SPECIAL REPORT

Teleconsultation Program for Deployed Soldiers and Healthcare Professionals in Remote and Austere Environments

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Abbreviations:
AKO = Army Knowledge Online
OTSG = [US] Office of the Surgeon General

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Abstract

Background: In April 2004, the US Army Medical Department approved the use of the Army Knowledge Online (AKO) electronic e-mail system as a teleconsultation service for remote teledermatology consultations from healthcare providers in Iraq, Kuwait, and Afghanistan to medical subspecialists in the United States. The success of the system has resulted in expansion of the telemedicine program to include 11 additional clinical specialty services: (1) burn-trauma; (2) cardiology; (3) dermatology; (4) infectious disease; (5) nephrology; (6) ophthalmology; (7) pediatric intensive care; (8) preventive and occupational medicine; (9) neurology; (10) rheumatology; and (11) toxicology. The goal of the program is to provide a mechanism for enhanced diagnosis of remote cases resulting in a better evacuation system (i.e., only evacuation of appropriate cases). The service provides a standard practice for managing acute and emergent care requests between remote medical providers in austere environments and rear-based specialists in a timely and consistent manner.

Methods: Consults are generated using the AKO e-mail system routed through a contact group composed of volunteer, on-call consults. The project manager receives and monitors all teleconsultations to ensure Health Insurance Portability and Accountability Act compliance and consultant's recommendations are transmitted within a 24-hour mandated time period. A subspecialty "clinical champion" is responsible for recruiting consultants to answer teleconsultations and developing a call schedule for each specialty. Subspecialties may have individual consultants on call for specific days (e.g., dermatology and toxicology) or place entire groups on-call for a designated period of time (e.g., ophthalmology).

Results: As of May 2007, 2,337 consults were performed during 36 months, with an average reply time of five hours from receipt of the teleconsultation until a recommendation was sent to the referring physician. Most consultations have been for dermatology (66%), followed by infectious disease (10%). A total of 51 known evacuations were prevented from use of the program, while 63 known evacuations have resulted following receipt of the consultants' recommendation. A total of 313 teleconsultations also have been performed for non-US patients.

Conclusions: The teleconsultation program has proven to be a valuable resource for physicians deployed in austere and remote locations. Furthermore, use of such a system for physicians in austere environments may prevent unnecessary evacuations or result in appropriate evacuations for patients who initially may have been "underdiagnosed."

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Introduction

Telemedicine and telehealth are defined as the delivery of health care to a remote or geographically distant location through the use of communications tools and technology.[1] Typical implementations encompass a variety of technologies, including telephone, radio, fax, videoconferencing, high-speed net-

Program
Burn-Trauma (US Army Institute of Surgical Research)
Cardiology
Dermatology
Infectious Diseases
Nephrology
Neurology
Ophthalmology
Pediatrics Intensive Care
Preventive Medicine/Occupational Medicine
Rheumatology
Toxicology

Table 1—List of current teleconsultation services

works, medical telemetry systems, and monitoring devices, which provide varying degrees of telepresence capabilities within a connected healthcare environment.[2] The application of these technologies for delivery of accurate and reliable remote health care has undergone extensive transformation and improvement during the past decade. As the cost of telecommunications equipment continues to decline and access to high-speed communication channels becomes commonplace, many applications have been devised that take advantage of this access to provide some type of remote health care across multiple environments.[3,4]

Driven by the lack of resources and operational constraints in remote and austere locations, the use of technology to enhance health care in the field provides a natural solution that can be applied in several different forms depending on the network and technology resources available at each location.[5–7] This especially is important in the battlefield and operational theaters in which the US military forces function. The lack of specialized medical expertise in the field necessitates the use of technology to deliver health care to the far forward environment. Furthermore, as both military and civilian casualties continue to accrue in remote healthcare delivery facilities, the lack of specialists' expertise for patient treatment continues to be a critical issue.

Recently, the advent and globalization of high-speed networks (both wired and wireless) in the combat environment within Iraq and Afghanistan have afforded deployed healthcare providers with the tools necessary to institute telemedicine technology to enhance the capabilities of the healthcare sites in the field. However, in order to deploy a telemedical system in the military operational environment, the system had to meet stringent requirements for reliability and effectiveness while providing a mechanism to assist in the delivery of health care to all patients received in the unit.

Implementation in the military environment focused on two critical issues: (1) development of a system for providing consults from specialists to remote providers in the field to guide therapy for atypical patient cases; and (2) using remote consults to provide a better indicator and guidance of the need for evacuation in the field. The use of a specialist's expertise may be required during acute and emergent care cases where these consultants often are not available in the austere, far-forward environment. Furthermore, appropriate use of the telemedical system may result in more appropriate use of the evacuation system by correctly identifying and evacuating those patients that require specialty care outside of the immediate arena.

By using electronic mail (e-mail) capabilities within the remote, austere environment, providers now have the capability to request additional medical information that assists in improving both patient outcomes and streamlining the evacuation requirements for some cases in the field through this teleconsultation program.

Background

The Office of the Surgeon General (OTSG) teleconsultation program began in April 2004. The program originated from the efforts of the Clinical Consultant to the Surgeon General for Dermatology to develop a centralized system or method for providing dermatology consultations to deployed healthcare providers. Dermatology has been practiced widely in the remote telemedicine environment in the past.[8] Other small-scale or regional telemedicine programs had been implemented in the past as well, such as in Operation Joint Endeavor in Bosnia,[9,10] at Walter Reed Army Medical Center,[11] and at the Naval Medical Center in San Diego.[12,13] However, this program represented the first centralized effort to track and monitor Army telemedicine activities worldwide, with particular emphasis on providers in remote and austere locations.

Minimally, the proposed program had to be accessible from anywhere in the combat zone using existing low bandwidth technology. The Army Knowledge Online (AKO) e-mail system was chosen as the ideal solution for this program. All deployed medical personnel currently have access to the system via the Internet from all operational medical facilities. The system provides a centralized, Web-based data repository and e-mail management tool for information exchange across the US Army and any Department of Defense-designated affiliate. Using the built-in capabilities of the AKO system, personnel in the field can communicate with other personnel anywhere in the world using standard e-mail capabilities. Additionally, through the formation of online "communities", AKO users can create discussion forums, user groups, and establish protected Websites to post information only for authorized users.

The Department of Dermatology at Brooke Army Medical Center was selected to serve as the initial specialty to test the feasibility for the teleconsultation program. The Great Plains Regional Medical Command provided administrative and consultation management support while OTSG provided information management support. Based on overwhelmingly positive feedback from referring physicians, the test phase of the program was discontinued within 60 days, and the program was expanded immediate-

	Total Consults									Program Totals	Consults Program %
	2004	2005	2006	2007							
	Totals	Totals	Totals	Oct	Nov	Dec	Jan	Feb	Mar		
Burn-Trauma	0	23	24	1	2	3	0	1	3	57	2
Cardiology	0	2	67	5	2	4	7	6	2	95	4
Dermatology	321	543	528	33	37	40	25	23	44	1,594	66
Infectious Diseases	0	82	110	5	12	5	10	6	6	236	10
Internal Medicine	0	0	0	0	6	5	0	1	0	12	0.5
Nephrology	0	13	18	6	5	2	2	2	4	52	2
Neurology	0	0	0	2	6	7	5	6	8	34	1.4
Ophthalmology	10	51	38	6	2	2	2	2	5	118	5
Pediatrics	0	8	21	6	0	2	1	0	2	40	2
Preventative Medicine	0	0	3	2	0	0	3	0	1	9	0.4
Rehabilitation	0	0	1	0	0	0	0	0	0	1	0.0
Rheumatology	0	0	13	2	5	1	1	4	2	28	1.2
Toxicology	0	2	19	--	--	1	--	--	0	22	1
Other Specialties	0	7	61	7	13	9	6	13	12	128	5
Totals	331	731	903	75	90	81	62	64	89	2,426	100.5

Table 2—Summary of teleconsultations received from April 2004 through March 2007

Location of Referring Physician										Program Totals	% Consults
	2004	2005	2006	2007							
	Total	Total	Total	Oct	Nov	Dec	Jan	Feb	Mar		
Afghanistan	6	90	127	14	11	15	9	12	4	278	11
Bosnia	25	22	5	0	0	0	1	0	0	53	2
Chad	0	1	0	0	0	0	1	0	0	2	0.1
CONUS	0	20	17	1	0	2	0	1	1	42	2
Cuba	0	0	1	0	0	0	0	0	0	1	0
Diego Garcia	0	0	2	0	1	0	0	0	0	3	0.1
Djibouti	0	0	0	0	0	0	1	2	3	6	0.2
Ecuador	0	0	0	0	0	0	0	0	4	4	0.2
Egypt	1	22	16	2	1	1	0	3	1	47	2
Germany	0	9	6	0	0	0	1	0	0	16	1
Honduras	0	1	0	0	0	0	0	0	0	1	0.0
Iraq	197	477	570	48	61	57	40	40	63	1,553	64
Italy	0	0	5	0	1	0	0	0	0	6	0.2
Korea	0	0	3	0	1	0	1	0	0	4	0.2
Kuwait	64	52	32	0	2	1	1	0	1	153	6
Kyrgyzstan	0	2	5	0	0	0	0	0	0	7	0.3
Nepal	0	0	0	1	0	0	0	0	0	1	0.0
Okinawa	0	1	0	0	0	0	0	0	0	1	0.0
Pakistan	1	2	38	0	0	0	0	0	0	41	1.7
Qatar	2	27	40	2	3	2	3	3	7	85	4
Turkey	0	0	0	0	0	2	2	2	0	14	0.6
United Arab Emirates	0	0	4	1	1	0	1	1	1	6	0.2
US Navy Afloat	16	4	28	6	9	1	0	0	4	68	3
Not Stated	19	9	4	0	0	0	1	0	0	33	1
Total	331	729	903	75	90	81	62	64	89	2,426	

Table 3—Summary of teleconsultations received by country from April 2004 through March 2007 (CONUS = military facilities located in the continental US)

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ly. The Department of Ophthalmology began its teleconsultation program in July 2004, followed by the Burn-Trauma Center at the US Army Institute for Surgical Research, Fort Sam Houston, Texas in January 2005. Five other specialties initiated service within the following nine months.

The current specialties participating in the consult program are summarized in Table 1. The number and complexity of data calls has increased substantially since the program began. Over 2,426 consults were performed (from April 2004 to March 2007) from 23 countries, with an average reply time of five hours and eight minutes from receipt of the teleconsultation until a recommendation was sent to the referring physician. A total of 782 providers have participated in the program. Most consultations have been for dermatology (66%), followed by infectious diseases (60%; Table 2). Currently, 51 known evacuations have been prevented by the program while 63 known evacuations were facilitated following receipt of consultants' recommendations. The variety of locations from which the teleconsultations have been received are listed in Table 3. Currently, the highest percentage is from Iraq, where 64% of teleconsultations have been received. The next highest percentage is from Afghanistan, where 12% of teleconsultations have been received. A total of 313 consultations have been performed for non-US personnel.

Program Management

The teleconsultation program is overseen by a program manager who receives and monitors all teleconsultations to ensure compliance with provisions of the Health Insurance Portability and Accountability Act (HIPAA) of 1996, and to ensure that the consultant's recommendations are transmitted within the 24-hour, OTSG-mandated time period. The project manager also facilitates collaboration among specialties by routing consultations from one specialty to another. Referring physicians may contact the project manager whenever they require assistance for a specialty not listed in the formal contact groups. Subspecialties such as Allergy and Immunology, Endocrinology, Gastroenterology, Neurology, Obstetrics and Gynecology, Oral Pathology, Orthopedics, Pulmonary Medicine, and Urology all have participated as consultants for one-on-one teleconsultations and/or have agreed to provide standby service when contacted by the project manager. Furthermore, the project manager is aware of the geographic locations of all the subspecialty assets that are located in and out of the combat theater, and is able to route the consults to the appropriate location.

Program Overview

Currently, each medical subspecialty is managed by a "clinical champion" who is responsible for recruiting consultants to answer teleconsultations and developing a call schedule. Some subspecialties, such as dermatology, have individual consultants on call for specific days, while others, such as ophthalmology, place entire groups on-call for a designated period of time.

Specialists desiring to participate in the teleconsultation program must go through an extensive review process. Although the process has been streamlined, currently, it takes between two and four months from inception until the first teleconsultation is answered. When a specialty is approved for inclusion in the program, an announcement is sent to the senior healthcare leaders in a current combat theater.

One of the initial and primary goals of the teleconsultation program was to reduce the number of evacuations from the theater by using the subspecialty experts to render remote care. However, referring physicians soon began using the teleconsultation service for routine, second opinions. As healthcare providers gained experience with unfamiliar medical conditions not usually experienced in their normal practice, the number of teleconsultations per referring physician declined.

Initially, healthcare providers deployed into the Iraq and Kuwait combat environments were the primary audience for the program. As healthcare providers became aware of the program and the number of available subspecialists for consultation increased, the number of countries from which teleconsultations were transmitted also increased. Currently, teleconsultations have been received from Afghanistan, Bosnia, Chad, Diego Garcia, Egypt, Honduras, Germany, Italy, Iraq, Korea, Kuwait, Kyrgyzstan, Okinawa, Pakistan, Qatar, and US and Australian Navy ships serving in the Middle East. The program also was expanded to support military and public healthcare providers supporting Hurricane Katrina.

Thirty-one data elements are monitored for each teleconsultation. The project manager creates a Microsoft Word (Microsoft, Inc., Redmond, WA) file for each teleconsultation that consists of the referring and consulting physicians' initial and subsequent e-mails and any images that are attached. Most consultants delete their recommendation after answering a teleconsultation. If the referring physician has problems at a later date and sends a re-consult, the project manager retrieves the file and makes it available to the on-call specialist. The average teleconsultation from a referring physician consists of one or two paragraphs with two or three images. Consultant recommendations usually are one or two paragraphs in length, but collaboration among specialties obviously increases the size of the file. One case of pesticide poisoning of a young child that stretched over three months involved many different collaborating specialties and exceeded 20 pages in length.

When the program began in April 2004, the average e-mail size including digital photographs was between 500 kilobytes and one megabyte. The advent of cheaper digital cameras with greater memory has resulted in an increase in the e-mail size. The average file size is now 2 mB. It is not uncommon for e-mails to contain between 6–12 mB of images. Because consultants are under pressure from their information management directorates, many risk exceeding the allowed size of their e-mail inboxes. The project manger uses compression technology to keep the official records under 100 kBs. This compression unfortunately may degrade the image quality when a reconsult is transmitted to the on-call consultants.

Example Cases

Two example cases are provided, one involving a burned soldier in the field, and the other involving an atypical skin lesion (Appendices 1 and 2). Note that the time from ini-

tial consultation to the first response from the specialist was <4 hours. These cases illustrate typical scenarios, whereby care was managed remotely through the use of the teleconsultant medical specialist.

In the first case, a marine sustained first and second degree burns from a flare. The consultation recommended appropriate lubricant, dressing, and exercise. The second case involved a 50-year-old man with a recent growth on his neck. The dermatologists suspected malignant melanoma. Surgery was performed that confirmed this diagnosis.

Future Directions

As improved and more robust networks are implemented in the austere and remote environments, real-time video teleconferencing systems may be used for providing real time consults and diagnosis of acute cases. The AKO system recently added a "video chat" capability, whereby individuals may communicate securely via a video format, although the resolution of this video capability currently is suboptimal for widespread clinical use. Other new uses of telemedicine encompass the use of medical imaging, such as microscopic analysis of blood smears to accurately diagnose malaria.[14] The ability of specialists to interact with remote healthcare providers will enhance the ability of the consultants to provide better diagnosis and treatment regiments. Similarly, if a "real time" consult can be obtained through the use of teleconferencing systems, patient evacuations may be further improved during acute and emergency cases and result in preventing delays in evacuation decisions or treatments that may negatively impact patient care.

Limitations

This study was descriptive and retrospective in nature, and thus, has limitations worthy of discussion. First these data are retrospective and may not represent all teleconsultations performed in combat. Furthermore, there is no method for follow-up for the consultations and the final diagnosis may have been different than the original diagnosis, thus verifying the appropriateness of the evacuation. Finally, these consultations did not undergo secondary review to determine accuracy of diagnosis and disposition.

Conclusions

Telemedicine and teleconsultation use cutting-edge technology to bring specialized medical expertise to the remotest corners of the globe, where sub-specialty care, and even primary care, often are not available. Furthermore, its use may be expanded to incorporate areas affected by disasters due to natural hazards or terrorist attacks, where medical care will be in short supply. The Department of Defense's model of telemedicine is a vibrant example of a structured and well-monitored program, benefiting and educating both patients and providers around the world. Further research and close monitoring is needed to validate the clinical efficacy of this practice, as the capabilities of telemedicine will continue to grow at the rapid pace of technological advance.

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Appendix 1—Teleconsultation Example #1 (BAMC = Brooks Army Medical Center; BID = twice a day; NS = normal saline; PRN = as needed; ROM = range of motion; USAISR = US Army Institute of Surgical Research)

Consult from field
From: Field healthcare provider
Sent: Thursday, 2005, 0428 AM
To: derm consult
Subject: Burn

Sir or Ma'am
We have a young Marine that sustained 1st and 2nd degree burns to the right axilla. Date of injury 12 Sept 05. He threw a flare, it bounced back and lodged in his axilla. Initially treated with silvadene—now on Levoquin for propholaxis against bacterial infection, with daily wound dressing changes, dry/Telfa. Patient has had gross sensory tenderness throughout post injury course.

1. Any topicals? silvadene, vitamin A, E?
2. Continue Antibiotic Propholaxis?
3. Daily cleaning? NS or warm water soap?
4. Concerned about Range of Motion in shoulder as ROM limited by pain?
5. Do you have a contact at a Burn Center (Brooks Army Med) that may have ideas as well?

Thank you-

Project manager reply
From: Project manager
Sent: Thursday, 2005, 0604 AM
To: Burn-trauma consult
Cc: Derm consult
Subject: FW: Burn

Dermatology Team: I am cc'ing the Burn-Trauma team at the ISR to also provide recommendations on this teleconsultation.

Burn-Trauma: I would appreciate your comments on this teleconsultation.
Project Manager, OTSG .consult Programs
Fort Sam Houston, TX

Consultant's reply
Burn-trauma
From: Burn-trauma consult
Sent: Thursday, September 29, 2005 8:12 AM
To: project manager
Cc: Derm consult
Subject: RE: Burn

This is a partial thickness burn with budding apparent and should heal in 10–21 days. Prophylaxis with antibiotics is not indicated for this or any burns. This can be treated with BID silvidene cream or bacitracin with daily shower and washing the area, no significant scrubbing. If silvidene is used all remaining silvidene from the prior application must be washed off therefore BID washing with soap and water or pseudoeschar will appear (a white to grey appearing film which is a combination of serous discharge and cream). If bacitracin is used only one wash with soap and water is needed and the ointment can be applied BID, no pseudoeschar will appear. Once healed keep moist with moisturizer BID and PRN and keep ROM of the shoulder during the healing process. Thanks for including the burn consult on this transmission. If there are any questions please feel free to contact us at the USAISR again using the burn consult service.

Dermatology
From: derm consultant
Sent: Thursday, September 29, 2005, 0815 AM
To: Project manager
Subject: RE: Burn

I would add a lubricant such as petrolatum to the daily regimen. There is crusting of the lesions (not sure these are impetiginization). Soaking the lesions daily with normal saline soaked guazes may help remove loose crusting. Agree with continuing the antibiotic coverage. After the lubricant is applied would put on a non stick dressing such as telfa daily. ROM exercises would be useful. I defer definitive advice to the folks who do this on a daily basis at the BAMC Burn Center. Please include me in that e-mail. Thanks.

Field Reply
From: Field healthcare provider
Sent: Friday, 2005, 0542 AM
To: Burn-trauma;Derm; project manager
Subject: RE: Burn

Gentlemen-
Thank you for the help. We believe we will be able to care of this Marine here as we have supply for the dressing changes and access to showers daily, but will not hesitate to call for help again. Thank you.

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Appendix 2—Teleconsultation Example #2 (hx = history)

Referring Physician's Narration:
50 y/o male with new growth over last 6 months. Found on nape of neck. Variegated and fleshy. Looks like it ought to be cut off just for cosmetic purposes alone.

Dermatologist's Recommendation/Diagnosis:
I'll put money on this one being a Malignant Melanoma, probably arising out of a mole. This one has all the criteria: Asymmetry, irregular Borders, varied Color, large Diameter, and uneven Elevation. It looks like it has been there a lot longer than 6 months.

At any rate, he needs to see a Surgeon ASAP, in the next week or two....sooner, if possible.

To be complete, include in your referral note to the surgeon, patient's history of blistering sunburns, any past hx of skin cancers, family hx of melanoma, his exposure to sun (grew up in Florida, lived at beach, etc...). Do a complete skin exam (including scalp, genitalia, bottoms of feet, etc.) looking for other suspicious lesions that you can alert the Surgeon to. Also, do a lymph node exam. If the patient has palpable lymph nodes in the cervical chain or axillae, it is more worrisome.

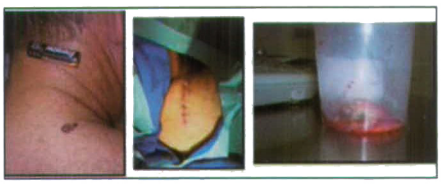
Try not to alarm the patient too much at this point. The prognosis is dependent on the thickness of the Melanoma, and we don't know that at this point. I would just tell the patient that you think the lesion may be a Melanoma, and that the prudent thing is to get him to a Surgeon who can remove it and send it to the lab for testing.

As for his unit commander, I would tell him that the soldier could be lost to the unit for weeks or could be med-evaced back to the states, depending on several factors, yet to be determined.

Diagnosis: Malignant Melanoma

Outcome:
Surgery 5 days after receiving recommendation. Pathology confirmed malignant melanoma.
Patient completed chemo therapy and returned to duty.

50-year-old male with new growth



Outcome
Surgery occurred five days after receiving recommendation.
Pathology confirmed malignant melanoma.
Patient completed chemotherapy and returned to duty.

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