THE UNITED STATES ARMY MEDICAL DEPARTMENT

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COMMANDER'S INTRODUCTION

MG David A. Rubenstein

In my remarks introducing the previous issue of the AMEDD Journal, I pointed out the distinct, symbiotic relationships of healthcare services across the military and civilian settings. Those invaluable links include education, certifications, delivery practices and experiences, facility design, and research and development. Understandably, the availability of easily identifiable and accessible information from both types of healthcare systems is vital to stimulating and advancing the practice of medical science for everyone. Again fulfilling its important and unique role as a resource for such information from military medicine, this issue of the *Journal* contains a number of articles on subjects which have direct corollaries in civilian medical science and healthcare delivery.

The first article is an ideal example of the exploitation of the broad range of available information sources to develop a focused look at what is arguably military medicine's most important responsibility, battlefield trauma care. LTC Kyle Remick led an impressive group of highly skilled, broadly experienced Army surgeons in an extensive literature review to evaluate available information on multiple aspects of trauma care. The review parameters were carefully defined in focus and scope, and rigorously followed, ensuring study results are scientifically sound, balanced, and evidence-based. The article presents the extensive information derived during the review in a carefully organized, easily understood structure which supports 5 specific recommendations for transformation of Army trauma care. The concept development, design, execution, and analysis presented in this study once again demonstrates the exceptionally high caliber of talent, skill, and dedication that is typical of our military medical professionals. Their study results should absolutely be a part of the ongoing development of protocols, procedures, organization, and training which will define trauma care in combat environments of the future.

Number 4 on the recently promulgated list of The Army Surgeon General's top 10 issues is "Implementation of mild Traumatic Brain Injury (mTBI)/Concussive Injury Protocols." As is so often the case, our military medical professionals in the combat theater have recognized the import of an increasingly encountered serious condition, and are directly addressing it within the capabilities of their environment and resources. LTC Ralph Caldroney and Navy CAPT James Radike have contributed a timely, important article describing their experiences in Afghanistan (2009-2010) in the development and implementation of protocols and guidelines for recognition, screening, evaluation, and management of mTBI at the Kandahar hospital. Their article presents well-researched, detailed information about the presentation of symptoms of brain injury, and the various screening techniques and tools that are used to gauge the severity of indicated TBI. They explain the various approaches to treatment that were adopted at Kandahar. Perhaps most importantly, they detail their focus on repetitive brain injuries as a vital factor in determining a patient's potential susceptibility to more severe, perhaps permanent, damage from further exposure. This article is a valuable contribution in support of one of The Surgeon General's most urgent priorities.

The historically high survival rate of wounded US Warriors from current conflicts has resulted in a proportionally larger number of combat Veterans who require extended follow-on care as their external wounds heal and they seek to return to as normal a lifestyle as possible. Loss of limbs is one of the more common of the conditions faced by these valiant Warriors. Lead author Brad Issacson and a group of highly qualified orthopaedic and rehabilitation professionals from the Department of Veterans Affairs, Walter Reed, and university medical schools have contributed a timely, important article which clearly synopsizes the major concerns involved in the recovery and rehabilitation of military amputees. Their extensively-researched article consolidates data and experiences from a broad range of sources to present the latest information concerning amputation wound care, residual limb complications, prosthesis technology, and approaches to physical and occupational therapy which are available for recovering Warriors. This article is yet another example of the wide range of dedicated healthcare professionals who collaborate time and again to advance the state-of-the-art of care for our Warriors who willingly go into harm's way in defense of our freedom and way of life.

It is obvious that the extended nature of the current combat operational tempo has taxed our Warriors, both physically and psychologically. Throughout these commitments, military medicine has continued to make tremendous advances with trauma injuries, saving lives

and restoring the injured to amazing levels of recovery. The behavioral and mental health professionals have worked tirelessly to develop techniques and approaches to care for those Soldiers suffering from mental and psychological disorders. One of the undesirable consequences of the psychological pressures and stresses that affect Soldiers in a combat environment is the negative impact they can have on the Warrior's family relationships. Dissolutions of marriages and family breakups following return from deployment are far too common. At the extreme, we see the reports of physical abuse, including the death of one or both spouses, and sometimes children. The family advocacy approach to address the stresses of military life on the family was developed in the 1980s. It is by necessity an evolutionary methodology as the nature of combat changes, while at the same time the very character and structure of American society itself are constantly in flux. COL Derrick Arincorayan teamed with Dr Larry Applewhite and Dr Rene Robichaux to look at an adaptation of the family advocacy approach to address the domestic stresses inherent in an multiple deployment environment. Their article makes a very strong case for providing (in effect extending) family advocacy support to the forward operating areas with deploying units, and ensuring such support is closely coordinated with each unit's home station. The availability of such resources accomplishes many things, most importantly ensuring continuity of support for those deploying personnel who were already receiving family advocacy services, and providing immediate, onsite services for those encountering difficulties, either from home or at the deployed location. This article is another indication of the dedication and commitment of our healthcare professionals to the "whole" Soldier, proactively adapting to the times and places as required.

Of the many benchmarks with which we gauge the quality of military medicine, perhaps the one most widely discussed by healthcare beneficiaries is access to care. This is nothing new, access to healthcare services by dependents and other beneficiaries has long been a major concern for military medical planners and policy makers. Indeed, efforts to directly address dependent healthcare began with the Dependents Medical Care Act in 1956, which evolved into CHAMPUS in 1966 and is now TRICARE, which serves all eligible beneficiaries. The program functions well within the United States, but the biggest challenges for military healthcare providers are overseas. This issue of the *Journal* contains 3 articles dealing with the difficulties presented in Europe by the reduction of forces permanently assigned there, combined with the demands of the ongoing combat operations in Afghanistan and Iraq. In the first article COL Robert Smith provides a manager's overview of the circumstances which complicate the ability of the military to meet the demands, and expectations, of the eligible beneficiary population. His discussion examines the difficulties presented by not only the operational and resource reduction requirements, but also the internally imposed demands on the time of providers, which directly translates into less time for patient care. He offers suggestions to mitigate the problems and increase access, most of which will have to be addressed at the policy level because they would be applicable across the entire Military Health System. COL Smith's article is a clear, well-reasoned look at the realities of providing healthcare services to our eligible beneficiaries around the world.

Next, LTC Ivan Speights and his coauthors describe the actions they implemented at the Army Health Clinic, Mannheim, in 2008 to address the combined challenges of the transformation of the US forces in Europe, combat theater deployments, and the normal personnel turbulence of a military medical organization. The first step was a statistical analysis of the users of the clinic's services, segregated by type of beneficiary and the nature of services used, which was then used to adjust service and resource assignment schedules. They implemented a telephone screening and consultation process to focus provider appointments towards those for which actual caregiver contact was necessary. The clinic itself was remodeled after an analysis determined the optimum, standardized layout to support the processes and services required by the user community. Finally, since nothing in the provision of medical services is static, the clinic's operational data are reviewed every quarter to adjust schedules and resources as necessary. This is a wonderful example of the initiative and resourcefulness of our military medical professionals as they face a challenge head-on, roll up their sleeves, and make it work for the benefit of their supported population.

In the earlier two articles, access to care was discussed from a broad perspective, then it was considered in the efforts of a single clinic to optimize its operations to ensure access was not compromised. LTC Raymond Gundry and MAJ Christoph Hillmer have contributed an excellent article discussing the challenges of realigning medical assets across an entire region of responsibility in response to the reduction of forces and other resources in Europe. Unfortunately, strategic planning for the reduction of support services, including medical support, was not detailed as part of the overall planning of the force transformation. Further, there was no documentation or lessons-learned available from the last

major force downsizing in the early 1990s. Adding to that mix was the turmoil of the constant deployment rotations of medical personnel and resources into the combat theaters. Consequently, the realignment of medical support across their area of responsibility was initially reactive, but was successful because of the skill, knowledge, and sheer hard work of those responsible for making it happen. LTC Gundry and MAJ Hillmer describe the numerous considerations and problems, many unexpected of course, they encountered as they contended with the myriad of responsibilities involving personnel, logistics, facilities, budget, host nation concerns, and transportation involved in this enormous undertaking. At the end of the article, they have provided 5 points of planning guidance derived from their experience to assist future, similar efforts. The experiences detailed in this article, and especially the invaluable planning guidance, should be incorporated as part of contingency planning process for future realignment of overseas medical support assets.

Throughout history, advances in medical science have been the result of scholarship, experimentation, and technology, elements which themselves are absolutely interdependent. Indeed, great strides in one area drive the other areas, and the cycle builds momentum. Over the past century, the accelerated breakthroughs in various areas of technology have stimulated stunning advancements in medical science as researchers and engineers quickly developed medical applications, which then redirected technological development in entirely new directions. However, sometimes the assumed omnipotence of technology may lead to unwise decisions with detrimental results. In his well-researched article, LTC Lee Bewley investigates an area of technology that is one of those assumed mainstays of American business success, and focuses on its actual efficacy in healthcare organizations. Some form of information management is absolutely essential for any successful enterprise, and, unquestionably, digital technology has revolutionized our ability to organize, analyze, research, archive, and access information—but management should understand that technical expansion can reach a point of diminishing returns. LTC Bewley presents a strategic analysis of the investment and productivity returns for investment in information management technology, and develops some cautionary perspectives for those charged with responsibility of such systems. His clearly presented analysis of a complex subject, along with the detailed findings and recommendations are yet another indication of the high level of scholarship and expertise which is characteristic of our military medical professionals.

Previous issues of the *AMEDD Journal* have presented articles discussing various aspects of the provision of healthcare services to prisoners and detainees in the combat theaters of Iraq and Afghanistan. LTC Beverly Patton has contributed an interesting and informative article which details an important, related consideration of detainee management which is much more complex than it may appear on the surface. The provision of nutritional meals in keeping with the customary diet of internees is not just the obligation of a civilized nation, it is also specified in the 1949 Geneva protocols. However, it is not as straightforward as distributing pallets of military rations among the detainees. Not only should the dietary patterns of the general internee population be understood and followed, but the specific dietary considerations for those with certain health conditions must be addressed. The article discusses the efforts made to ensure pregnant, diabetic, or injured detainees, as well as infants, malnourished children, and hospitalized internees were provided nutrition suitable to their conditions as much as possible. Further, provision of special meals was hampered by the forced segregation of the population by ethnic groups (to minimize tension and conflict), and the separation of adolescents from the adults. LTC Patton has not only done an excellent job of describing the difficulties and complexities involved in this effort, she has also cited the governing regulations and helpful references, and presented a valuable list of lessons-learned for planners of future, similar operations.

This issue of the *AMEDD Journal* closes with a collection of abstracts prepared by the 2011 class of doctoral students of the US Army-Baylor University Doctoral Program in Physical Therapy. The 9 abstracts report the results of the students' research projects which were conducted as part of their curriculum and in support of the Neuromusculoskeletal Injury Prevention and Rehabilitation Research Program. These abstracts are representative of the outstanding opportunities for professional education and career enhancement available in military medicine.

Transforming US Army Trauma Care: An Evidence-Based Review of the Trauma Literature

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LTC James A. Dickerson II, MC, USA
LTC Shawn C. Nessen, MC, USA
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ABSTRACT

The US Army has been charged to transform to meet the demands of current and anticipated near-future combat needs, covering a full spectrum of military operations. The US Army combat trauma care system was created to deliver combat casualty care in a variety of situations and has been adapted to meet the needs of such care in both Operations Enduring Freedom and Iraqi Freedom. Questions related to our current system include the use and positioning of medical evacuation assets, the type of training for our trauma care providers, the positioning of these providers in proximity to the battlefield, and the type of units most suited to the wide variety of medical operations required of today's military medical team. The review was performed to evaluate available information in light of anticipated future needs to ensure preparedness. We reviewed trauma literature regarding the areas of civilian trauma systems, military trauma systems, presurgical trauma care, medical evacuation times, and the medical evacuation system. Among the conclusions drawn from the reviewed data include the following: regional trauma systems improve outcomes in significantly-injured patients; rural trauma care as part of a trauma system yields improved results compared to nontrauma hospitals and comparable results to those at a higher level center; and delivery of advanced trauma life support care has the potential to extend the period of time of safe medical evacuation to surgical capabilities. These lessons are used to discuss components of an improved system of trauma care, flexible for the varied needs of modern battlefield trauma and adaptable to provide support for anticipated future conflicts.

INTRODUCTION

Much has changed in US military combat operations between September 11, 2001, and today. Operation Enduring Freedom (OEF) has changed from a special operations mission to remove the Taliban from control of Afghanistan to one of full-spectrum operations. The United States conducted a war to overthrow Sadam Hussein's Iraq regime and is now, in Operation Iraqi Freedom (OIF), dealing with stability and counterinsurgency operations. Just in these 2 respects, the US Army is tasked with fighting concurrently in many different ways. None of this resembles our prior planning for a large-scale, conventional war against an opposing superpower.

During this same period, there has been significant progress regarding the development of our military trauma system. Well-documented improvements since 2001 include research into prevention of combat injuries with new types of body armor, improved hemorrhage control techniques at the point-of-injury, information management systems to enable continuity of care between facilities within the theater and on different continents, development of the Joint Theater Trauma Registry to compile data that will provide insight into future improvements, and a leadership system to ensure better joint and combined medical resource cooperation and utilization.[1]

To build upon this success and to prepare for the future, we must first know what we face. In 2004, the Chairman of the Joint Chiefs of Staff described our current security environment as including a wider range of adversaries and a more complex and distributed battlespace from austere to urban environments with anticipated conflicts including "traditional" (other nations), "irregular" (terrorist organizations), "catastrophic" (weapons of mass destruction), and "disruptive" (technology use against stronger opponents).[2]

So the question at hand is not how to adapt our military (including our medical support) to our current conflicts (OEF and OIF). Quite the opposite, we should determine how the military can transform to meet the predicted near-future threats. In 2005, the Army Chief of Staff clearly articulated our charge:

> Modularity is the Army's major force transformation initiative which involves the total redesign of the operational Army into a larger, more powerful, flexible, and deployable force…An operational Army organized around modular Brigade Combat Teams and support forces will better meet the challenge of the 21st Century security environment…[3]

As military surgeons, we want the Army Medical Department to keep pace with this necessary transformation along with the rest of the Army. Our current theater trauma assets, including the battalion aid station, medical evacuation, the forward surgical team, and the combat support hospital, are working adequately after several years of focused development. However, these components alone may be inadequate to meet our future needs. An evidence-based literature review was performed and a modular, theater-based hospital system utilizing a comprehensive trauma system model is suggested. This review articulates an evidence-based, proactive solution, one that can be applied in near-future, anticipated operational environments.

METHODS

A literature search was performed covering topics relevant to military and civilian trauma systems, battlefield and combat casualty care, timing of trauma care, the "golden hour" concept, helicopter evacuation, and published reviews of world trauma experiences over the past 30 years. Over 100 articles from the literature were reviewed, 50 of which were determined to contain the most pertinent data. Articles were categorized as related to (*a*) civilian trauma systems, (*b*) military trauma systems, (*c*) presurgical trauma care, (*d*) medical evacuation times, and (*e*) medical evacuation system.

- Civilian trauma system lessons are taken from articles discussing Level I urban trauma centers, rural trauma centers, and how the different level trauma centers function together as a coherent system of trauma care.
- Military trauma system lessons are taken from articles that discuss the recent US experience and the experience of other nations with developed military trauma capabilities.
- Presurgical trauma care articles evaluated the role of the emergency medicine physician, advanced trauma life support (ATLS) interventions, triage criteria, and the components of a military trauma system.
- Medical evacuation articles deal with times to ATLS intervention versus surgical intervention, physiologic parameters, mortality curves based on injury type, the golden hour fallacy, the composition of the medical evacuation team, and prehospital triage.

Lessons from the literature are summarized by category. We provide recommendations for change of the US Army trauma system to meet future challenges.

RESULTS

Literature search results are divided into topics relevant to US Army combat trauma care. Topics include civilian trauma systems, military trauma systems, presurgical trauma care, medical evacuation times, and medical evacuation system. Evidence-based lessons for each category are listed in Table 1.

Civilian Trauma Systems

The origin of the civilian trauma system is well-documented in the literature[1,35,42] and can be traced to the National Highway Safety Act of 1966 (Public Law 89-564) which mandates that

> …coordination, transportation, and communication are necessary to bring the injured person and definitive medical care together in the shortest practical time…[42]

This has been a noble goal of both military trauma care and civilian trauma care since that time. The American College of Surgeons established state systems in 1976 with the initial publication of *Resources for Optimal Care of the Injured Patient* (2006 version available at: https://web4.facs.org/ebusiness/ProductCatalog/product.aspx?ID=194).

The benefit of trauma systems is decreased mortality. Injured persons treated at a designated trauma center have a lower mortality, but exactly why is unknown.[35]

Is it the presence of a trauma surgeon, the integrated and well-practiced trauma team, the decreased time to treatment and time to the operating room, or the

Table 1. Evidence-based lessons about trauma care derived from the literature.

Civilian Trauma Systems

1. Trauma systems improve mortality.[4-7]
2. Integration of designated trauma centers within a state improves outcomes.[4-7]
3. Initial treatment by ATLS-trained physicians at rural level III trauma centers decreases preventable deaths.[8-10]
4. Initial transport to a rural level III trauma center with only an ATLS physician does not increase mortality and may decrease mortality in rural areas even with delays of up to 4 hours to reach the level I trauma center.[6,11-13]
5. RTS <6.00 and hypotension in patients with chest or abdominal injury predicts a need for DCS prior to transfer to a level I center.[14]

Military Trauma Systems

1. Battlefields and tactics change over time and modern battlefields may contain multiple types of conflict simultaneously within the same battle-space.[15-18]
2. Combat trauma system contingency planning is important to remain prepared for future complex battlefields.[1]
3. Proper utilization of surgical resources within a trauma system improves survival within the system and up to 50% of potentially survivable injuries are surgical.[19,20]
4. The FST is proven in rapid, modern maneuver warfare and with modifications has succeeded in providing surgical and nonsurgical trauma care for stability and counterinsurgency operations in our current theaters.[21]
5. Current Army trauma system surgical and presurgical (ATLS) assets need increased modularly and flexibility to rapidly tailor trauma care for changing conflict types within a single, complex battlefield.[1,16-18,22]

Presurgical Trauma Care

1. Prehospital paramedic care decreases mortality and increases trauma system efficiency.[23]
2. A large portion of trauma patients can be treated or temporized by EM physicians performing ATLS level LSIs.[24-26]
3. EM physicians are currently underutilized within the Army trauma system.[24,25]
4. Using EM and highly-trained ATLS physicians in the presurgical portion of the trauma system can increase system efficiency and resource utilization.[24-27]
5. Certain patients always need early surgeon involvement for life-saving surgery (hypotension with penetrating neck and torso trauma).[27,28]

Medical Evacuation Times

1. The golden hour was a “best guess” rule-of-thumb created 30 years ago and was not based on data.[29]
2. Combat trauma deaths likely occur in a bimodal distribution with the first peak of death from immediately after wounding to 15 minutes and the second peak at 60 to 180 minutes.[19,30-32]
3. The time distribution of death is highly dependent on type of injury and not all injuries produce temporal-based peaks of death (specifically severe head injury).[32]
4. High-level enroute care may decrease mortality despite longer evacuation times.[33]
5. Prehospital care in the military system is divided into ATLS facility care and surgical facility care.[33,34]
6. By reviewing TPtoA and TPtoS data, we can begin to describe which injuries require rapid initial ATLS care versus surgical care.[32,35,36]

Medical Evacuation System

1. Advanced care (paramedic-level and above) during transport of the severely wounded improves survival.[37-39]
2. A template for each type of conflict with specific MEDEVAC triage criteria to determine appropriate enroute and presurgical treatment is needed.[22,34,39]
3. Research is needed to determine the physiologic and anatomic parameters for appropriate enroute treatment and triage (ATLS versus surgical).[39-41]

GLOSSARY

ATLS - advanced trauma life support
DCS - damage control surgery
EM - emergency medicine
FST - forward surgical team
LSIs - lifesaving interventions
MEDEVAC - military medical evacuation
RTS - revised trauma score
T_{PtoA} - time from point-of-injury to the first ATLS facility
T_{PtoS} - time from point-of-injury to first surgical facility

mature intensive care unit staff and protocols? It is unknown which of these components is the most important for improvement in outcome. The applicability of results from civilian trauma systems to the military situation is unclear. There are several differences between these 2 types of trauma. Military trauma produces more complex injuries than those seen at modern urban trauma centers. Military injuries often occur in larger numbers and in more austere locations than even the most rural parts of the United States. Despite these differences, it is still reasonable to evaluate civilian data for its applicability to the military setting.

In 1979, West, Trunkey, and Lim studied trauma in the city of San Francisco versus the much larger suburban land area of Orange County, California.[15] There were more preventable deaths in Orange County, an area without a trauma system, than in San Francisco. In a further review of trauma system development in 1985, Cales and Trunkey found that studies of trauma systems showed improved outcomes over areas that did not have organized systems.[43] Other recent studies continue to show decreased mortality of 15% to 25% in designated trauma centers and trauma systems.[4-7] Surgeons who trained in urban medical centers prior to the era of the trauma system and then went to work at other hospitals observed that it was:

> …impossible to deliver optimal care to injured patients outside urban trauma hospitals; a surgeon's individual effort was not enough when a systematic approach to trauma care did not exist in an area.[42]

In 1991, the University of Michigan Medical Center compiled its 4-year data to determine if patients still benefited from the trauma center if they were first seen at an outlying center, then transferred to the level I center after initial treatment. Survival of 469 blunt trauma patients received from outlying centers after an average of 4.7 hours was identical to predicted survival when compared to national norms.[11]

A similar study in Vermont in 1999 concluded that initial stabilization of trauma patients at an outlying facility does not increase mortality. Their data showed an average time of 182 minutes at the referring hospital with an average transfer transport time to the level I center in Vermont of 72 minutes. Patient injury severity score (ISS) and age contributed to mortality ($P = .0001$), but transfer times did not ($P = .473$).[12]

A study of 2003 data from Rhode Island demonstrated that hypotensive patients who were transported to the level I trauma center from an outlying hospital had a 38% mortality versus a 5.1% mortality for transferred patients who were normotensive ($P \leq .001$). The 2 groups had a similar emergency department (ED) time at the referring hospital (134.3 minutes versus 167 minutes, $P = .114$), but the hypotensive group had a significantly higher ISS (29.6 versus 15.6, $P \leq .001$) and lower Glasgow Coma Score* (8.1 versus 12.7, $P = .001$).[44]

Data from the Carolinas Medical Center collected over a 7-year period from 1996 to 2003 regarding transfers from level III facilities compared with other nondesignated facilities showed significantly improved outcomes in patients treated first at level III designated centers prior to transfer. Average scene time for these patients was 18.6 minutes, average transport time was 12.0 minutes, and average stay in the level III ED was 120 minutes. Despite the long ED times at the outlying level III referral centers, patients did better when seen in these facilities first as compared to other nondesignated referral hospitals.[6]

Most recently, the literature and the focus of the trauma community has shifted to an examination of the quality of rural trauma care.[14] A 1995 preventable death study in rural Montana concluded that "factors such as time to definitive care may not be as important as the type of care rendered during that time…"[8] The study found a preventable death rate of 13% and a rate of inappropriate care of 32%. Fifty-nine percent of preventable deaths occurred in the ED and were the result of poor initial trauma management techniques dealing with airway control, the recognition of chest trauma, volume replacement, hemorrhage control, and delayed surgical intervention. It was hypothesized that such deficiencies were attributable to lack of knowledge of ATLS among physicians working in the rural EDs.[8]

A 1996 study in rural northern Michigan showed results similar to the Montana study. The preventable death rate was 12.9% and included primarily inappropriate prehospital care (23%) and inappropriate ED

*The Glasgow Coma Scale is a quick, practical, standardized system for assessing the degree of consciousness in the critically ill and for predicting the duration and ultimate outcome of coma, primarily in patients with head injuries. The system involves eye opening, verbal response, and motor response, all of which are evaluated independently according to a rank order that indicates the level of consciousness and degree of dysfunction. Source: *Mosby's Medical Dictionary*. 8th ed. St Louis, MO: Mosby-Year Book, Inc; 2009.

trauma evaluation and treatment, especially regarding airway and hemorrhage control (39%).[9] This study again highlighted the importance of adequate ATLS skills in initial trauma treatment in the ED.

A 2002 study comparing data from Oregon and Washington during the period January 1991 to December 1994 highlighted that centers designated as level III and those preparing for designation both have 24-hour coverage in the ED by ATLS trained physicians and have equal risk-adjusted odds of death. When probability of death was compared with observed deaths, both of these hospital categories had more excess survivors than level IV and level V centers that did not maintain ATLS trained physician coverage.[10]

A publication in 2003 provides data on patients undergoing damage control surgery (DCS), specifically exploratory laparotomy, at a rural hospital prior to transfer to a regional trauma center. It concluded that DCS at a rural center prior to transfer does not affect mortality.[13]

A study from rural Missouri level III centers in 2007 indicates that approximately 1% of trauma patients at these centers will need a chest or abdominal operation. Approximately 3% of patients had a revised trauma score (RTS) below 6.00, and approximately 2% were hypotensive on admission. The data indicated a potential need for DCS prior to transfer to a level I center.[14]

In conclusion, the implementation of trauma systems in the civilian sector has resulted in improved outcomes for trauma patients. The presence of level III centers that have ATLS-trained physicians on duty 24 hours a day decreases preventable deaths in rural areas. The transportation of a patient to a designated level III center with the subsequent delay in arrival at a level I center, even up to 4 hours, does not increase mortality, and may decrease mortality in rural areas. An RTS less than 6.00 and hypotension in patients with chest or abdominal injury may determine a need for DCS prior to transfer to a level I center.

Military Trauma Systems

Civilian and military trauma have a shared history over the past century as lessons learned from major wars and conflicts have translated into advances in civilian trauma care. Complimentary advances in civilian trauma care during times of peace have affected the way we manage military trauma. There have been 4 significant areas of development in the past century: wound care, control and correction of blood loss, prevention and treatment of organ failure, and organization of surgical care.[16]

In World War I, the US Army fought a major war against an opposing nation on a continental scale. Trench warfare and artillery use were prevalent tactics. Removal of injured soldiers from "no-man's land" was difficult, and evacuation times to first physician medical care averaged 12 to 18 hours.[15] World War II brought motorized vehicles and tanks with rapid maneuver warfare. Transportation advances resulted in a decrease in casualty transport times of more than 50%.[15] Additionally, injured soldiers were resuscitated with fluids and blood, and there were advances in surgical care. Starting in 1942, auxiliary surgical groups treated casualties at locations which, by that day's standards, were considered close to the front lines.[17]

During the Korean Conflict, helicopters were used for the first time to bring battle casualties directly to the mobile army surgical hospital (MASH), decreasing time from injury to surgical treatment to 4 to 6 hours. In Vietnam, transport time was further decreased to 1.2 to 5 hours from the point-of-injury.[16] During Operation Desert Storm, the MASH was not able to keep pace with the rapidly advancing ground assault. Portions of the MASH were used as smaller surgical teams and moved forward more rapidly in support of the forward edge of the battle area.[18] Modern technology and tactics used for this large-scale invasion outpaced surgical support assets. Recognizing this shortfall in surgical support, the Army created the forward surgical team (FST).

During the initial phases of Operations Enduring Freedom and Iraqi Freedom, FSTs were used to provide combat surgical support. OEF was primarily a special operations fight in an austere and geographically challenging environment (Afghanistan). Initial life- and limb-saving surgery was performed by 2 FSTs. The battlefield slowly shifted to conventional units performing full-spectrum operations after the initial downfall of the Taliban. Change in conflict type created a change in optimal FST utilization. Efficient placement of surgical assets in this theater continues to be influenced by medical evacuation limitations,

including a rugged geography and difficult winter weather.

During the initial phase of OIF, FSTs successfully provided surgical support for a rapidly advancing conventional force. After the capture of Baghdad, the establishment of the combat support hospital (CSH) and the freedom of movement for medical evacuation helicopters minimized time from injury to arrival at surgical care throughout the theater. The 17 surgical units (including FSTs and US Navy surgical units in support of Marine forces) still under the operational control of combat commanders were no longer needed.[18] In this theater, reevaluation of surgical resource utilization did not occur immediately after completion of the maneuver phase. Both of these recent conflicts demonstrate the lack of well-defined planning parameters by which to determine the optimal trauma resource utilization for support of the Army as it rapidly transitions between various stages of warfare and between various conflict types.

In 2004, the US military jointly collaborated to introduce a theater trauma system for OEF and OIF. Along with appointing a trauma director over the 2 theaters, improvements included recommendations for optimal placement of surgical assets, effective utilization of surgical assets, development of triage criteria for casualty evacuation, and implementation of trauma clinical practice guidelines. Since that time, there have been marked improvements. Noteworthy advances have occurred regarding prevention of injury, point-of-injury battlefield care by the combat medic, information management systems, data gathering and research, and predeployment education.[1]

Our current experience in OIF compares favorably to Vietnam and World War II. In 2007, Bellamy[45] compared the killed-in-action statistic (see inset) of 16.1% in OIF versus 21.1% in Vietnam. Interestingly, the died-of-wounds statistic (see inset) of 5.3% in OIF was higher than in Vietnam (3.3%). Likely contributing factors for this difference are improved body armor and advances in battlefield care decreasing immediate KIA numbers. These results beg the question of the best design of a military trauma system that provides optimal point-of-injury care, the most rapid evacuation to ATLS care or surgical care, and rational utilization of scarce trauma resources to produce the best outcomes for casualties of war.

Insightful data regarding causes of mortality in patients with potentially salvageable injury is available in 2 papers. Champion et al note that 50% of battlefield deaths are due to exsanguinating hemorrhage using all data from World War I to the Somalia combat. Of these, 80% are in noncompressible torso areas. They also show that 25% of the Vietnam ground combat KIA died of surgically-uncorrectable torso injury, 10% died of surgically-correctable torso injury, and 9% died of exsanguinating extremity wounds.[19] Kelly et al compare deaths from 2003 and 2004 to deaths in 2006 in OEF and OIF. Among potentially survivable injuries, 83% were due to hemorrhage. Among these, 49% were noncompressible torso hemorrhage, 21% were hemorrhage not amenable to tourniquet placement (axillary, neck and groin regions), and 33% were hemorrhage amenable to tourniquet placement.[20] Overall, this data suggest that some KIA from penetrating torso injury, possibly up to 50%, are potentially salvageable by an immediately available and appropriately placed surgical team.

Most recently, Eastridge et al reviewed Joint Theater Trauma Registry data from April 2004 to April 2006. They compared outcomes for US military battle casualties that were admitted first to the FST versus a CSH. With comparable ISS scores, he found no significant difference in DOW rates between the 2 groups. They conclude that both the FST and the CSH have equivalent trauma outcomes.[21]

It is useful to also examine the combat trauma system of the Israeli Defense Forces (IDF) as they are a modern military and have been engaged in multiple conflicts of a varying nature throughout the last half century. Their military medical support is structured around 3 types of conflict. In a full-scale war, they place nonsurgeon physicians, trained in "military trauma life support" (MTLS), their version of ATLS adapted to battlefield conditions, at battalion and

Killed in Action: percentage of immediate deaths among all seriously injured (those injured not returning to duty within 72 hours).

Died of Wounds: percentage of deaths following admission to a medical treatment facility among all seriously injured (those injured not returning to duty within 72 hours).

Source: Holcomb et al[46]

brigade levels. They also train paramedics for combat and for medical evacuation helicopters. Their small surgical units remain part of their field hospitals until needed for specific missions or for an unexpected event. During low-intensity conflicts, medical teams with MTLS-trained physicians deploy along their border. Civilian level I trauma centers are used as military surgical support. Wounds are treated and temporized by the border MTLS teams if the evacuation time to the trauma center is more than 30 minutes. The IDF finds no benefit in delaying transport to the trauma center to stabilize the patient if evacuation time is less than 30 minutes. "Team-10" is the Israeli mobile surgical unit developed for support of IDF special operations missions. It can be recalled and moved by helicopter or by small boat within 30 minutes of notification.[22]

In summary, military battlefields and tactics change over time. Our combat trauma systems and components must change to keep pace with the changing requirements of the modern battlefield. The FST has proven itself successful as a supporting trauma surgical asset for modern, rapidly advancing, conventional warfare. With modifications, the FST has also successfully filled the role of providing surgical and nonsurgical trauma care at below the theater military role III setting for current stabilization and counterinsurgency operations with proven equivalent outcomes when compared to the role III CSH facilities. Placement and appropriate utilization of surgical assets within the current battle environment is of the utmost importance as up to 50% of potentially survivable KIA injuries may be surgically correctable. The appropriate mobile surgical asset capable of maintaining modularity and flexibility for the rapid shifts in conflict type within a single, complex battlefield has yet to be designed. Providing a theater trauma system with the capability to rapidly and seamlessly blend surgical and nonsurgical trauma capabilities to support these rapid shifts is the next challenge.

Presurgical Trauma Care

The care of civilian trauma patients starts with the first responders and proceeds through evacuation to a trauma facility. Civilian level I/II trauma centers will have emergency medicine (EM) physicians and trauma surgeon teams available at all times for serious injuries, comparable to the capabilities of the theater CSH. A civilian level III trauma center will have an EM physician with a plan for trauma surgeon recall if needed. The military equivalent of the civilian level III trauma center includes treatment at both an ATLS facility (the level III emergency department) and a surgical facility (the level III with surgeon activation). Thus, in the military it is possible to render presurgical lifesaving interventions (LSIs)[47] at an ATLS trauma facility without necessarily having the trauma surgical capabilities at the same location.

Several reports in the literature focus on military presurgical care. In a 1999 article, Husum cites data from the battle of Jalalabad (1989-1992). Comparing the effect of untrained first responders in 1989 to data collected after the institution of paramedics in the battle zone, prehospital mortality decreased from 26.1% to 13.6%. These paramedics were trained to provide basic lifesaving techniques plus intubations, chest tubes, bleeding control, intravenous fluid, antibiotics and analgesia. They were also trained to determine if a patient was unstable and needed immediate surgical intervention, and those patients were immediately diverted to the surgical hospital in Peshawar, Pakistan, arriving in 5 to 7 hours. Other patients were treated on-scene and arrived at the nearest clinic in an average of 20 minutes as compared to the previous 90 minutes.[23]

A 2008 report of a US Marine Corps shock trauma platoon (STP) by Sallee et al describes the work of a military role 1, contingency-based, initial trauma response team. The team is designed to be staffed with 2 EM physicians as well as a physician's assistant, a registered nurse, and 11 corpsmen. During OIF II in March 2004, STP-2 treated 141 combat related casualties with only 3 DOW. Interventions included 2 emergency thoracotomies, intubations, chest tubes, blood transfusions, central lines, and FAST exams. This unit provided initial LSIs, allowing many patients to survive to reach the nearest surgeon.[24]

Gerhardt et al reports the unique experience over one year in OIF during which time Gerhardt was the emergency medicine physician at a battalion aid station (BAS) (military role I). Standard BAS equipment was available which did not include laboratory and x-ray capabilities or blood products. The article compares patients seen at the BAS versus aggregate OIF data over the same time period, with favorable results. With ISS equal between the 2 groups, the article notes a battle-casualty rate of 22.2% (versus 6.7% aggregate) and a DOW mortality of 2.8%

(versus 5.3% aggregate). The 5 DOW patients included one exsanguination from lower extremity amputations at the BAS, and 4 patients that survived to reach the next level of care but died later. Two patients had gunshot wounds to the head and two had gunshot wounds to the torso with reported "protracted" evacuation times to the BAS.[25]

The integration of care at the civilian level III trauma center with care at the level I trauma center is comparable to the integration of military trauma units forward of the CSH with the CSH. This equivalent military system of care can draw lessons from civilian data examining this relationship. The previously-mentioned study from Rhode Island in 2003 examined trauma victims brought directly to the level I trauma center (transport time < 20 minutes) and compared them to those brought to the nearest facility (> 20 minutes transport to level I center).[44] The data showed that overall hypotensive patients had a higher mortality (38% versus 5.1%). However, there was no association between ED time and mortality. The authors conclude that patients with severe trauma (ISS > 40) may benefit from ATLS at outlying EDs if evacuation time to the level I trauma center is long. In a commentary on the article, J. W. Meredith, MD, also notes that:

> There is…a degree of preventable injury, preventable death, which cannot be addressed by simply having a good trauma center in the middle of a population. That is the part where a trauma system comes in.[44]

Another key component of the civilian trauma system is the EM physician who is trained to provide the ATLS LSIs in every civilian level I trauma center. Before the creation of the EM physician, emergency rooms were staffed with physicians without appropriate trauma training to provide the stopgap measures needed to temporize the patient until seen by a trauma surgeon. Thus, trauma surgeons evaluated and treated all trauma patients regardless of need for surgery or continued intensive care. Additionally, operative management was much more common prior to the development of the CT (computed tomography) scanner. Today, well-trained EM physicians are capable of initially managing and treating a majority of moderately injured trauma patients and provide important ATLS interventions in conjunction with or prior to arrival of the trauma surgeon, or sometimes even independently at certain trauma centers.[26] Although many military trauma patients will eventually require surgery, most such surgeries are not life- or limb-saving and can wait up to several hours. Thus, most combat surgery can be performed later at the theater trauma hospital after the patient is seen by an EM physician shortly after being wounded.

The American College of Surgeons mandates surgeon presence for major criteria that include hypotension, respiratory compromise, penetrating gunshot wounds to the neck, chest, abdomen, or pelvis, and a Glasgow Coma Score < 8.[27] However, Green argues in a 2006 article for the use of "secondary triage criteria." This allows primary triage on the scene and then secondary triage at the trauma center to determine the need for the presence of the surgical trauma team. He rightly argues that for certain traumas, a surgeon may not be needed immediately. For example, an EM physician can manage a head injury requiring intubation, initial ATLS, and a head CT before neurosurgeon consultation.[26] There is little role for the surgeon in this case. In his commentary on Green's article, Moore supports this premise but also reaffirms the overarching role of the trauma surgeon in the care of trauma patients:

> I submit the strategic question is *when* the surgeon should assume responsibility for the patient with potential significant injuries in the ED, not *if* the surgeon should be involved during the ED phase of trauma care…I strongly believe that the trauma surgeon must be present for the resuscitation and decision making for patients who may need early operative intervention because this will save them.[28]

In 2007, Markovchick and Moore wrote that protocols for trauma surgeon presence should be created with the goal:

> …to have a trauma surgeon present on arrival for those patients who have a high likelihood of going to an operating room immediately for life- or limb-threatening injuries.[27]

They summarize that a "needs assessment" should be done in communities to determine how many and of what level trauma centers are needed to support the population. The creation of new trauma centers should be:

> …limited so that the valuable resources and expense of trauma care can be kept to a minimum while at the same time ensuring optimum outcome.[27]

To summarize, our Army trauma system does not have a modular, fixed facility system that provides both the central theater care (civilian level I-type trauma center) and the outlying center care (level III-type, fixed-

facility). The military may benefit from a single unit that incorporates both of these aspects of the system. Beyond this level of care, specific presurgical trauma units and paramedics can provide near–point-of-injury (near-POI) ATLS care. Currently, only surgeons at FSTs are filling this ATLS role, in addition to their surgical role.

A significant portion of trauma patients can be treated initially by EM physicians and paramedics performing ATLS level LSIs near the point-of-injury in outlying locations. Although most penetrating military trauma will eventually require surgical involvement, much of this trauma can be first stabilized with ATLS, extending the survival time until surgery at another location. Military EM physicians are currently underutilized in this role. Using EM physicians to their full potential may improve survival within this presurgical, near-POI portion of the military trauma system, and it may increase system efficiency and resource (especially surgical resource) utilization.

Some EM physicians and trauma surgeons are advocating the development of secondary triage criteria for alert of the trauma surgeon teams. Still, a subset of trauma patients must have early trauma surgeon involvement to save life and limb. Specifically, these include hypotensive patients with penetrating neck and torso wounds.

Medical Evacuation Times

Bellamy et al point out that 80% to 90% of casualties that survive to evacuation have little chance of dying, and that military trauma has an "all-or-none nature."[48] In another article, Bellamy even asks whether there is only a "platinum 5 minutes."[49] Champion et al propose that:

> Those with ongoing hemorrhage of a rate that does not result in prompt exsanguination might benefit from resuscitation strategies, tactics, and techniques that aim to stretch the mythical golden hour to a 4- to 6-hour window before definitive care can be exercised.[19]

A review of the literature and how times affect our trauma system is more pertinent now than ever.

The term "golden hour" is traced to Cowley, who in a 1974 speech to the American Academy of Orthopedic Surgeons stated that "care given in the first hour determines the extent of organ damage." He goes on to say that "it may even be that we should be talking about the first golden fifteen minutes as a vital period."[29] To be clear, there were no published data to support his statements.

Turning to the literature, we find relatively sparse data regarding prehospital times and survival. A Swiss study published in 2002 reviews data on patients separated into 2 groups, the first with prehospital times < 60 minutes, and the second with times > 60 minutes. Median ISS scores were similar and time to ED had no influence on mortality ($P = .057$). Although the P value approached significance, the "death < 1 day percentage" was actually higher for the < 60 minute group when compared to the > 60 minute group (73 deaths versus 40 deaths respectively). Also noteworthy was the fact that within the > 60 minute group, 91% of transports had an EM physician on the scene (scene time of 34 minutes) compared to the < 60 minute group that had an EM physician on the scene only 49% of the time (scene time of 17 minutes). In the > 60 minute group, more EM physicians were on the scene and scene times were longer, but patients had a lower mortality that approached statistical significance.[30]

A 2002 study by Clark was significant in that it segregated times to the ED and times in the ED (prior to the operating room). Of 243 patients with a systolic blood pressure (SBP) < 90 from the Pennsylvania Trauma Systems Foundation trauma registry, total time from injury to the operating room was 28 to 938 minutes, with a median of 110 minutes. The relative risk (RR) of death was significantly higher in those with SBP < 60 (RR $= 2.40$) versus those with SBP > 80 (RR $= 0.62$) and a SBP > 90 (RR $= 0.45$). Risk of death was not influenced by the prehospital time. Risk of death was significantly increased at an ED time of 60 to 90 minutes and with a total time (prehospital time plus ED time) of 60 to 90 minutes.[31]

A different review of penetrating torso injuries in patients aged 18 to 45 years from the Pennsylvania trauma registry was cited by Champion in 2003. It significantly related an increased risk of death and a decreased time to death with worsening hypotension as shown in Table 2. With a SBP < 90, time to death was still 188 minutes, and with a SBP < 75 time to death was 161 minutes.[19]

An interesting article by Demetriades et al regarding data from Los Angeles County (California) was published in 2005. Data was collected on 3,549 trauma

center deaths and 602 scene deaths. Scene deaths reflected a significantly higher percentage of penetrating trauma deaths than blunt trauma deaths (24.8% versus 15.8%). The time distribution of penetrating trauma deaths showed 24.8% dead on the scene, 38.9% dead in less than one hour, 19.0% in one to 6 hours, 7.1% in 6 to 24 hours, and 10.2% in more than 24 hours (Figure 1). The authors conclude a bimodal death distribution supporting a less than and greater than one-hour division. However, they do not attempt to break down data based on times shorter than one-hour and the category of "one to 6 hours" is relatively broad. Additionally, they examined the temporal distribution of trauma deaths of severe (abbreviated injury score (AIS) ≥ 4) versus not severe chest trauma (AIS < 4) and concluded that a higher percentage of those with severe chest trauma died within the first hour (Figure 2). A similar analysis of severe versus not severe head trauma showed that there was no peak of death in those with severe head trauma (Figure 3). Adjusted odds ratios of death within one hour of injury were calculated and were found to be 2.21 for penetrating versus blunt trauma, and 4.35 for severe chest trauma.[32]

Finally, in 2008 Haas et al studied patients with hypotensive penetrating trauma and blunt traumatic brain injury in trauma centers and nontrauma hospitals. They noted that the relative risk of death was lower at trauma centers versus nontrauma centers (RR = 0.61). The survival advantage was the largest for patients with penetrating trauma and shock (RR = 0.43) and with traumatic brain injury (TBI) with mass effect (RR = 0.72). Interestingly, however, there was no difference in time to operation in patients with penetrating injury (61 minutes versus 41 minutes respectively, $P = .20$) and no difference in times to assessment and intervention in patients with TBI (3.3 hours versus 3.6 hours respectively, $P = .17$). This raises the question as to the cause of improved outcomes in trauma centers since more rapid transport, evaluation, and intervention were not present in trauma centers. The authors conclude that improved critical care, increased physician experience, and improved interdisciplinary communication at trauma centers may lower the relative risk of death.[35]

Table 2. Risk of death and average time to death in civilian settings by systolic blood pressure*

Systolic Blood Pressure (mm Hg)	Risk of Death	Time to Death (min)
90 +	0.042	419
76-89	0.061	188
50-75	0.458	161
< 50	0.95	18

*Data from Champion et al.[19]

There is no published comprehensive US military review of prehospital or medical evacuation data. However, in 2007 McLeod et al discuss prehospital times for United Kingdom (UK) personnel in Afghanistan and Iraq during 2006 and 2007. They note that in the study group of 528 casualties, median times of

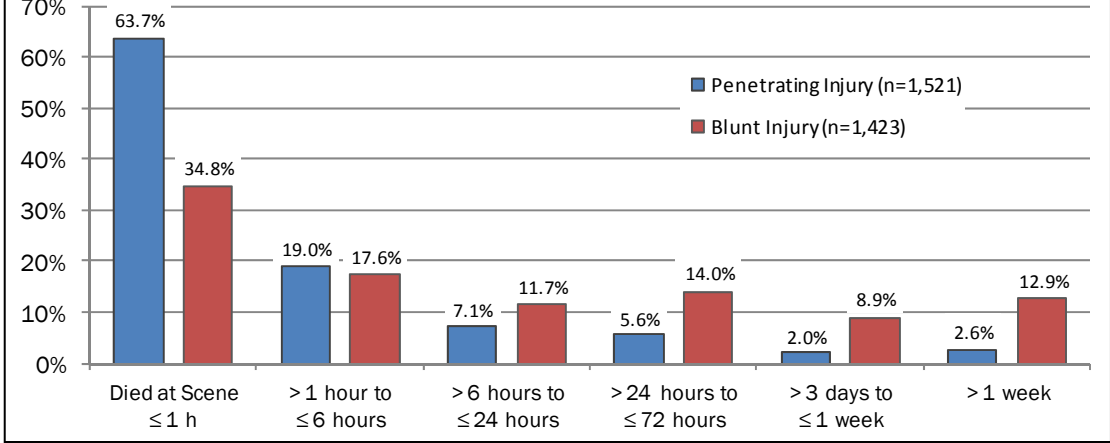

Figure 1. Temporal distribution of trauma deaths according to mechanism of injury (Los Angeles County, January 2000 to December 2002). Data from Demetriades et al.[32(p346)]

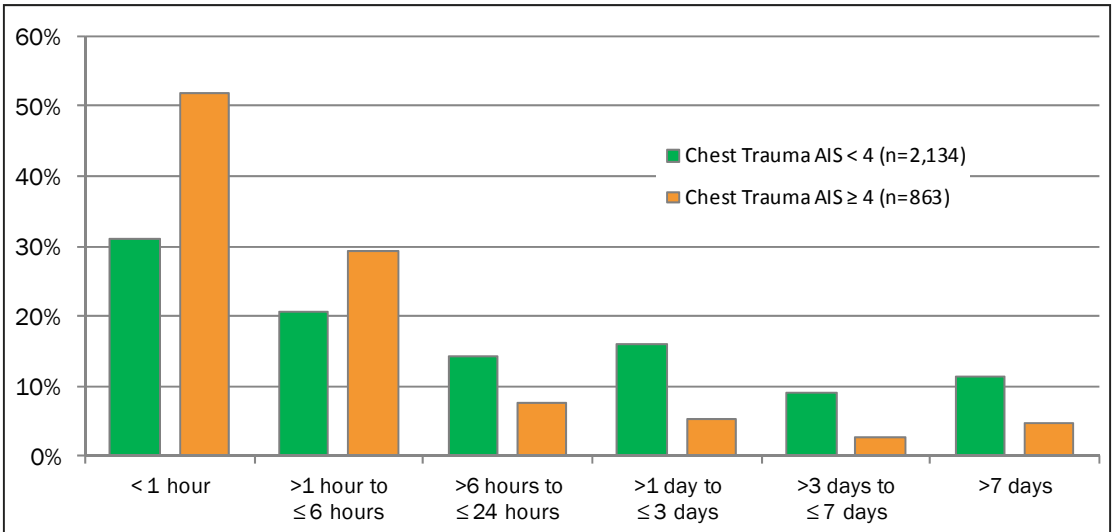

Figure 2. Temporal distribution of trauma deaths according to severity of chest trauma (Los Angeles County, January 2000 to December 2002). AIS indicates abbreviated injury score. Reproduced from Demetriades et al[32(p347)] with permission.

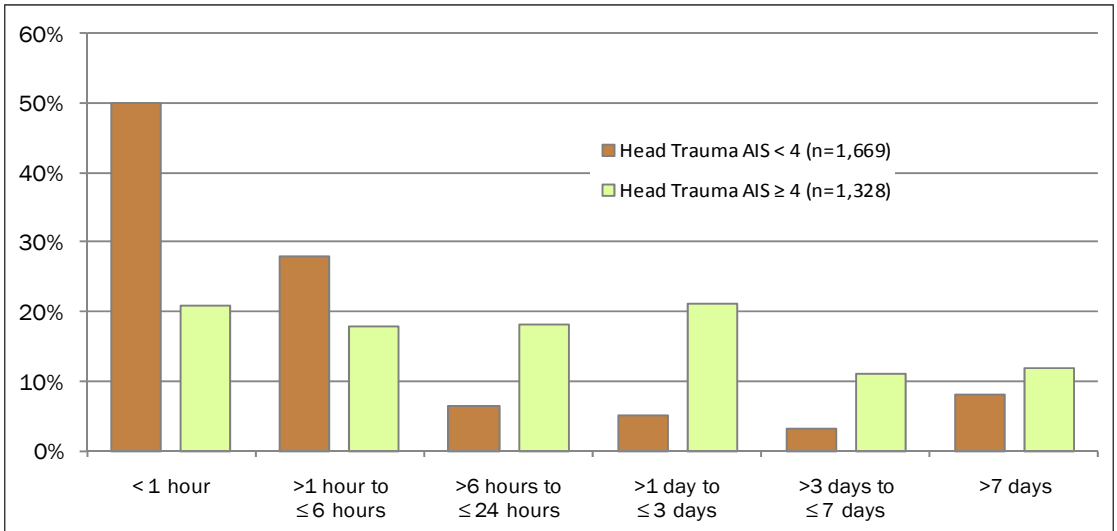

Figure 3. Temporal distribution of trauma deaths according to severity of head trauma (Los Angeles County, January 2000 to December 2002). AIS indicates abbreviated injury score. Reproduced from Demetriades et al[32(p347)] with permission.

injury to arrival of the medical emergency response team (MERT) was 80 minutes, median time on scene was 5 minutes, and median time of injury to handover at ED 120 minutes. For all UK military immediate ("T1") patients, evacuation times were not different than civilian UK "Category A" calls (99 minutes versus 70-80 minutes). The author also notes the addition of a physician on the "MERT-enhanced" helicopter evacuation teams. Compared to the UK civilian system,

> The effect of a prehospital time extended over urban civilian models is ameliorated by the seniority of the attending clinical team and the range of advanced intervention that can be performed in transit.[33]

In another article from 2007, Parker reports a review by the UK military Consultant Orthopedic Surgeon of the military planning time rule of "1:2:4." The battlefield casualty should have advanced first aid within one hour, resuscitative surgery if needed within

2 hours, and definitive surgery within 4 hours. Although he concedes that no published data exists to back this doctrine, he did review the UK, Palestinian, and Israeli data. From this he notes that "a goal of less than 30 minutes is clearly simplistic, futile, and simply unachievable." Also,

> Over 4 hours, the data now suggests that this is when the head injured succumb to secondary brain injury and the slow torso and junctional bleeders start to die. It is also when bacteria on superficial wound surfaces begin to divide and penetrate tissue.

No further data is provided. He concludes that "We should aim to have the wounded soldier in the well-resourced operating theatre at the 2- to 3-hour point."[34]

Finally, extraordinary data published in 1992 from Cutting and Agha describe Cutting's experience over 18 months as a surgeon in the Bourj al Borajneh refugee camp in Beirut, Lebanon in the late 1980s. Her surgical facility was within the camp and no farther than 250 meters from all of the wounded. Of 1200 wounded, there were 160 deaths. Fifty-two percent were dead on arrival (< 5 minutes), 12% were dead prior to initializing interventions (5 to 15 minutes), 11% had unsalvageable central nervous system injury, and 9% had uncontrollable hemorrhage. So despite having a surgical facility virtually at the location of injury, she concludes that 84% of deaths could not possibly be prevented.[36]

In summary, despite the classic description of the golden hour in trauma care, currently available evidence does not support such a concept for most injuries. Current data show a bimodal distribution of death after serious trauma with the first peak of death from immediately after wounding to 15 minutes, and the second peak between 60 and 180 minutes. Interestingly, mortality of severe head injury is not associated with a peak in occurrence of death and shows an even temporal distribution.

The one category of injuries most likely to respond to early surgical intervention is penetrating thoracic and abdominal injuries with hypotension, which are predictive of earlier death.

A higher level of enroute care may decrease mortality despite longer evacuation times. Risk of death is lower in trauma centers versus nontrauma centers due to factors that remain obscure but not related to time of care. It is likely that combat injuries can be divided into several groups: those that require rapid surgical evaluation and intervention (eg, penetrating torso injury with hypotension), those that require eventual surgery (major orthopedic injuries), and those that can be cared for without surgery (eg, severe head injury).

Evacuation time can also be divided into 2 components in the military realm. They are time from point-of-injury to the first ATLS facility (T_{PtoA}), and time from point-of-injury to first surgical facility (T_{PtoS}). By distinguishing between these different evacuation times, we may describe which injuries require more rapid ATLS care versus surgical care. This may help improve future triage criteria used by paramedics and EM physicians near the point-of-injury.

Medical Evacuation System

A trauma system will incorporate efficient medical evacuation. Identifying presurgical facility and pre-ATLS facility treatment and triage criteria will markedly improve this system. In 1988, West et al commented on the current status of trauma systems and explained that to improve the system, prehospital care must include a medical control element, field treatment protocols, a communication method, and training for personnel. Furthermore, formalized triage criteria should be developed to bring the trauma patients with the worst injuries to the most appropriate facility.[50] This was reemphasized by Johnson et al in 2001 in an article examining data on patients with exsanguinating penetrating abdominal injuries. The authors noted that "…it is our belief that measures taken in the early minutes after injury may significantly impact patient outcome." They defined this initial treatment as "damage control ground zero (DC0)."[51] The Denver trauma system uses specific prehospital triage criteria (Table 3) based on physiologic and anatomic parameters.[32] Development of this component of the military trauma system is exactly what Eastridge et al advocate and what the Joint Theater Trauma System continues to advocate with its motto, "Right Patient, Right Place, Right Time."[34]

Military medical evacuation (MEDEVAC) from point-of-injury to ATLS or surgical facility involves more than simply care in a helicopter. Army Flight Medics (FMs) must be soldiers and aircraft crew-members trained to be proficient in hostile environments. Also FMs must work with limited available resources due to

tactical constraints. Finally, although formally trained by the Army at the EMT-B level, most obtain the skills necessary to perform more advanced LSIs.[37] Provision of advanced formal training for FMs and appropriate triage criteria may improve the overall Army trauma system.

A 2007 article by Holcomb et al reviews causes of death among US Special Forces Soldiers. They conclude that 8 deaths may have been prevented with more rapid transport to a surgical facility.[38] Unfortunately, rapid MEDEVAC in the special operations environment is not always possible, but the article does highlight that some deaths may be prevented by LSIs performed by Special Forces medics in the field, by LSIs at an ATLS facility, and by life-saving surgery at a surgical facility. Also, some deaths are simply not preventable.

In a 2005 article, Holcomb et al advocate the use of initial SBP < 90 and Glasgow Coma Score (GCS) motor < 6 as a predictor of mortality and the need for advanced care.[40] In 2006, Eastridge et al reviewed physiologic parameters in 1,127 wounded and determined that SBP, temperature, GCS, hematocrit, pH, base deficit, and ISS were all significantly different between survivor and nonsurvivor groups. The only parameter that was not different was heart rate. Furthermore, all of these parameters except GCS were significantly different in groups divided by those that needed an operation and those that did not.[41] This data is evidence that supports use of the SBP as a triage parameter.

In 2007, Davis et al reviewed the prehospital literature to determine the composition and benefit of the MEDEVAC team for the UK military. He concluded that a team with a physician with critical care skills will have improved outcomes in patients with major trauma, earlier intubation and ventilation in severe head-injured patients improves survival, and the use of chest tube drainage and controlled ventilation will improve outcomes of patients with severe thoracic injury. The authors note that the UK system uses a flight nurse and flight paramedic on its MERT.[39]

The Israeli Defense Force (IDF) also uses personnel with advanced training on its MEDEVAC teams. Based on the Israeli Surgeon General's review of the literature, he advocates training for all military physicians in military trauma life support (MTLS). The team of an MTLS-trained physician and a paramedic makes up the IDF MEDEVAC team. IDF evacuation policy separates wounded by those with or without hemorrhagic shock. If hemorrhagic shock is controlled and evacuation time is less than one hour, the team will secure airway and breathing, "scoop and run," and start an IV enroute. If the evacuation time is more than one hour in the same scenario, the team will secure airway and breathing and start an IV with fluids at the scene first. In those cases with hemorrhagic shock with uncontrolled hemorrhage, the team will "scoop and run" and start an IV enroute after controlling the airway and breathing in cases where evacuation time is less than one hour. If evacuation time is more than one hour, the team will do the same but will give minimal colloid IV fluid until surgical intervention is available.[22] The British characterize this Israeli approach that is used in their low-intensity conflicts centered around their own country's level I trauma centers as a "zero-echelon medical plan" with the motto "don't stop, ever!"[34]

Table 3. Prehospital triage criteria for transport to a level I trauma center.*

Physiologic Parameters	Anatomic Parameters
Intubation	Penetrating injuries – head, neck, torso, pelvis
SBP < 90 mm Hg, or	Flail chest
Respiratory rate < 10 or > 29 with distress, or	Bilateral femur fractures
GCS motor score ≤ 5	Unstable pelvis or suspected significant pelvic fracture
	Paralysis or evidence of spinal cord injury
	Amputation above the wrist or ankle
	Significant burns
	Unreactive or unequal pupils

*Data from Demetriades et al.[32]

In summary, the literature recognizes that advanced care above the EMT-B level during transport of the severely wounded improves survival. Other modern nations are placing physicians with special training and paramedics on their military evacuation teams. A template for each type of conflict with specific triage

criteria to determine the appropriate enroute and presurgical treatment is needed.

Physiologic parameters to use for the system include SBP which has been linked to mortality and the need for rapid triage to advanced care. Further research and development is needed regarding best anatomic and physiologic triage parameters. An example triage template is included as Table 4.

RECOMMENDATIONS

Based on the above lessons from the literature as summarized in Table 1, the following recommendations will help transform the current US Army combat trauma system to keep it relevant for our military's future needs.

1. Increase training of combat medics and FMs to provide higher level of care at point-of-injury and during transport of patients. The temporal distribution of combat death is likely bimodal with the first peak of death at 0 to 15 minutes. Thus, of utmost importance to immediate survival is provision of ATLS care at the point-of-injury (akin to the described DC0). Combat medics and FMs should progress in training from EMT-B to EMT-P (based on tactical combat casualty care adaptations for the combat zone) during their progression to noncommissioned officers.

2. Develop MEDEVAC contingency plans detailing conflict-specific treatment and transfer triage protocols. Combat casualties enter the military trauma system most frequently via helicopter evacuation. Clear treatment protocols and transfer triage criteria should be developed to determine the patient's destination (ATLS trauma team, surgical team, or theater trauma center). These contingency plans, based on various conflict types, will best prepare MEDEVAC assets to rapidly assume maximum efficiency operations within the trauma system, even in unique theaters.

3. Augment current BAS to provide ATLS level of care. The ATLS facility should reflect our current civilian system of care by EM physicians at US civilian level I trauma centers. The BAS already exists as a framework within the combat battalions and should trans-

Table 4. Example template for MEDEVAC triage criteria.

Ground Point of Injury Triage

1. If patient can be transported by ground MEDEVAC to nearest ATLS facility < 20 minutes from time of injury (or within shorter time than air MEDEVAC time to transport to nearest facility), transport to ATLS facility by ground MEDEVAC.
2. If ground MEDEVAC > 20 minutes from time of injury to nearest ATLS facility (or longer than air MEDEVAC time), call for air MEDEVAC.

Air MEDEVAC Triage

1. If uncontrollable hemorrhage from penetrating neck or torso injury, transport to nearest surgical facility with the "don't stop, ever!" paradigm.
2. If initial SBP < 90 with controlled or controllable extremity bleeding, transport to nearest ATLS facility for resuscitation per ATLS guidelines, then on to surgeon at theater hospital
3. If initial SBP > 90 with controlled or controllable extremity bleeding, transport to surgeon at theater hospital
4. For 2 and 3 above – if tourniquet in place and time to theater hospital > 3 hours, transport to nearest surgical facility to preserve limb
5. If GCS < 15 with isolated head injury, transport to nearest ATLS facility for resuscitation per ATLS guidelines, then to CT scanner and neurosurgeon at theater hospital
6. If blunt trauma only, transport to nearest ATLS facility for evaluation per ATLS guidelines. After ATLS evaluation:
   - if SBP< 90, transport to nearest surgical facility
   - if SBP>90, transport to surgeon and CT scanner at theater hospital

GLOSSARY

ATLS - advanced trauma life support
CT - computed tomography
GCS - Glasgow Coma Scale
MEDEVAC - military medical evacuation
SBP - Systolic blood pressure

form to be a "Battalion Aid *and Trauma*" team or "BAT" team. To meet this capability, it should include EM physicians (or highly-trained ATLS physicians such as in the IDF), EM-trained midlevel providers (nurse practitioners and physician's assistants), emergency medicine and/or intensive care unit RNs, and combat medics. Its equipment should be equivalent to the current FST ATLS section. It should also have blood and blood products available for resuscitations, portable ultrasound capability, portable laboratory capability, and portable x-ray capability. The BAT team must be relevant to the combat environment, meaning it should be properly placed and accessible by ground or air MEDEVAC, even in difficult terrain such as in Afghanistan. The team should be mobile to accommodate changing operational needs at the battalion level. Effective use of BAT teams will decrease or eliminate the need for fixed surgical teams forward of the CSH in a mature theater.

4. Optimize the current FST surgical trauma concept for modularity and flexibility. The surgical resuscitation unit (SRU) should replace the current FST as the surgical capability designed to support the full spectrum of operations (rapid maneuver phase, stability, counterinsurgency, special operations). It should consist of 2 general surgeons, an anesthesia provider, 2 operating room technicians, an emergency room or intensive care unit RN, a licensed practical nurse, and a combat medic. The 8-soldier SRU should be mobile by tactical vehicle, but also airmobile if needed. It should carry a basic laboratory capability, an ultrasound machine, and blood products. Its flexibility and modularity are its advantages over the current FST design, enabling it to rapidly adapt to a changing environment. For example, it can operate independently (like a split FST), as augmentation of a BAT team at a battalion level, or with another SRU and a BAT team (like a full FST) during large maneuver warfare operations. Its design enables it to rapidly shift a surgical capability based on changing operational environments within a single theater.

5. Augment the current CSH to provide the full-spectrum theater trauma system. The theater trauma system can be based on the current US Army CSH design. The CSH-Combat Trauma System (CSH-CTS) should provide command and control of the entire theater trauma system. One-half of the CSH-CTS should be the military equivalent of a civilian level I-trauma center for the theater. The other half should be modular. This modular portion should be designed to tailor the trauma system based on the specific theater needs, and it does this by splitting from the main portion and moving to cover up to 2 outlying locations, assuming the equivalent role of civilian level II/III trauma centers. These modular portions should still be commanded by the CSH-CTS commander to ensure a smoothly operating theater trauma system comparable to the leadership in the civilian trauma system model.

In summary, the scheme of support of the CSH-CTS should entail:

- Initial ATLS-level trauma support by the BAT teams at the battalion level providing LSIs to prolong acceptable time to surgical care,
- Outlying CSH-CTS surgical facilities placed based on individual theater analysis to perform life- and limb-saving surgical interventions,
- The main CSH-CTS as the "theater trauma center,"
- An efficient, protocol-driven treatment and transfer triage criteria MEDEVAC system, and
- Two contingency-based, centrally located SRUs under the operational command and control of the CSH-CTS.

Finally, through collection and assessment of data from current military operations, by proactive assessment of near-future military operational needs, and by a continuous review of relevant trauma literature, we can optimally transform our current combat trauma system for future operational environments. This paper provides an evidence-based review of key aspects of the trauma literature relevant to our goal of trauma system transformation. As US Army surgeons and physicians, we must remain proactive and prepared to provide the optimum combat trauma care for our American Soldiers wherever and whenever they must go.

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Photo courtesy of LTC Kyle Remick.

Experience with Mild Traumatic Brain Injuries and Postconcussion Syndrome at Kandahar, Afghanistan

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Introduction

In this article, we describe the in-theater experience with mild traumatic brain injuries (TBIs) and the changing approach to management, with the emphasis on in-theater evaluation that maximizes return to duty status and minimizes evacuation to Germany or to the United States. We also discuss the incidence, pathophysiology, recognition, and treatment of both TBI and its aftermath, postconcussion syndrome.

Background

Every war seems to have its singular pattern of distinctive injuries or illnesses. Examples include the extremity amputations of our American Civil War and the cold weather injuries that were so prevalent during the Korean conflict. For Operation Enduring Freedom (OEF) [Afghanistan], the signature injury has become TBIs secondary to improvised explosive device (IED) exposures.[1] This situation is the result of a variety of reasons, but the additional protection provided by the enhanced body armor and the greater protection provided by the newer armored vehicles have reduced the number of fatalities from these blasts, and increased the number who suffer blast effects and survive.

The Department of Defense definition (below) of TBI is one of many available[2]:

> A traumatically induced structural injury and/or physiological disruption of brain function as a result of an external force that is indicated by the new onset or worsening of at least one of the following clinical signs, immediately following the event:
>
> - Any period of loss or a decrease in the level of consciousness.
> - Any loss of memory for events immediately before or after the injury.
> - Any alteration in mental state at the time of the injury (confusion, disorientation, slowed thinking, etc).
> - Neurological deficits (weakness, loss of balance, change in vision, praxis, paresis/plegia, sensory loss, aphasia, etc) that may or may not be transient.
> - Intracranial lesion.

We favor the above definition for its cause and effect relationship and the fact that it is reliant upon input not just from the affected individual, but requires input from a trained, objective provider.

Published data from the mid phases of the Iraq conflict show an incidence of 5% of Soldiers suffered a TBI with some effect on the loss of consciousness (LOC) and up to 10% suffered a TBI without any effect on LOC.[3] These reports are likely an underrepresentation since this was drawn from retrospective and self-reported data. Current efforts are underway to improve real-time tracking and reporting, but we feel the incidence in OEF is even higher, especially as troops are subject to multiple tours and repeated exposures to IEDs. The exposure to IED blast is a very common event among actively patrolling troops. We expect that eventually the published figures will show numbers beyond that experienced in Operation Iraqi Freedom.[4] An empirical observation is that repetitive subclinical injury from prior event(s) over time, often suffered over multiple tours, lowers the threshold for induction of TBIs by the next blast.

Pathophysiology

A long term assumption was that since typical central nervous system imaging studies (ie, computerized tomography (CT) scans of the head) are normal in the vast majority of those with mild TBI, no structural damage had occurred. We now know from a variety of sources that microscopic level damage occurs diffusely throughout the brain.[5] This has been confirmed in examinations of pathologic specimens and is also evident in functional central nervous system imaging

studies, such as single photon emission computed tomography and positron emission tomography scans. The damage is to the level of the axons and often involves axonal stretching or even separation. Additionally, numerous excitatory neurotransmitters are released, as well as the typical acute phase reactants of tissue injury.[6] While recovery of the structural and biochemical damage is anticipated, the central point is that this is *not* a feigned injury. The damage is quite real.

SYMPTOMATOLOGY

The cardinal immediate phase symptoms can be defined into neurocognitive, somatic, and behavioral categories as follows:

- Neurocognitive – attention deficit, reduced speed in processing new information, or language dysfunction in the form of difficulty in finding words for expression.
- Somatic – focal neurologic deficits, headache, nausea with or without vomiting, sleep disturbance, visual complaints, fatigue, seizures, or vestibular symptoms, usually in the form of a sense of imbalance.
- Behavioral – depression, anxiety, irritability, impulsive behavior (including disinhibition) and, on rare occasion, symptoms of mania or psychosis.[7]

The cardinal symptoms are confusion and amnesia. Amnesia is typically for the period immediately following the injury. It is generally measured in minutes but can be retrograde and encompass longer time frames. The confusion is typically more evident to observers than the victim. The simplest approach is to ask the squad members: is this the same person or is he/she acting differently?[8] Simple questions as to whom, what, and why (ie, the sideline sports screen used for decades), are poor screening tools and suffer considerably in terms of sensitivity. More formalized screening tools are strongly suggested. In the civilian sector, the best validated tool is the Westmead Posttraumatic Amnesia Scale[9] (Figure 1), but the military now uses the Military Acute Concussion Evaluation[10] (MACE) (Figure 2). No head-to-head comparisons of the 2 tools are available, but the Westmead is more subjective while the MACE is more quantitative. In addition, the MACE scale can be used to follow serial responses and after physical exertion to see if replication of the physical stressors that a Soldier faces will cause worsening of the neurocognitive symptoms. The postexertional MACE functions as a poor man's central nervous system "stress test."

Other symptoms seen in the first 24 hours can include a constellation of complaints including escalating headaches, dizziness, true vertigo, insomnia, tinnitus, nonspecific visual complaints, nausea and vomiting (primarily in the first 24 hours), difficulty concentrating, short-term memory dysfunction, and a sense of imbalance. Our experience is that a grief reaction is frequently intertwined as the blasts often involve others in the squad who have been wounded-in-action/killed-in-action (WIA/KIA). Some component of immediate posttraumatic stress disorder is common in the form of flashbacks and nightmares. Effects of secondary soft tissue injuries are often more noticeable in the delayed phase as the fright and flight response begins to wane.

Signs can include a multitude of findings including the "thousand-yard stare," delayed verbal responses, an apparent concentration deficit, alterations in speech pattern, visible but subtle cerebellar findings, and emotional responses that are atypical or disproportionate for the individual. Many of these parallel what would be seen in a driving under the influence setting. Since the medical observers at the scene are typically medics and may not know the baseline appearance and function of the individual Soldier, the question should be posed to the battle buddies: is this the same guy you saw before the injury?

Figure 1. The Westmead Posttraumatic Amnesia Scale questions used by civilian healthcare providers to screen patients with possible traumatic brain injury.[9]

What is your name?
What is the name of the place you are in now?
Why are you here?
What month is this?
What year are we in now?
In what town/area are you from?
How old are you?
What is your date of birth?
What time of day is it? (morning, afternoon, evening)
Show three pictures and ask for delayed recall. (within one to two minutes)

Since presentation may be delayed to a medical treatment facility, the evaluation is best begun in the field by the medic or corpsman. MACE cards for use in the field are becoming available. The importance of the field evaluation is that it establishes an immediate baseline that then can be referenced as the casualty moves though the various echelons of the evacuation system. In particular, the MACE questionnaire provides an index that is quantifiable and simple to administer. If the MACE scores are regressing versus improving, it is a "red flag" to all concerned, and serves as a prompt to search for a reversible structural central nervous system injury, eg, a subdural hematoma.

While discussed in detail in prior TBI literature, prospective data shows seizures are relatively rare events, in mild to moderate TBI patients with an incidence of no greater than 5%.[11] Of those who suffer seizures, most are seen in the first 24 hours. The earlier seizures occur, however, the greater the likelihood of recurrences long term. Prophylactic antiepileptics have not been shown to be effective in prior prospective studies. Onset of seizures, however, is a red flag and should prompt immediate neuroimaging, even if previously done.

Prior reviews show CT head scan abnormalities in about 5% of those who present with a Glasgow Coma Scale* (GSC) score of 15 and are routinely scanned, as is often the case in civilian settings. As anticipated, the percentage of abnormal scans goes up as the severity of injury worsens, with up to 30 % of those with GSC of 13 (or less) showing demonstrable CT changes. Even these latter figures may be misleading in that only 1% of patients scanned have an abnormality that warrants neurosurgical intervention.[13] Sensitivity is excellent for CT scanning but specificity is poor. This has lead to criteria such as the Canadian CT head rule that help

Figure 2. Sample of the Military Acute Concussion Evaluation form used to screen patients with possible traumatic brain injury.[10]

Orientation:

Month	0 ″	1 ″
Date	0 ″	1 ″
Day of Week	0 ″	1 ″
Year	0 ″	1 ″
Time	0 ″	1 ″

Orientation Score _____ / 5

Immediate Memory

List	Trial One	Trial Two	Trial Three
Elbow	0 ″ 1 ″	0 ″ 1 ″	0 ″ 1 ″
Apple	0 ″ 1 ″	0 ″ 1 ″	0 ″ 1 ″
Carpet	0 ″ 1 ″	0 ″ 1 ″	0 ″ 1 ″
Saddle	0 ″ 1 ″	0 ″ 1 ″	0 ″ 1 ″
Bubble	0 ″ 1 ″	0 ″ 1 ″	0 ″ 1 ″
Trial Score	_____ / 5	_____ / 5	_____ / 5

Neurological Screening: (no points)

Concentration

4-9-3	6-2-9	0 ″ 1 ″
3-8-1-4	3-2-7-9	0 ″ 1 ″
6-2-9-7-10	1-5-2-8-5	0 ″ 1 ″
7-1-8-4-6-20	5-3-9-1-4-8	0 ″ 1 ″

Months in reverse order (1 point for entire sequence)

Concentration Total Score _____ / 5

Delayed Recall: (1 point each)

Ask the patient recall the 5 words from the earlier memory test.
(Do NOT reread the word list)

Elbow	0 ″ 1 ″
Apple	0 ″ 1 ″
Carpet	0 ″ 1 ″
Saddle	0 ″ 1 ″
Bubble	0 ″ 1 ″

Delayed Recall Total Score _____ / 5

Total MACE Score _____ / 30

Diagnosis: (circle one or write in diagnosis)

850.0 Concussion without loss of consciousness

850.1 Concussion with loss of consciousness

Other diagnoses

*The Glasgow Coma Scale is a quick, practical, standardized system for assessing the degree of consciousness in the critically ill and for predicting the duration and ultimate outcome of coma, primarily in patients with head injuries. The system involves eye opening, verbal response, and motor response, all of which are evaluated independently according to a rank order that indicates the level of consciousness and degree of dysfunction.[12]

to select those who warrant scanning for lesions that have immediate clinical import.[14] The Canadian rules suggest scanning based on the following presenting clinical criteria:

- GSC score of less than 15 at 2 hours postinjury. The emphasis is on the individual who is failing to show signs of improvement in the immediate postinjury phase.
- Suspected skull fracture, especially with a history of blunt trauma.
- Physical findings of basilar skull fracture, such as hemotympanum, raccoon eyes, Battle's sign, or evidence of a cerebrospinal leak.
- Repetitive vomiting, defined as 2 or more episodes in the first 24 hours.
- Aged 65 years or older.
- A mechanism of injury that involves projection or a fall from a significant height, typically 3 feet or more, or a fall down 5 or more stairs.

We are not aware of any studies that have validated the Canadian rule in military field settings, but the rule has held up well in civilian trauma centers. CT scans may be difficult to access in theater, and we think the Canadian criteria provide an excellent triage tool.

Patients can and will deteriorate after a seemingly benign initial presentation. A variety of intracranial catastrophes can occur in the hours following initial presentation. Fortunately, these declines are rare. The key to recognition is the initially stable patient who deteriorates for no obvious and apparent reason. Then, immediate central nervous system imaging is mandatory to exclude treatable abnormalities such as epidural and/or subdural hematomas and/or intracranial hemorrhage.[15]

Although much discussed in the civilian literature, such postpresentation degradation is rarely seen and reported. The presentation is one of a seemingly benign TBI, typically seen in the context of a sports participant who suffers a mild TBI, returns to competition, and suffers a second concussion, in short succession. The affected patient then undergoes a rapid downhill course with features of diffuse cerebral edema and often suffers either death or severe disability.[16] Since many mild TBI patients have returned to play or duty and *not* suffered this sequence of events, the question remains as to whether there is some preceding genetic or structural process that makes these individuals uniquely susceptible. Since one cannot predict who is at higher or lower risk for this rare event, no one should be exposed to further risk of head trauma, in short sequence, unless it is absolutely unavoidable. The sports equivalent of "shake it off and get back in" no longer applies, either in the military or civilian sectors.

TREATMENT APPROACHES

No specific drug interventions are typically suggested in the immediate phase outside of simple analgesics as needed. The time-honored dictum of avoiding drugs with central nervous system depressant effects remains true as they may color interpretation of evolving signs and symptoms. In fact primum non nocere [first do no harm] holds especially true as *no* drug interventions, including systemic steroids, have proven effective in ameliorating brain damage, even in those with the most severe of injuries. It remains best to keep any and all drugs to a minimum until stability is insured over the first 24 hours.[17]

Beyond the window of the first day, one can be more liberal with medications, though drug use remains reactionary and treats the symptoms but not the root cause, the injured brain. The intervention we have found to be of greatest benefit after the first 24 hours of insured stability are efforts at restoration of a more normal sleep-wake cycle. For a variety of reasons, insomnia is extremely common in the field setting and is typically a combination of difficulty with sleep initiation and sleep maintenance. We are not aware of any direct drug trials, but we have had empiric success with the older sedating antidepressants such as amitriptyline or trazodone. The most important thing for the injured brain is time and rest.

As anticipated, the earlier in the course we were able to see the patient and intervene, the better the outcome, with the vast majority returning to duty. If presentation was delayed to the care level of the combat support hospital, outcome was more suspect. Is this selection bias or a real phenomenon? We have no hard data to confirm this but observations from the field are by nature often empiric.

Adjunctive therapies can be used in the immediate phase that is nonpharmacologic and therefore low risk,

if not necessarily high reward. A concussion class and/or Soldier directed handouts explain in common terminology the anticipated course of events. This helps reassure affected individuals that what they are experiencing is very real, and describes the expected course and progress in recovery of their symptoms. It also reemphasizes the idea to the patient that the goal is to return them to duty, but full recovery will take time. A 20-year old Soldier is not blessed with the utmost of patience. We felt that the group rehabilitation milieu was beneficial because "misery loves company." We had a low threshold to involve mental health and/or combat stress control, especially if fellow squad members were WIA/KIA or if the patient had preinjury mental health difficulties. In this situation, "talk is cheap," and effective. If combat stress control resources are not available, chaplains can fill a similar role.

We also used physical and occupational therapy for the secondary soft tissue injuries that are not uncommon, especially to the neck or back. Lastly, we had the luxury of having acupuncturists available who were helpful with soft tissue injuries and also helped with certain aspects of the of the postconcussion component, mainly cervical pain. Overall, we found the busier we kept the patients, the less they dwelled on the event, and the more quickly they recovered. Our TBI clinic kept the patients on base for as short a period as possible and aimed to return them to their forward operating base as soon as our "hard court press" was completed. In reality, our clinic was a program.

In the immediate phase, the question is whether or not the individual should be hospitalized. We were liberal about initial hospitalization. Any hint of regression of GSC or MACE scores was a trigger. In addition, a history of blunt head trauma was often a trigger to hospitalize. Since these patients were often brought from outlying bases and were separated from their battle buddies,* we did *not* always have the luxury of using the civilian equivalent of sending them home with a head trauma sheet for a "family" to follow in the first 24 hours postinjury. With all of those provisos, the vast majority of those with a mild TBI, even in a battlefield environment, still do *not* need to be hospitalized, and their entire course of management can be performed on an outpatient basis.

Unit leaders want their Soldiers, Marines, Sailors, and Airmen back to fill their ranks immediately. Although the goal must be to preserve the fighting strength, this must not trump the need for the brain to have adequate time to recover. As a general rule of thumb, we found that a minimum of 2 to 4 weeks was necessary to stabilize the injury. Recovery did not mean that the service member needed to stay at our facility or under our guise for the entire length of the rest and recovery phase. It did mean that they could *not* be exposed to potential head trauma during the minimal time frame of rest. Further, even if they did return to their forward operating base, they were *not* to go "beyond the wire" for whatever time period we determined to be necessary for recovery.

An evolving and very important question is whether there is a point at which we must say too many cumulative injuries have occurred and a long-term modification of duties is absolutely necessary. The Marines have taken the lead in this regard. The current USMC intheater guidelines[18] are:

- First injury: "brain rest" for between 2 to 4 weeks.
- Second injury: a minimum of 4 weeks (and possibly longer) of no risk or very low risk exposure.
- Third injury: the line is drawn and that individual will not go beyond the wire for the remainder of his or her tour.

The above guidelines are defined by injuries within a given tour. However, there are *no* current guidelines to address the common scenario of multiple exposures over multiple tours. In our experience, individuals were often not "back to baseline" by the time of their redeployment, and the next injury that occurred on the current tour was the breaking point. On occasion, the 3 strikes rule was not exceeded, but the clinical line was undoubtedly crossed, and we had to insist that the individual be withdrawn from exposure on a permanent basis. This is a grave decision that affects the individual, the unit, and the higher command, and it is not taken lightly. We invoked such limitations only if we were convinced that return to preinjury status was unlikely, and that further exposures bring a high likelihood of an irrevocably injured brain.

*Generally defined as the person to whom a Soldier can turn in time of need, stress, and emotional highs and lows who will not turn the Soldier away, no matter what. This person knows what the Soldier is experiencing because of experience with similar situations or conditions, either current, previous, or both.

DISCUSSION

There is no clear separation between the acute injury and the potential aftermath. Studies have shown that up to 80% of head injury patients have symptoms of a postconcussion syndrome.[19] Unfortunately, we do not have good data from the battlefield environment, particularly for those with multiple blast exposures and head injuries over multiple tours. Most published data for postconcussion syndrome is drawn from the civilian sector, but we suspect that carefully gathered information from the current active theaters would show similarly high rates of occurrence. Only data from predeployment information which is compared to postdeployment information will be objective enough to qualify, since retrospective data is subject to considerable recall bias.

Symptoms far outweigh signs, and nondynamic CNS imaging studies, if done, are typically normal. This means that the postconcussive syndrome is defined almost entirely based on subjective symptoms. There is no current objective test to separate those with superimposed secondary gain. Perhaps the currently used Automated Neuropsychological Assessment Metrics[20] screening will help to fill this information gap, but since predeployment screening was only recently begun, it will not be of any use for the thousands who have been injured prior to late 2009.

In our experience and that of others, the most frequent symptoms were headaches and cognitive dysfunction. Other symptoms include mood liability, continued sleep disturbance, and a residual sense of imbalance. To the previously invulnerable 20-year old, the most frightening symptom is cognitive dysfunction. The pattern most often seen is a combination of short-term memory difficulty and an overall sense of difficulty in concentration. These mimic in many ways the early stages of the memory dysfunction often seen in the elderly such as the subtle syndrome of mild cognitive disorder. A parallel exists in what has been observed in some former professional and amateur athletes, the worst being dementia pugilistica seen in professional boxers who have suffered repeated head trauma. A limited number of former professional football players have experienced a neuropathologic entity called chronic traumatic brain injury or chronic traumatic encephalopathy.[21] The disturbing pathologic information is that the visible macro- and microscopic damage is quite similar to that seen in traditional dementia. While all of these tantalizing bits of information are nothing more than food for thought, the aggregate harkens back to the concept that structural damage does occur even with a mild TBI, the changes may not be fully reversible in all, and cumulative damage may occur.

Treatment of the headaches includes a variety of therapies, both reactive as well as prophylactic in nature. Most of these have existed in the civilian literature for decades. As discussed previously, one caution is to avoid agents with sedative capacity, for obvious reasons, in field settings. Fortunately for most patients, the headaches do diminish in severity and frequency over time.

Unchartered territory exists in terms of how to address the cognitive dysfunction. Are cholinergic agents such as donepezil appropriate for those with features of mild cognitive dysfunction? Are stimulant agents such as the amphetamine compounds of value for those with features of attention deficit disorder? Considerable research is ongoing to address these questions, but for now they remain unanswered and considerable empiricism is necessary.

Our experience was that a considerable admixture of depression and posttraumatic stress disorder coexists in those who suffer long term symptoms.[22,23] This raised a logical question as to the efficacy of any of a variety of psychotropic medications, in particular, antidepressants, in treatment of those individuals. Since these drugs are, in general, medications with excellent therapeutic/toxic ratios, we had little hesitation to use these medications, if the mood component was becoming dominant and time was not providing alleviation. Obviously, the hope is that the use of antidepressants is a short-term rather than a long-term requirement. We consider major and minor tranquilizers to be inappropriate at the front and more rear echelon type interventions, and consciously avoided their use. Psychiatric treatment, if available, can be of considerable help. However, it may be a limited resource, especially at the level of the forward operating base and the battalion aid station's level 1 care must by necessity often assume this role. Combat stress control assets can provide counseling, but again, availability may be limited.

Both short- and long-term sleep disturbance is common. A variety of sopoforic agents are now

available, most of which again have favorable side effect profiles and minimal capacity for dependence. Very few of us sleep well in-theater, but patients with structural and somatic overlay have an especially difficult time sleeping. The net debt from chronic sleep fragmentation is well-described. We felt that part of both the immediate and long-term treatment was liberal use of drugs, such as low dose trazodone, to restore some semblance of a more normalized sleep pattern. At low dose, those are drugs with low toxic risk, though we purposely limited the volume of the distributed medication to minimize risk of an intentional overdose.

While not the intention of this article, some comments about the experience in the United States with severe TBI patients is not only of interest, but also relevant as we providers encounter such patients when we return to our US facilities, be they military, Veterans Affairs, or civilian. Severe injuries are more commonly caused by penetrating head injuries and are typically associated with very low Glasgow Coma Scores on presentation. Salient observations of this unfortunate subset of individuals include the following[24]:

- As anticipated, presenting Glasgow Coma Scores correlate with both survival and residual morbidity.
- However, severe injuries do not always equate to poor outcomes; the young and previously healthy brain can have amazing recuperative powers.
- Overall survival rates are high (95%) among those who survive long enough to be evacuated to the United States.
- In-hospital complication rates are high and include a variety of events that have both short- and long-term import. Some of these include:
  - Systemic infections are common (46%).
  - Pulmonary embolism is common, especially since anticoagulation prophylaxis is contraindicated (7%).
  - Cerebrospinal fluid leaks and infections are not infrequent (9%).
  - Early onset seizures are not infrequent (12%).
  - Spinal cord and column injuries often accompany the initial injury (10%).
  - Posttraumatic aneurysms and arteriovenous malformations are surprisingly common (8%).

Patient Data

From mid November of 2009 through mid April 2010, 125 new patients were seen in the TBI clinic at the combat support hospital at Kandahar Air Field. Most were referrals from outlying forward operating bases (FOBs), and virtually all patients were seen for at least one follow-up visit. The time from initial injury to presentation to our clinic varied from days to months, but since the beginning of 2010, most were seen in the immediate phase, allowing better evaluation and treatment. A total of 360 patient encounters occurred prior to our departure. No patients required hospitalization, and well over 90% returned to duty and to their prior military occupation specialty functions and duty assignments, in particular the combat roles. The goal is to return to the referring FOB immediately, drawing from the model of combat stress control to make the recovery process FOB-centric. Whatever time is necessary for limited duties and activities inside the wire is best spent within the environment of the squad and unit.

Conclusions

Traumatic brain injury is common in the current operational environment. Diffuse brain injury is the norm, though this condition cannot be readily measured by current means, including standard central nervous system imaging. Screening for a significant injury is best accomplished by a standardized format, such as the MACE scale, which can be initiated at the level of the squad medic. While recovery is anticipated, a significant percentage suffers long-term sequalae, especially in the form of mood disturbances and cognitive dysfunction. The point at which the individual must be removed, at least short-term if not permanently, from further blast exposures is a looming concern. For now, we concur with the "3 strikes and you're out" policy practiced by the Marines. However, at present this is defined by exposures during a single tour and does *not* address the more common situation of multiple TBIs occurring in an interspersed manner over multiple tours.

Treatment is largely supportive, though this is an area of intense interest for effective immediate phase therapies. *Brain rest is imperative* in the immediate phase of injury, and a minimum time spent inside the

wire (at least 2 to 4 weeks) is absolutely mandatory. As one moves into the area of the postconcussion syndrome, long-term treatment involves maintenance of sleep and treatment of depression and posttraumatic stress syndrome, if they coexist. At present, no known and proven treatment exists for the neurocognitive sequalae. Whether use of dementia and attention deficit disorder drugs used in the civilian sector will be of benefit remains to be determined. As we move further away from the initial military TBI injuries of the early 2000s, both military and civilian caregivers will likely be forced to use such therapies more and more in this atypical subset of young/old brains to maintain function. This will be necessary within both the military and civilian environments as the injured experience the lingering effects of cumulative damage and deterioration brought about by time and the aging process.

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The Road to Recovery and Rehabilitation for Injured Service Members with Limb Loss: A Focus on Iraq and Afghanistan

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ABSTRACT

Amputation of an extremity due to traumatic injury or a vascular occlusive disease is a life-altering event that occurs when limb salvage is not possible. While an amputation is viewed as a life saving procedure clinically, limb deficiency may result in an immediate loss in social, physical and financial well-being for the patient. Military personnel returning from Operation Enduring Freedom and Operation Iraqi Freedom face unique challenges due to short residual limbs, unplanned amputations, high incidences of multiple limb loss, and accustomed activity levels prior to an amputation. The primary rehabilitation goal for these individuals is to provide them with an expedited recovery and progressive reintroduction into the civilian or active duty population. It is the purpose of this review to discuss the most frequent rehabilitation hardships service members endure following combat related trauma and future of prosthetic limb technology.

INTRODUCTION

The early ability to stabilize and transport injured servicemen and women from Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) to specialized military centers in the United States has resulted in an approximate 92% survival rate, a higher percentage than any other major military conflict.[1] As a result, service members have been returning from theatre with multiple amputations that require extensive rehabilitation from medical centers within the Department of Defense and the Department of Veterans Affairs. Approximately 2% of injured military personnel returning from OEF and OIF have sustained limb loss.[2] Military databases have indicated that as of April 2010, US medical centers have treated combatants with 992 major limb amputations (822 from OIF and 170 from OEF) and 341 minor amputations (317 from OIF and 24 from OEF). The relative youth and high fitness level of injured service members with ampuations[3] make them an ideal population for aggressive rehabilitation, but have also exposed the limitations of today's existing prosthetic technologies. Military personnel with amputations face unique challenges due to their short residual limbs,[2] unplanned amputations,[4] high incidences of multiple limb loss and accustomed activity levels prior to an amputation.

NARRATIVE

Debridement, Wound Care & Revision

The use of buried explosive devices such as land mines and improvised explosive devices (IEDs) have been used as a form of weaponry in every military conflict since World War II,[5] and a large portion of severe injuries occurring from military operations in Iraq and Afghanistan have resulted from blasts.[6] The use of explosive armaments generates extensive tissue trauma and disruption of vascular and neurological networks.[7] IED blasts expel the neighboring earth and shrapnel into the wound sites and require rapid wound care strategies.[5,7]

The meticulous debridement of injured tissues has remained of utmost importance in combat wounds as nonviable tissue has been known to create a nidus for infection and may impede the natural healing process.[7] The risk of infection has demanded staged debridement strategies and may result in the decision to delay wound closure. One survey of 230 patients with transtibial amputations conducted during the Vietnam War indicated that 59% of wound closures were left open and 41% were closed in theater. For service members who returned to the United States with closed amputation sites, 56% failed due to gross

infection and required urgent surgical revision that reduced residual limb length.[8]

Infection Complications

Traumatic amputations present unique problems for surgeons which may be made more difficult by bacterial colonization. Infections have been a particular concern for combat-related injuries since the disruption of vascular integrity and localized tissue necrosis prevents antibiotics from reaching the wound site. When this occurs, the bacteria in the affected region may become resistant to antibiotics, especially when dosages are below the minimal inhibitory concentration. Studies investigating the infection rate in ischemic lower-extremity amputees report a broad infection range which depends largely on anatomical location.[9] Reports of resilient infections have occurred in over 600 injured service members from OIF and OEF following an extremity amputation[10] and include drug-resistant *Acinetobacter baumannii, Pseudomonas aeruginosa, Klebsiella pneumoniae* and *Staphylococcus aureus*.[10] Cultures obtained from wound sites of 732 injured service members involved in OIF concluded that a plethora of both gram-negative and gram-positive bacteria cultured were resistant to broad spectrum antibiotic treatments (Figure 1).[11] Additionally, blast injuries from IEDs often generate extensive burns and subsequent nosocomial infections because of multidrug resistant *Acinetobacter baumannii.*[11] Aggressive debridement and antibiotic usage has remained the standard of care for preventing and treating infections, but multidrug resistant bacterial infections have been a dangerous concern for service members injured in Iraq and Afghanistan.[11]

Residual Limb Problems

Skin Breakdown

Successful treatment of an amputation in theatre has been the first phase in a challenging road to recovery and rehabilitation. Residual limb skin breakdown following wound closure has often resulted in superficial infections, the inability to properly wear prostheses, interference with rehabilitation and the need for surgical revisions. The high frequency of skin-related socket complications has occurred from mechanical breakdown, since skin thickness at extremity amputation sites are considerably thinner than the palms and soles which are especially equipped for high load bearing regimens.[12] Previous studies investigating skin breakdown in below-knee amputees revealed that one-third of patients suffered from unhealed wounds or damaged skin,[13] and 40% of lower extremity amputees had at least one skin problem on the lower limb.[14] To prevent breakdown at the skin-prosthetic interface, mechanical forces exerted on newly formed residual limbs must be carefully controlled since excessive skin tension may trigger localized tissue necrosis.

Skin breakdown in sockets has also been known to occur due to scar asymmetry and the suboptimum location of tissue reconstruction relative to weight bearing pressure. The location of the surgical closure scar in traumatic amputations has been commonly dictated by the initial injury and the attempt to retain as much residual limb length as possible. This situation has been further complicated by the dysvascular nature of mature scar tissue and the relative common attachment of scar tissue to the residual bone.

Heterotopic Ossification

Heterotopic ossification (HO) has been a frequent complication following blast-related injuries and traumatic amputations.[15] Ectopic bone has been reported to be variable in nature,[16] metabolically active[16] and results in mature osseous growth in the neighboring soft tissue[17] (Figure 2). While HO has been known to be a consequence of muscle and bone injury, the exact pathological process of HO has not yet been fully understood.[18] The development of HO has been strongly correlated with the presence of head, spine

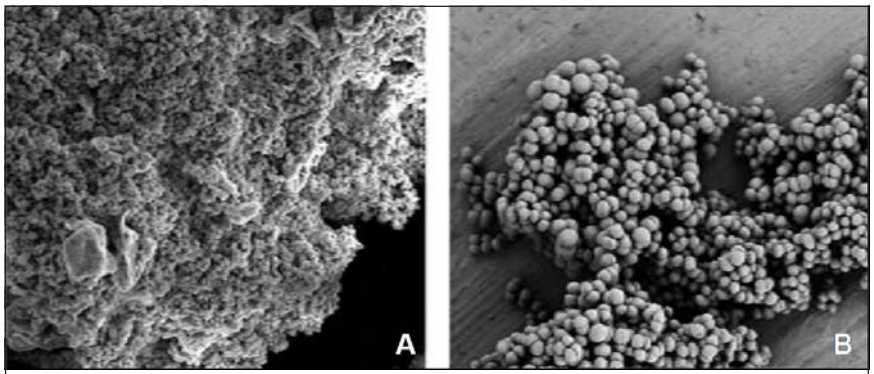

Figure 1. Biofilm formation of *staphylococcus epidermidis* present on an orthopaedic implant using scanning electron microscopy at 4,000x (A) and 12,000x (B) magnification.

and blast injuries.[15] In fact, the frequency of HO in the residual limb of amputees with blast injuries returning from OIF and OEF has been reported as high as 63% in a study of 213 wounded service members.[15]

Large formations of ectopic bone have been especially disabling for service members who use sockets for prosthetic attachments. Rehabilitation of an amputee with HO may be challenging since wide variations in ectopic bone have been known to occur and may lead to an uncomfortable prosthetic fit.[19] HO may also manifest months after a blast injury and has a maturation rate upwards of 18 months.[20] As a result, poor prosthetic fit may occur and delay the rehabilitation for service members who require socket adjustments to compensate for HO formation. The interface between the residual limb and prosthetic socket overlying a bony prominence may also lead to skin breakdown and significantly restrict mobility of a patient with limb loss.[2,21]

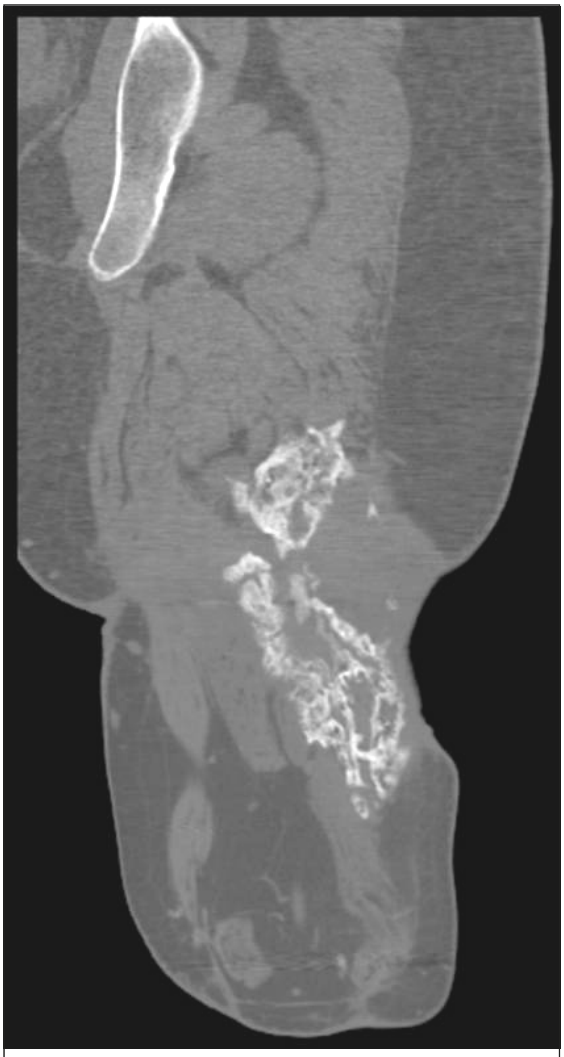

Figure 2: Coronal computed tomography scan demonstrating a pronounced mass of HO in the residual limb of a returning service member.

Premature surgical resection of HO often results in more florid ectopic bone than before resection. For this reason, surgical resection of HO has often been delayed until complete HO maturation has occurred, along with the inflammatory stage of "myositis ossificans." Surgical resection of HO may also result in neurovascular damage[22] as these structures may be entwined in the bony deposits. While some studies have demonstrated success after removing HO 8 months from the initial amputation,[15] others have cautioned that 18 months may be a more appropriate timeframe, especially when head injuries or comorbidities have been involved.[16,23]

Phantom Limb Pain

Phantom limb pain (PLP), the painful sensation that an amputated limb is still present, has been known to occur in up to 85% of amputees.[24] Pain has been described as burning, itching, stabbing, cramping, throbbing, or feeling of "pins and needles."[25] While many causal factors have been proposed for PLP, including intrinsic residual limb pain, limb pain that was present prior to amputation, and the presence of neuromas formed after nerve transection, all of these correlations have been both supported and refuted by the literature.[24,26,27] The incidence of PLP has shown to be independent of gender, age (in adults), location, and level of amputation.[28]

It is important to note that congenital amputees have also reported PLP, and it has been speculated that both central and peripheral nervous systems must be active in the pain mechanism.[29] PLP has remained notoriously difficult to treat with few randomized controlled trials demonstrating significant results. Memantine, an oral NMDA receptor antagonist has demonstrated limited success in larger clinical trials for treating acute pain, but may be less effective for long-term established chronic neuropathic pain.[30] Mirror therapy, in which the patient observes the movements of a reflection of their intact limb in a mirror while simultaneously moving their phantom limb has been demonstrated to significantly decrease PLP in a randomized sham-controlled trial.[31]

Rehabilitation – Physical and Occupational Therapy

The severe injuries sustained by OIF and OEF service members have frequently required complex rehabilitation management. Rehabilitation interventions should be designed to maximize functional outcomes and the needs of each individual. Following prosthetic fitting, physical therapy may

begin with simple standing and walking activities and slowly progress to higher level balance and mobility training, depending on the individuals' goals and abilities. Specific techniques include strengthening exercises for the residual limb and intact body parts as well as cardiopulmonary conditioning.

Rehabilitation for a service member with an amputation begins immediately following the amputation and includes education and training on skin care, residual limb desensitization, edema control and soft tissue mobilization.[32] Another significant goal of the early stages of rehabilitation has been the use of a prosthetic limb to restore lost function. Management of both postoperative residual limb pain as well as phantom limb pain has remained vital.[33] In order for an individual to return to functional independence, training has included strategies for activities of daily living such as dressing, bathing and other self-care activities.

Prosthesis Fitting and Choices: Options Available for Upper and Lower Limb Amputees

Historically, military conflicts and the associated trauma-related amputations have led to increased attention and advances in prosthetics.[34] Numerous improvements over the past 10 to 20 years in prosthetic design and components have allowed individuals with amputations to achieve functional goals not previously possible. These advances have included improvements in the actual components of the prosthesis as well as artificial limb attachment systems and prosthetic control mechanisms.[35] Newer socket designs utilizing lightweight carbon composites and flexible inner liners have provided better accommodation for fluctuations in residual limb volumes.[35] Various materials including silicone, urethane and copolymer gels have provided an interface between the residual limb and the prosthetic socket to provide cushioning, stability and shear reduction to the skin.[35] Patient specific liners may also be fabricated for residual limbs with unique shapes or pain considerations. Customized options for the suspension of the prosthesis to the residual limb have included various forms of suction and vacuum suspension.

Developments in lower limb prosthetics have led to microprocessor controlled knee and foot devices capable of monitoring gait in real-time and making automatic adjustments based on changes in terrain and angular velocity of the prosthetic component.[35] Targeted muscle reinnervation techniques, which specifically relocate nerves severed in an amputation to alternative muscles to improve control of a myoelectric prosthesis are now being implemented in individuals with upper limb loss.[32] Additionally, newer foot and ankle prosthetic components are capable of energy storage and return during ambulation because of dynamic elastic response properties intrinsic to the materials.[32,35] These foot and ankle components accommodate for uneven terrain, vertical shock absorption and allow service members the ability to return to military deployments.

Recently, transcutaneous osseointegrated implants (TOI) have emerged as a viable option for amputees. Although currently available in Europe, TOI may assist service members in the United States in the near future following FDA approval.[35,36] Osseointegration avoids common socket complications by using direct skeletal attachment of an exoprosthesis to the residual limb[35] and has demonstrated success in transhumeral, transtibial and transfemoral amputations.[37] With osseointegration, a metal fixation is surgically inserted directly into the bone of the residual limb and serves as an attachment system for connecting and suspending a prosthesis to the residual limb.[18] This procedure may reduce skin irritation, enhance osseoperception and better serve individuals with limited residual limb length (Figure 3).[18,38] However, before employing this operative procedure, solutions must be developed to accelerate rehabilitation regimens and prevent periprosthetic infections for future service members.[38]

Figure 3: The distal residual limb of a transfemoral amputee with an osseointegrated implant. The transcutaneous post serves as the exoprosthetic docking mechanism for an artificial limb. (Photo courtesy of the University of Utah Dept of Orthopaedics.)

CONCLUSION

Servicemen and women have been returning from combat with a higher percentage of amputations compared to other military conflicts[2] and require intensive follow-up care, extensive rehabilitation, and expensive prosthetic services. The primary rehabilitation goal for these individuals has been to provide them with an expedited recovery and progressive reintroduction into the civilian or active duty population.[21] However, in order to continue to provide the best care for wounded service members, novel diagnostic tools and prosthetic devices must continue to be developed to address the many concerns and complications still present today.

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Family Advocacy: A Program to Support an Expeditionary Army

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INTRODUCTION

Over the past several decades, the Army has grown to appreciate the important contributions Families make in maintaining the psychological health of Soldiers. The Army Family Covenant is a testament to the Army's commitment to creating a strong supportive environment that promotes resiliency in Army Families.[1] These measures have become essential as large numbers of Soldiers deploy in support of 2 continuing overseas contingency operations. This point was illustrated by the Presidential Task Force on Military Deployment Services for Youth, Families, and Service Members as it acknowledged that the demands of a robust deployment tempo place service members and their families at-risk for the development of significant emotional problems.[2] One disturbing manifestation of the distress experienced by Soldiers returning from a military deployment can be seen in the well publicized accounts of Soldiers physically assaulting, and in some cases killing, their spouses after returning home from combat duty.[3-5] The Army Family Advocacy Program (FAP), which has responsibility for preventing abuse, protecting abuse victims, and treating all individuals impacted by family violence, currently does not routinely extend to combat zones.[6] Consequently, the present pace of deployments has created a gap in services that limits the program's effectiveness in reaching those individuals who may be at greatest risk for family violence. Although the US Army Medical Command encourages family advocacy personnel to collaborate with forward deployed behavioral health assets,* a standardized process has yet to be implemented. After 9 years of war, it is time to transform the program to more effectively meet the evolving needs of the most vulnerable Army Families. This article proposes expanding the FAP across all phases of the deployment cycle by the better use of behavioral health assets currently assigned to maneuver units. The experience of the 4th Infantry Division during Operation Iraqi Freedom (OIF) 05-07 offers insight into the types of family advocacy problems encountered during a deployment and provides examples of actions to address the issues. Moreover, recommendations are made for adapting policies and procedures to strengthen the partnership between the FAP and deployable units across all stages of the Army Force Generation (ARFORGEN) process (details, page 32).

DOMESTIC VIOLENCE AND MILITARY DEPLOYMENTS

A growing body of evidence indicates that military deployments can disrupt family functioning by altering family roles,[7] stressing adaptive coping strategies[8] and increasing the likelihood of child maltreatment.[9] Frequent deployments are thought to be linked to the dramatic rise in divorce rates in Army marriages with infidelity, domestic violence, and substance abuse believed to be contributing to the increasing numbers.[10] According to a study of the psychological effects of deployments on military families, feelings of loneliness, and problems communicating with deployed spouses stand out as prominent stressors reported by spouses left at home.[11] Deployments also have been shown to place families at a heightened risk for domestic violence. McCarroll et al[12] discovered that Soldiers who had deployed within the past year were more likely to report committing severe aggression towards their spouses and that the longer the deployment, the more likely violence would occur. Similarly, deployment-induced family separation has been suggested as a contributing factor in the increased rates of spouse abuse among enlisted personnel.[13] Particularly relevant to contemporary military operations is a study of families affected by Operation Desert Storm that found coping with residual aggression to be more problematic for war-time veterans and their families than for those who endured a routine deployment.[14] This may be due, at least in part, to the

*MEDCOM Family Advocacy Program Interim Guidance for Handling Cases of Deployed Soldiers. MCHO-CL-H. September 27, 2007. Internal military document not generally accessible by the general public.

introduction of psychological symptomatology, including posttraumatic stress disorder (PTSD), into the family dynamic. This possibility is supported by a 6-year study of veterans who received couples therapy at a Veteran's Affairs Medical Center which found that veterans diagnosed with PTSD were 26 times more likely to commit severe acts of violence towards their partners.[15] Also, PTSD has been correlated with a greater likelihood of female Vietnam veterans becoming psychologically abusive in relationships with significant others.[16] Interestingly, depression and PTSD symptoms have been found to be more closely linked to postdeployment aggression than the degree of actual combat exposure experienced by veterans.[17] A connection between postdeployment psychological symptoms and an increased potential for violence may be especially disconcerting, given the estimated 17% of Soldiers that are at-risk for developing mental health problems, including PTSD, depression, and alcohol misuse, after returning home from combat duty in Afghanistan or Iraq.[18]

Army Force Generation Model and Family Advocacy

Today's Army finds itself confronted by persistent conflicts and protracted operations against an enemy that uses asymmetrical tactics such as those used in Afghanistan and Iraq. To counter these threats, the Army developed the ARFORGEN model to meet the demands of current operations and to prepare for future contingencies. A Department of the Army White Paper describes the ARFORGEN as:

> …a rotational readiness model that is designed to effectively and efficiently generate trained and ready forces for combatant commanders at sustainable rotational levels.[19]

The model categorizes the operational force into 3 functional pools based upon recent deployment utilization: Train-Ready, Available, Reset. As units move through the ARFORGEN cycle, mission-essential tasks must be completed to successfully transition from predeployment preparation to mission execution in a theater of operations, then return for postdeployment reconstitution. During the Train-Ready phase, a unit trains to restore readiness levels to prepare for future contingency operations. Throughout this period, a unit prepares for deployment through individual and collective training that typically culminates in a mission readiness exercise conducted at either the Joint Readiness Training Center or National Training Center. At the pinnacle of the ARFORGEN cycle, a unit deploys to tactically implement national security strategy during the Available phase of the process. Afterwards, during the Reset phase, efforts are made to restore Soldiers and Families to predeployment levels of functioning. Reintegration programs, such as Battlemind postdeployment training, Strong Bonds, and Yellow Ribbon, help ease the transition from a war zone. Additionally, the postdeployment health assessment and postdeployment health reassessment, conducted during the first 180 days following a deployment, are used to gauge a Soldier's biopsychosocial adjustment after returning home. Referrals for medical and psychological assistance are made as needed.

The ARFORGEN model provides a logical framework for the design and implementation of family advocacy measures to support deploying units. Each stage presents distinct opportunities to target interventions to those Soldiers and Families that may be at-risk for domestic violence. Evidence-based prevention and treatment initiatives can be tailored to address the unique family stressors characteristic of each step in the deployment process. The establishment of a partnership between the military treatment facility's family advocacy treatment team and the deploying unit's behavioral health officer is essential to achieving this objective. More importantly, the benefits of working together become most evident during the deployment.

The 4th Infantry Division Experience

The 4th Infantry Division's deployment to OIF 05-07 provides insight into constructive actions to take, and obstacles to avoid, in the creation of an operational family advocacy program. Author Arincorayan, who was assigned to the 4th Sustainment Brigade at Fort Hood, Texas, about one month prior to deployment, proactively worked to structure a comprehensive behavioral health support plan that included family advocacy outreach and follow-up. Conceptually, activities were planned based on the unit's immediate requirements and on the anticipated future needs of Soldiers. Special consideration was placed on the identification of high-risk populations that could emerge at each stage of the deployment.

Train-Ready Phase (Predeployment)

To secure support for behavioral health initiatives, relationships were established with the division's

senior leadership and the local family advocacy supervisor. Each endorsed the incorporation of family advocacy interventions into the behavioral health plan. In an effort to provide continuity of care during the 12-month deployment, a list of 56 Soldiers who were actively receiving family advocacy services was obtained from the FAP supervisor. Shortly thereafter, the division surgeon was briefed on the status of high-risk Soldiers enrolled in FAP and brigade behavioral health officers were alerted so they could plan the provision of care to those assigned to their area of operations. Recognizing the importance of maintaining an efficient flow of communication between the theater of operations and the home station, one FAP staff member was designated the primary point of contact for the unit during the deployment. As an aside, although telephone and e-mail capabilities were readily available in Iraq, time zone differences and communication blackouts created challenges that mirrored the same frustrations Soldiers experienced trying to communicate with spouses back home.

Much more could have been accomplished, had time permitted. Integrating into the unit as a provider from the Professional Filler System (PROFIS*) late in the Train-Ready phase hampered deployment preparation. Foremost, not training with the unit during the mission readiness exercise was a missed opportunity. The exercise, which usually lasts 30 to 45 days and simulates the deployment, provides an indication of how well Soldiers and spouses might cope during the year-long deployment and can be used to test the link between the behavioral health team and the supporting FAP staff. Additionally, time constraints made it difficult to establish credibility and develop trusting relationships with company commanders and first sergeants. Having limited access to company-grade leadership made it difficult to identify, and provide early intervention, to Soldiers at-risk for domestic violence based on a history of previous incidents of family violence, marital discord, alcohol abuse, or financial problems. In some instances, the behavioral health provider, in concert with the FAP staff, may need to recommend the delay of a Soldier's deployment or suggest that he/she be assigned to the rear detachment to grant additional time to stabilize the family environment. Nevertheless, these recommendations should be used judiciously and only if sufficient evidence suggests that additional time at home will eventually produce a deployable Soldier.

Available Phase (Deployment)

While operating in a war zone, behavioral health providers primarily focus on the prevention and treatment of combat and operational stress reactions. However, the provision of FAP support is an important, if often overlooked, component of a comprehensive behavioral health program. This is particularly true since the Army broadly defines domestic violence as the use, or threat to use, force or violence against a current or former spouse, a person with whom one has a child, or a current or former intimate partner with whom a domicile has been shared.[6] With the composition of today's military, many units have dual military couples who may share living quarters while deployed, and unmarried, cohabitating couples who deploy together with the same unit. Therefore, it is reasonable to expect that domestic violence incidents could occur in theater. It is prudent that the behavioral health officer prepare a protocol to respond to abuse allegations.

Operationally, a forward-deployed family advocacy program would essentially involve the same activities as those found in garrison, namely, continued care for existing active cases; assessing reports of domestic violence that occur in theater; providing treatment to new cases and conducting secondary prevention for Soldiers who become at-risk due to marital conflict caused, or exacerbated, by deployment-related family separation. That being said, it is worth reiterating that the primary purpose of all deployed Soldiers, to include behavioral health providers, is to conduct potentially stressful military operations. Family advocacy intervention is a secondary objective. Nevertheless, an exception should apply to individuals who become victims while in theater. For them, implementation of a safety plan and the provision of emotional support become a priority.

*PROFIS predesignates qualified Active Duty health professionals serving in Table of Distribution and Allowance† units to fill Active Duty and early deploying and forward deployed units of Forces Command, Western Command, and the medical commands outside of the continental United States upon mobilization or upon the execution of a contingency operation.

†Prescribes the organizational structure, personnel and equipment authorizations, and requirements of a military unit to perform a specific mission for which there is no appropriate table of organization and equipment (the document which defines the structure and equipment for a military organization or unit).

Behavioral health operations at Camp Taji during OIF 05-07 reflect many of the challenges inherent in managing FAP cases during a combat deployment. Most notably, only 12 of the 56 Soldiers (21%) identified as enrolled in family advocacy treatment prior to deployment received follow-up in Iraq. Most could not access care because of assignment to outlying patrol bases throughout the Multi-National Division–Baghdad area of operations. Others could not make appointments because of mission requirements such as combat logistics patrols, command post duty, and other combat support activities. At about the 7-month point of the deployment, 3 allegations of domestic violence were reported on Taji. In response to each incident, command was notified and safety plans were implemented, including temporary weapons restrictions for all involved Soldiers. Also, to remain compliant with the family advocacy regulation, law enforcement and the FAP reporting point of contact (RPOC) were notified. These steps in the FAP protocol were complicated by the fact that the RPOC was located at Fort Hood, and there was no clear guidance with regard to which law enforcement agency has jurisdiction over in-theater family advocacy reports. Frustratingly, neither the provost marshal at Camp Taji nor the military police at Fort Hood accepted responsibility for the report.

Soldiers going home for environmental management leave, commonly known as R&R, presented an interesting and somewhat unexpected set of challenges. After returning to Taji from R&R, one female Soldier reported being physically assaulted by her civilian husband while on leave. Implementation of the FAP protocol with this allegation was made more difficult due to the Soldier's assignment to a unit deployed from Fort Riley, Kansas. Unfortunately, no predeployment coordination had been arranged with the supporting FAP office. Initially, the RPOC at Fort Riley refused to accept the spouse abuse report, but relented only after consulting with the US Army Medical Command's FAP program manager. While the Soldier entered treatment at Taji and continued services until redeploying 5 months later, the eventual outcome of the case is unknown. Also, in conjunction with R&R, 4 Soldiers with acute marital conflict were believed to be at-risk for committing family violence while on leave. Prior to each of them leaving Camp Taji, coordination was made with the rear detachment commander and FAP supervisor to have them evaluated by FAP personnel at Fort Hood before having contact with their spouses. These precautionary steps may have helped to prevent any incidents, as no abuse reports were received.

The majority of the FAP work focused on providing secondary prevention to Soldiers experiencing marital problems with spouses back home. Twenty-five Soldiers, 21 male and 4 female, received supportive counseling for partner relational problems associated with infidelity or being told that their spouse wanted a divorce. Most presented to the clinic experiencing anger, depression, inability to concentrate on missions, sleep difficulties, and appetite disturbances. Some expressed suicidal ideations while others wanted desperately to go home so they could "fix" their marriages. Usually, once the initial crisis was stabilized, Soldiers received supportive intervention using individual and group modalities that emphasized stress management strategies, methods to cope with family separation, improving communication in a marriage, and restoring trust in a relationship. No one had to be redeployed early because of FAP related issues.

Reset Phase (Postdeployment)

At this point in the deployment cycle, the primary responsibility for the unit's family advocacy support reverts to the home station FAP. After the 4th Infantry Division redeployed from Iraq, the 3 abuse cases that occurred in-theater, including all documentation, were formally transferred to Fort Hood's FAP supervisor. Of the cases that were active prior to deployment, written updates were provided on the 12 Soldiers who received follow-up in Iraq. Eleven of the Soldiers who received treatment for partner relational problems were recommended for continued follow-up by FAP clinicians due to lingering symptoms that placed them at-risk for family violence. Additionally, 8 Soldiers were referred to the outpatient Resilience and Restoration Center for further assessment and treatment of combat-related psychological symptomatology in hopes that any related family difficulties could be averted. As a PROFIS provider, the behavioral health officer did not accompany the unit to Fort Hood and thus was unable to personally ensure that Soldiers received recommended follow-up. This lack of continuity reinforces the importance of direct assignment of organic behavioral health providers to the brigades they support. Finally, redeployment is the time to review lessons-learned so that behavioral health ser-

vices can be improved for future operations. The review should include the FAP protocol to determine if adjustments should be made to develop more effective family advocacy support for the next deployment.

POLICY IMPLICATIONS

Although there are limited empirical data to help define the extent of family advocacy problems in the current theaters of operation, we believe that the anecdotal evidence inherent in the 4th Infantry Division's experience during OIF 05-07 reflects the challenges confronted by most operational units. Presently, since no standardized approach to operational family advocacy exists, deploying units must rely on the professional experience and personal interests of its behavioral health officer for the design and implementation of a FAP support plan. Institutionalizing a systemic response, rather than relying on individual initiative, requires the modification of existing policy. We recommend consideration of the following policy initiatives:

- Issue command guidance on which provisions of *Army Regulation 608-18*[6] apply to deployed units operating in a combat zone.
- Assign the Chairperson, FAP Case Review Committee (CRC) as the responsible agent for ensuring that follow-up of all active cases is properly coordinated between the installation's FAP and the deploying unit.
- Modify the composition of the FAP CRC to include the brigade behavioral health officer for cases involving Soldiers assigned to his or her brigade.
- Clearly designate one organization, either the deployed unit or home station, to take responsibility for the management of family advocacy cases that occur in theater, to include CRC review and records management.
- Clarify whether the in-theater provost marshal or the law enforcement agency at the home installation has responsibility for spouse abuse reports from the deployment area.
- Create a reporting mechanism to specifically track the number of spouse abuse incidents occurring in a theater of operations.
- Extend the victim advocate program to support victims of domestic violence in theater.
- Update the programs of instruction for the Family Advocacy Staff Training and Combat Operational Stress Control Courses, conducted at the Army Medical Department Center and School, to include family advocacy support for overseas contingency operations.
- Reduce the reliance on PROFIS providers for filling behavioral health officer authorizations in the brigade combat teams.

Other policy actions may be warranted as we learn more about the impact multiple deployments have on marriage and family relationships. To help target prevention efforts at critical junctures, domestic violence rates should be carefully monitored for increases associated with each phase of the deployment cycle.

CONCLUSIONS

As the Army continues its transformation into an expeditionary force, new approaches to the delivery of behavioral healthcare to Soldiers and Families will be needed. The Army Campaign Plan for Health Promotion, Risk Reduction, and Suicide Prevention aims to improve existing programs and to ensure they are well coordinated to maximize effectiveness.[20] For some, blending family advocacy functions into brigade behavioral health operations will not be a popular proposal, and it is arguable that active spouse abuse cases could be suspended during a deployment since the threat of physical harm is minimal. However, ensuring continuity of care for family advocacy cases sends a strong message that meeting the psychosocial needs of our Soldiers and the execution of operational missions can coexist. The provision of family advocacy support to forward operating areas, with its bureaucratic complexities and clinical challenges, requires innovative thinking that integrates contributions from behavioral health providers, family advocacy personnel, and unit commanders. Deployment area family advocacy procedures, at least those measures to protect and support victims in theater, will further solidify the Army's commitment to provide for the psychological health and well-being of its Warriors and Families.

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Increasing Our Access to Care: A View From Middle Management

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Increasing access to care has been declared a priority of the US Army Medical Department.[1] Accomplishing this goal will take action on the strategic as well as the tactical level. The problems currently impeding access to care seem pervasive as there are several components:

- regional variations
- technology issues
- patient expectations
- current staffing levels

The key to increasing access to care is to individually examine and address the identified components that presently stand in our way. This paper addresses several innovative ways to increase access to care in our current medical system. Some are currently being employed at the medical activity level, others will require bold moves by those in the US Army Medical Command leadership and involve major paradigm shifts in the way we approach the entitlement of free medical care in a system with finite financial limitations.

The first issue is to identify if access to care is indeed a problem and, if so, at what level (national, regional, local) does the problem exist. The second issue is to find contributing factors to the problem. The third is to prioritize the solution(s). The fourth is acceptance from all those involved in patient care.

Is access to care a problem? Many regions report data showing they are not meeting TRICARE* standards. When this data is elevated, it seems to take on a life of its own. All regions then respond to access to care with equal intensity, whether or not data supports that a region may, indeed, meet TRICARE access to care standards. This can be a distracter for those regions already meeting the standards. In addition, the politics and emotion of this issue seem to outpace reality. When we look at anecdotal cases from very distraught beneficiaries, such as "we cannot get appointments at my Army health clinic," a nonissue can be blown out of proportion.

Access to care begins with a patient's phone call to the military treatment facility seeking an appointment. Our [US Army Medical Department Activity, Heidelberg] phone system is a hodge-podge of phone systems manned by central appointment clerks, office staff, clinic clerks, and Soldiers. Wait times, busy signals, and the like all degrade patient satisfaction. If a clinic phone system is manned by a single person, the loss of that clerk due to illness, leave, or transition of the position will have a deleterious effect on the clinic's access to care. Perhaps it is time to establish Regional Medical Command level phone systems to provide a robust service to our beneficiaries. The Europe Regional Medical Command is currently investigating this option.

The greatest challenge to military treatment facilities is the constant loss of providers and support staff to deployments. This not only degrades the number of staff personnel available, it also chronically affects the continuity of care. The loss of a single provider for a year in a large, 10-person clinic can lead to an annual loss of 10% in relative value units. Since the beginning of Operations Enduring Freedom and Iraqi Freedom, thousands of providers and support staff have deployed. It has proven difficult at times to replace lost staff as the Army Reserves have been decimated by years of activations. The acquisition of civilian hires to replace deployed physicians at some remote locations or at locations identified for closure has proven very challenging. Some military treatment facilities have occasionally offered extremely high salaries for providers to relocate to their areas. In addition, appointing patients to a primary care manager is not reflected in the current reality of military medicine. Appointing a primary care manager was difficult at best when providers routinely moved every 3 years. Now primary care managers not only rotate every 3

*TRICARE is the Department of Defense healthcare program for members of the uniformed services, their families, and their survivors. Information available at http://www.tricare.mil.

years, they often deploy in the middle of most assignments. Some of our Soldiers and Families may rotate through 3 or 4 primary care managers in their 3-year tour. Appointing patients to teams or clinics, such as the Red Team or the Pediatrics Clinic, is a more realistic goal due to the current transient nature of our military providers. This appointing system is allowed under the US Army Medical Command's Access to Care Operation Order,[1] but it has proven difficult to execute due to the limitations of the Composite Health Care System Primary Care Manager appointment system.

Our overseas military bases also deal with a large number of long-term nonbeneficiaries such as Department of Defense (DoD) civilians, DoD Dependents School teachers, DoD contractors, and retirees seeking medical care in our military treatment facilities. Our current military treatment facility staffing models do not account for these populations, and although they are entitled to purchased care, or free care for retirees, on a space-available basis, these employees and retirees have come to expect care from our military treatment facilities. Access to space-available care varies greatly from clinic to clinic and from year to year. It is difficult to turn healthcare on and off for our chronically ill nonbeneficiaries and retirees. Most Army providers feel they are abandoning their chronic patients when continued care is denied due to access to care issues.

Military physicians may work 60 hours or more per week, while civilian physicians under the National Security Personnel System (NSPS) are required to work 40-hour weeks. Although civilian physicians could work more than 40 hours per week, they would accumulate compensatory time for this overtime. The physicians would then use their compensatory time for additional days off, leading to fewer patient appointments and a decrease in access to care. The NSPS is attempting to correct this issue by eliminating overtime and compensatory time for physicians and dentists. NSPS physicians seem unaware of this transition as it is written only in 5 CFR §9901.361(e) (2009), not in an employee contract. The vision of the NSPS system is that physicians are hired to complete the mission and are not employees paid by the hour. Their salaries are supposed to reflect this change in work expectations and be negotiated to compensate employees for additional work such as, overtime, on call, shift work, holiday and weekend work. The NSPS system needs to establish written contracts for physicians that explain the mission-oriented work mentality before the employee begins working. Currently, this is not briefed, in writing or verbally, to these employees when they negotiate their initial salary.*

Another factor that affects provider productivity is the military's current electronic medical record system, AHLTA. This system has many outstanding features such as a lifetime continuous medical record, medical records that are viewable worldwide in all military treatment facilities, no legibility issues, and the ability to import medical summaries from outside the military treatment facilities. But these features come with a huge cost—provider time. The system is designed to make the provider enter the data. Data entry is a tremendous distracter, especially for those providers who cannot type or who are challenged by the use of computers.

Providers who would see 30 patients a day when using a simple, paper-based medical record system see only half that number using AHLTA. The US Army Medical Activity, Heidelberg (USAMH), and now the Europe Regional Medical Command have sought to mitigate some of these documentation issues using some off-the-shelf technologies. These technologies use wireless laptops, medical dictation software, and pretyped text macros that make documentation quicker and more efficient. They have increased provider-level satisfaction with AHLTA and have improved the overall medical record. These best practices are now being taught throughout the Army Medical Department, but they are still of little help if the provider suffers from computer phobia. Until all our providers are truly computer literate, this form of data entry will come with a cost. Another issue with AHLTA is its instability. The system is chronically unavailable[†] and, since the main server is located in the US, it is extremely slow for many locations around the world. Clearly the benefits of this system do outweigh the problems, but AHLTA comes with a

*Note: The National Defense Authorization Act of 2010 (PL 111-84) has eliminated the NSPS and requires the transition of all NSPS employees into non-NSPS personnel systems not later than January 1, 2012. *The Editor*

†Data from Information Management Division. AHLTA/CHCS Actual and Scheduled Downtime for Central Europe; August 2008. Internal military information, limited access.

technological tax on providers' time. There is not a current solution, and the situation will continue to affect our overall access to care.

Medicine itself has changed over the years. Changing Joint Commission* standards has increased the quality of medical care, but has also imposed many standards that demand large amounts of additional time from our providers and support staff. These Joint Commission standards force staff to address many issues, such as abuse, depression, learning issues, smoking, nutrition issues, deployment issues, medicine reconciliation, and patient safety discussions with every patient at every visit. Although this data can be answered by the patient in a simple questionnaire, it can take a fair amount of the patient's time. Further, that data must then be entered into AHLTA by the support staff and, if relevant, addressed by the provider. Yes, this is a very holistic practice of medicine, but the cost in time for patients, staff, and providers is tremendous. Screening patients for very simple medical issues is now a very complex process, absorbing time and thus affecting access to care.

The issue in the Military Health System is that the structure of the healthcare benefit increases patient expectations and leads to overuse. The Army Medical Department defines access to care as the patient being seen by the right provider, at the right time, in the right venue. Many patients would define access to care in the Military Health System as being seen by their primary care manager when they want to be seen. Patient expectation of the Military Health System is very high and there is no other model for it in the world. If a patient pays out-of-pocket for all his medical care, he might wait until the last minute before seeking care. If there is no cost to the patient such as in the cases of socialized medicine, military healthcare, or Medicaid, the patient might expect immediate medical care for every ailment, whether it be hyperacute, "I vomited once this morning," or only for simple convenience, "I just need a bottle of Tylenol for my baby." The balance may be obtained in a copay system. A $5 to $10 copay weeds out many needless visits to a provider, thus reducing appointments booked into the system, decreasing demand, and increasing access to care. An additional method to reduce demand in the Military Health System is the use of phone triage. Nurses or nurse practitioners, using well-established algorithms, are highly skilled at phone triage. Military treatment facilities which have used this system have shown a significant decrease in patients seeking acute appointments, thus producing an increase in access to care by decreasing demand in a safe, cost-effective manner. The Stuttgart Army Health Clinic is currently using a contracted Nurse Advice Line to screen all acute appointments. Patients initially did not like the extra step in obtaining an appointment, but the system has reduced the need for a provider to see every patient who thinks he or she should be seen. The Europe Regional Medical Command is also looking into incorporating this service into its regional telephone appointment system.

One way to increase patient flow and to reduce the time the patient spends in the clinic is to hire more support staff. Support staff personnel, like providers, vary in proficiency and must be carefully chosen. Computer-savvy support personnel who can complete patient questionnaires, take vital signs, and accurately complete the subjective part of the AHLTA note quickly and efficiently can greatly increase provider productivity and the overall system's access to care. At the USAMH, we have sought to increase efficiency by linking a support staff member, medic or nurse, directly to a provider. This has resulted in a better flow of patients and increased provider and support staff work satisfaction.

Patient no-show rates of 3% to 20% also have a huge impact on clinic predictability and the Army Medical Department's access to care. Many civilian practices bill a patient for the full cost of a no-show. A nominal nuisance fee of $5 to $10 would produce a significant decrease in clinic no-show rates at our military treatment facilities. Electronic and phone reminder systems do make a positive difference in patients appearing on time for their appointments, but our penalty-free system is a very poor business practice and should be revised.

The Military Health System must also determine the priority for access to care. The US Army Medical Department Center & School's priority is to teach physicians. Our US Army Medical Activity's priority is patient care. In 2009 the Army Medical Department

*The Joint Commission (One Renaissance Blvd, Oakbrook Terrace, Illinois 60181) is a private sector, US-based, not-for-profit organization founded in 1951. The Joint Commission operates accreditation programs for a fee to subscriber hospitals and other healthcare organizations.

published the aforementioned Access to Care Campaign Operations Order (OPORD).[1] Many tasks in this OPORD will help increase appointments and access to care if this remains the priority. Every time we task a provider for additional stovepipe training such as suicide prevention, provider resiliency training, sexual harassment, sexual assault, equal opportunity, equal employment opportunity, composite risk management, antiterrorism, or Health Insurance Portability and Accountability Act (Pub L No. 104-91 110 Stat 1936 (1996)), we reduce our access to care. Each of these topics is individually a worthy endeavor, but when they are combined, they produce "death by 1,000 paper cuts" on the support staff and providers' time, and therefore affect access to care. Many military treatment facilities still attempt to set aside large blocks of time to accomplish this training, but the number of training hours may soon outnumber patient care hours. Every new training requirement should be properly vetted and have a price tag attached showing its true cost in time and money to our access to care.

A way to increase access to care at the strategic level is to use the limited number of providers in the Army Medical Department in a more efficient manner. Many senior physicians serve in administrative positions and see a very limited number of patients. One recommendation is a reduction in the number of these positions, or simply reduce the administrative expectations of these providers and allow them all to practice medicine at least one day a week. This would be a bold move and provide an immediate and significant number of available patient appointments in the Army Medical Department. Middle management at the physician level of a military treatment facility is a challenge. Every physician, provider, nurse, and noncommissioned officer is considered a leader and should be in charge of something. This can be a double-edged sword and lead to an entire workforce seeing patients at a half-time equivalent. Consolidation of middle management can decrease administrative duties to a few select people while allowing others to see more patients and increase access to care. At the USAMH, we have eliminated the Department of Outlying Clinics and the Department of Primary Care and placed all those administrative duties under the Deputy Commander for Clinical Services. This allowed 2 providers to return to the role of patient care.

Finally, our providers' paradigm needs to change. A number of providers serve selfishly—they decide that since military physician pay is less than civilian pay, they expect the military work to be less demanding. For some, a 40-hour work week that addresses both administrative and patient care duties is the norm. In a capitalist system, the incentive to work is directly tied to compensation; the more patients you see, the more you or your practice makes. In a salaried system, the amount of work one performs has no additional value and there is no monetary compensation to see more patients. Competition amongst providers for the number of patients seen per day, hours worked, and patient satisfaction will only go so far in increasing provider productivity. Many believe increasing the number of patients seen in a day will degrade the quality of patient care and lead to a decrease in patient satisfaction. The saying that you cannot have it all "good, fast, and cheap" holds some weight. Perhaps one of the many current physician bonus programs should be linked to the quantity and quality of care provided by the physician.

Overall, increasing access to care can be accomplished if the problem is attacked from various angles. Provider and support staff deployments are not likely to decrease in the near future, so other strategies should be attempted. Phone systems can be centralized to help decrease call wait times and standardize access across regions. Using civilian, government-employee physicians and paying them fair compensation for time worked will allow the Army Medical Department civilian workforce to be more productive and increase access even in geographic areas where hiring additional staff may be difficult. Systems to make AHLTA more user-friendly will help make documentation easier, but will not increase the overall speed of the program. Attrition of our less computer-savvy workforce will also help, over time, in this area. Appreciating the additional time it takes to enter data into the electronic medical record is the key to its success. Joint Commission medical standards have increased the quality of medical care over the years, but, again, the time it takes to fulfill these requirements must be programmed into each visit, and its effect on our access to care must be appreciated. Patient expectation can be met by using a skilled nursing triage system to help reduce demand on the Military Health System. The quickest wins could be

obtained by shifting physician administrative duties to patient care and realigning bonuses to productivity. This would be a major paradigm shift for the Army Medical Department and would yield the biggest and quickest increase in access to care.

Army medicine is at a crossroads. Its beneficiaries and stakeholders demand access to care. How the Army Medical Department addresses this challenge could determine its future.

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Access to Care Initiatives

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Innovations in Access to Care

In the eyes of the beneficiary, how quickly can one obtain an appointment is a key benchmark of the success or failure of a clinic commander. Access to care was defined by a 2006 Joint Service Access to Care Committee consisting of the Deputy Surgeon Generals of each service and senior representatives of the TRICARE* Management Activity as "encompassing all of the necessary activities that will ensure our beneficiaries get to the right provider at the right time at the right place."[1] At first glance, access to care can be as deceivingly simple as having enough appointments for the healthcare demands of the community. However, access to care within the Military Health System is an orchestration of distinct processes occurring before, during, and after every patient visit. A short-sighted, quick solution in one area can have great impact elsewhere in the system. If you want to maximize your potential for positive outcomes, it is important to identify and appreciate the impacts of one process on other processes.

Access to care consists of interrelated components that address getting the patient into an appointment, having the right resources available to see the patient, and efficient processes to record, close, refer, or follow-up appropriate care. Not appreciating the impact of one area on another can cause great risk in creating redundancies and delays that hinder the efficiency and efficacy of completing a beneficiary's episode of care.

This access to care process within the US Army Europe Theater has an additional challenge: transformation. Transformation is a complete restructure of the location and size of US forces and supporting elements throughout the Europe Theater. My clinic, the US Army Health Clinic, Mannheim, our parent organization (the US Army Medical Department Activity, Heidelberg), and our supported communities have been designated for relocation and eventual closure. This article addresses some of the Army Health Clinic (USAHC), Mannheim initiatives to maintain access to care in a high operations-tempo community with decreasing healthcare resources and increasing healthcare demands of more than 6,000 enrolled beneficiaries and more than 4,000 Soldiers rotating to and from various global contingencies.

*TRICARE is the Department of Defense healthcare program for members of the uniformed services, their families, and their survivors. Information available at http://www.tricare.mil.

No Appointments Available?!

This was our projected crisis for the summer of 2008. We were losing available providers to a myriad of deployments, stateside medical boards, notices of termination, and civilian provider summer leaves bringing our clinic down from the 9 authorized full-time providers to 2.5 available full-time providers. What were we going to do? The easy answer was to limit access to only Active Duty Soldiers. And this we were not willing to do…yet.

Our first challenges were to identify replacement providers and discover how and where we could maximize the use of our available providers' time and efficiency. We were fortunate to receive borrowed manpower from our higher medical organization, including providers from closed facilities and 2 additional providers pulled back into service while they awaited their retirement dates.

Our efforts to maximize the efficiency of our providers' time continued. A healthcare provider's time is any facility's most valuable asset.[1] The critical common denominator for access is the available man-hours of our providers. I believe anything that takes the provider away from face-to-face contact with a patient is a distracter. Indeed, there are "necessary" distracters within the Military Health System—distracters which improve the providers' ability to maintain and sustain their personal medical readiness and survive within a battlefield environment; to facilitate the medical readiness of deploying and returning Warriors; and to deliver urgent and compassionate services to nonactive

duty beneficiaries. Beyond these, all other distracters were targeted for identification and resolution.

Through the great work and efforts of many, we were able to find a variety of top-notch, credentialed providers who were quickly absorbed into the normal operational flow and soon cherished by the community. Our projected crisis of having no available providers was avoided, but we were still having access problems. We had providers, but still had limited available appointments.

Where Did They Go?

There is the old axiom that "healthcare is local." This is most evident when you start looking at who is using the appointments. This will help you determine what services and types of appointments may be better for your given population. Figure 1 presents the charts depicting beneficiary utilization for the full fiscal years of 2007 and 2008 and the first 2 quarters of FY 2009 (October 2008 through March 2009) for the USAHC Mannheim. Comparison of the number of visits in FY 2007 to those in FY 2008 reveals a decrease of approximately one-third in every category: Family Members from 1248 to 940; Retirees from 469 to 298; Others (retiree family members) from 1871 to 1143; and Active Duty from 469 to 298. This is most likely a reflection of the US Army Europe transformation and major deployments of units. An alarming observation is that the number of Others is larger than Family Members. A significant change is noted when comparing FY 2008 to the first 2 quarters of FY 2009. The categories of Retirees and Others are half of the FY 2008 total visits as expected, but the Family Member total visits are two-thirds of the FY 2008 total. This is trending toward being one-third higher than the FY 2008 total visits and the Active Duty visits for 2 quarters are nearly equal to the total FY 2008 number, which may result in double the total visits of FY 2008 by year's end. The positive aspect is that there appears to be increased visit accessibility for Active Duty and Family Members in FY 2009.

Figure 2 depicts the monthly number of encounters and relative value units of acute, routine, and wellness appointments. The wellness

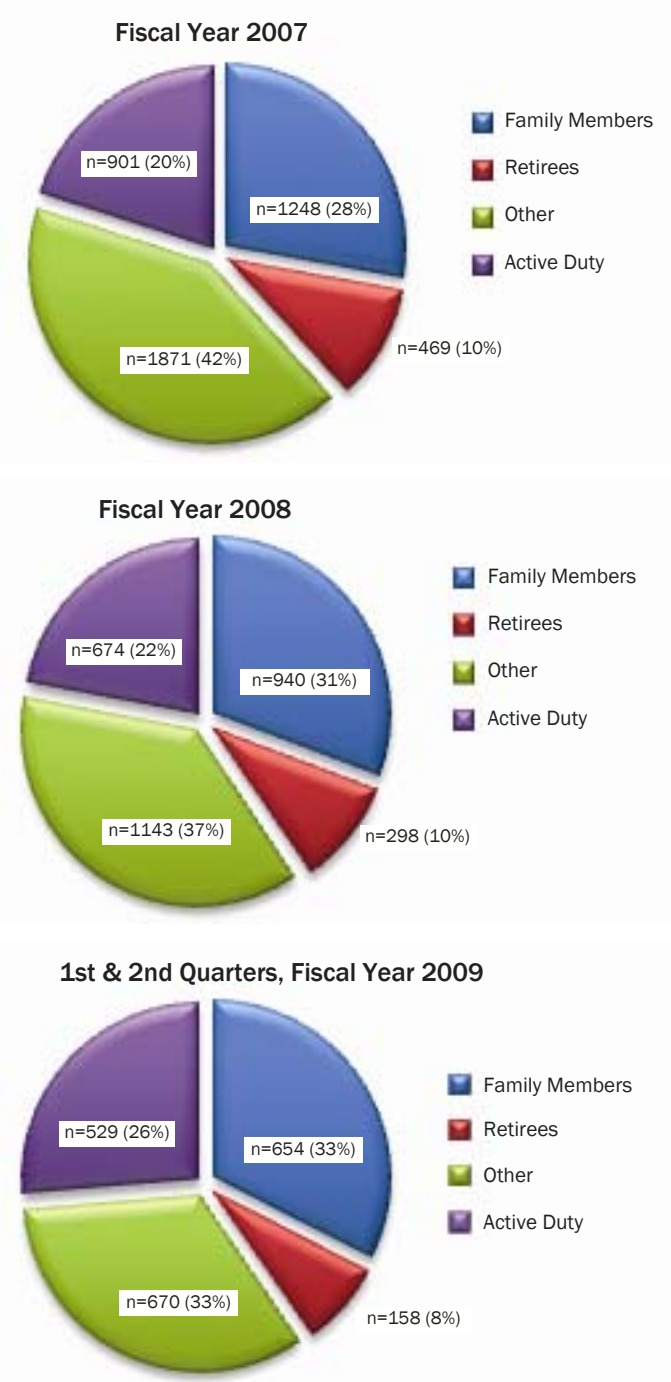

Figure 1. Beneficiary utilization statistics at USAHC Mannheim for fiscal years 2007 and 2008, and the first half of fiscal year 2009.

Source: Military Health System Management Analysis and Reporting Tool (http://www.tricare.mil/mhsophsc/mhs_supportcenter/Library/1_M2.pdf).

appointment increases align with major unit deployment and redeployment activities. Acute and routine appointments show a negative trend over the full period of the charts. However, it is important to note the significant increases in acute and wellness appointments starting from August 2008, but a decrease in the number of telephone consults being seen by providers. This decrease in telephone consults relates to the implementation of a telephone consult nurse initiative and additional processes to promote the "right care" to the right level of healthcare. Instituting a consult nurse option to review and, as appropriate, resolve less urgent beneficiary concerns (like prescription refills), as well as provide follow-up care as requested by providers increased the available man-hours for providers to have face-to-face interaction with more urgent beneficiary concerns.

The breakouts of utilization by beneficiary categories and actual appointment types seen are areas that warrant close review for any healthcare facility seeking not only increased access, but also increased access to the right care. Initial observations raise the consideration of decreasing access to the Others beneficiary category to allow better access for the primary beneficiary category. Reviewing what appointments are actually seen in your facility helps determine if your providers' time is being used efficiently and if lower-skilled healthcare providers could be better utilized in your facility.

To dig more deeply, we looked objectively at the process of getting care, then implemented the following initiatives to promote not simply access to care, but access to the right care.

Template Management

It is critical to ensure your schedule templates reflect the demands of your community. The medical director and supervisor of central appointments have the best view of the realities of patient requests and provider concerns within the facility, and they used the previous year's historical demand to develop our templates. Historical data showed the percentage of visits to be 58% acute, 16% routine, 18% wellness, and 8% established patient appointments, where the patient had been seen in clinic before. Templates were then reviewed at least every 3 months and adjusted based on clinic operations tempo. There were many factors affecting access which drove the need for close supervision and the ability to adapt quickly to the following:

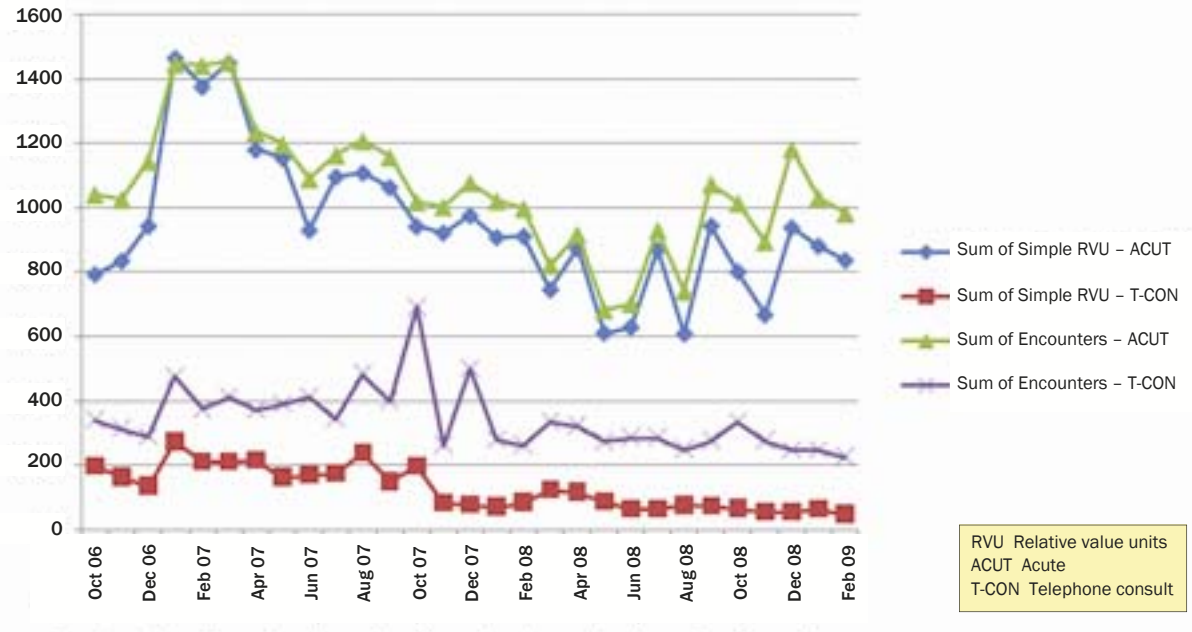

Figure 2. The number of monthly encounters and relative value units of acute, routine, and wellness appointments at the USAHC, Mannheim.

Source: Military Health System Management Analysis and Reporting Tool (http://www.tricare.mil/mhsophsc/mhs_supportcenter/Library/1_M2.pdf)

- Number of providers available compared to needs shown in historical data.
- Support services and providers available.
- Season. In winter there were more appointments for common colds; in fall/spring there were more appointments for sports physicals; in summer there was a low overall acute demand as a result of more people being away.
- Operations tempo. Deployments and redeployments of large units affect access at an unpredictable pace. Priority of care must go to Active Duty service members. Templates should be adjusted to reflect additions caused by priority care to Active Duty.
- Historical daily demand. Monday and Tuesday were busiest for acute care appointments, and Friday was least busy overall.

Other considerations are whether you want all providers to have similar templates (distribution of types of appointments) or whether you designate certain providers to see only patients for certain types of appointments, such as acute appointments. There are pros and cons with each type of template, and most providers would not want to see acute appointments all day. An equal distribution, adjusted as needed, is preferred.

The number one issue within our clinic was the number of available providers, the second was the number of appointments available. Appointment types can be adjusted at the time of the request. For example, you could convert a routine appointment to an acute appointment. But without an available slot, there is no further option.

THE TELEPHONE APPOINTMENT LINE

The telephone appointment line is the primary means that most patients use to access any healthcare system. Previously, there were more than 3 separate telephone numbers a patient could call for an appointment at our clinic. A patient would call one line, then call the second one, and then call the third in hope of getting into a shorter wait time for a human voice. This was changed to a single number, 385-CARE, which routes each caller to an automated system that cues calls into 6 available lines. Our initial close review of the telephone script found an obsolete cue number that apparently was the source of complaints in that there was no answer on that appointment line. The establishment of a standard and easily remembered phone number was a proactive, value-adding innovation made by the previous clinic commander. Unfortunately, it did not help our situation of no available appointments.

Our first innovation was to establish starting times for beneficiaries to call for appointments. Active Duty service members were given first priority for available appointments, calling as early as 7 AM for any available acute appointments. At 8 AM, Active Duty Family members could call for remaining available appointments, and any remaining appointments could be booked for retirees and retiree family members starting after 9 AM. The community's compliance resulted in decreased initial traffic peaks on phone lines, reduced overall telephone wait times, and provided better consistency for central appointment personnel. Most importantly, it increased the opportunity for Active Duty Soldiers to be scheduled first for available appointments.

Our second innovation was to establish a telephone consult nurse option within the telephone script. Providers stated that a number of their appointments could have been handled by a skilled healthcare provider such as a registered nurse. A registered nurse was designated to personally answer basic medical requests such as prescription refills and basic health-related queries, which reduced the necessity of patients' 20 to 30 minute appointments with providers. This resulted in immediate positive feedback from patients who were now able to come directly to the pharmacy for their refills as opposed to first navigating the appointment system to see a provider for that renewal. The patient experienced less difficulty/inconvenience and the clinic saved an appointment for a patient in potentially greater need.

Suite Standardization

Our clinic is structured as one long building with individual branches to either side which we call "suites." In each of the 5 major suites are 2 provider offices with 4 treatment/exam rooms, a general waiting and front desk area. There had been a great variation in processes and equipment in each suite. A suite standardization project started in 2007 was reinstated as a priority. The goal of the suite standardization project

was the implementation of a standardized process for medication reconciliation and medical record documentation, physical uniformity of the suites, and improved patient flow. The Plan, Do, Check, and Act performance improvement methodology was used to establish an organized approach:

Plan

The plan began with the establishment of a "Tiger Team" consisting of a cross section of clinical staff and providers. The team's first mission was to review our clinic and parent organization's policies concerning medication reconciliation, medical documentation, and patient flow recommendations. The team focused their planning on developing new processes, writing new policies, and communication of those policies with actual implementation of the new process.

Do

This phase focused on development and implementation of a pilot study of the new process. Initially, a template for prescreening was initiated based on the Joint Commission's* focused questions. During our progression, we incorporated the Army Medical Command AHLTA† provider satisfaction automation initiatives as our foundation. Wireless networking and other technological innovations were simultaneously introduced to enable more efficient and accurate documentation. All patient treatment areas were outfitted with standardized equipment allowing screening and treatment to be performed in the same room, and all clinic staff were retrained on the current standardized processes. Realized benefits included increased third-party insurance compliance improvements, increased patient turnover rates and managed patient flow, and effective resource utilization, including one dedicated healthcare assistant for every physician.

Check

This phase monitored implementation through statistical data gathering and identifying successes, failures, and potential trends. Feedback was gathered from providers, medics, and nursing assistants on the effectiveness and compliance of the new processes. Root causes for failures were quickly identified, with solutions gathered and implemented. One root cause for inconsistent documentation was the continuous movement of personnel from one suite to another. This situation was improved by identifying suite teams with 2 medics assigned to 2 physicians. Another issue was that administrative requirements in each suite were taking away from the critical time available for medics and nurses to screen and prepare patients for providers. This was improved by diverting the administrative duties of third-party insurance verification and the AHLTA check-in to a centralized check-in process at the entrance of the facility. The centralized check-in, collocated with the Patient Administrative Division, allowed the introduction of a greeter for traffic control, and each provider's dedicated healthcare assistant personally escorted patients to their screening and treatment area. This process allowed the dedicated healthcare assistant to conduct a face-to-face handoff of each patient to the provider, an opportunity for provider-to-medic training, and a more personalized experience for each patient.

Act

This is our current phase which continues the monitoring of the check phase. The whole clinic is operating under the new processes. New policies and procedures were written and communicated throughout the clinic. Minor construction projects were programmed to facilitate better traffic control within the centralized check-in area, and opportunities for better patient education are being explored. These processes will continue to be monitored to identify successes, failures, and potential trends.

Benefits noted within the first 4 months included:

- Faster patient turnaround time gave physicians more time to see additional patients or to complete administrative duties.
- Decreased patient congestion in the suite areas.
- Medics and nursing assistants focus their energies on screening and assisting their assigned physicians.
- Better utilization of enlisted medical specialists, healthcare assistants, and administrative personnel.
- More consistent insurance checks with a compliance rate improvement from 45% to 95%.

*The Joint Commission (One Renaissance Blvd, Oakbrook Terrace, Illinois 60181) is a private sector, US-based, not-for-profit organization founded in 1951. The Joint Commission operates accreditation programs for a fee to subscriber hospitals and other healthcare organizations.

†AHLTA is the US military electronic medical record.

- Improved accuracy of demographics, which is currently updated only 30% of time.
- Patients verbalize satisfaction with less waiting time and more of a personal touch in the provision of healthcare.

When the dust settled, the "number-crunchers" saw that workload and productivity looked fairly the same. However, I believe our efforts succeeded in that we maintained our access availability, avoided an access crisis, and started to align the right people to the right care. Hopefully, one or more of these initiatives will be helpful to another facility's efforts to improve access to care.

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COL PIERCE JOINS THE *AMEDD JOURNAL* EDITORIAL REVIEW BOARD

The *AMEDD Journal* welcomes COL Carol Pierce, AN, USA, as a member of the Editorial Review Board. COL Pierce has been selected to be the next Chief, Department of Nursing Science, Academy of Health Sciences, AMEDD Center and School, Fort Sam Houston, Texas.

COL Pierce joins the board replacing COL Kathleen Dunemn, AN, USA. COL Dunemn has been a member of the Board since April, 2008. We thank COL Dunemn for her dedication to the high standards and professional quality of this publication, and her years of service and support to our mission.

The Editor

Case Study: Realignment of US Army Medical Activity, Heidelberg Assets During US Army Europe Transformation-Driven Health Clinic Closures

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INTRODUCTION

Strategic planning for our nation is a dynamic process and is continually adapted to current situational information. As strategic plans are adapted, changes result which are then transmitted through operational channels to the tactical levels. In military healthcare, tactical medicine is the level where healthcare personnel provide direct care to beneficiaries, whether it is lifesaving care delivered to an injured Soldier by a medic on the battlefield, an operation performed by a surgeon on a beneficiary in a military treatment facility or health maintenance counseling to retired Soldiers in a primary care clinic.

In 2004, the Army announced strategic planning with broad restructuring plans that included massive troop movements and resulted in a dramatic decrease in American troop presence in Europe and Korea. A natural follow-on to the decrease in supported population was a decrease in support services provided by the Army in Europe. Although the original troop movements were planned with proposed dates and number of troops to transfer, the specific plans for support services were not supplied. Due to the lack of advance planning for downsizing of supporting services, a reactive process developed, with support services curtailed as the supported population departed.

This article reviews the Army Transformation, Europe, process as it has been conducted at US Army Medical Activity, Heidelberg (USAMH) with realignment of healthcare assets, describes problems encountered, and identifies best practices to improve the process as Army transformation continues now, and is included in future strategies.

THE TASK AT HAND: THE PROBLEM OF CONDUCTING ARMY HEALTHCARE TRANSFORMATION

Historical Perspective

The European theater experienced significant changes after the Gulf War in the early 1990s, with downsizing of troops and withdrawal of the overall US Army presence. Although Army personnel were subjected to situational problems and conditions similar to the Army's current transformation, the Army has retained no institutional knowledge of the downsizing process. No written or published record documenting closure procedures, problems encountered, or solutions developed has been discovered. The people who experienced and implemented the downsizing procedures conducted 15 years ago are either unknown or no longer available.

Current Perspective

The USAMH mission is to positively affect Soldier and family health through high quality, integrated healthcare while maximizing medical readiness. Healthcare services provided are seamless and uninterrupted during peacetime and war as well as during times of stability and during periods of turmoil, such as closure operations when units depart and Soldiers out-process from the community.

When Army Transformation in Europe commenced, the Army was intensely involved in Operation Iraqi Freedom. Various troop populations were identified either for transfer to new locations, return to the United States, consolidation, or restructuring with other units or dissolution of member units and casing of the colors. When orders for transformation and movement of particular troop populations were publicized, it naturally followed that supporting services should also transform, but no orders could be generated or plans made until specifics of the troop movements became known. Most troop movement orders are appropriately handled as classified information, complicating actions and making it difficult for support services to establish a timeline for downsizing and eventually curtailing services.

Information to plan for curtailment of support services was obtained by attending town hall meetings, communicating directly with line unit commanders, and reading the newspapers to gain insight into how to appropriately plan for clinic closure.

The Army Health Clinic (Babenhausen) was closed in 2006 when transformation established the departure of all remaining troops from Babenhausen, Germany (lst Battalion, 27th Field Artillery Regiment; 2 batteries of the 5th Battalion, 7th Air Defense Artillery Battalion; and the 71st Ordnance Battalion). The 1st Brigade Combat Team (BCT), 1st Armored Division was stationed with its supporting elements in the Baden-Württemberg area of Germany and received medical support from outlying healthcare clinics which had been established after World War II in communities with substantial troop concentrations. The clinics were supported and manned by the USAMH. On June 6, 2006, it was publicly announced that the 1st BCT with all combat support units and beneficiaries had received orders to relocate to the United States. This announcement was the stimulus for a reassessment of healthcare services provided in the area of support. Executive analysis determined that the clinics that had been providing healthcare services in Buedingen, Friedberg, and Butzbach would no longer be required after the departure of the 1st BCT. The following year, 2 additional installations, Hanau and Darmstadt, were marked for closure due to additional realignments and unit deactivations.

As the beneficiary population declined, affected clinics continued to provide a full spectrum of services, including laboratory and radiological services. In order to continue to provide full services, the clinics were required to maintain basic staff and equipment until the last Soldier and beneficiary departed, rendering the provision of services inherently inefficient. Operating under the Performance Based Assessment Model recently adopted by the US Army Medical Department, no allowances exist for the inefficiencies of clinic closure, producing a negative contribution to the performance of the entire USAMH under this model. After bringing this issue to the attention of higher levels of the Army Medical Department, planned decrements to the operating budget were adjusted to compensate for the basic inefficiencies of clinic closure. This allowed the organization to continue normal operations and avoid drastic measures to stay within the budget for the remainder of the fiscal year.

In addition to healthcare services, all other support services (housing, transportation, commissary, and post exchange) were curtailed as the last line Soldiers departed. When obtained information made it obvious that clinic closure was definite, medical personnel were instructed to request orders for transfer. In other words, Soldiers were ordered to leave the clinic and then directed to request permission for transfer. Since clinic closure actions were not initiated until unit movements were publicized, medical personnel were not able to submit requests for personnel actions to generate requests for orders until well after the supported units had initiated personnel actions. When requests for orders were ultimately generated for clinic personnel, they were submitted into a system that was already overwhelmed, resulting in last-minute orders and assignments. Subsequent movement of clinic personnel presented challenges in coordinating transportation of household goods from a service that was overwhelmed with supported unit moves, was already downsizing, or had ceased provision of services in the closing community, which necessitated the provision of support for moving personnel by an appropriate agency in another community.

Since Operation Iraqi Freedom was at its peak at the start of Army Transformation, many clinic personnel were deployed in support of the war effort. In some cases, personnel were deployed from a community that was scheduled to close before they returned, so there would be no Army facility remaining when they arrived. Fortunately, clinic commanders anticipated the implications in all such situations and successfully managed each individual case. Due to the lack of a proper mechanism to process cases for clinic Soldiers who were deployed, commanders were challenged by a stodgy system that was unresponsive to the resulting unique, individual requirements. Each situation required active, persistent, and frequent interventions by commanders to properly move Soldiers and Families prior to deployment.

TRICARE* Service Center enrollment and disenrollment of remaining beneficiaries, mostly retirees, proved particularly cumbersome. The remaining beneficiaries at the clinic were advised to transfer their care to the facility of their choice. Fortunately for the affected beneficiaries at Hanau, an Army clinic located nearby in Wiesbaden provided flexibility for beneficiaries remaining in the area to either transfer their enrollments and continue to obtain access to care and referrals for specialty care within the Army medical system, or move into the German host nation medical care system, as necessary.

German host nation medical care facilities characteristically do not bill on a timely basis, and sometimes do not bill until a year or more after care is

*TRICARE is the Department of Defense healthcare program for members of the uniformed services, their families, and their survivors. Information available at http://www.tricare.mil.

provided, resulting in receipt of bills well after the clinic closure date. Intense efforts were made to contact all possible billing physicians and facilities to ensure they knew where to send their bills after closure of the Army clinics. The USAMH Managed Care Division was the central point of contact for resolution of all billing issues.

One of the biggest challenges in transformation was taking care of the valued clinic personnel. There were 3 basic categories of personnel supported by their respective personnel systems that required placement upon clinic closure: active duty Soldiers, supported by the military personnel system; Department of the Army civilians, supported by Civilian Personnel Office and Civilian Personnel Advisory Center; and local national employees, supported by the Works Council. Each of these systems presented a unique set of difficulties in either avoiding or overcoming the bureaucratic obstacles that existed in systems unprepared for massive personnel movements. Due to the sheer volume of personnel actions, the military personnel system was unable to efficiently process the enormous number of movements of Soldiers. The necessary actions placed an extreme strain on the military personnel system, overloaded the process, and produced extended delays in receipt of orders and assignments. The majority of civilian employees departed with active duty line unit spouses prior to cessation of support services, which compromised clinic staffing as unit departures occurred prior to clinic closure. Fortunately, all remaining civilian personnel were reassigned to existing vacant slots, thus eliminating the need for reduction in force action. Unique to Germany is the Works Council, a local national organization that is similar in function to a union. Since the system is an entity of the German social system, the Army has no direct control and little influence regarding prioritization or expedition of actions. Their thorough and methodical system of reassigning employees mandated extensive lead time to communicate and gain concurrence of the Works Council to process actions.

Future Perspective

Army Transformation will continue, with further implications to the level and amount of healthcare provided in Europe. In order to use the lessons learned in previous clinic closures and to institute the best practices that were developed, the following planning guidance is provided to assist future transformation efforts.

1. Upon learning of possible closure actions, immediately employ the Medical Command Medical Service Action Plan format to initiate clinic closure planning and provide chain of command visibility to the impacts of clinic closure on business operations. Receipt of the Medical Service Action Plan at the Medical Command is critical to accomplish closeout of the Unit Identification Code and to facilitate issuance of closure orders for the clinic. Additionally, generate an operations order to ensure synchronization of all staff sections during the closure process, and identify specified and implied tasks which are critical to the successful transition and facility closure. Also, establish adequate social services programs for the expanded requirements of redeploying Soldiers caused by the turmoil of transfer and Family movements.

2. The Medical Command's current model for business planning, the provision of funding and budgetary adjustments under the Performance Based Adjustment Model, penalizes organizations that have a decreasing enrollee population due to transformation. With enrollees departing with moving units, it is impossible for an organization to increase its productivity and workload and meet business plan productivity targets. Business plan projections are based on a 12-month baseline which includes the workload from closed clinics, and makes projections for future workload based on a population that no longer exists. As the fiscal years progress and the workload fails to materialize, the organization is penalized for at least 2 fiscal years after the clinic has closed. Enduring clinic operating budgets must include adjustments which anticipate significant Performance Based Adjustment Model decrements as money is taken away due to failure to meet workload and productivity targets.

3. Maximize equipment redistribution/reutilization and maintain property accountability. Conduct frequent in-process reviews with staff and closing clinic command teams, in person or via video teleconference as required, ensuring synchronization of efforts and adequate resourcing. Frequency and duration of in-process reviews can be adjusted as planning progresses, but involvement of key and essential staff components are critical to successful clinic closure. During organizational transformation, establishment of teams focusing on strategic communications, personnel, facilities and logistics, and clinical operations is extremely beneficial in mission analysis, course of action development, and mission execution. Preparation for curtailment of services requires coordination of efforts so that equipment is not removed or facilities altered until they are no longer needed. The logistics section must conduct onsite preclosure visits to assess quantity and condition of property for turn-in and compile a list of hand receipts which can be reviewed and posted on the organization's intranet for wide visibility to enable tracking of turn-in status. Advertising the lists to

prospective enduring clinic recipients provides advance awareness of the condition/life expectancy of the equipment inventory available for redistribution, aiding decision-making and procurement. Coordinate with garrison officials to comply with garrison guidance for clearing the installation, ensuring compliance with local standards for turn-in. Timely movement of assets requires advance arrangement of transportation and may require contracting additional services to facilitate turn-in from affected installations.

4. Develop processes to manage staff within the individual personnel systems which are designed to provide efficient, timely services for future large troop movements. Develop flex within the systems that allow for surges in affected areas. Recommend that operational Army units avoid transferring entire units immediately upon redeployment. This will allow sufficient time for returning Soldiers to reunite with their Families prior to experiencing the compounded stress of relocating their Family while the entire unit is moving from overseas to stateside or to another overseas location. Ensure appropriate restationing of military healthcare personnel and their dependents by anticipating challenges and initiating actions prior to unit movements. Provide sufficient lead time for all personnel actions to ensure timely receipt of orders prior to closure of installation essential services. Advise line units to include support personnel in appropriate briefings to facilitate early planning. Classified information can be handled as appropriately by support personnel as line unit personnel. Such available information will serve to synchronize smooth movement of support personnel along with line unit personnel. Identify and retain valuable civilian performers and restation them within the local area or at next consecutive higher levels within the Army healthcare system. Establish and maintain frequent informative communications with Civilian Personnel Advisory Center to enable Department of Defense civilian and local national employee actions.

5. Beneficiaries must be informed of the requirement to transfer enrollment to another healthcare facility. Transfer of enrollment must be closely coordinated by TRICARE Service Centers. Establish an enduring central billing point, develop a comprehensive communication plan with all host nation hospitals and providers, and educate all potential host nation providers of billing procedures to ensure they understand where to send bills after the closure of the clinic.

CONCLUSIONS

Strategic planning is a dynamic process that reacts to global changes in international relationships and politics and will continue to change the way we provide healthcare, both in garrison and in the field. Previous experiences with population downsizing and curtailments of support services in Europe have provided little insight or lessons learned as no documented record of actions was found. Many of the problems and inefficiencies encountered with curtailment of support services in conjunction with Army Transformation in Europe would have been avoided if a documented record of lessons learned had been produced and retained. US Army Transformation in Europe continues to proceed and will continue to produce new challenges. Clinics and organizations which are reducing services in the closure process must immediately implement the Medical Command's Medical Service Action Plan format to gain approval to close facilities and ensure that proper planning procedures are performed on a timely basis. Allowances must be made for the inefficiencies and costs incurred by closure as the current funding model, Performance Based Adjustment, does not apply to military operations in flux. Support service leaders must be involved in transformation and closure planning at the outset to ensure proper realignment of support services assets. Conducting transformation during a war with active deployment of personnel significantly complicates closure operations. As US Army Europe continues transformation, it will become increasingly difficult to facilitate the continued employment of many Department of the Army civilians and local national employees. Significant reduction in the number and type of jobs available will ultimately necessitate Reduction in Force actions.

We hope that this case study will assist medical leaders as they face similar circumstances of downsizing or clinic closures in the future.

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Evaluating the Impact of Investments in Information Technology on Structural Inertia in Health Organizations

LTC Lee W. Bewley, MS, USA

ABSTRACT

Structural inertia is the overall capacity of an organization to adapt within a market environment. This paper reviews the impact of healthcare investments in information management/information technology (IM/IT) on the strategic management concept of structural inertia. Research indicates that healthcare executives should consider the relative state of structural inertia for their firms and match them with potential IM/IT solutions. Additionally, organizations should favorably consider IM/IT solutions that are comparatively less complex.

Executives have long considered investments in information management/information technology (IM/IT) to be essential for conducting business operations and maintaining viability in the marketplace. IM/IT resources, ranging from computers to consultants, conspicuously occupy offices across all industries and have been a major element of emphasis for strategic planning, capital investment, departmental design, and financial analyses. During the period 1970–2002, approximately $23.9 trillion ($10^{12}$) was invested in the US economy for IM/IT resources including hardware, software, staff, supplies, communications equipment, and research (Figure 1). By comparison, during that same period, about $29.6 trillion ($10^{12}$) of healthcare services were consumed by the government and individuals (Figure 2).[1]

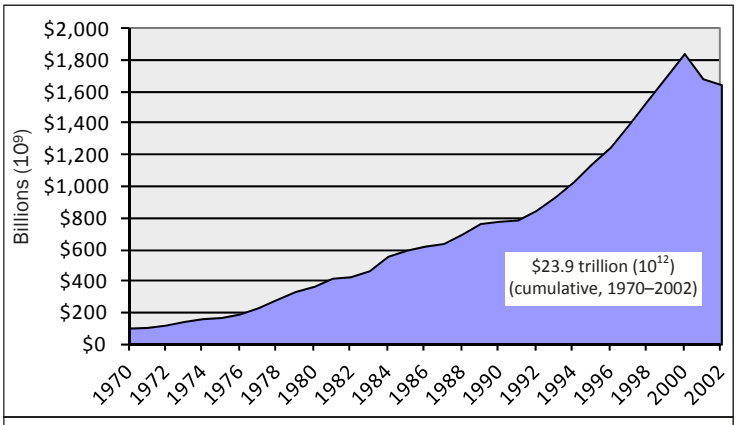

Figure 1. Annual US investment in IM/IT, 1970–2002. Data from the US Department of Commerce, Bureau of Economic Analysis.[1]

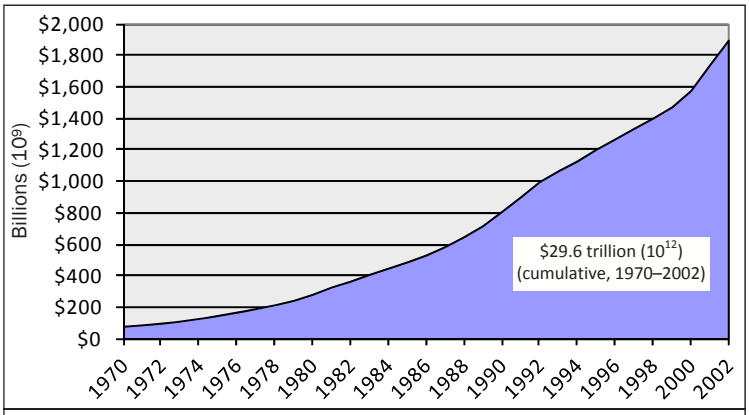

Figure 2. Annual US healthcare expenditures (private sector and government), 1970–2002. Data from the US Department of Commerce, Bureau of Economic Analysis.[1]

The healthcare industry has historically invested relatively conservatively in IM/IT; approximately 2% to 3% of healthcare revenues are directed toward these resources, while other industries such as financial services and technology firms spend 5% to 10% of revenues on technology.[2,3] This level of resourcing relative to revenues indicates that healthcare executives may have invested as much as $694 billion ($10^9$) in IM/IT over a 22-year period since 1970 (Figure 3).

Clearly, a central goal of a healthcare organization investment in IM/IT is to facilitate more effective and efficient operations for delivery or coordination of healthcare services to beneficiaries in a manner that will enable the firm to remain viable in the marketplace. A general collection of managerial expectations of IM/IT include faster communications, increased quantity and quality of data, "on-demand" solutions or services, reduced dependence on manual operations for analysis, and enhanced service efficiency. The track record for the utilization of IM/IT resources in healthcare includes numerous advancements in operational efficiency while enabling firms to be more responsive to changes in the market. Automation of common administrative tasks, electronic claims settlement, and digital medical records are a few key developments enabled by IM/IT investments. However, overtaxed appointment lines, bloated electronic mail inboxes, seemingly more data than analysis, and a generation of IM/IT assets that occupy space in our facilities while remaining comparatively idle are still pervasive within the industry.

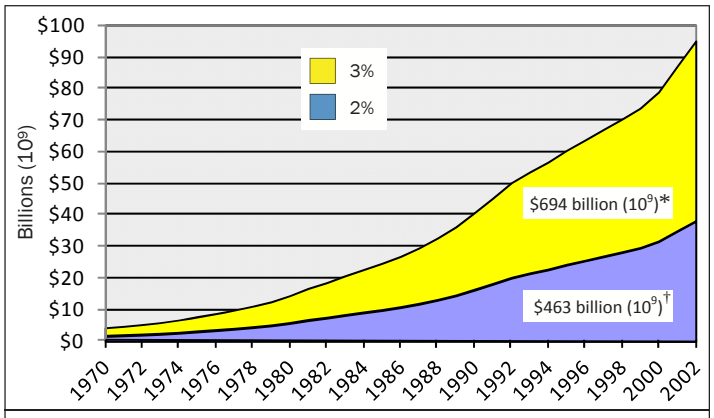

Figure 3. Estimated investments by the US healthcare industry in IM/IT as percentages of annual revenues.[2,3]
*Cumulative total at 3%, 1970–2002
†Cumulative total at 2%, 1970–2002

Given the current and historic levels of IM/IT investments by the healthcare industry and the counterbalancing aspects of progress and challenges resulting from these investments, executives must ask: what has been the net impact of these investments; what lessons can be learned from these investments; and, simply, have investments in IM/IT been worth it? In terms of strategic analysis, the overarching issue is how these investments have, on balance, impacted the ability of firms to compete in the healthcare marketplace.

One specific area of organizational theory provides a basis to examine the effects of investments in IM/IT in terms of strategic impact in the healthcare market. Population ecology is an organizational-environment theory that generally holds that organizations survive or die in the marketplace based on their ability to adapt to the environment. A key concept of population ecology is structural inertia. Structural inertia can be simply defined as the capacity of a firm to adapt. Information plays a central role in determining the level of structural inertia within the organization. Consequently, by studying the impact of healthcare investments in IM/IT resources on structural inertia, we may be able to better explain whether firms survived or died within industries in a manner that is associated with IM/IT investments. Accordingly, the goal of this paper is to examine the impact of investments in IM/IT on structural inertia in the healthcare industry and to determine if we can explain or predict this effect. I intend to demonstrate this impact by examining the effects of IM/IT investments on structural inertia judged against a classical framework for strategic analysis.

Population Ecology and Structural Inertia

Hannan and Freeman developed the theory of population ecology in order to explain organizational change in the context of biological natural selection applied to the population of organizations.[4,5] Organizations, like the many species of the animal kingdom, exist in a variety of different forms and characteristics. Like the natural world, these organizations inhabit different environments and compete for limited resources with other organizations in order to survive. Organizations that have characteristics ill-suited to a particular environment are more likely to be selected out or die unless they are able to adapt. Conversely, organizations with characteristics that are congruent with the environment or that demonstrate an ability to successfully adapt to environmental changes are more likely to survive.

Structural inertia is a key concept within population ecology. It is basically the aggregate state of an organization in terms of ability to adapt to the environment. Hannan and Freeman describe the concept as "a correspondence between the behavioral capabilities of a class of organizations and their

environments."[6] A further point regarding the concept illustrates that:

> …there are a number of processes that generate structural inertia. The stronger the pressures, the lower the adaptive flexibility and the more likely that the logic of environmental selection is appropriate.[4]

In later work, Alexander and Amburgey extended the impact of structural inertia to include the ability to generate foundings of new organizations based upon the level of inertial forces within organizations.[7]

Sources of structural inertia are both internal and external to organizations. Internal sources of inertial pressures include investments in plants, equipment, and specialized personnel that cannot be readily used for other purposes; information available to executives that result in business decisions being made with less than perfect information; internal politics that inhibit an organization's ability to adapt; and organizational histories that preclude elements of change based upon long established operational processes. External sources of inertial forces are derived from legal and fiscal barriers that restrict entry into markets or specific operational processes; constraints on the availability of information about the environment that result in business decisions being made with less than perfect information; market legitimacy status that ties potential changes to the reputation held by external market forces of the organization; and maintaining market equilibrium when changes that an organization makes to adapt to the environment may be readily copied by other organizations.[4]

Hannan and Freeman further extended the concept of structural inertia by noting that organizational changeability varies from firm to firm depending on the relative relationship of the organization to the environment. They observed "organizations are often unable to match the content of their changes to environmental conditions in a timely manner."[6] Reuf tested this hypothesis by examining attributes of healthcare organizations in relation to relative structural inertia. In his empirical study of hospital organizations in California,[8] Reuf studied size (in absolute and local market density terms), age, service specificity, for-profit/nonprofit status, and the impact that these organizational attributes had on structural inertia. He found that size, service specificity, and for-profit/nonprofit status were statistically significant attributes that impact the ability of hospital organizations to effect organizational change.

Other researchers have contributed to the body of literature regarding structural inertia as they study the ability of organizations to adapt to market conditions. Concepts such as competitive posture, strategic flexibility, and organizational agility, among others, are used practically interchangeably to explain the concept of structural inertia.[9-11]

Framework for Strategic Analysis

A thorough assessment of the level of competition in an environment or market requires a comprehensive evaluation of the critical determinants of organizational survival. Porter developed a classic framework of strategic analysis to study the competitive posture of an organization within a market in terms of propensity to survive or die.[12] His framework for analysis encompassed the major determinants of an organization's competitive standing in the market. The components of this framework include the following: threat of new entrants, bargaining power of customers, bargaining power of suppliers, threat of substitutes, and existing rivals. Each of these components is negatively associated with the competitive posture of an organization. For instance, as the threat of new market entrants and substitutes such as a new hospital in a health service area increases, the competitive posture and corresponding likelihood of survival diminish. On the other hand, if suppliers or customers have relatively little bargaining power, the organization should be expected to have a more favorable competitive standing in the market and therefore, be more likely to survive.

Porter's framework for strategic analysis is consistent with Hannan and Freeman's description of the external sources of structural inertia.[6] The competitive posture of an organization is dependent upon the relative level of structural inertia of the firm compared to the environment. In each aspect of the framework for strategic analysis, it is intuitively essential that healthcare executives obtain information regarding aspects of their environment in order to gauge their competitive posture, and in order to develop adaptive processes to ensure the viability of their organization within the market. The critical component for securing

this requirement is IM/IT resources that enable executives to obtain something closer to perfect knowledge about the internal and external environments in which their organization exists.

Porter and Millar reinforced this premise by evaluating the impact of information technologies and systems on competition in the business environment.[13] They found that technology impacted the market in 3 ways: alters industry structures, supports cost and differentiation strategies, and spawns entirely new businesses. Each of these impacts is completely consistent with the concepts of population ecology and the role of structural inertia in organizational change. The alteration of industry structures reflects adaptation and evolution within the business environment as organizations either appropriately change their internal and external processes and relationships, or be selected out in the market. The organization's ability to accomplish this adaptation is clearly dependent upon the impact of IM/IT on structural inertia. Support of cost and differentiation strategies indicates that organizations implement IM/IT resources to reduce inertial forces within the organization via enhancements in operational processes, while seeking to reduce external inertial forces by increasing legitimacy status with relevant stakeholders. Spawning of new businesses reflects Alexander and Amburgey's position that structural inertia can facilitate both organizational deaths and births.[6] In this case, IM/IT impacts structural inertia in a manner that facilitates the creation of an entirely new business line by facilitating an organizational adaptive response which yields an organizational genesis.

At face value, an examination of Porter and Millar's findings[13] on the impact of IM/IT is that investments in IM/IT resources generate enabling effects that reduce the inertial forces of an organization and positively facilitate adaptive initiatives by healthcare executives. Again, this observation is consistent with the intuitive purpose of IM/IT and has been borne out by selected examples from IM/IT implementation in the field. However, it is important to review the entire spectrum of the IM/IT experience, particularly in the healthcare field, in order to achieve a fully balanced perspective of the impact and to be better able to explain, predict, and implement IM/IT solutions to maintain or enhance the viability of an organization.

THE HEALTHCARE IM/IT EXPERIENCE

Numerous researchers and executives have studied the various impacts of IM/IT in the business world over the past 3 decades. Their findings span a broad range of IM/IT interfaces with business processes and have been derived from a variety of methods including observations, surveys, and tests. Two clear themes have emerged from a review the literature involving the healthcare IM/IT experience: there is a general underutilization of IM/IT capabilities across the market, and IM/IT complexity is positively associated with business failure.

Underutilization

General underutilization of IM/IT capabilities has been refined to 5 basic themes: management inexperience, poor communication/linkage between the IM/IT staff and the rest of the organization, resistance to change, lack of focus, and lack of metrics.[14-16]

Management inexperience contributes significantly to IM/IT underutilization because these individuals often lack the background, education, or basic fundamental knowledge of how to fully field, use, or promulgate IM/IT capabilities within organizations. Accordingly, and by extension, poor communication/linkage between the IM/IT staff and the rest of the organization also contributes to underutilization as key executives fail to properly synchronize and coordinate IM/IT staff activities with the rest of the operational divisions. Resistance to change and lack of focus obviously inhibit adoption of IM/IT capabilities and increase the likelihood that new technologies will be assimilated in a manner closer to compliance rather than commitment, thereby narrowing the opportunity for the full capabilities of new IM/IT resources to be exploited. Finally, lack of metrics exists as a major variable leading to underutilization of IM/IT resources, as executives are blind to the level of success that specific implemented elements of IM/IT are achieving within the organization. Executives cannot be fully certain if a specific resource is significantly or marginally enhancing or even inhibiting operations and therefore, most IM/IT applications or initiatives fail to achieve full utilization because their impact cannot be fully appreciated and exploited.

Complexity and Failure

Complexity of IM/IT systems has been demonstrated to be positively associated with business failure. As

organizations attempt to assimilate or develop IM/IT capabilities within their organization, complexity has been found to be the key variable that contributes to organizational failure. Empirical studies by Kim and Michelman,[17] and Singh[18] illustrate aspects of IM/IT that increase the likelihood of organizational selection.

Kim and Michelman surveyed several healthcare organizations that had applied IM/IT resources to strategic initiatives within the strategic framework articulated by Porter.[12] Their assessment of the impact that IM/IT resources had on strategic initiatives was that new, complex systems often contributed to organizational failure while existing, legacy systems were more likely to yield organizational success and ultimately survival.[17]

Singh's study of healthcare organizations that developed IM/IT solutions demonstrated that higher levels of complexity resulted in higher levels of business failure. His study indicated that the 2 central issues derived from complex systems that contributed to organizational failure were increased difficulty in developing and maintaining competencies to sustain complex systems and greater organizational costs for bringing complex IM/IT systems into operational or commercial status.[18]

The healthcare IM/IT experience appears to contrast Porter and Millar's report[13] on the impact of IM/IT resources in the business environment. Healthcare organizations have demonstrated experiences of increased inertial forces as result of IM/IT investments characterized by underutilization of capabilities and difficulties associated with complex systems. My view of these findings is that there should not be contention in terms of efficacy of conclusions, but rather that IM/IT investments can either increase or decrease structural inertia within organizations, depending upon environmental factors that should be considered before IM/IT investments are executed.

Implications for Current Application and Future Study of Healthcare IM/IT

What can healthcare executives and researchers draw from the implications drawn from studies already conducted on the impact of IM/IT investments on structural inertia? Two key points for practical application within healthcare organizations are readily apparent:

- Executives should try to gauge the relative structural inertia of their organization against the market environment, then match a potential IM/IT investment to this assessment. Executives could assess organizational relative structural inertia in a manner similar to a strength, weakness, opportunities, and threats analysis by evaluating current IM/IT internal capabilities, competencies, and capacity, then comparing this evaluation to the external environment using Porter's framework for strategic analysis.[12] The comparison should illustrate the strategic/competitive posture of the organization in the market environment and serve as a measure for relative structural inertia. As an additional point of practical application, healthcare executives should favorably consider simple rather than complex IM/IT solutions as they evaluate potential initiatives for implementation.
- Future research regarding the impact of IM/IT investments on structural inertia could focus on more specific elements of IM/IT resources and their impact on the ability of an organization to adapt. For instance, what is the separate impact of office automation suites, electronic communication applications, mobile communication solutions, or in-house IM/IT staff on the ability of an organization to compete in the market environment? Additionally, a synthesis of the respective methods of Reuf[8] and Singh[18] explaining the impact of IM/IT investments on structural inertia could be employed by combining Reuf's examination of organizational attributes with Singh's use of a panel of judges to evaluate the complexity level of IM/IT initiatives. Finally, a retrospective forensic study of the causes of healthcare organization failures could reveal other IM/IT considerations that may have increased inertial forces within the selected organization which contributed to or resulted in organizational failure.

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Nutritional Care of Detained Persons in Operation Iraqi Freedom

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INTRODUCTION

In the aftermath of the Iraqi invasion and the rapid increase in detained persons, the United States made concerted efforts to meet the tenets outlined in the 1949 Geneva Conventions, Convention (IV).[1] Section IV (Regulations for the treatment of internees) of this Convention specifically delineates the housing, feeding, and medical care of all detained persons.

Article 89 outlines nutritional requirements:

> Daily food rations for internees shall be sufficient in quantity, quality and variety to keep internees in a good state of health and prevent the development of nutritional deficiencies. Account shall also be taken of the customary diet of the internees.… Expectant and nursing mothers and children under fifteen years of age, shall be given additional food, in proportion to their physiological needs.

Article 91 states:

> Every place of internment shall have an adequate infirmary, under the direction of a qualified doctor, where internees may have the attention they require, as well as an appropriate diet.

According to Article 92:

> Medical inspections of internees shall be made at least once a month. Their purpose shall be, in particular, to supervise the general state of health, nutrition, and cleanliness of internees, and to detect contagious diseases, especially tuberculosis, malaria, and venereal diseases. Such inspections shall include, in particular, the checking of weight of each internee and, at least once a year, radioscopic examination.

To meet these tenets, in 2005 the United States deployed the first of the series of medical assets, the 115th Field Hospital, designated to provide care exclusively to detainees. Using split-based, task-organized operations, augmented with additional medical assets (ambulance companies and forward medical support teams), the United States and its coalition partners staffed 2 hospitals at Camp Bucca, near Um Qasr, in the southern region of Iraq, and the Abu Ghraib detention center in Baghdad. In 2006, the latter internment camp was closed, and detainees and medical assets moved to Camp Cropper near the Baghdad International Airport. Both of these hospitals also moved from a deployable medical systems configuration and existing building to a modular fixed facility. In addition to upgrading the facilities, documents to guide the provision of healthcare to detained persons were written. Specific nutritional requirements based on recommended nutrient minimums were derived from the Dietary Reference Intakes: Food and Nutrition Board, of the Institute of Medicine:[2]

- Energy: 2500 cal
- Protein: 75 g to 95 g
- Vitamin A: 900 μg retinol equivalents
- Vitamin C: 90 mg
- Thiamin (B1): 1.2 mg
- Riboflavin (B2): 1.3 mg
- Niacin (B3): 16 mg
- Calcium: 1,000 mg
- Vitamin D: 5 mg
- Iodine: 150 μg
- Iron: 8 mg

Later, with the growing number of adolescent detainees, increased requirements for calories and calcium for those male detainees aged 15 through 18 years were addressed. Further practice guidelines for medical nutrition therapy as outlined in the military's nutrition guide, *The Manual of Clinical Dietetics*[3] was used for inpatient treatment.

Feeding of detainees, both within the hospital and in the theatre internment facility (TIF), had changed significantly since the onset of the conflict. Early on, the combat support hospitals, using organic personnel and equipment, prepared meals for detainees with American rations. Beginning in 2006, contracted meals

were provided by foreign companies. These companies brought their own equipment and personnel, set up commercial kitchens, and served individual meals to inpatients and bulk meals to those in the TIF. Meal patterns were geared to the local dietary patterns and used local as well as foods obtained commercially. Contracts outlined guidance for the production of safe and wholesome foods and stipulated that certain nutritional requirements be met following the guidelines contained in *Special Text 4.02-46: Medical Support to Detainee Operations*.[4(pp4-4,4-5)]

31st Combat Support Hospital Nutrition Care Operations

The 31st Combat Support Hospital arrived in Kuwait in late March 2007, and assumed the detainee health-care mission from the 21st Combat Support Hospital in the first week of April. Continuing the split-based operations, one section moved to Camp Bucca and the other to Camp Cropper in Baghdad. Each section had a dietitian and nutrition care specialists. While the hospitals no longer had an organic food production capability, they did have a microwave, blender, and food processor to modify the contracted meals. A variety of nutritional supplements or enteral feedings were available, and 2 premixed parenteral solutions and 2 lipid solutions were also available.

The Iraqi diet contains a large amount of carbohydrates and consists of rice, potatoes, flatbread, fruits and vegetables, and smaller amounts of meat and dairy products. However, with travel and globalization, foods from other Middle Eastern countries became integrated with the Iraqi diet.[5(p6),6(pp35-36,93-94),7(ppF1,F4)] The meals provided by the contract feeding mirrored those dietary patterns, but those hospital patients suffering trauma required more and higher biological value protein in the form of meat and dairy products. Thus, the patients at Camp Cropper hospital were changed to a diet with more meat and were given the high calorie, high protein supplement of Ensure Plus® (Abbott Nutrition, Columbus, OH). An evening snack of bread, 2 wedges of a soft processed cheese, and a piece of fruit was also offered to each patient by the nursing staff. Ensure Plus was initially provided to select patients with their meal, but it was a nursing suggestion that every patient receive Ensure Plus and it be dispensed between meals 3 times per day in an effort to increase consumption. Each patient who was admitted for greater than 24 hours was screened for nutritional risk and those deemed to be high risk were nutritionally assessed by the dietitian. A protein and calorie goal was set, and weekly weights and serial measures of visceral proteins were used to monitor nutritional status. Patients were reassessed for nutritional risk every 7 days per the Nutrition Care Department standard operating procedure (SOP).

The dietitian had privileges to write orders in the medical record for enteral and parenteral feedings, and order appropriate monitoring laboratory studies, and weight measurements. While trauma was the most common admitting diagnosis for detainees, many of the detainees had preexisting medical conditions such as diabetes, cardiac disease, and hypertension. In addition, because the 31st Combat Support Hospital was the only level III medical facility within the large Victory Base Complex (comprising 5 forward operating bases, a US Air Force base, and a firing range), the medical personnel frequently provided care not only for American military, but also Coalition military, some Iraqi military and police, and civilian third country national contractors. Thus, these varied populations frequently had ongoing medical conditions which may have required more immediate attention, but not evacuation out of the country.

Detainees in the TIF were provided bulk meals prepared in the contractor-provided kitchen. These kitchens were regularly inspected by preventive medicine specialists, and the later food service contracts required that all food be obtained from an approved source (foods for consumption by military members must be inspected and approved by the US military veterinarian food inspection teams). Eventually, separate food preparation trailers produced fresh flatbread and yoghurt daily, and there was no longer a need to obtain the bread on the economy. The meals were delivered in insulated containers to the various compounds within the TIF, and were distributed to the detainees. Each military unit with responsibility for overseeing the TIF had its own food production contract representative and small staff to oversee every aspect of the execution of the contract, and did facilitate the addition of culturally-appropriate foods. It should be noted that the medical nutrition specialist from the combat support hospital was also occasionally dispatched to monitor the commercial food production areas and storage. The nutritional adequacy of the diet was not only monitored by the

contractor, but the dietitian used the contractor's recipes to assess the compliance with nutrition standards and the tenets of the food production contract.

The nutritional status of the detainees in the TIF was assessed through monthly weighing. A database was built, and the weights entered each month. By SOP, any detainee losing 10% or more of weight based on the last month's or the last weight taken was reweighed. If the weight loss was confirmed, then he was referred to the outpatient detainee medical clinic for medical evaluation. Detainees themselves could request to be seen by the dietitian or be referred for nutritional assessment by one of the medical providers. Outpatients were brought to the hospital in the morning and afternoon for scheduled appointments. It was estimated that approximately 75% were weighed on a regular basis, and less than 0.5% demonstrated 10% or more weight loss within a month's duration. After rechecking those weights that suggested significant weight loss, the percentage often dropped below the 0.5% figure. In general, detainees gained weight during their detainment. Detainees who lost weight were referred to the dietitian for an individual appointment. If deemed necessary, the dietitian wrote a prescription for an enteral nutritional supplement, which was issued by the pharmacy and distributed by the guards in the TIF.

ISSUES

Since 1995**,** Iraqis had received subsidized food commodities such as oil, tea, potatoes, rice, beans, and wheat.[8] Because of the long economic embargo and the later discovered widespread fraud by the Saddam Hussein government in the "Oil for Food Program," it was assumed that nutritional status of patients and growth, particularly children and teenagers, was compromised. Neither the US standardized height and weight tables nor the World Health Organization standards, which are based on "healthy children living under conditions likely to favour achievement of their full genetic growth potential,"[9] provided a standard to assess growth status of children and adolescents. Additionally, many detainees did not know the year of their birth, so there was no definitive way to assess age related growth.

Assessment of nutritional status and recovery was challenged by the limited availability of appropriate laboratory measures in theatre. The capability to test for urine urea nitrogen became available in Iraq only during the latter half of the deployment. However, results for short-phase protein tests from samples sent to Landstuhl, Germany, were always received too late to have any clinical relevance. Initially, there was no available method in which to assess weight for those nonambulatory patients as another method to assess health improvement. Eventually, a bed scale was obtained and nonambulatory patients were then weighed on a regular basis. Indeed, before the 31st CSH left Iraq, a routine was established which brought each TIF detainee with spinal cord injuries to the hospital once a month for weights.

The traditional diet of Iraqis contains little or no fluid milk beyond childhood, and individuals instead consume a very sweet tea called chai, or even soft drinks. Thus, while every effort was made to both provide a culturally-appropriate diet, and meet the nutritional standards of *Medical Support to Detainee Operations*,[4] it was a challenge when the particular nutrient was little consumed in the diet. The nutrient most commonly deficient in the diet was calcium, and the nutrient needs could not be met without supplementation. All hospital patients and detainees in the TIF received milk for breakfast and frequently were given a soft, processed cheese as a snack. Hospitalized adolescents and children were given milk at every meal and provided such cereals as Total Raisin Bran (General Mills, Inc, Golden Valley, MN) which contained additional calcium. Hospitalized detainees were also offered Ensure Plus 3 times per day.

Patients with oral-maxillofacial injuries were fed Ensure Plus as a source of nutrition. There were patients who were able consume other types of liquids such as cream soups. However, there was no mechanism within theatre to order special dietary items or purchase them on the economy, even such mundane items as soup. Formerly, operational rations contained Medical B Rations, which contained broth and Carnation Instant Breakfast® (Nestlé HealthCare Nutrition, Minneapolis, MN), but this ration was discontinued. Another type of supplemental pack containing broth, Gatorade® (Pepsico, Inc, Purchase, NY), and other items was also fielded on a limited basis for trial, but had not been put into the ration supply system. Thus, while shelf-stable items such as Soup At Hand® (Campbell's Soup Company, Camden, NJ) and Carnation Instant Breakfast were

available in the post exchanges (PX) on the forward operating bases, there was no method to purchase such items for detainees.

By SOP, detainees in the TIF should be weighed monthly to assess weight status. However, the movement of individuals in and out of the compound for court appearances, release, movement to Camp Bucca, or to retard the development of agitator cells challenged the ability to weigh all detainees each month. Another mechanical challenge to weighing the detainees was an initial lack of home-use type weight scales on the central supply order catalog. As a result, attempts were made to buy them at the PX, if available, but some scales had to be initially purchased commercially via the internet. Digital home-type scales were not useful since the bright sunlight rendered the reading impossible. Sand and heat also quickly degraded the scales, which therefore had be obtained frequently because of mechanical failure.

Provision of special diets was not possible in the TIF due to a variety of reasons. Although those detainees with special medical conditions such as cardiac disease, diabetes mellitus (all detainees with known insulin-dependent diabetes were kept at Camp Cropper), and hypertension were medically monitored and received medications, it was not possible to provide special diets. The detainees were grouped according to religious affiliation with Sunni, Shia, Takfiri, and Christians segregated from each other. Adolescents were also separated from the adult population. Thus, it was not possible to group detainees who required special dietary meals. The individuals with diabetes mellitus were given an evening snack of a piece of flatbread and 3 pieces of soft cheese.

Four years after the onset of the conflict, automation and internet connectivity had significantly increased in theatre. However, the bandwidth was inadequate for the increasing demand, and the capability to access online references became limited. A copy of the *Manual of Clinical Dietetics*[3] was obtained from the Army Medical Department Center and School, along with references on sports nutrition, nutrition support, and nutrition and diet therapy. Additionally, references on the nutritional analysis of foods, and books[5,6] on Middle Eastern cuisine and dietary patterns were purchased. Inadequate internet bandwidth and lack of a medical library made it difficult to obtain information or use the nutritional analysis software cited in the *Medical Support to Detainee Operations*[4] to analyze the diets offered in the TIF. Some reference texts did become available for order, but the selections offered few nutrition texts.

LESSONS LEARNED

Initial planning guidance for the Iraq conflict estimated that Saddam Hussein would be quickly toppled, and American forces would be reduced to 30,000 by August 2003, just 5 months after the initiation of hostilities.[10] Consequently, there was little planning for a long-term conflict, including detention of large numbers of detainees. In the wake of the Abu Ghraib incidents, specific efforts were made to ensure that detainee operations absolutely met the tenets of the 1949 Geneva Conventions, including healthcare for detained persons. Feeding of detainees had progressed from providing American field rations to a culturally-appropriate diet prepared onsite by commercial catering companies and delivered for bulk feeding in a communal milieu. The 115th Field Hospital developed the core of the *Medical Support to Detainee Operations*,[4] which incorporated practical experience with the tenets of the 1949 Geneva Convention (IV)[1] and other Army guides such as *Army Regulation 190-8*.[11] The initial *Special Text 4-02.46: Medical Support to Detainee Operations* has evolved into *Field Manual Interim 4-02.46*,[12] which is organized around each medical specialty with specific guidance for treatment. While the 31st Combat Support Hospital arrived 4 years after the initiation of hostilities, we realized that to meet the nutritional needs of the population, both detained persons as well as the local population, we must have available information sources such as *Medical Support to Detainee Operations*,[4,12] *Technical Bulletin MED 530*,[13] and *Natick Pamphlet 30-25*,[14] as planning guidance for feeding operations. Additional references may be obtained from the National Center for Medical Intelligence, which develops a variety of products including the Environmental Health Risk Assessment; Medical, Environmental, Disease Intelligence and Countermeasures; and Medical Intelligence Note. These documents can provide information concerning the overall health of the population, the state of the healthcare system, and potential health risks. For this particular conflict as well, there were also a limited number of journal articles about prisoner of war

healthcare in Desert Storm. In 1991, articles by Dennan,[15] and Longmire and Deshmukh[16] concerning their experiences in Operation Desert Storm (1991) depicted precisely the conditions experienced in Operation Iraqi Freedom more than a decade later—rapid arrival of large numbers of prisoners of war, many with chronic medical conditions which required attention.

Often conflict planning initially plans only for the medical care of US and coalition military personnel. However, the reality of repeated experiences is that some of the first patients admitted to US military hospitals are detained persons and local civilians. Thus, the addition of the currently developing pediatric augmentee module can be readily used to treat child and adolescent patients. Pediatric enteral feedings and parenteral solutions, as well as baby formulas, should also be stocked and made readily available at the beginning of a conflict.

Initial feeding of patients was performed with the same rations eaten by US Soldiers. When the responsibility for feeding patients passed to a contractor, the combat support hospitals ceased to have food production capability. While the numbers of hospital patients may have been small compared to the total number of Soldiers and contractors in theatre, maintaining a limited food production capability for patients is very important. It was difficult to modify pre-prepared meals for diverse medical conditions encountered among the detainees and local population. The Kosher/Halal[14(p43)] rations designed for US military personnel who wish to adhere strictly to their religious diet are *not* designed to be used for detainees. The foods contained in the packages are designed specifically to be consumed by deployed, highly active American military personnel and are high in calories and relatively high in fat and sugars. Thus, while sufficient to meet caloric and protein needs for a short period of time, they are neither items of a standard, healthy diet nor appropriate for patients with diabetes mellitus.

The senior dietitian in theatre became the de facto dietetics consultant. However, it would be very helpful to have a designated individual assigned to the theatre surgeon's office. This officer would advise the theatre surgeon on nutritional issues, not only for detained persons, but also involving all Soldier nutrition readiness issues. The officer would facilitate the medical regulating process of moving enteral and parenteral solutions around theatre to facilitate care of patients requiring nutrition support. The officer would also serve as nutrition representative on the pharmacy and therapeutics committee, and facilitate acquisition of appropriate enteral and parenteral products, infant formulas, and pediatric vitamin/mineral supplements. Finally, the officer would serve as consultant to other dietitians in theatre, and work with food service contractors to provide nutrition information and direct Soldiers to healthy food choices.

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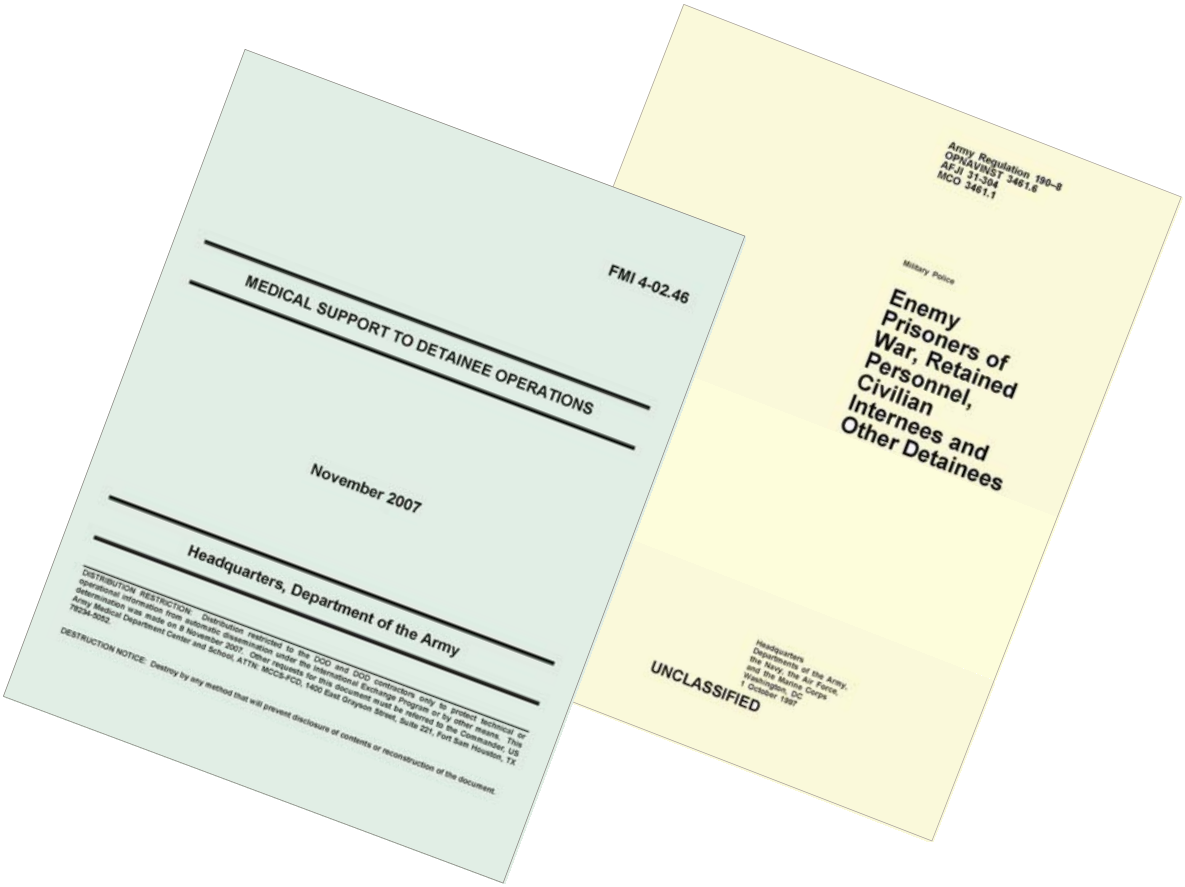

Abstracts from the US Army-Baylor University Doctoral Program in Physical Therapy

The following research abstracts were presented on June 22, 2010, as part of US Army-Baylor University Doctoral Program in Physical Therapy Research Day at Fort Sam Houston, Texas. The research abstracts were prepared as part of a capstone event for the doctoral student Class of 2011 that highlights their involvement in faculty directed research.

The research projects support the mission of the Neuromusculoskeletal Injury Prevention and Rehabilitation Research Program (NIPRRP):

> Promote Warrior readiness and human performance through systematic research and the advancement of evidence-based practice related to neuromusculoskeletal conditions.

The NIPRRP focuses on optimal prevention, diagnostic, and intervention strategies associated with neuromusculoskeletal conditions. NIPRRP accomplishes this mission by integrating the results of clinical and applied research to help achieve the ultimate goal of minimizing disability and maximizing performance for beneficiaries of the military healthcare system and the overall population. Target populations include healthy individuals and patients with a broad range of neuromusculoskeletal conditions such as extremity overuse injuries, low back and neck pain, and neuropathic conditions.

Median and Ulnar Neuropatheis in US Army Medical Command Band Members

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Purpose/Hypothesis: Musicians have been reported as having a high prevalence of upper-extremity musculoskeletal disorders, including carpal tunnel syndrome (CTS). Previous research has not involved professional military musicians. Therefore, the purpose of this study was to determine the presence of median and ulnar neuropathies in US Army Medical Command (MEDCOM) Band members, Fort Sam Houston, Texas.

Subjects: Thirty-five US Army Soldiers (30 male, 5 female), in the MEDCOM Band volunteered to participate in the study. The mean age of the band members was 36 ± 8.4 years (range 22-51). There were 33 right handed musicians, and the mean length of time in the US Army MEDCOM Band was 12.2 years (range 1 to 30 years).

Materials/Methods: Subjects completed a history form, were interviewed, and underwent a physical examination of the cervical spine and bilateral upper extremities. Nerve conduction studies of the bilateral median and ulnar nerves were performed. Electrophysiological variables served as the reference standard for median and ulnar neuropathy and included distal sensory latencies (DSL), distal motor latencies (DML), amplitudes, conduction velocities, and comparison study latencies. Descriptive statistics for subject demographics and nerve conduction study variables were also calculated.

Results: Ten of the 35 subjects (29%) presented with abnormal electrophysiologic values suggestive of an upper extremity mononeuropathy. Nine of the subjects had abnormal median nerve electrophysiologic values at or distal to the wrist. Two of these 9 subjects had bilateral abnormal values. One subject had an abnormal ulnar nerve electrophysiologic assessment at the elbow. Nine of these 10 subjects had clinical examination findings consistent with the electrophysiological findings.

Conclusion: The prevalence of mononeuropathies in this sample of MEDCOM Band members is similar to previous research involving civilian musicians (20% to 36%) and far exceeds that reported in the general population. Prospective research investigating screening, examination items and injury prevention measures in musicians appears to be warranted.

Military/Clinical Relevance: Median mononeuropathy at or distal to the wrist has been reported to be of significant concern in musicians, and this concern is reinforced in our sample of professional military musicians.

Supports: Neuromusculoskeletal Injury Prevention & Rehabilitation Research Program

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Functional Movement Screen: A Reliability Study in Service Members

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Dustin F. Donofry* Michael J. Walker* Jessica L. Dugan* John D. Childs*

Purpose/Hypothesis: The Functional Movement Screen (FMS) has demonstrated acceptable reliability and predictive validity (composite scores of $\leq$ 14 points) for time loss injury in select populations. Unfortunately, extensive critical analysis of the FMS in diverse populations and among raters with limited experience is lacking. Therefore, the purpose of this initial study was to determine intrarater test-retest and interrater reliability of the FMS in a military setting by novice raters.

Subjects: Sixty-four (53 male, 11 female) healthy active duty Soldiers (aged 25.2 ± 3.8 years, body mass index 25.1 ± 3.1 kg/m^2) recruited while in training at Fort Sam Houston, Texas.

Materials/Methods: Subjects completed the 7 component tests of the FMS in a counterbalanced order. Each component test was scored on an ordinal scale (0 to 3 points) resulting in a composite score from 0 to 21 points. Intrarater test-retest reliability was assessed between baseline scores and those obtained 48 hours later, while interrater reliability was assessed based on 2 raters assessing the same movements on day two. A total of 8 raters were used as part of the reliability analysis. In addition to descriptive statistics, weighted Kappa (k_w) and percentage of agreement were calculated on all component scores and intraclass correlation coefficients (ICC) and standard error of the measurements (SEM) were calculated on all composite scores.

Results: The average score on the FMS was 15.72 ± 0.24 points with 15.6% of the sample scoring $\leq$14 points. The intrarater test-retest and interrater reliability resulted in an ICC (1,1) of 0.76 (0.63-0.85) and an ICC (3,1) of 0.74 (0.60-0.83) respectively. The SEM of the composite test was within one point on the 21 point scale for both inter- and intrarater reliability. The interrater reliability of the individual FMS components ranged from moderate to excellent (k_w: 0.45 to 0.82).

Conclusions: The results of this study demonstrated good interrater reliability, moderate intrarater test-retest reliability, and acceptable levels of measurement error for the FMS among novice raters. The interrater reliability of the weighted kappa was good to excellent for the pushup, quadruped, shoulder mobility, straight leg raise, squat, hurdle, and lunge. Only 15.6% of the sample was identified at-risk for injury based on previously published cut-off values.

Military/Clinical Relevance: Findings suggest that the FMS is reliable when tested in a military population by novice raters and the FMS may be applicable in the military population for identifying a subgroup of individuals at risk of injury. Future research should assess the validity of the FMS in a larger sample population.

Supports: Neuromusculoskeletal Injury Prevention & Rehabilitation Research Program

Collaboration: This study was performed in collaboration with research assistants from the Physical Therapy Department, University of Texas Health Science Center, San Antonio, Texas.

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Lower Extremity Measures Predictive of Functional Movement in Service Members

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Moshe D. Greenberg* Chelsea L. Lorenson* Christina M. Yost* John D. Childs*

Purpose/Hypothesis: To determine the association between measures of power, strength, flexibility, and endurance with functional movement as measured with the Functional Movement Screen (FMS) in healthy subjects.

Subjects: Sixty-four (53 male, 11 female) healthy active duty service members (aged 25.2 ± 3.8 years, body mass index 25.1 ± 3.1 kg/m^2) recruited at Fort Sam Houston, Texas.

Materials/Methods: Measurements of strength (hip abduction and external rotation), power (6 meter and crossover hop test), flexibility (hamstrings, gastrocnemius, soleus, quadriceps, and iliotibial band / tensor fascia lata), endurance (trunk flexion, extension, lateral flexion muscular endurance), balance (Y-Balance test), and functional measures (FMS, lower extremity functional scale, and lateral step down) were assessed. A significant Pearson product moment correlation ($r > 0.2$ and $P < 0.01$) was used to narrow the number of variables of interest. A hierarchical stepwise backwards regression analysis was then performed to determine the most parsimonious set of variables associated with the FMS performance scores.

Results: Pearson product moment correlations yielded 22 variables of interest that entered the regression analysis. The resulting 4-variable model ($F=11.813$; $P<0.001$) was able to predict FMS scores ($R=0.70$, $R^2=0.50$) with a mean residual of 0.0 ± 1.5 points. The Durbin-Watson score for the model was 1.96. Variables in the final model indicated an association between FMS scores an increased anterior reach on the YBT, distance measured for cross over hop test, hamstring flexibility and self-reported lower extremity function via the lower extremity functional scale.

Conclusions: FMS scores at or below 14 points have been associated with an increase risk of injury. The multivariate model developed in this study helps to inform the clinician about the underlying clinical measures that are predictive of FMS performance. Future research should assess if improvements in these measures are associated with improvements in FMS performance.

Military/Clinical Relevance: Musculoskeletal injures are a primary source of disability in the US military. Lower extremity prevention programs are necessary to reduce the impact of musculoskeletal injury. The FMS has been found to be predictive of injury; however there is scant evidence about its association with other physical performance measures. This study helps to inform the association between the FMS and common clinical measures of power, balance, flexibility, and self-reported function.

Supports: Neuromusculoskeletal Injury Prevention & Rehabilitation Research Program

Collaboration: This study was performed in collaboration with research assistants from the Physical Therapy Department, University of Texas Health Science Center, San Antonio, Texas.

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Reliability of Lower Quarter Physical Performance Measures in Healthy Service Members

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Jessica L. Dugan* Michael J. Walker* John D. Childs*

Purpose/Hypothesis: Measures of endurance, flexibility, strength, power, and function may be of value in predicting injury risk; but application to the military setting has been limited. The purpose of this study was to assess the reliability and precision of lower quarter physical performance measures among novice raters.

Subjects: Sixty-four (53 male, 11 female) healthy active duty Soldiers (aged 25.2 ± 3.8 years, body mass index 25.1 ± 3.1 kg/m^2) recruited while in training at Fort Sam Houston, Texas.

Materials/Methods: Subjects completed 13 lower quarter physical performance measures in a counterbalanced order. Measures included indicators of lumbopelvic endurance (trunk flexor endurance, trunk extensor endurance, and lateral trunk endurance), lower extremity flexibility (gastrocnemiusm, soleus, iliotibial band, hamstring, and quadriceps), hip strength (abduction and external rotation), and lower extremity power (timed hop test and cross over hop test). Interrater test-retest reliability was assessed between baseline scores and those obtained 48 hours later. Intraclass correlation coefficients (ICC) and standard error of the measurements (SEM) were calculated to determine reliability and response stability.

Results: Measures of lumbopelvic endurance had ICC (2,1) values ranging from 0.77 to 0.79 with SEM ranging from 18.3 to 24.5 s. Measures of flexibility had ICC (2,2) values ranging from 0.27 to 0.59 with SEM ranging from 4.1 to 9.9°. Measures of hip strength had ICC (2,3) values ranging from 0.65 to 0.82 with SEMs from 2.9 to 6.5 lbs. Measures of power had ICC (2,3) values ranging from 0.78 to 0.93 with SEM values of 0.2s and 27.4 cm.

Conclusions: The majority of measures assessed had adequate reliability in the military population when assessed by novice raters. The measures of strength and power had moderate to good reliability with small measurement error, indicating the possibility for these measures to detect change in a population overtime. The measures of lumbopelvic endurance had good reliability but had relatively large SEM values compared to the group mean, thus possibly limiting the ability of these tests to detect change over time. The measures of flexibility had limited reliability which may be associated with restriction in range.

Military/Clinical Relevance: These results can help inform which physical performance measures should be used in future research studies that assess injury prediction and human performance optimization in a military setting.

Supports: Neuromusculoskeletal Injury Prevention & Rehabilitation Research Program

Collaboration: This study was performed in collaboration with research assistants from the Physical Therapy Department, University of Texas Health Science Center, San Antonio, Texas.

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Lower Extremity Measures Predictive of Dynamic Balance in Service Members

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Moshe D. Greenberg* Chelsea L. Lorenson* Christina M. Yost* John D. Childs*

Purpose/Hypothesis: To determine the association between measures of power, strength, flexibility, and endurance with measures of dynamic balance as measured with the Y-Balance Test (YBT).

Subjects: Sixty-four (53 male, 11 female) healthy active duty service members (aged 25.2 ± 3.8 years, body mass index 25.1 ± 3.1 kg/m^2) recruited at Fort Sam Houston, Texas.

Materials/Methods: Measurements of strength (hip abduction and external rotation), power (6 meter and crossover hop test), flexibility (hamstrings, gastrocnemius, soleus, quadriceps, and iliotibial band/tensor fascia lata), endurance (trunk flexion, extension, lateral flexion muscular endurance), balance (YBT), and functional measures (Functional Movement Screen, lower extremity functional scale, and lateral step down) were assessed. A significant Pearson product moment correlation ($r > 0.2$ and $P < 0.01$) was used to narrow the number of variables of interest. A hierarchical stepwise backwards regression analysis was then performed to determine the most parsimonious set of variables associated with the YBT performance scores.

Results: Pearson product moment correlations ($r > 0.2$) yielded 13 variables of interest that entered the regression analysis. The resulting 4 variable model ($F = 13.413$; $P < 0.001$) was able to predict YBT scores ($R = 0.72$, $R^2 = 0.51$) with a mean residual of 0.0 ± 6.1 cm. The Durbin-Watson score for the model was 1.7. Variables in the final model indicated an association between YBT scores with an increase in performance on the FMS lunge and shoulder/upper trunk mobility tests, number of hops required during a 6 meter hop tests, and gastrocnemius flexibility.

Conclusions: Decreased and asymmetrical YBT scores have been associated with an increase risk of injury. The multivariate model developed in this study helps to inform the clinician about the underlying clinical measures that are predictive of YBT performance. Future research should assess if improvements in these measures are associated with improvements in YBT performance.

Military/Clinical Relevance: Musculoskeletal injures are a primary source of disability in the US military. Lower extremity prevention programs are necessary to reduce the impact of musculoskeletal injury. The YBT has been found to be predictive of injury; however there is scant evidence on its association with other physical performance measures. This study helps to inform the association between the YBT and common clinical measures of functional movement, power, and flexibility.

Supports: Neuromusculoskeletal Injury Prevention & Rehabilitation Research Program

Collaboration: This study was performed in collaboration with research assistants from the Physical Therapy Department, University of Texas Health Science Center, San Antonio, Texas.

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Y-Balance Test: A Reliability Study in Service Members

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Purpose/Hypothesis: The Y-balance Test (YBT) has demonstrated acceptable reliability and predictive (anterior right/left reach distance difference >4 cm) validity for injury risk in high school athletes. Unfortunately critical analysis of the YBT in diverse populations and among raters with limited experience is lacking. Therefore, the purpose of this initial study was to determine interrater test-retest reliability of the YBT in a military setting using novice raters.

Subjects: Sixty-four (53 male, 11 female) healthy active duty Soldiers (aged 25.2 ± 3.8 years, body mass index 25.1 ± 3.1 kg/m^2) recruited while in training at Fort Sam Houston, Texas.

Materials/Methods: Soldiers attending training at Ft Sam Houston without a current or prior history of lower extremity injury over the last 3 months or history of surgery were recruited. After completing a history form, subjects viewed an instructional video and performed 6 practice trials of the YBT to minimize the influence of a learning effect. Subjects stood on the center foot plate with the distal aspect of the foot at the starting line. While maintaining single leg stance, the subject reached with the free limb in the anterior, posteromedial, and posterolateral directions in relation to the stance foot by pushing the indicator box as far as possible. The maximal and average distance reached after 3 trials in each direction were recorded at baseline and 48 hours later by 2 different raters. A total of 7 raters were included as part of the reliability analysis. In addition to descriptive statistics, intraclass correlation coefficients (ICC) and standard error of the measurement (SEM) values were calculated on each reach direction and composite scores.

Results: On average, service members demonstrated a 57.7 ± 7.3 cm anterior reach, 93.4 ± 8.8 cm posteromedial reach, and a 90.2 ± 9.0 cm posterolateral reach. Although there was no significance reach difference between limbs, 31.3% (n=20 of 64) had an anterior reach asymmetry of >4cm suggesting an increased risk for injury. ICC (2,1) values for interrater reliability maximal reach ranged from 0.80 to 0.85 with an associated SEM ranging from 3.1 to 4.2 cm for each direction. ICC (2,3) values for interrater reliability average of 3 trials ranged from 0.85 to 0.93 with an associated SEM ranging from 2.0 to 3.5 cm for each direction.

Conclusions: Y-Balance reach distances in our sample of healthy young service members exhibited variable test performance. In addition, novice raters demonstrated good interrater reliability and an acceptable level of YBT measurement error. The average of 3 trials demonstrated superior reliability compared to maximal reach values.

Military/Clinical Relevance: Findings suggests that the YBT was a reliable and stable measure of dynamic balance between raters and testing days in our sample of active duty service members. Future research should validate the associated risk for injuries based on poor performance on the YBT in the military population.

Supports: Neuromusculoskeletal Injury Prevention & Rehabilitation Research Program

Collaboration: This study was performed in collaboration with research assistants from the Physical Therapy Department, University of Texas Health Science Center, San Antonio, Texas.

*Center for Physical Therapy Research, US Army-Baylor Doctoral Program in Physical Therapy, San Antonio, Texas

Effects of Load Carriage on Foot Anthropometrics

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Jacob A. Naylor* Brittany M. Rodriguez* Michael J Walker* Deydre S. Teyhen*

Purpose/Hypothesis: Understanding how military load carriage influences arch height (AH) and other foot anthropometrics, may influence the development of military footwear and orthoses. These developments could help mitigate the effects of load carriage and reduce the incidence of injuries related to military operations and training. The purpose of this study was to explore the effects of increasing levels of load carriage on foot anthropometrics.

Subjects: Participants (n=117; 99 male, 18 female) were military members (aged 31.2 ± 5.5 years, body mass index 27.4 ± 2.9 kg/m^2) who weighed at least 70 kg and had no limitations precluding them from lifting 40 kg.

Materials/Methods: Heel-toe length (HTL), midfoot width (MFW), and AH were measured in 4 conditions: nonweight bearing (NWB), weight bearing (WB), 20 kg load (20 kg), 40 kg load (40 kg). The load conditions included an M16, body armor, helmet, and a weighted rucksack. The reliability of the foot measurements had an ICC (2, 1) ≥0.94. Subjects were divided into groups based on arch height index (AHI; high, normal, and low) and arch mobility (hypomobile, normal, hypermobile) for analysis. AHI was calculated by dividing the dorsal AH of the foot (taken at 50% of HTL) by HTL. Arch mobility was calculated by subtracting AH in WB from AH in NWB.

Results: Classifications by AHI resulted in 28 high (AHI >0.267), 61 normal, and 28 low (AHI <0.229). Classification by arch mobility resulted in 20 hypomobile (<8.4mm), 77 normal, and 20 hypermobile (>13.8mm). The percent agreement between AHI and arch mobility groups was 52.1% (kappa=0.17). The interaction between AHI and load condition was significant for AH (F=7.15, *P*<.001) and MFW (F=5.72, *P*=.002) but not for HTL (F=2.27, *P*=.09). The main effect of load was significant for HTL (*P*<.001). The interaction between arch mobility and load condition was significant for AH (F=93.68, *P*<.001); and MFW (F=7.35, *P*<.001) but not for HTL (F=0.144, *P*=.91) values. The main effect of load was significant for HTL (*P*<.001). In general, as load increased AH decreased, MFW increased, and HTL increased regardless of foot classification system. AH decreased significantly with each increase in load (*P*<.014) except in low arched and hypermobile feet between 20 kg and 40 kg (*P*>.47). The mean decrease in AH was 12.4 ±2.7 mm from NWB to 40 kg load condition. MFW increased significantly from NWB to WB and from WB to 40 kg load (*P*<.03), regardless of foot classification system. Independent of group, HTL increased from NWB to WB and WB to 40 kg (*P*<0.02). The mean increase in HTL was 9.7 ± 4.3 mm from NWB to 40 kg load condition.

Conclusions: Decreases in AH and increases in MFW appear to approach a maximal change with loads as small as 20 kg in most individuals. The greatest excursion in HTL occurred under the 40 kg condition. Future research should assess characteristics of combat boot and orthotic design to determine how these devices might mitigate the impact of load. Although the impact of load was similar when analyzed based on AHI and arch mobility, the differences between the 2 classification systems warrant further research.

Military/Clinical Relevance: The assumption that a high arched foot is hypomobile and a low arch foot is hypermobile is not supported by our findings. The impact of arch mobility on lower extremity injuries should be assessed.

Supports: Neuromusculoskeletal Injury Prevention & Rehabilitation Research Program

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Dynamic Plantar Pressure Changes During Loaded Gait

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Jacob A. Naylor* Brittany M. Rodriguez* Michael J Walker* Deydre S. Teyhen*

Purpose/Hypothesis: Lower extremity overuse injuries are a detriment to military readiness. Extreme values of arch height and heavy loads carried by military personnel are associated with an increased risk of overuse injuries. Little is known regarding the impact of load carriage on plantar pressure distributions. This study was conducted to determine how load carriage affects plantar pressure distributions during gait in individuals with varying arch types.

Subjects: Participants were 115 healthy service members (19 male, 18 female), aged 31.3 ± 5.6 years, body weight 86.0 ± 11.0 kg, at least 70 kg.

Materials/Methods: Participants were categorized by arch type based upon accepted cutoff values for Arch Height Index (AHI). AHI was calculated by dividing arch height by heel-toe length (28 high, 61 normal, 26 low arched right feet). Plantar pressure measurements were obtained using an in-shoe pressure measurement system while the subjects wore combat boots. Subjects walked for approximately 30 seconds at 3.0 mph on a treadmill under each of 3 levels of load: uniform without additional load, 20 kg, and 40 kg load. A mean of 9.8 ± 0.6 steps were analyzed for each load condition. Maximum force (MaxF) and force time integral (FTI) were calculated for the plantar foot using a 9 sector mask. Changes in each were analyzed with a 3×3 repeated measures ANOVA across the levels of load carriage and arch type.

Results: There was a significant interaction between arch type and load for MaxF (P=.001) and FTI (P≤.005) in the medial midfoot. Although MaxF and FTI increased in all regions of the foot with load (p<.001) regardless of foot type, the forces in the medial midfoot were greater in those with low arches. There was a significant interaction between arch type and load for MaxF (P=.004) in the medial forefoot; indicating increased MaxF in high arched feet relative to normal and low arched feet (P<.001) across all loads. The reverse was true at the great toe region (P≤.004). The relative distribution of pressure increased proportionately in all regions of the foot regardless of foot type for all load conditions.

Conclusions: Higher forces in the medial midfoot in low arched feet may be related to the increased surface area in this region or may represent increased pronation. However, the relative increases in medial midfoot forces in low arch feet did not increase disproportionately with increases in load compared to normal or high arched feet. Force distributions in the 1st ray differed based on foot type. Those with high arched feet had greater forces in the medial forefoot region, while those with normal or low arched feet had greater forces in the great toe region, regardless of load. These differences in force distributions may demonstrate different strategies to generate a rigid lever during toe-off.

Military/Clinical Relevance: Regardless of foot type, increases in load did not alter the relative distribution of pressure over the plantar foot. These findings possibly indicate a negligible impact of loads ≤40 kg on footwear and orthoses prescription. However, differences in dynamic plantar pressure during gait based on foot type were supported.

Supports: Neuromusculoskeletal Injury Prevention & Rehabilitation Research Program

Acknowledgement: The research reported in this abstract was funded through the US Army Bone Health and Military Medical Readiness Program.

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Predictors of Web-Based Response Rate in the Prevention of Low Back Pain in the Military Trial

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Purpose/Hypothesis: Follow-up in clinical trials is essential to establish the validity of the findings. Achieving adequate response rates reduces the amount of bias and helps to insure that the findings can be generalized to the population of interest. Therefore, the purpose of this study was to examine the influence of psychological, health status, physical activity, injury status, attention/relationship effect, and demographic characteristics on one year response rates in the Prevention of Low Back Pain the Military (POLM) trial.

Subjects: Subjects were 4,295 healthy Soldiers aged 18 to 35 years who were participating in Advanced Individualized Training and enrolled in the POLM trial.

Materials/Methods: Twenty companies of Soldiers were cluster randomized to complete a traditional exercise program including situps with or without a psychosocial educational program (PSEP) or a core stabilization exercise program with or without PSEP. A subgroup of Soldiers (n=250) was randomized to receive a physical and ultrasound imaging examination of key trunk musculature. All Soldiers were encouraged to completed monthly surveys via email during the first year following completion of training to record incidence/severity of subsequent lower back pain episodes. Descriptive statistics of the demographic and clinical variables were obtained and compared between the responders and nonresponders using two sample t-tests or chi-square test, as appropriate. Generalized linear mixed models were subsequently fitted for the dichotomous outcomes to estimate the effects of independent variables and other explanatory variables. A random company effect was included in the models to accommodate for the correlation among Soldiers within the same company. The significance level was set at 0.05 a priori.

Results: The overall response rate was 18.9% (811 subjects). Nonresponders and responders differed significantly in age, race, education, income, military status, length of service, depression, back beliefs, anxiety, health status, smoking history, body mass index, and whether a Soldier received the physical/USI examination ($P<.05$). Income, time in army, depression, back beliefs, and health status became statistically nonsignificant after adjusting the previously stated factors. Lastly, the above findings were consistent with the results of a reduced model derived from a stepwise backward selection procedure that eliminates nonsignificant factors at alpha level of 0.10.

Conclusions/Military Relevance: Response rate was significantly associated with psychological variables, demographic characteristics, and receiving individualized attention. Although the overall response rate was low compared to standard clinical trials, it was consistent with typical response rates observed in similar studies using web-based surveillance systems. Understanding which factors are associated with response rates can help to inform the design of clinical trials. Additional attention during a trial may improve response rates.

Supports: Neuromusculoskeletal Injury Prevention & Rehabilitation Research Program

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THE US ARMY MEDICAL DEPARTMENT REGIMENT

The US Army Medical Department was formed on July 27, 1775, when the Continental Congress authorized a Medical Service for an army of 20,000 men. It created the Hospital Department and named Dr Benjamin Church of Boston as Director General and Chief Physician. On 14 April, 1818 the Congress passed an Act which reorganized the staff departments of the Army. The Act provided for a Medical Department to be headed by a Surgeon General. Dr Joseph Lovell, appointed Surgeon General of the United States Army in April 1818, was the first to hold this position in the new organization. The passage of this law marks the beginning of the modern Medical Department of the United States Army.

Throughout its early history, the size and mission of the US Army Medical Department would wax and wane in response to military events around the world. There was, however, no formal regimental organization until World War I. Then, in the late 1950s, the brigade replaced the regiment as a tactical unit. In the reorganization that followed, some Army units lost their identity, their lineage, their history. This loss did not go unnoticed. The US Army Regimental System was created in 1981 to provide soldiers with continuous identification with a single regiment. Department of the Army Regulation 600-82, The US Army Regimental System, states the mission of the regiment is to enhance combat effectiveness through a framework that provides the opportunity for affiliation, develops loyalty and commitment, fosters a sense of belonging, improves unit esprit, and institutionalizes the war-fighting ethos.

The US Army Medical Department Regiment was activated on July 28, 1986, during ceremonies at Fort Sam Houston in San Antonio, Texas, the "Home of Army Medicine." Lieutenant General Quinn H. Becker, the US Army Surgeon General and AMEDD Regimental Commander, was the reviewing officer. He was joined by general officers of the US Army Reserves and the Army National Guard, representing the significant contributions and manpower of the reserve forces in the Total Army concept.

INSIGNIA

The AMEDD Regimental Distinctive Insignia was designed by the Institute of Heraldry and is one of the oldest crests In the Army today. The 20 stars on the crest correspond to the number of states in the Union between December 10, 1817, and December 3, 1818. The origin of the crest dates from the Act of April 14, 1818, by which the Medical Department of the Army was first organized.

The alternating red and white stripes on the left side of the shield are the 13 stripes of the American Flag. The green staff is the staff of Asclepius (according to Greek mythology, the first healer, the son of Apollo, the sun god); and green was a color associated with the Medical Corps during the last half of the 19th century. The phrase "To Conserve Fighting Strength" gives testimony to our mission as combat multipliers and guardians of our Nation's strength and peace.

INFORMATION

The Regimental web site (http://ameddregiment.amedd.army.mil/default.asp) is designed to provide you with useful information about the US Army Medical Department (AMEDD) Regiment. Through the web site, you can learn the history of the AMEDD Regiment, the symbolism behind our heraldic items, how to wear the Regimental Distinctive insignia, and various programs available to you and your unit.

The Office of the AMEDD Regiment is located in Aabel Hall, Building 2840, on Fort Sam Houston, Texas. The Regimental staff can provide further information pertaining to the history of the Army Medical Department and the AMEDD Regiment, and assist with any of the services described in the web page.

For additional information please contact the Army Medical Department Regimental Office at the following address:

Commander
US Army Medical Department Regiment
ATTN: MCCS-GAR
2250 Stanley Road
Fort Sam Houston, Texas 78234-6100

The telephone number is (210) 221-8455 or DSN 471-8455, fax 8697.

Internet: http://ameddregiment.amedd.army.mil/

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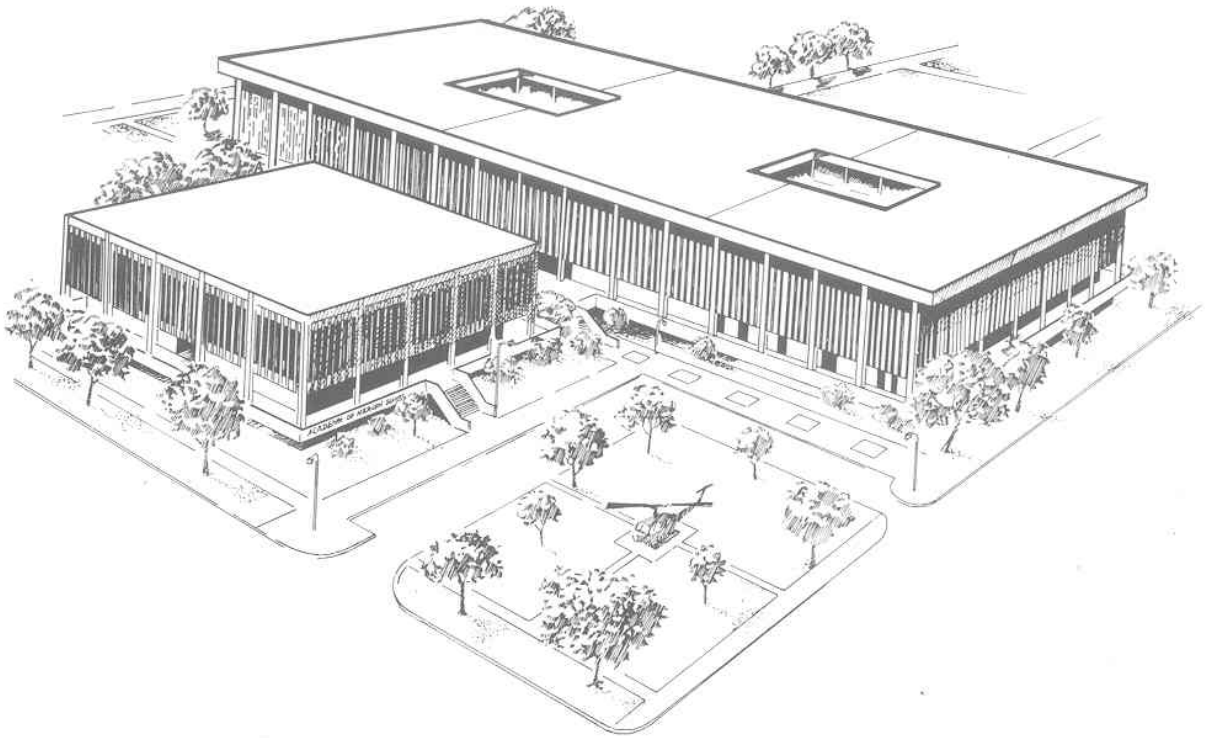

The US Army Medical Department Center and School, Fort Sam Houston, Texas

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