Web interface.

TOLD has been transferred to VCU's Office of Intellectual Property Foundation (IPF) as an invention disclosure. It is currently being copyrighted by VCU. The authors are listed under the Inventions and Copyrights section of this report.

A contractual relationship has been established by Knowledge Systems International (KSI), Inc. to utilize the TOLD in a commercial telemedicine enterprise. KSI has acquired the rights to the TOLD through a licensing arrangement with VCU's IPF.

In the early part of the year, VCU contracted on behalf of MITAC with the Space Biomedical Center (SBC) for Training and Research at Moscow State University to make modifications to this Web-based consultation service. A second series of changes are underway through a contractual relationship between VCU and MITAC.

Home Health Care

As a result of our work at Devon Island, Mt. Everest and the growing opportunity of technology being integrated into the home, the MITAC began working with the VCU Department of Engineering to explore new technologies that could be integrated into a telemedicine schema for the home. Initial work has indicated that wireless physiological sensors, hand held computing devices – such as the PDA, and the Internet can be of tremendous benefit to home bound individuals. The commercial market potential is great.

INVENTIONS AND COPYRIGHTS

During the past twelve months, MITAC work has resulted in a number of works that are copyrightable and one piece of technology that has been submitted for patent application. In all cases, this work has been coordinated with the VCU IPF.

Invention Disclosure	Description	Status	Submission Date	Inventors/Authors
Inventions				
Rapidly Deployable Telemedicine Unit	Portable telemedicine device that can be used in remote environments for telecommunications and telemedicine.	Patent pending	Oct 2000	Doarn, Harnett, and Merrell
Copyrighted Material				
Telecollaboration On Line Database	Web-based teleconsultation tool for telemedicine and education	©	Feb 2000	Doarn, Harnett, Merrell, and Stewart

Computer-Based CME	Web-based continuing medical education tool using video streaming	©	Feb 2000	Doarn, Harnett, Merrell, and Russell
Composite Control Module	An interactive program that operates the RDTU	©	Feb 2000	Harnett and Russell
Engineering the Future of Medicine Symposia	CD and Web interactive tool that summarizes this symposia	©	Feb 2000	Merrell and Bowlin
Telemedicine Rehab of Land Mine Victims	Interactive CD on educational materials for land mine victims	©	Feb 2000	Merriam and Russell
Spanish Electronic Medical Record	Electronic medical record	©	Feb 2000	Merrell, Doarn, Harnett, Stewart, and Egge
Tissue Symposium	CD - interactive tool that summarizes this symposia	©	Feb 2000	Merrell and Cohen
Telemedicine Course	Extensive course work on telemedicine, including principles and technological approaches.	©	Feb 2000	Doarn, Harnett, Merriam, and Stewart
Symposia in Medical Informatics: Infrastructure for Space Medicine	Proceedings	©	Feb 2000	Doarn
Symposia in Ultrasound Applications and Implications in Space Flight	Proceedings	©	Feb 2000	Doarn

Table 4. Current patents and copyrights pending.
Note: © - Copyrighted Material

COMMERCIAL DEVELOPMENT

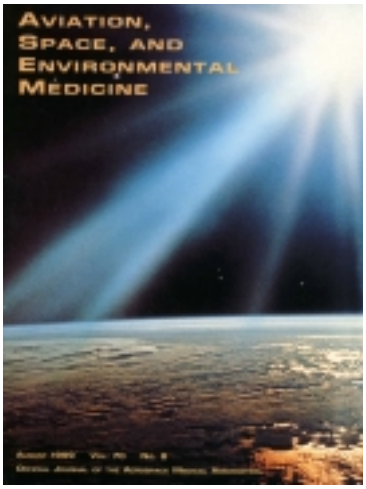
During the past 12 months MITAC has explored, evaluated and validated a number of new technologies. Through its partnership with its affiliates and the telemedicine test beds it has conducted, these technologies have shown commercial value in meeting needs in the telemedicine community.

Mature technologies have been submitted to the VCU IPF for patent or copyright application (See Section on Inventions and Copyrights). In addition, MITAC has explored several options for commercializing this technology. This includes the formation of a number of individual companies, which will spin out this technological innovation. Presented at the two MITAC Board meetings and discussed with NASA during the past10 months, the concept has received good reviews. MITAC continues to work with VCU, VCU IPF and the Virginia Biotechnology Research Park (VBRP) to establish the best approach for making this objective of commercial development a reality.

During the past 12 months, one company associated with MITAC has been formed and is doing business in the VBRP. This company, Immediate Care, LLC, is focused on telemedicine kiosks.

PUBLICATIONS

The MITAC has published its work in a number of peer-reviewed journals. These include:



The following is a complete list of publications of MITAC personnel or consortium members:

Manuscripts

1. Satava R, Angood PB, Harnett B, Merriam N, and Merrell RC. Ambulant Physiological Cipher: Real-time Monitoring of Status and Position on Everest. *Telemed J*, 6(3):303-313. 2000.

2. Angood P, Satava R, Doarn CR, Merrell R, and E^3 Group. Telemedicine at the Top of the World:The 1998-1999 Everest Extreme Expeditions. *Telemed J*, 6(3):315-325. 2000.

3. Williams D, Bashshur R, Pool SL, Doarn CR, Merrell RC, and Logan JS. A Strategic Vision for Telemedicine and Medical Informatics in Space Flight. ACCEPTED TO BE PUBLISHED IN *Telemed J*, 6(4): 2000 – At press.

4. Satava RM. New Imaging Strategies for Laparoscopic Management of Cancer. *Seminars in Laparoscopic Surgery*, 7(7):87-92. June 2000.

5. Satava RM. Virtual Reality for Medical Applications. *Am Journal of Anesthesiology*, 27(4):197-198. May 2000.

6. Orlov OI, Drozdov DV, Doarn CR, and Merrell RC. Wireless ECG Monitoring by Telephone. ACCEPTED TO BE PUBLISHED IN, *Telemed J*, 7(1): 2000 – At press.

7. Broderick TJ, Harnett BH, Merriam NR, Kapoor V, Doarn CR, and Merrell RC. Impact of Varying Transmission Bandwidth on Image Quality in Laparoscopic Telemedicine. ACCEPTED TO BE PUBLISHED IN *Telemed J*, 7(1): 2000 – At press.

8. Doarn CR. Medicine in the Future: Influences from Human Space Flight. *M.D. News*, p 26. January 2000.

9. Rosser JC, Prosst RL, Rodas EB, Rosser LE, Murayama M, and Brem H. Evaluation of the Effectiveness of Portable Low-Bandwidth Telemedical Applications for Postoperative Followup: Initial Results. *J Am Coll Surg*, 191(2):196-203. 2000.

10. Rosser JC, Herman B, Risucci DA, Murayama M, Rosser LE, and Merrell RC. Effectiveness of a CD-Rom Multimedia Turtorial in Transferring Cognitive Knowledge Essential for Laparoscopic Skill Training. *The American Journal of Surgery*, 179:320-324. 2000.

Published Abstracts

1. Latifi R, Doarn CR, and Merrell RC. Kosova's International Virtual e-Hospital. Surgery in Health During the War in Kosova. Prishtina, Kosova. Sep 2000

2. Lacroix A, Lareng L, Padeken D, Nerlich D, Bracale M Sanders JH, Doarn CR, McGee J, Wootton RM, Ogushi Y, Okada Y, Prerost S, and Orlov O. Final Report and Recommendations of the G-8 Global Healthcare Applications Subproject 4. *The 5th International Conference on the Medical Aspects of Telemedicine.* Montreal, Canada. Oct 2000.

3. Doarn CR. Applications of Telemedicine and Telehealth in NASA. *The 5th International Conference on the Medical Aspects of Telemedicine.* Montreal, Canada. Oct 2000.

4. Doarn CR, Harnett BH, and Merrell RC. Analogous Environments as Telemedicine Testbeds: Experience at Devon Island. *The 5th International Conference on the Medical Aspects of Telemedicine.* Montreal, Canada. Oct 2000.

5. Latifi R, Nerlich M, Richardson R, Doarn CR, Al Nuaim AA, Range P, and Merrell RC. International Virtual e-Hospital of Kosova. *The 5th International Conference on the Medical Aspects of Telemedicine.* Montreal, Canada. Oct 2000.

6. Darenkov IA, Latifi R, Russell M, Lavrentyev VA, Kapoor V, Doarn CR, and Merrell RC. Multinational Distance Learning Project Utilizing Low Bandwidth Internet. *The 5th International Conference on the Medical Aspects of Telemedicine*. Montreal, Canada. Oct 2000.

7. Doarn CR and Merrell RC. Telecommunications to Integrate Mobile Medical Services. *Smart Systems 2000*. Houston, TX. Sep 2000.

8. Doarn CR, Harnett BM, and Merrell RC. Wearable Computers: A Physiological Cipher in Extreme Environments. *Smart Systems 2000*. Houston, TX. Sep 2000.

9. Angood PB, Satava RM, Doarn CR, and Merrell RC. A Himalayan Adventure: Lessons Learned from the Yale/NASA Mount Everest Telemedicine Project. *American Telemedicine Association Annual Meeting*. Phoenix, AZ. May 2000.

10. Doarn CR, Kapoor V, and Merrell RC. Applications of Telemedicine Applied in Disaster Preparedness and Response. *World Congress on Telemedicine*, Toulouse, France. Mar 2000.

11. Doarn CR, Sanders J, and Merrell RC. Medical Informatics – Smart Systems for Medicine: Space Station and Beyond. *Medicine Meets Virtual Reality*, Newport Beach, CA. Jan 2000.

12. Doarn CR, Rosser JC, and Merrell RC. Feasibility of Low Bandwidth for Telemedicine Applications. *G-7/G-8 Global Healthcare Forum*. London, England. Nov 1999.

Technical Reports

1. Seminar in Ultrasound: Applications and Implications in Human Space Flight. Author: Charles Doarn. July 2000.

2. Final Report and Recommendations of the G-8 Global Healthcare Applications Subproject 4. International Concerted Action on Collaboration in Telemedicine. Authors: Andre Lacroix (Canada); Louis Lareng (France); Dittmar Padeken and Michael Nerlich (Germany); M. Bracale (Italy); Y. Ogushi and Y. Okada (Japan) Oleg Orlov (Russia); James McGee and Richard Wootton (United Kingdom); Jay Sanders and Charles Doarn (United States); and Sandra Prerost and Ian McDonald (Australia). April 2000.

3. Seminar in Medical Informatics: Infrastructure for Space Medicine. Author: Charles Doarn. March 2000

4. NASA's Strategic Plan for Telemedicine and Telehealth. Authors: Charles Doarn, Ronald Merrell, and Jay Sanders. March 2000.

Presentations

MITAC team members have been invited to and participated in meetings, conferences and symposia in countries all over the world. The titles of the presentations given are highlighted in Table 5.

Table 5. List of presentations that MITAC Personnel have given

Title	Conference	Presenter
Telemedicine in Extreme Environments – Commercial Potential	NASA Tech 2009	Charles Doarn
Telemedicine in Transition	2nd Conference on the Development of Technology in Medicine	Ronald Merrell
Overview of MITAC	Telemedicine Conference in Russia	Charles Doarn/ Ronald Merrell
MITAC Program – NASA Telemedicine Commercial Development	ATA Industry Briefing	Charles Doarn
Medical Informatics – Smart Systems for Medicine: Space and Beyond	Medicine Meets Virtual Reality	Charles Doarn
NASA/NLM/NGI Project	Distributed Medical Intelligence	Charles Doarn
Application of Telemedicine as Applied In Disaster Preparedness and Response	Distributed Medical Intelligence	Charles Doarn
Application of Telemedicine as Applied In Disaster Preparedness and Response	World Congress on Telemedicine	Charles Doarn
Application of Telemedicine within the Federal Government – non DOD	Telemedicine World 2000	Charles Doarn
How Telemedicine and Computer Technology Change the Way We Practice, Teach and Learn	Richmond Colloquium	Ronald Merrell
Education in the New Millennium	Bridgeport Hospital – CT	Ronald Merrell
Project Medical Education	Virginia Congressional Delegation	Ronald Merrell

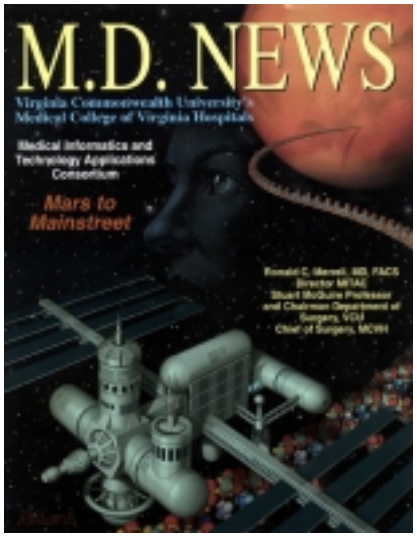
Applications of Telemedicine in Disasters	Telemedicine on the Threshold of the 21st Century: Rendering of Urgent Assistance Seminar	Ronald Merrell
Virtual e-Hospital of Kosova	G-8 Subproject 4 Summary Meeting	Rifat Latifi
Himalyan Adventure: Lessons Learned from the Yale/NASA Mount Everest Telemedicine Project	American Telemedicine Association	Peter Angood
Space Medicine: Challenges & Opportunities	Cybermedicine and Virtual Collaborative Clinic	Charles Doarn
Space Medicine: Concepts and Practice	Cybermedicine and Virtual Collaborative Clinic	Ronald Merrell
Application of Telemedicine on the Internet NASA Experience	SURA-Health Sciences Workshop	Charles Doarn
Space Medicine	J. Shleton Horsely Lecture - Richmond Academy of Medicine	Ronald Merrell
Medical Informatics and the Architecture of Health Care	Advanced Informatics in Medicine	Ronald Merrell
Telemedicine: Past, Present, and Future	Downtown Richmond Kiwanis Club	Ronald Merrell
Innovations in Telemedicine Applications	Virginia Joint Commission on Health Care	Ronald Merrell
Telemedicine: New Frontiers for Technology and Science	Virginia Joint Commission on Technology and Science	Ronald Merrell
Remote Monitoring and Management of Surgical Procedures	Moscow Surgical Society	Ronald Merrell
Virtual e-Hospital of Kosova	Surgical Conference in Kosova	Rifat Latifi
Overview of MITAC	Smart Systems 2000	Charles Doarn
Telecommunications to Integrate Mobile Medical Services	Smart Systems 2000	Timothy Broderick
Wearable Computers: A Physiologic Cipher in Extreme Environments	Smart Systems 2000	Charles Doarn
Applications of Telemedicine and Telehealth in NASA	International Society for Telemedicine	Charles Doarn
Analagous Environments as Telemedicine Testbeds: Experience at Devon Island	International Society for Telemedicine	Charles Doarn
Multinational Distance Learning Project Utilizing Low Bandwidth Internet	International Society for Telemedicine	Charles Doarn
International Virtual e-Hospital of Kosova	International Society for Telemedicine	Rifat Latifi
Internet Telementoring in Laparoscopy	Surgical Biology Club III	Ronald Merrell

PUBLIC INTEREST – OUTREACH

MITAC personnel have been involved in a variety of activities, which have been reported in the press. These included interviews on television, radio, and newsprint. The following is a listing of these.

Print Media

January 2000 and June 2000 issue of MD News



Television

Dr. Merrell and Mr. Doarn were interviewed by WHRO TV with regards to the International Space Station (ISS) Teleconference program, which aired on PBS February 24, 2000. The focus of the interview was on how the MITAC serves as a commercial incubator for NASA and human space flight, and how telemedicine and the MITAC interact with industry

FUTURE PLANS

The future for MITAC looks promising. Advancement in technologies in computers, displays, information systems, communications, sensors and medical care devices will create unique opportunities to establish medical informatics as an infrastructure for medical care delivery whether the patient is in space, in some remote area of the world or in an urban area. The focus of the MITAC will be one of continued evolution of telemedicine technologies as well as a robust effort in the field of medical informatics and medical technologies. MITAC will continue to evaluate and validate technologies in test beds, conduct discipline specific symposia to meet NASA operational needs, and concentrate efforts on developing wireless home health care monitoring. The coming months will see further development of partnerships with industry and academia to meet the challenges set before the MITAC.

MITAC's efforts to commercialize products and services through company formation will continue in the coming year. This effort will continue with close interaction with VCU and the VBRP.

Details of the proposed scope of work are outlined in the 2000-2001 MITAC Business and Operation Plan.