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THIS EDITION'S FEATURE ARTICLES:

Dedicated to the Indomitable Spirit & Sacrifices of the SOF Medic

Contents

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COVER

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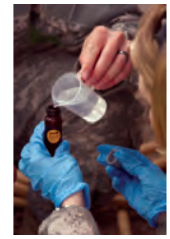
The Combined Joint Special Operation Task Force-Afghanistan preventative medicine team recently surveyed firebase Thomas, near Shindand district, in Herat province, to ensure the servicemembers there are protected from environmental hazards. The preventative medicine team places five drops of acid into their first water sample, which will be sent to a lab in the U.S. for testing. (U.S. Army photo by SFC Marie Schult/Released)



From the Editor

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Dedication

MSgt Mike Maroney renders a salute after removing the flash from his pararescue beret and leaving it on the casket of his fallen comrade, TSgt Michael Flores who died in a helicopter crash 9 June 2010, in Afghanistan. Pararescuemen have begun the tradition of leaving their beret flashes to their fallen warriors as a sign of honor and respect. (U.S. Air Force photo/SSgt Bennie J. Davis III)

Pararescuemen: Honoring Fallen Warriors

Two pararescuemen were among the four Airmen killed on 9 June 2010 when insurgents shot down their HH-60G Pave Hawk in southern Afghanistan, near Forward Operating Base Jackson, in the Helmand province. TSgt Michael Flores, 31, from San Antonio, TX, and SrA Benjamin D. White, 24, from Erwin, TX, were both assigned to the 48th Rescue Squadron at Davis-Monthan Air Force Base, AZ. Their HH-60G Pave Hawk crashed as the pararescue airmen were performing a medical-evacuation mission. The motto of the pararescue men is "... these things we do, that others may live." These pararescuemen and their helicopter crew gave their lives in the defense of our nation and their fellow Soldiers in need of rescue. Their motto is very fitting for these heroes.

The airmen were deployed in support of Operation Enduring Freedom and were responsible for casualty evacuation. Senior Airman White was on his first deployment and had been in Afghanistan less than two months. The Taliban claimed responsibility for the attack.

"It's a big deal every time we lose someone," said Brig Gen. Frederick B. Hodges, "But this is more of a jolt. The MEDEVAC crews are some of the bravest people in the world. Just by the nature of what they do; they're always moving into danger."

More than 20 pararescuemen, active duty, retired, and prior service from across the U.S., donned their service dress uniforms, with boots and maroon berets, and fell into formation to pay their final respects to their fallen comrade, TSgt Michael Flores, in a funeral ceremony at Fort Sam Houston National Cemetery on 19 June.

There are approximately 350 to 375 pararescuemen currently in the Air Force, said CMSgt Lee Shaffer, the pararescue career field manager.

"Once you're a pararescueman, always a pararescueman," Chief Shaffer said of the retired and prior pararescuemen who came out to honor TSgt Flores. "It's not uncommon for prior [pararescuemen] to show up at these events. We want them to wear their berets. We are a brotherhood."The ceremony proceeded much like many other services do, but once the official ceremony concluded, the pararescue ritual began.

The pararescuemen fell out of formation and formed a line up to the casket. One by one, they marched smartly to the casket and saluted TSgt Flores. Then, they took off their berets and removed the flash, and placed it on TSgt Flores' casket. They put their berets back on and saluted TSgt Flores for the last time.

The flash is a device worn on the beret and is worn only by pararescuemen who have completed the two years of training it takes to become fully qualified. The flash comprises a guardian angel wrapping its arms around the world, which symbolizes the mission of pararescuemen. Underneath the flash it reads "That others may live," the pararescue credo.

The tradition of slamming the flashes into the casket, so they stick and stay with the member forever, began shortly after 11 September 2001, when SrA Jason Cunningham, a pararescueman, was killed in the battle at Roberts Ridge in Afghanistan, Chief Shaffer said.

The beret, and the flash that's pinned on it, are probably the single most important uniform item to a pararescueman. "To us it represents all of our hard work, our dedication, and basically our heart and soul." Chief Shaffer said. "We want our fallen warrior to be forever buried with what's most precious to us and what was most precious to him."Flores, a 32-year-old pararescueman, had earned the Distinguished Flying Cross and deployed eight times during his 12 years in the service. White, a 24-year-old pararescueman, had served in the Air Force since July 2006 and was on his first deployment.

Editor's Note: In the Army, the "flash" is a colored woven patch that is sewn onto the beret. The "crest" is a metallic device that is pinned onto the beret through the flash. The Army shares in this tradition by slamming their crests into the casket of fallen brother.

Warrior Model for Human Performance and Injury Prevention: Eagle Tactical Athlete Program (ETAP) Part I

Timothy C. Sell, PhD; John P. Abt, PhD; Kim Crawford, PhD; Mita Lovalekar, PhD, MBBS, MPH; Takashi Nagai, PhD; Jennifer B. Deluzio, MS; COL Brian W. Smalley, DO; COL Mark A. McGrail, MD; LTC (p) Russell S. Rowe, MD; Sylvain Cardin, PhD; Scott M. Lephart, PhD

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Abstract

Introduction: Physical training for United States military personnel requires a combination of injury prevention and performance optimization to counter unintentional musculoskeletal injuries and maximize warrior capabilities. Determining the most effective activities and tasks to meet these goals requires a systematic, research-based approach that is population specific based on the tasks and demands of the warrior. **Objective**: We have modified the traditional approach to injury prevention to implement a comprehensive injury prevention and performance optimization research program with the 101st Airborne Division (Air Assault) at Ft. Campbell, KY. This is Part I of two papers that presents the research conducted during the first three steps of the program and includes *Injury Surveillance*, *Task and Demand Analysis*, and *Predictors of Injury and Optimal Performance*. **Methods**: Injury surveillance based on a self-report of injuries was collected on all Soldiers participating in the study. Field-based analyses of the tasks and demands of Soldiers performing typical tasks of 101st Soldiers were performed to develop 101st-specific laboratory testing and to assist with the design of the intervention (Eagle Tactical Athlete Program (ETAP)). Laboratory testing of musculoskeletal, biomechanical, physiological, and nutritional characteristics was performed on Soldiers and benchmarked to triathletes to determine predictors of injury and optimal performance and to assist with the design of ETAP. **Results**: Injury surveillance demonstrated that Soldiers of the 101st are at risk for a wide range of preventable unintentional musculoskeletal injuries during physical training, tactical training, and recreational/sports activities. The field-based analyses provided quantitative data and qualitative information essential to guiding 101st specific laboratory testing and intervention design. Overall the laboratory testing revealed that Soldiers of the 101st would benefit from targeted physical training to meet the specific demands of their job and that sub-groups of Soldiers would benefit from targeted injury prevention activities. **Conclusions**: The first three steps of the injury prevention and performance research program revealed that Soldiers of the 101st suffer preventable musculoskeletal injuries, have unique physical demands, and would benefit from targeted training to improve performance and prevent injury.

Introduction

Unintentional musculoskeletal injury is a persistent and principal health concern for the United States military. Recent epidemiological evidence indicates that 19.5% of troops currently deployed to Iraq and Afghanistan report at least one nonbattle injury with 84.8% of individuals (of the 19.5%) seeking medical attention.[1] Many of these injuries are potentially preventable as 57% involved Sports/Athletics or Heavy Gear/Lifting. Earlier epidemiological studies demonstrate similar findings. In 1992, 31% of all U.S. Army hospitalizations were due to musculoskeletal conditions and injuries.[2] This percentage of musculoskeletal injuries remains high in the current conflicts.[3] The majority of these injuries were non-combat related[4] musculoskeletal injuries[5-8] and typically occurred during physical training, sports, and recreational activities. The Armed Forces Epidemiological Board has indicated that musculoskeletal injuries have a greater impact on health and readiness than medical complaints during peacetime and combat.[9] Furthermore, musculoskeletal injuries are a leading cause of hospitalization;[2] account for a large number of disability reviews;[7, 10] account for a significant amount of lost duty time;[11, 12] cost nearly one billion dollars yearly in care;[9, 10, 13] result in both short term and long term disability; and place a substantial burden on the medical system.[14] Although there are a number of identified predictors for unintentional musculoskeletal injuries (age, gender, anatomy, physical activity and fitness, flexibility, smoking, absolute amount of training, type of training, and acceleration of training),[14] they persist as a significant health concern facing servicemen and women and the individuals who care for and command them. Additional research is necessary to identify the modifiable neuromuscular, biomechanical, physiological, and musculoskeletal characteristics that predict injury.

Musculoskeletal injuries are potentially preventable with scientifically driven, culturally-specific, and population-specfic physical training programs. Typically, injury prevention research targets one specific injury, one joint, or one extremity, but injury prevention in the military must be more comprehensive in order to address the most common injuries across multiple joints and all extremities. But, injury prevention alone is only one aspect of a comprehensive physical training program. A successful program will also address physical performance and nutritional needs. Providing nutrients and fluid in the right combination to meet the unique demands of military training and missions will help fuel the muscle demands, allow for optimal adaptation, reduce fatigue and injury, and optimize physical performance. All three components (injury prevention, performance optimization, and nutritional repletion) must be specific to the Soldier based on the specific tasks he has to perform as well as the physical demands placed on him. Addressing specificity is based on a process that we refer to as *Task and Demand Analysis* (Figure 1) and it is part of our approach to injury prevention and performance optimization.

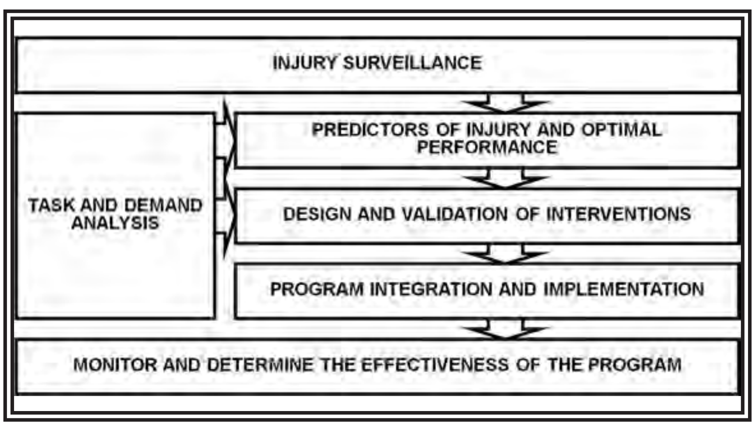

Figure 1: *University of Pittsburgh Injury Prevention and Performance Optimization Model*

Our approach is based on a conventional public health model of injury prevention and control[15-17] adapted to also include performance and nutrition interventions (Figure 1). Our model incorporates multiple research designs utilizing sound scientific methods to establish the following:

1. Scope and magnitude of musculoskeletal injuries through *Injury Surveillance*
2. Methodological and intervention specificity to meet the demands of distinct groups of service men who have to perform different tasks that have unique physical and physiological demands with *Task and Demand Analysis*
3. Modifiable neuromuscular, biomechanical, physiological, musculoskeletal, and nutritional characteristics that are *Predictors of Injury and Optimal Performance*
4. Effective training and education programs through the *Design and Validation of Interventions* that modify risk factors for injury and predictors of optimal performance
5. Appropriate procedures for *Program Integration and Implementation*
6. Capabilities of the intervention to reduce the incidence of unintentional musculoskeletal injury and optimize performance as we *Monitor and Determine the Effectiveness of the Program*

Currently, the University of Pittsburgh and the 101st Airborne Division (Air Assault) have established the Human Performance Research Center at Ft. Campbell, KY. The overall purpose of this collaboration is to create a systematic, data driven, and sustained injury prevention and performance optimization program to reduce the risk of unintentional, musculoskeletal injuries and improve physical performance in 101st Airborne/Air Assault Soldiers. Specifically, we are customizing our injury prevention and performance optimization model for application to a specific population of Soldiers.

The first step of the model is *Injury Surveillance*. Data are collected on the target population to understand the magnitude, nature and impact of the injury problem. Data includes the type of injuries (anatomical location, tissues involved, acute, overuse), where injuries occur, activity performed when injury occurred (physical training, tactical operations, for example), and the mechanism of injury. Data are collected utilizing self-report surveys or through queries of existing medical databases.

Task and Demand Analysis is critical component and a hallmark of our model. It provides a means by which the entire injury prevention and performance research model can be implemented within different populations of athletes or Soldiers. Data are collected in the field (physical training and tactical training) an includes both qualitative and quantitative examination of the tasks during which injuries typically occur, examination of the musculoskeletal and biomechanical qualities necessary for efficient and safe functional performance, and the physiological demands of the individual while performing his or her functional tasks. Typically these are single-case descriptive studies. *Task and Demand Analysis* data are incorporated into the identification of predictors of injury and performance as well as the design and validation of intervention programs.

The collection of *Predictors of Injury and Optimal Performance* is the next step and includes collection of subject-specific neuromuscular, biomechanical, physiological, musculoskeletal, and nutritional characteristics. Testing methodology must include task-specific biomechanical analyses as well as musculoskeletal and physiological protocols based on the demands of the target population (see *Task and Demand Analysis* above). The goal is to identify modifiable factors that predict injury and performance that can be targeted with intervention programs. Prospective studies are the most powerful research design to examine these factors. Descriptive and comparative studies can also be utilized to a lesser extent to narrow down and identify potential predictors of injury and performance.

Design and Validation of Interventions are population specific and based on the modifiable injury and performance predictors identified in the previous step. The design of the program must include the specific task and demands (see *Task and Demand Analysis* above) of the target population and can utilize population-specific data (descriptive/comparative studies) and previously identified predictors (existing peer-reviewed literature). Design must consider the environment, venue, and the logistical needs of the population (delivery and integration). The validation of the intervention is focused on the capability of the program to modify the identified predictors of injury and performance and is typically tested through randomized, controlled, clinical trials.

The next step in the model is *Program Integration and Implementation* and requires careful logistical planning and cooperation in order to deliver the intervention to the target population within their environment while accounting for the necessary procedures, training, and logistical concerns necessary for full integration. Data collection can include audits of participation and adherence to the program as well as clinical trials to test the efficacy of in the field deployment.

The final goal of the intervention is to reduce injury and improve performance. This is performed in the final step, *Monitor and Determine Effectiveness of the Program*. Long term injury tracking (similar to the first step) is performed on populations that have been exposed to the intervention and on populations who serve as the control group. Randomized, controlled, clinical trials are employed to examine the effectiveness of the program to reduce injury. Longitudinal studies are conducted on other variables of performance to examine the impact of the intervention on performance.

The purpose of the first of two companion papers is to describe the methodology and research results through the first three steps of our injury prevention and performance model (*Injury Surveillance*, *Task and Demand Analysis*, and *Predictors of Injury and Optimal Performance*) as it is implemented and integrated within the 101st Airborne Division (Air Assault). Although this model is currently being applied to the 101st Airborne Division (Air Assault), by design it can be applied to different populations including Special Operations Forces where it may be more relevant due to the elite athlete benchmarking and the capability to individualize it to the specific needs of each Operator. Epidemiology data will be presented based on the self-reports of Soldiers tested in the Human Performance Research Center at Ft. Campbell, KY. An overview and example of a *Task and Demand Analysis* will be provided. Descriptive data across all testing methodologies (biomechanical, neuromuscular, musculoskeletal, and physiological) will be presented and will include profiling against elite athletes. Although nutrition data has been collected, it will not be reported in these two papers. The second paper will describe the methodology and research results for the *Design and Validation of Interventions, Program Integration and Implementation*, and *Monitor and Determine the Effectiveness of the Program*.

Methods

Subjects

Two groups of subjects were enrolled in the study. The first group was composed of Soldiers from the 101st Airborne Division (Air Assault) in Ft. Campbell, KY. Demographic information is listed in Table 1. Soldiers were recruited via advertisement flyers and information sessions organized by the investigators of the study. A total of 404 Soldiers were tested (347 males and 57 females) across 121 different Military Occupational Specialties and all Physical Demand Rating categories.[18] To be included the study, Soldiers had to be 18 to 45 years old without any medical or musculoskeletal conditions that precluded them from full active duty. The second group included triathletes triathletes (15 males and 9 females) recruited via advertisement flyers as a benchmark for comparison to the Soldiers and for identification of suboptimal characteristics. To be included in the triathlete group, all individuals had to be healthy and free of any current medical or musculoskeletal conditions that would prevent participation in any of testing procedures. All of the triathletes were age group qualifiers for the Ironman World Championships. Triathletes were selected for the comparison group based on their multidisciplinary training and recognition as those who would have optimized many musculoskeletal and physiological characteristics such as aerobic and anaerobic endurance. Both groups were subdivided based on gender and comparisons between groups were within gender only. Human subject protection for the current study was approved by the University of Pittsburgh, Dwight D. Eisenhower Army Medical Center, Army Clinical Investigation Regulatory Office, and Army Human Research Protection Office. All aspects of the study were explained to each Soldier and triathlete prior to voluntary participation.

TABLE 1
Subject Demographics

	101st Airborne Division (Air Assault)		Triathletes	
	Males (n=347)	Females (n=57)	Males (n=15)	Females (n=9)
Age (yrs)	28.1±6.6	26.7±5.5	35.7±8.5	34.7±7.1
Height (cm)	69.7±2.8	64.8±2.5	70.8±4.2	64.7±2.0
Mass (kg)	183.6±27.6	142.9±21.8	164.3±21.2	121.0±10.2

Instrumentation

Injury Surveillance

Demographic, medical, nutrition and injury data were collected using the University of Pittsburgh Military Epidemiology Database (UPitt-Med). Laboratory data were imported into the UPitt-MED. All data in the UPitt-MED were de-identified upon entry.

Task and Demand Analysis

Typically the *Task and Demand Analysis* utilizes accelerometers (ZeroPoint Technology, Johannesburg, South Africa) to examine segmental acceleration at the tibia, L5, and C7; a portable metabolic unit (OxyCon Mobile, Viasys, Yorba Linda, CA) to examine oxygen consumption and gas exchange; a heart rate monitor (Polar USA, Lake Success, NY); and an in-shoe plantar pressure system (Novel GmbH, Munich, Germany) to measure detailed foot pressure. Not all of these instruments are used during each task and demand analysis as logistical, environmental, and operational restrictions force modifications to actual testing instrumentation.

Predictors of Injury and Optimal Performance

Flexibility measurements of the shoulders, hips, knees, and ankles were assessed with a standard goniometer or digital inclinometer (Saunders Group, Chaska, MN). Strength of the shoulders, hips, knees, and back was assessed using the Biodex Multi-Joint System 3 Pro (Biodex Medical Systems, Inc, Shirley, NY). Ankle strength was assessed with a hand held dynamometer (Lafayette Instrument Company, Lafayette, IN). Balance testing data were collected with a single force plate (Kistler 9286A, Amherst, NY) at a sampling frequency of 1200 Hz. A portable metabolic system (OxyCon Mobile, Viasys, Yorba Linda, CA) was used to assess oxygen consumption during a maximal oxygen uptake test. Blood lactate was assessed with a portable lactate analyzer (Arkray, Inc, Kyoto, Japan). A heart rate monitor (Polar USA, Lake Success, NY) was worn by the subject during testing. Anaerobic power was measured utilizing the Velotron cycling ergometer (RacerMate, Inc, Seattle, WA). Body composition was assessed with The Bod Pod Body Composition System (Life Measurement Instruments, Concord, CA) through air displacement plethysmography. Raw coordinate data for the biomechanical analysis of lower extremity performance and functional testing was collected with the six high-speed cameras (Vicon, Centennial, CO). Ground reaction forces were measured using two Kistler force plates (Kistler Instrument Corp., Amherst, NY).

<u>Procedures</u>

All testing of Soldiers of the 101st was performed in the University of Pittsburgh Human Performance Research Center at Ft. Campbell, KY. Subjects who were part of the athlete comparison group were tested at the Neuromuscular Research Laboratory at the University of Pittsburgh (Pittsburgh, PA). Testing occurred over two days (approximately two hours each day) separated by approximately one week. After informed written consent was obtained, each subject was asked to provide a detailed medical history and a history of all musculoskeletal injuries. Subjects were also given a detailed diet history including a food frequency and 24 hour recall to be filled out prior to returning on the second day (data not reported in the current manuscript).

Injury Surveillance

A detailed self-report of injury was obtained from participants in the study. Operational definitions of data (anatomic location of injury, type of injury, activity when injury occurred, etc.) were discussed and defined in meetings of the research group prior to the initiation of the study, in order to ensure validity and consistency of data.

Task and Demand Analysis

A total of seven task and demand analyses were performed to examine different physical training, tactical training, and other functional tasks that Soldiers have to perform as part of their regular duties. The activities chosen were based on consultation with the Division Surgeon and Division Command. They included the following:

<u>Task Analysis</u>

1. Drop exit from a vehicle
2. Rope climb (up and down)
3. Loading and unloading equipment from a vehicle
4. Night training – landing from a jump with low light conditions

<u>Demand Analysis</u> (Obstacle Course)

1. Eagle First Responder Course
2. Air Assault O-Course
3. Joint Readiness Training Center activities

The results of these analyses were utilized to develop the procedures examining *Predictors of Injury and Optimal Performance* and the exercises and activities included in the *Design and Validation of Interventions* (See Companion Paper). Additional tasks were examined based on the potential for injury. Data were collected in the field. The actual data collection procedures and equipment utilized was dependent on the specific task, environmental conditions, and the capability to collect data with minimal interference to training and the Soldier. For sake of brevity, a description of two examples of *Task and Demand Analysis* are provided.

Qualitative observations (See Figure 2 for task analysis and Figure 3 for demand analysis) were collected on one Soldier exiting a vehicle (task analysis) and quantitative data was collected on one Soldier during the 101st Airborne Division (Air Assault) Obstacle Course (demand analysis). The qualitative observations included musculoskeletal, neuromuscular, and biomechanical demands and an examination of the movement patterns, forces, velocities, joint angles, and planes of motion which identifies the muscles and other parts of the body used to execute the specific joint and whole body actions. The O-course was designed to evaluate Soldiers' ability to negotiate and maneuver obstacles without fear of height. There are nine obstacles that include: "tough one"

Figure 2: *Task analysis – Field observation with laboratory simulated testing*

Figure 3: *Demand analysis – Field testing as observed on the O-Course*

(rope climb), incline wall, "low belly over" (jump onto beam, forward flip, and land on the ground), "confidence climb" (log/beam climb, walk across beam, climb down), six vaults, swing stop and jump on a rope, low belly crawl (not performed due to equipment considerations), high step over, and "weaver" (over and under beams suspended in the air). One male Soldier (Age: 20 years; Height: 68 inches; Weight: 161 pounds) was observed during the O-Course and outfitted with the portable metabolic equipment and the heart rate monitor. The Soldier was wearing his army combat uniform and boots. For the purpose of task and demand analysis, the Soldier was asked to complete the O-course twice with an 8 minute 45 second rest between each run. The data (VO_2) were monitored during the rest period until it returned to resting value prior to the beginning of the O-course. Data were collected for a total of 24 minutes and 15 seconds while the subject was engaged in the O-Course training.

Predictors of Injury and Optimal Performance

Passive shoulder, hip, and knee motion were measured passively using the methods described by Norkin and White.[19] Passive measurements included hip flexion and extension, knee flexion, and triplanar shoulder motion. Posterior shoulder tightness was measured in a supine position but was based on the description by Tyler et al.[20, 21] Hamstring flexibility was measured in supine using the active knee extension test.[22] Active dorsiflexion was measured with the knee straight as described by Norkin and White.[19] Torso flexibility was measured in a seated position utilizing the torso rotation attachment of Biodex Multi-Joint System 3 Pro based on a previous study.[23]

Bilateral shoulder internal/external rotation, hip abduction/adduction, knee flexion/extension, and torso rotation strength were assessed with the Biodex System III Multi-Joint Testing and Rehabilitation System (Biodex Medical Inc., Shirley, NY). All torque values were adjusted for gravity by the Biodex Advantage Software v.3.2 (Biodex Medical Inc., Shirley, NY) and calibrated according to the specifications outlined in the manufacturer's service manual. For each test, the subjects were provided details of the procedure, stabilized according to the manufacturer's guidelines, given three practice trials (three sub-maximal contractions (50% effort) followed by three maximal contractions) to ensure patient understanding and familiarity. A rest period of at least 60 degree/seconds was given prior to each strength test. Reciprocal concentric isokinetic shoulder internal/external, knee flexion/extension, and left/right torso rotation strength was tested at 60°/second (5 repetitions). Isometric hip abductor/adductor strength was tested in the side-lying, hip neutral position while they performed three, five-second alternating hip abduction and adduction isometric contractions. Ankle inversion/eversion strength was measured with a handheld dynamometer. All ankle strength tests were performed in a seated position based on traditional manual muscle strength testing hand placement. Three trials for each movement were collected and averaged.

Balance testing was assessed according to Goldie et al.,[24, 25] using a single force plate sampling at a frequency of 100Hz. Subjects performed three trials (10 seconds each) of a single-leg standing balance test (barefooted) for each leg under eyes open and eyes closed conditions. Subjects were asked to remain as still as possible with feet shoulder width apart and hands on hips.

Subjects performed an incremental ramped protocol to determine maximal oxygen consumption and lactate threshold. Subjects were fitted with the portable metabolic system and a heart rate monitor. The protocol consisted of a five-minute warm-up; an initial three-minute workload at 0% grade (starting speed for each Soldier was 70% of the two-mile run time during the Soldier's most recent Army Physical Fitness Test); and followed by an incline increase of 2.5% (grade) every three minutes while the speed remained constant.[26] Prior to each change in incline, a finger stick for a blood sample was taken to assess blood lactate levels. Subjects were instructed to continue running until exhaustion (defined as the inability to continue the test due to cardiovascular or peripheral inhibition). Heart rate and VO_2 were monitored continuously throughout the test. The specific variables analyzed included relative maximal oxygen uptake (VO_{2max}: ml/kg/min), heart rate max (HR_{max}) in beats per minute (bpm), respiratory exchange ratio (RER: VCO_2/VO_2), VO_2 at lactate threshold (ml/kg/min), percent of VO_{2max} at lactate threshold (%VO_{2max}), heart rate at lactate threshold (bpm), and percent of heart rate max at lactate threshold (%HR_{max}).

Anaerobic power and capacity were measured with an electromagnetic cycling ergometer utilizing the Wingate protocol (Racermate Inc, Seattle, WA). Proper seat and handlebar adjustments were made before the subject's feet were secured to the pedals, and a warm-up cycle at a self-selected cadence was initiated at 125 Watts. Subjects underwent a 50-second cycling protocol. After fifteen seconds of maintaining 100 RPM at 125 Watts, the participant was instructed to sprint and generate as much speed prior to the initiation of the normalized resistance. The participant continued to sprint and maintained as much speed as possible during the remainder of the 30s resistance duration. A standardized braking torque of 9% body weight was utilized for males and 7.5% body weight was utilized for females.[27,28] Anaerobic power was reported as the peak watts normalized to body weight produced during the first five seconds of the test, and anaerobic capacity was reported as the average watts normalized to body weight produced during the entire 30-seconds (W/kg).

The Bod Pod® Body Composition System (Life Measurement Instruments, Concord, CA) was used to measure body composition. The Bod Pod® utilizes air-displacement plethysmography to measure body volume and calculate body density. The system underwent a standard calibration utilizing a 50.683 L calibration cylinder, and an additional two-point calibration prior to each test. Subject wore spandex shorts and swim caps. Body volume was measured until two consistent measurements were achieved. Predicted lung volume and an appropriate densitometry equation were used to calculate percent body fat (% BF). The Bod Pod Body Composition System was utilized to calculate body mass and percent of fat and fat free mass.

A biomechanical analysis was performed while subjects performed an athletic task (stop jump task) and a functional landing task (drop landing task). Subjects were fitted with sixteen retro-reflective markers on anatomical land marks according to Vicon's Plug-in-Gait (Vicon, Centennial, CO). Subjects' height, mass, ankle width, knee width, and leg length were entered into the operating software (Nexus v1.3, Vicon, Centennial, CO) prior to collecting a static calibration trial with the participant standing in anatomical position. After completing the static calibration trial, participants were instructed to perform the stop jump task – a standing broad jump from a normalized distance of 40% of the participant's height followed immediately (after landing on the force plates) by a maximal effort vertical jump.[25] For the drop landing task, subjects were instructed to drop from a standardized height of 20 inches and land on the force plates. Although this height is less than that observed during the task analysis of exiting a vehicle, it was deemed the safest height appropriate for the large range of subjects tested in the current study. Additionally, the protective mechanisms studied in are the same regardless of height.

<u>Data Reduction</u>

Injury Surveillance

Self-reported data about injuries in study participants were entered into UPitt-MED by athletic trainers at the Ft. Campbell laboratory, in the presence of the study participant. The Pitt-MED is designed to facilitate an epidemiological analysis of the factors associated with performance, injuries, disabilities and tactical readiness. Tables in the database store data about physiological measures of strength, endurance, cardiovascular fitness; and musculoskeletal (strength, flexibility and balance), biomechanical, anthropometric and demographic data; in addition to the data related to medical events and injury. A detailed nutrition history was completed for each subject including a 24 hour diet recall, food frequency questionnaire and dietary supplement survey (not reported in the current manuscript).

Task and Demand Analysis

Quantitative variables calculated for the specific *Task and Demand Analysis* performed and presented in the current manuscript included the minimum, maximum, and average heart rate; breathing frequency; oxygen consumption; and respiratory exchange ratio. Time spent exercising at or above the anaerobic threshold was estimated using laboratory determined VO_2 and lactate threshold data. A description of the tasks performed including the perceived musculoskeletal, neuromuscular, and biomechanical demands is presented as part of the qualitative analysis.

Predictors of Injury and Optimal Performance

All flexibility and range of motion measures are presented as an average of three trials. Strength measures are reported as an average of three trials and then normalized to each subject's individual body weight (tests using the Biodex System III Multi-Joint Testing and Rehabilitation System) or mass (hand held dynamometer). The standard deviation for the ground reaction forces for each direction (anterior-posterior, medial-lateral, and vertical) was calculated during the 10-second trial and then averaged across all three trials for both balance testing conditions.

For the aerobic test, a maximal test was verified by identifying one of the following physiological achievements: HR at or above age predicted max (220 – age), absolute oxygen uptake values not rising despite increase in intensity, blood lactate at or above 8mmol/L, respiratory exchange ratio (RER)

TABLE 2
Number of Injuries per Subject

Number of Injuries	Number of Subjects	Relative Frequency (%)
0	174	72.2
1	45	18.7
2	17	7.1
3	2	0.8
4	2	0.8
6	1	0.4
Total subjects	241	100.00%

at or above 1.1, or volitional fatigue. The metabolic data were filtered with a 15-second moving window to reduce the overall breath-by-breath data points. The VO_2 data were then plotted across time to identify the highest consecutive values over the time period of one minute during the test. Lactate values for each stage were plotted across time to identify lactate threshold. An inflection point was identified in the lactate plot as the point at which levels began rising greater than or equal to 1mmol/L between stages. The oxygen uptake and heart rate data points corresponding with the point in time of the lactate inflection point were used to calculate percent of VO_{2max} and HR_{max} at lactate threshold. Anaerobic power, anaerobic capacity, and fatigue index are automatically generated by the Wingate software upon completion of the test. Anaerobic power output is calculated as the peak within five seconds of the test starting while anaerobic capacity is calculated as the mean power output of the 30s duration. Anaerobic power and capacity are reported as relative (W/kg) variables. Fatigue index is calculated as the average rate of change in power across the 30s test. Body composition is reported in percent body fat mass based on total body volume utilizing the subject's body mass and race/gender appropriate density formulas.

Data processing for the biomechanical analysis of the two different lower extremity tasks has been reported elsewhere.[30] The variables analyzed for both tasks included the maximum knee and hip flexion angle; knee and hip flexion at initial contact; the maximum knee valgus/varus angle; the knee valgus/varus angle at initial contact; and the peak vertical ground reaction force.

TABLE 3
Anatomic Sub-Location of the Injuries

Anatomic Location	Sub-Location	Number of Injuries	Percent of Injuries
Lower Extremity	Foot and Toes	10	10.1
	Thigh	8	8.1
	Lower Leg	12	12.1
	Hip	1	1.0
	Knee	13	13.1
	Ankle	18	18.2
Upper Extremity	Hand and Fingers	3	3.0
	Upper Arm	2	2.0
	Shoulder	11	11.1
	Wrist	4	4.0
Spine	Cervical	1	1.0
	Thoracic	1	1.0
	Lumbopelvic	7	7.1
	Other	3	3.0
Head/Face		5	5.1
Total		99	99.9%*

*Percents do not add up to 100.0 due to rounding

TABLE 4
Types of Injuries

Type of injury		Number of injuries	Percent of injuries
Concussion		4	4.0
Ear injury		1	1.0
Fracture	Upper Extremity	2	2.0
	Lower Extremity	3	3.0
Sprain	Upper Extremity	6	6.1
	Lower Extremity	16	16.2
Strain	Spine	5	5.1
	Upper Extremity	4	4.0
	Lower Extremity	7	7.1
Dislocation – Lower extremity		1	1.0
Chondromalacia/Patellofemoral Pain		4	4.0
ITB		6	6.1
Plantar Fasciitis		7	7.1
Back pain/spasm		2	2.0
Other pain		2	2.0
Tendonitis - Lower Extremity		2	2.0
Nerve injury – Upper extremity		1	1.0
Shin Splints		3	3.0
Disc injury		1	1.0
Contusion		2	2.0
Subluxation – Lower extremity		1	1.0
Reported "overuse"		1	1.0
Shoulder separation		1	1.0
Meniscal		3	3.0
Shoulder impingement		2	2.0
Unspecified injury type		9	9.1
Others		3	3.0
Total		99	99.8%*

Percents do not add up to 100.0 due to rounding

<u>Statistical Analysis</u>

All data analysis was performed with de-identified data. The description of *Injury Surveillance* data included a calculation of the average number of injuries per person; relative frequencies of injuries by anatomic location; cause of injury; activity when injury occurred; and type of injury. The minimum, maximum, and average for each of the variables collected during the *Task and Demand Analysis* are presented in table format for each portion of the activity analyzed. The qualitative description of the task relative to the biomechanical and musculoskeletal demands is presented. Means and standard deviations for each of the *Predictors of Injury and Optimal Performance* collected are calculated for each group (Soldiers and triathletes) within gender. Comparisons between the Soldier group and triathlete group were performed within gender utilizing independent t-tests with an alpha level of 0.05 chosen a priori. Statistical analysis was done using SPSS 17.0 (SPSS Inc., Chicago IL).

Results

Injury Surveillance

Self-reported injury data for the one year prior to testing was available for 241 Soldiers. There were 13 bilateral injuries, which have been counted twice in this report. A total of 99 injuries were reported. One hundred seventy-four subjects (174/241, 72.2%) did not report any injuries during a one year period. The average numbers of injuries reported per subject during a one year period were 0.41. Forty-five Army personnel (45/241, 18.7%) had reported one injury, and seventeen (17/241, 7.1%) had reported two injuries, during a one year period (see Table 2). Figure 4 provides an overview of the general anatomic location for each of the injuries with a more specific breakdown presented in Table 3. The majority of injuries (62.6%) occurred in the lower extremity. The ankle joint (18.2%) and

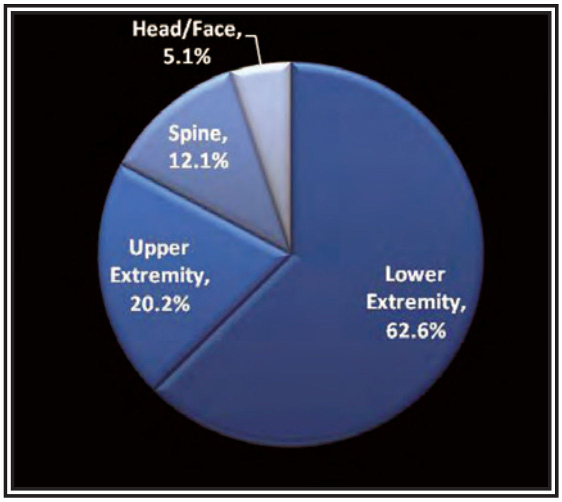

Figure 4: *Anatomic location of the injuries*

TABLE 5
Cause of Injuries

Cause of injury	Number of injuries	Percent of injuries
Running	34	34.3
Fall	8	8.1
Direct Trauma	8	8.1
Lifting	8	8.1
Landing	4	4
Twist/Turn/Slip (no fall)	2	2
Marching	2	2
Pulling	2	2
Cutting	1	1
Planting	1	1
Other	3	3
Not specified	15	15.2
Recreational activity/ sports related (cause not specified)	9	9.1
Training related (cause not specified)	2	2
Total	99	99.9%*

*Percents do not add up to 100.0 due to rounding.

knee joint (13.1%) were the two most commonly injured joints. The most common specified type of injury (see Table 4) was a sprain of the lower extremity (16.2%), followed by strains of the lower extremity and plantar fasciitis (7.1% each). Ankle sprain was the most common injury, followed by plantar fasciitis, and then strain of the spine. The cause of injuries is presented in Table 5. Running was the most common cause of injury (34.3%). Recreational activity/sports related causes were the second most common cause (9.1%). Nearly half of all the injuries (48.5%) occurred during training (physical training, tactical training or unspecified training), and 15.2% of injuries occurred during recreational activity/sports activity. Some other activities during injury included combat (6.1%) and motor vehicular accident (4.0%). Activity during injury was not reported in 14.1% of injuries.(Figure 5).

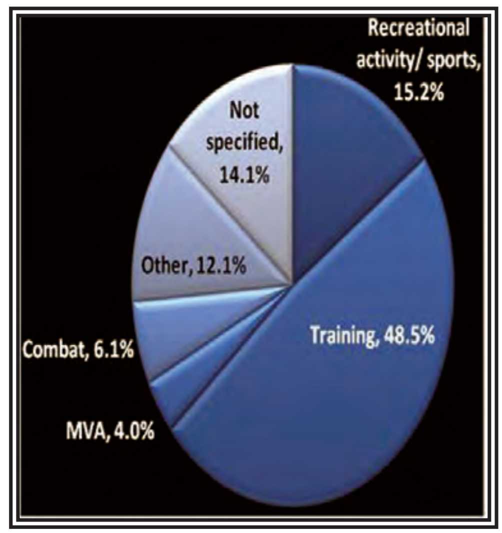

Figure 5: *Activity when injury occurred*

Task and Demand Analysis

<u>Task Analysis</u>

The following are the qualitative observations of exiting a vehicle. The task involves both a vertical and horizontal component. The vertical component involves the displacement of the body caused by gravity. As the Soldier drops off of the tailgate, from an approximate tailgate height of 1m, gravity accelerates him down to the ground. The Soldier's landing would exert a considerable amount of force to stop the vertical movement of his body. During the landing the Soldier flexes his hip and knee to reduce the impact caused by the vertical force. Additional load (equipment carried) would increase the magnitude of the force during landing. The horizontal component of this task requires the Soldier to neutralize his horizontal momentum and regain balance. During the landing the ground exerted a posterior force which would have to be neutralized by dynamic joint restraints.

<u>Demand Analysis</u>

The purpose of the demand analysis was to measure and characterize the metabolic and physiologic demands of specific military tasks including, energy expenditure, aerobic and anaerobic energy system usage and substrate utilization. Data from the laboratory maximal oxygen consumption test were utilized to evaluate the metabolic and physiologic responses of the O-Course training (Table 6). The O-Course training lasted 24 minutes and 15 seconds including an eight minute and 45 second rest between runs. The data revealed the O-course is a high intensity activity (Table 7). Of the 15 minutes and 30 seconds total O-Course run time, ~196kcals were expended, or ~12kcal per minute (10 METs). The Soldier completed the first run in six minutes and 35 seconds, of which approximately four minutes, or ~62%, was spent at or above anaerobic threshold. The second run was completed in eight minutes and 55 seconds, of which approximately one minute, or ~11%, was spent at or above anaerobic threshold. Of the total O-Course run time (15:30), approximately five minutes (32% of total time) involved training at or above the anaerobic threshold (laboratory determined lactate threshold) and five minutes and 30 seconds

(35% of total run time) involved training at or above 60% laboratory determined VO2max, but less than the lactate threshold, indicating high metabolic demands during the O-course training for both aerobic and anaerobic energy pathways (Figure 6). Heart rate averaged 173.6 beats per minute (87% HRmax) and peaked at 195.6 beats per min (98% HRmax) during the first run, and averaged 181.8 beats per minute (91% HRmax) and peaked at 197.6 beats per minute (99%HRmax) during the second run. Thus improving performance in training tasks similar to those tasks performed in the O-course requires adapting and enhancing both energy systems to optimize physical performance.

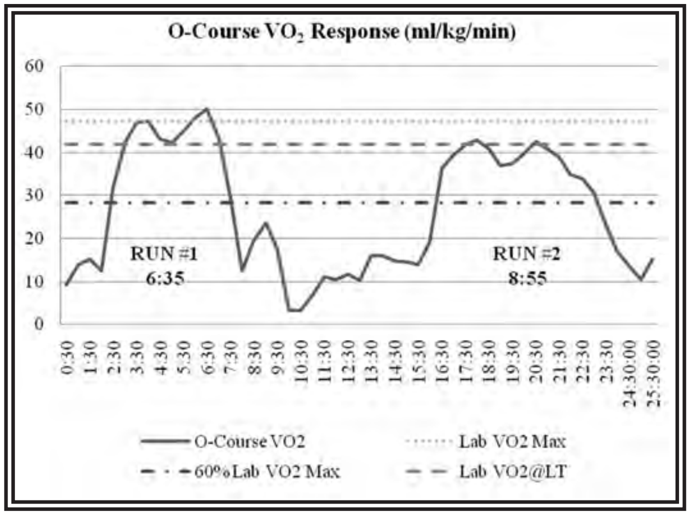

Figure 6: *VO2 response during the O-Course*

Predictors of Injury and Optimal Performance

The range of motion and flexibility data are presented in Table 8. A total of 24 comparisons were made between Soldiers and triathletes. Male Soldiers of the 101st demonstrated significantly greater right and left shoulder flexion; left shoulder extension; and right and left shoulder abduction than male triathletes. Male triathletes demonstrated significantly less posterior shoulder tightness for both the right and left shoulder as well as significantly greater right and left hip flexion. Male Soldiers of the 101st had significantly greater right and left hip extension and right and left calf flexibility. The comparisons between female Soldiers of the 101st and female triathletes revealed significant differences across nine of the flexibility and range of motion measures. Female 101st Soldiers had significantly greater right and left shoulder abduction but had more posterior shoulder tightness bilaterally than female triathletes. Female 101st Soldiers also had significantly greater knee flexion range of motion and calf flexibility. Right torso rotation was significantly greater in female triathletes compared to female 101st Soldiers.

TABLE 6
Laboratory Maximal Oxygen Uptake Data: O-Course Demand Subject (N=1)

VO_2Max* (ml/kg/min)	HR Max* (bpm)	RER Max* (VCO2/VO2)	VO_2 @ Lactate Threshold (ml/kg/min)	% VO_2 max at Lactate Threshold	Lactate at Lactate Threshold (mmol/L)
48.7	197.5	1.0	41.9	86.1	3.8

*Laboratory maximum values calculated by averaging the highest consecutive values over a one-minute period during the laboratory test.

Strength data are presented in Table 9. A total of 20 comparisons were made between Soldiers and triathletes. Male triathletes had significantly stronger left shoulder internal and external rotation; left knee flexion; and greater right knee flexion/extension strength ratio compared to male 101st Soldiers. Male 101st Soldiers had significantly stronger right and left ankle inversion and ankle eversion strength than male triathletes. Female triathletes had significantly stronger left shoulder internal rotation; right and left shoulder external rotation; right and left knee flexion; and left knee extension strength than female 101st Soldiers.

The balance data are presented in Table 10. Six comparisons were made for each of the two balance conditions tested (eyes open and eyes closed). The statistical analysis revealed only one significant difference between the 101st Soldiers and the triathletes, male 101st Soldiers had significantly lower (better) left leg medial/lateral ground reaction forces standard deviation (GRF SD) than male triathletes.

The physiology data is presented in Table 11. A total of 10 comparisons were made. Despite no significant difference observed in body mass index, male triathletes had significantly less body fat than male 101st Soldiers. Male triathletes also had greater mean anaerobic power, VO_{2max}, VO_2 at lactate threshold, and percent VO_2 at lactate threshold. Female triathletes had significantly lower body mass index and body fat percentage than female 101st Soldiers. Female triathletes also had significantly greater peak anaerobic power, mean anaerobic power, VO_{2max}, VO_2 at lactate threshold, percent VO_2 at lactate threshold, and heart rate at lactate threshold than female 101st Soldiers.

The biomechanical data for the stop-jump task and the vertical drop landing task are presented in Table 12 and Table 13 respectively. A total of 12 comparisons were made for each task.

TABLE 7
Physiological Data During *O-Course Demand Analysis*

	TOTAL O-Course				Run #1 (6 min 35 sec)				Run #2 (8 min 55 sec)			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Heart Rate (beats/min)	169.6	23.3	124.4	197.6	173.6	28.5	124.4	195.6	181.8	20.2	131.4	197.6
Breathing Frequency (breaths/min)	41.2	12.6	3.0	58.2	41.7	11.2	23.1	53.2	49.6	8.0	34.1	58.2
VO_2 (ml/kg/min)	26.7	14.4	3.2	50.1	34.4	15.8	9.1	50.1	32.8	10.1	13.5	42.8
Respiratory Exchange Ratio (VCO_2/VO_2)	0.9	0.1	0.7	1.2	0.9	0.1	0.8	1.0	0.9	0.1	0.9	1.1

TABLE 8
Range of Motion and Flexibility (Degrees)

	Males					Females				
	101st		Triathletes			101st		Triathletes		
	Mean	±SD	Mean	±SD	p-value	Mean	±SD	Mean	±SD	p-value
Right Shoulder Flexion[a]	187.2	7.3	177.4	10.9	$p<0.001$	188.0	14.7	188.0	10.7	1.0000
Left Shoulder Flexion[a]	187.8	7.3	176.7	10.7	$p<0.001$	186.6	17.2	188.7	11.5	0.7315
Right Shoulder Extension	70.8	13.3	69.2	8.5	0.6448	83.6	9.8	80.4	8.4	0.3585
Left Shoulder Extension[a]	72.6	13.0	71.4	9.2	$p<0.001$	85.0	10.0	82.4	6.3	0.4540
Right Shoulder Abduction[a,b]	206.1	9.5	194.1	11.3	$p<0.001$	211.8	8.8	198.1	18.3	0.0024
Left Shoulder Abduction	205.4	10.3	193.0	10.0	$p<0.001$	209.7	6.9	201.4	10.8	0.0071
Right Shoulder External Rotation	109.9	13.2	111.8	7.1	0.5803	120.3	16.8	123.3	12.2	0.6095
Left Shoulder External Rotation	104.2	12.0	109.1	8.6	0.1190	113.9	14.9	117.5	13.6	0.4985
Right Shoulder Internal Rotation	58.5	10.6	54.3	9.1	0.1320	59.9	11.6	62.9	16.4	0.4991
Left Shoulder Internal Rotation	66.1	13.2	62.4	9.7	0.2843	66.0	14.8	74.9	13.6	0.0953
Right Shoulder Posterior Shoulder Tightness[a,b]	102.4	9.7	109.7	7.0	0.0043	108.7	7.5	121.2	10.8	$p<0.001$
Left Shoulder Posterior Shoulder Tightness[a,b]	104.4	9.4	110.9	7.6	0.0089	110.5	6.7	122.8	11.2	$p<0.001$
Right Knee Flexion[b]	143.1	6.6	141.5	6.9	0.3729	148.5	5.9	141.3	8.0	0.0046
Left Knee Flexion[b]	142.3	7.1	139.2	6.3	0.1051	147.5	5.9	141.4	7.2	0.0122
Right Active Knee Extension	18.8	9.4	14.5	11.4	0.0867	11.4	7.9	12.3	11.5	0.7671
Left Active Knee Extension	17.6	9.9	14.4	9.6	0.2208	9.6	7.3	12.6	11.6	0.2977
Right Hip Flexion[a]	133.1	7.1	138.2	5.7	0.0075	135.8	16.9	141.3	10.4	0.3590
Left Hip Flexion	133.4	7.2	136.8	5.7	0.0869	135.8	16.3	139.0	8.2	0.5736
Right Hip Extension[a]	29.3	8.0	21	8.5	$p<0.001$	33.9	7.3	35.5	9.4	0.5598
Left Hip Extension[a]	30.0	8.2	20.7	6.3	$p<0.001$	34.2	7.1	36.7	7.8	0.3368
Right Calf Flexibility[a,b]	15.9	6.8	12.0	5.9	0.0296	15.1	5.4	10.7	5.5	0.0268
Left Calf Flexibility[a,b]	16.1	6.8	11.7	5.6	0.0140	15.1	6.1	10.1	6.3	0.0262
Right Torso Rotation[b]	70.4	11.0	71.8	9.1	0.6276	72.7	11.5	81.6	12.0	0.0357
Left Torso Rotation	65.8	10.6	69.7	11.9	0.1662	68.3	11.5	75.9	11.1	0.0689

[a]Significant difference between male Soldiers and Triathletes

[b]Significant difference between female Soldiers and Triathletes

TABLE 9
Strength

	Males					Females				
	101st		Triathletes			101st		Triathletes		
	Mean	±SD	Mean	±SD	p-value	Mean	±SD	Mean	±SD	p-value
Right Shoulder Internal Rotation (%BW)	59.64	15.54	64.30	9.67	0.2455	36.28	8.45	40.83	8.83	0.1404
Left Shoulder Internal Rotation (%BW)[a,b]	54.65	15.94	65.52	13.56	0.0094	33.97	8.14	42.99	8.18	0.0030
Right Shoulder External Rotation (%BW)[b]	42.09	8.75	46.49	6.92	0.0570	29.94	5.14	34.89	6.71	0.0124
Left Shoulder External Rotation (%BW)[a,b]	37.94	7.82	44.48	7.26	0.0014	26.99	4.62	32.71	7.45	0.0025
Right Shoulder Internal/External Strength Ratio	0.73	0.14	0.73	0.10	1.0000	0.85	0.20	0.87	0.15	0.7752
Left Shoulder Internal/External Strength Ratio	0.72	0.15	0.69	0.11	0.4448	0.82	0.17	0.76	0.10	0.3084
Right Knee Flexion (%BW)[b]	114.81	27.14	128.00	22.63	0.0648	92.98	21.05	115.47	15.44	0.0032
Left Knee Flexion (%BW)[a,b]	111.72	26.34	128.50	23.23	0.0158	88.82	20.80	113.96	14.88	0.0009
Right Knee Extension (%BW)	236.12	48.03	242.09	50.38	0.6387	191.30	37.16	216.53	21.68	0.0525
Left Knee Extension (%BW)[b]	226.02	44.56	241.31	42.89	0.1938	178.18	38.19	211.38	34.71	0.0170
Right Knee Flexion/Extension Strength Ratio[a]	0.49	0.09	0.54	0.10	0.0369	0.49	0.06	0.53	0.04	0.0585
Left Knee Flexion/Extension Strength Ratio	0.50	0.09	0.53	0.05	0.2011	0.50	0.08	0.54	0.05	0.1519
Right Ankle Inversion Strength (%BW)[a,b]	34.43	7.22	23.60	3.72	$p<0.001$	24.90	6.70	19.18	2.23	0.0141
Left Ankle Inversion Strength (%BW)[a,b]	33.21	6.86	23.15	4.76	$p<0.001$	24.08	6.16	19.01	3.23	0.0190
Right Ankle Eversion Strength (%BW)[a,b]	30.49	6.71	21.52	2.34	$p<0.001$	22.25	5.93	16.96	1.58	0.0103
Left Ankle Eversion Strength (%BW)[a,b]	30.99	6.50	21.61	3.48	$p<0.001$	22.61	6.00	18.16	4.24	0.0365
Right Ankle Inversion/Eversion Strength Ratio	1.15	0.19	1.10	0.12	0.4199	1.13	0.21	1.13	0.11	1.0000
Left Ankle Inversion/Eversion Strength Ratio	1.09	0.18	1.08	0.20	0.8342	1.08	0.20	1.08	0.22	1.0000
Right Torso Rotation Strength (%BW)	145.12	33.05	151.51	25.94	0.4607	110.49	32.89	118.53	24.59	0.4858
Left Torso Rotation Strength (%BW)	144.82	32.80	154.57	30.90	0.2596	111.62	28.02	114.85	25.74	0.7466

[a]Significant difference between male Soldiers and Triathletes

[b]Significant difference between female Soldiers and Triathletes

TABLE 10 Balance (SD)										
	Males					Females				
	101st		Triathletes			101st		Triathletes		
	Mean	±SD	Mean	±SD	p-value	Mean	±SD	Mean	±SD	p-value
Right Leg Eyes Open - Anterior/Posterior GRF	2.78	0.86	2.84	0.94	0.7938	2.02	0.55	2.32	1.22	0.2291
Left Leg Eyes Open - Anterior/Posterior GRF	2.79	1.01	3.26	1.06	0.1282	2.04	0.51	1.79	0.53	0.1828
Right Leg Eyes Open - Medial/Lateral GRF	3.44	1.16	3.88	1.52	0.1613	2.43	0.96	2.60	2.08	0.7068
Left Leg Eyes Open - Medial/Lateral GRF	3.43	1.46	4.09	1.54	0.0905	2.40	0.75	2.08	0.81	0.2481
Right Leg Eyes Open - Vertical GRF	4.65	2.19	5.26	2.14	0.2942	3.18	1.34	3.78	2.08	0.2618
Left Leg Eyes Open - Vertical GRF	4.77	2.74	5.87	2.79	0.1318	3.40	1.34	3.29	1.29	0.8203
Right Leg Eyes Closed - Anterior/Posterior GRF	6.44	2.66	6.84	2.14	0.5659	4.43	1.77	5.82	2.90	0.0552
Left Leg Eyes Closed - Anterior/Posterior GRF	6.76	3.40	7.59	4.16	0.3643	4.81	1.55	6.00	2.83	0.0699
Right Leg Eyes Closed - Medial/Lateral GRF	10.11	4.57	11.10	4.93	0.4169	6.15	2.39	7.59	6.28	0.2210
Left Leg Eyes Closed - Medial/Lateral GRF[a]	9.93	4.79	12.80	7.26	0.0295	6.98	2.41	7.92	6.40	0.4290
Right Leg Eyes Closed - Vertical GRF	14.53	12.22	13.82	6.37	0.8237	8.61	5.52	10.13	5.72	0.4517
Left Leg Eyes Closeed - Vertical GRF	14.75	11.94	18.88	14.53	0.1988	10.95	9.23	10.72	5.67	0.9428

[a]Significant difference between male Soldiers and Triathletes
[b]Significant difference between female Soldiers and Triathletes

TABLE 11 Physiology										
	Males					Females				
	101st		Triathletes			101st		Triathletes		
	Mean	±SD	Mean	±SD	p-value	Mean	±SD	Mean	±SD	p-value
Body Mass Index (BMI)[b]	23.0	2.9	23.1	2.3	0.8953	23.96	3.09	20.33	0.97	p<0.001
Body Fat %[a,b]	20.1	7.5	12.3	4.4	p<0.001	26.72	5.70	17.37	4.38	p<0.001
Peak Anaerobic Power (Watts)[b]	13.3	2.1	13.8	1.0	0.3601	9.49	1.66	11.92	1.43	p<0.001
Mean Anaerobic Power (Watts)[a,b]	7.8	1.0	9.3	0.7	p<0.001	6.13	0.75	8.37	0.80	p<0.001
VO2 Max (mL/min/kg)[a,b]	47.5	7.6	69.8	7.3	p<0.001	40.29	5.37	61.15	5.44	p<0.001
VO2 at Lactate Threshold (mL/min/kg)[a,b]	39.0	7.0	58.2	7.3	p<0.001	33.52	5.49	54.03	5.91	p<0.001
VO2 % at Lactate Theshold	81.8	10.3	83.7	8.5	0.4826	82.16	13.97	88.38	6.57	0.1968
HR Max[b]	188.6	14.2	182.7	11.3	0.1139	188.89	9.59	179.89	11.41	0.0139
HR at Lactate Threshold	169.4	15.3	167.2	12.2	0.5837	171.40	12.09	168.44	13.33	0.5057
HR % at Lactate Threshold	89.6	7.2	91.5	3.9	0.3113	90.96	5.18	93.62	3.77	0.1465

[a]Significant difference between male Soldiers and Triathletes
[b]Significant difference between female Soldiers and Triathletes

For the stop-jump task, male triathletes landed with greater hip flexion at initial contact bilaterally; less left hip abduction at initial contact; and greater left knee flexion at initial contact than male 101st Soldiers. Male 101st Soldiers had greater maximum knee flexion angle bilaterally than male triathletes. There were only two significant differences between female 101st Soldiers and female triathletes during the stop-jump task. Female triathletes landed with significantly greater knee flexion at initial contact bilaterally than female 101st Soldiers. There were no observed significant differences for either gender during the vertical drop landing.

Discussion

The purpose of this paper (Part 1 of two companion papers) was to describe the methodology and research results related to the first three steps of our injury prevention and performance optimization model. These steps included *Injury Surveillance*, *Task and Demand Analysis*, and *Predictors of Injury and Optimal Performance*. Data was presented based on self-reported injury history; quality and quantitative analysis of tasks and activities that Soldiers have to perform as part of their duties; and on musculoskeletal, physiological, and biomechanical testing in the laboratory. The injury epidemiology data revealed a history of injury that is consistent with previous studies; injuries that are primarily occurring during physical and tactical training; and injuries that are potentially preventable through interventions. The qualitative and quantitative analysis of the task and demand analyses demonstrated that a biomechanical analysis of a vertical drop landing as well as anaerobic ca-

TABLE 12 Stop-Jump Task	Males					Females				
	101st		Triathletes			101st		Triathletes		
	Mean	±SD	Mean	±SD	p-value	Mean	±SD	Mean	±SD	p-value
Right Hip Flexion at Initial Contact (Degrees)[a]	42.4	11.3	51.1	15.6	0.0049	45.9	11.7	49.6	11.7	0.3869
Left Hip Flexion at Initial Contact (Degrees)[a]	43.6	11.1	54.6	17.2	p<0.001	46.1	12.5	50.2	11.2	0.3628
Right Hip Abduction at Initial Contact (Degrees)	-3.7	4.1	-2.9	4.2	0.4637	-2.6	3.5	-2.6	3.9	1.0000
Left Hip Abduction at Initial Contact (Degrees)[a]	-3.7	4.0	-1.3	4.1	0.0248	-2.5	5.1	-5.0	3.0	0.1613
Right Knee Flexion at Initial Contct (Degrees)[b]	25.8	8.0	28.2	13.5	0.2813	26.8	7.7	33.7	7.8	0.0167
Left Knee Flexion at Initial Contct (Degrees)[a,b]	27.5	8.4	34.5	11.5	0.0024	27.4	8.2	34.9	8.2	0.0145
Right Knee Valgus/Varus at Initial Contact (Degrees)	4.6	6.3	5.9	5.3	0.4344	-1.4	5.6	-4.6	6.7	0.1318
Left Knee Valgus/Varus at Initial Contact (Degrees)	4.7	6.8	5.8	8.8	0.5498	-1.4	6.0	-2.6	3.7	0.5658
Right Knee Maximum Flexion (Degrees)[a]	92.0	14.0	77.7	18.0	p<0.001	89.4	13.4	89.6	9.6	0.9661
Left Knee Maximum Flexion (Degrees)[a]	92.1	13.9	81.6	11.1	0.0044	88.2	13.7	92.2	11.7	0.4151
Right Peak Vertical Ground Reaction Force (% BW)	205.3	56.3	208.4	47.2	0.8347	201.6	63.9	198.6	65.3	0.8978
Left Peak Vertical Ground Reaction Force (% BW)	195.7	54.3	221.3	62.0	0.0793	200.6	68.0	184.0	40.5	0.4828

[a]Significant difference between male Soldiers and Triathletes
[b]Significant difference between female Soldiers and Triathletes

pacity testing should be incorporated both in the methodology for examining *Predictors of Injury and Optimal Performance* and in the *Design and Validation of Interventions*. The laboratory testing revealed a number of significant differences across all testing categories (Range of Motion and Flexibility; Strength; Balance; Physiology; and Biomechanical variables) between the Soldiers of the 101st and the triathlete group used as comparison.

Injury Surveillance

The injury epidemiology collected on Soldiers of the 101st describes the magnitude, nature, scope, and impact of the injury problem and was the first step of our model, *Injury Surveillance*. Data was collected based on self-report surveys in which Soldiers were asked to describe the anatomical location and tissues involved in the injury; whether the injury was acute or chronic; where the injury occurred and during what activity; and what was the mechanism of injury. The results of the current study indicate the need for injury prevention measures to target common shoulder, knee, ankle, and back injuries that occur during physical and tactical training as well as sports and recreational activities. Our injury surveillance is consistent with previous, older studies that demonstrated the need for strategies and interventions to reduce unintentional musculoskeletal injury. Despite this historical evidence and efforts to mitigate unintentional musculoskeletal injury a significant need persists based on the results of the current study. All of the injuries reported in the current study are not preventable, but there are many instances where targeted intervention can successfully reduce injury (see Part II). The prevention of unintentional musculoskeletal injury also has an economic impact as each injury prevented results in a cost of care savings. Depending on the injury and the number of injuries prevented, the cost savings can be substantial and outweighs the cost associated with the prevention measures.[31]

Similar to previous studies, the results of this injury surveillance show that unintentional musculoskeletal injuries are very common. A total of 99 injuries were reported within the group of 241 Soldiers who participated in the injury sur-

TABLE 13 Vertical Drop Landing	Males					Females				
	101st		Triathletes			101st		Triathletes		
	Mean	±SD	Mean	±SD	p-value	Mean	±SD	Mean	±SD	p-value
Right Hip Flexion at Initial Contact (Degrees)	19.4	7.3	22.7	8.6	0.0943	23.6	6.7	19.5	6.6	0.0958
Left Hip Flexion at Initial Contact (Degrees)	20.7	7.5	24.1	8.2	0.0916	23.6	7.2	19.7	6.6	0.1358
Right Hip Abduction at Initial Contact (Degrees)	-3.7	3.4	-2.1	4.0	0.0816	-2.7	4.0	-2.9	2.5	0.8857
Left Hip Abduction at Initial Contact (Degrees)	-3.8	3.3	-2.8	3.9	0.2614	-3.2	3.9	-2.5	2.2	0.6042
Right Knee Flexion at Initial Contct (Degrees)	17.9	6.1	20.3	8.6	0.1515	20.1	6.4	20.3	5.0	0.9296
Left Knee Flexion at Initial Contct (Degrees)	19.7	6.3	21.4	7.5	0.3174	20.9	5.8	21.7	4.4	0.6959
Right Knee Valgus/Varus at Initial Contact (Degrees)[b]	2.8	5.0	3.4	4.9	0.6522	-0.5	4.4	-4.0	3.8	0.0292
Left Knee Valgus/Varus at Initial Contact (Degrees)	2.8	5.2	1.9	4.5	0.5133	-1.4	4.2	-2.2	2.5	0.5834
Right Knee Maximum Flexion (Degrees)	86.7	18.9	82.9	16.9	0.4483	90.5	14.0	83.7	13.2	0.1817
Left Knee Maximum Flexion (Degrees)	87.6	18.6	83.2	15.9	0.3715	89.8	13.4	87.2	12.7	0.5915
Right Peak Vertical Ground Reaction Force (% BW)	365.3	98.4	332.5	112.9	0.2158	359.2	92.3	309.1	65.7	0.1258
Left Peak Vertical Ground Reaction Force (% BW)	336.1	98.6	312.3	117.8	0.3711	337.0	85.8	297.4	84.9	0.2070

[a]Significant difference between male Soldiers and Triathletes
[b]Significant difference between female Soldiers and Triathletes

veillance survey which represents 410 injuries per 1000 person-years. In a recent study, Hauret et al.[32] used military medical surveillance data to identify injury-related musculoskeletal conditions among non-deployed, active duty service members in the year 2006, and reported the rate of injuries to be 628 injuries per 1000 person-years, which is slightly more than the self-reported rate in our study subjects. There are important methodological differences between the current study and Hauret et al. It is likely that their method of counting could have led to injuries being counted twice if the servicemember sought medical attention more than once, with a gap of more than 60 days between encounters, as is likely to happen with chronic musculoskeletal conditions. The lower rate of injuries in our study may also be because the injuries in our study were self-reported, and some Soldiers may not have reported all injuries. Interestingly, in the case of the majority of injuries, our study subjects were engaged in training or recreational activity/sports at the time of injuries. Combat was responsible for a very small proportion of the injuries. This is similar to findings from previous studies[11, 33] as more casualties have been caused among U.S. troops by non-combat injuries and disease than by combat.[34] Injuries outside of theater can limit the ability to prepare and train for deployment while injuries within theater can reduce the capacity of the individual to participate in tactical missions.

In our study, sprains and strains made up 38.4% (38/99) of all injuries; of these sprains and strains 60.5% (23/38) affected the lower extremity. According to a review of medical and personnel data for non-deployed active duty personnel for 2000–2006 by Jones et al.,[35] sprains and strains were responsible for 48.8% of injury ambulatory visits. Of the total sprains and strains, 49.8% affected the lower extremity. Even though Jones et al. counted injury ambulatory visits and our study counted injuries, the finding from these two studies highlight the relative importance of sprains and strains of the lower extremity. The high numbers of military personnel who seek outpatient care for sprains and strains highlights the need for greater attention to the prevention of these and other common unintentional musculoskeletal injuries.

Even though unintentional musculoskeletal injuries are not life-threatening, they result in pain, morbidity, loss of duty time,[11,12] increased medical costs,[12] disability,[10] medical evacuation from theater,[36] and attrition from the military.[5] All of these previous scenarios can reduce the capability and capacity of the Soldier to train and prepare for deployment and/or tactical missions while in theater. It has been estimated that the medical discharge of one active duty U.S. military member in his or her twenties costs the government approximately $250,000 in lifetime disability costs, excluding health care costs.[37,38] In the year 2005, Cohen et al., estimated that the financial cost of medically boarding one Special Operations or some other highly trained Soldier and retraining a replacement can be more than U.S. $1,000,000.[39]

Epidemiology studies often rely on self-reported data.[40-42] The advantages of using self-report are time-efficiency, easy availability and cost-effectiveness. Also, self-reported injury history can be expected to include information about all injuries that have occurred in the past, whether or not medical care was sought, and even if care was sought from a healthcare professional outside the system from which medical records were obtained. This is expected to give a complete picture of the injury history. An important limitation of self-reported injuries is problems with recall, which increase as the time period between injury occurrence and the self-report increases.[43] In our study, difficulties with recall were minimized by including only those injuries that occurred one year prior to the date of survey. Other potential limitations of self-reported injuries are that Soldiers may not report all their injuries due to the culture of stoicism in the military, and the accuracy of self-reported injuries may be influenced by the level of health knowledge of the study subject. Army medical records are currently being examined and compared to self-reported history to determine validity and correspondence between these two sources of injury surveillance data.

Task and Demand Analysis

We modified the traditional approach to injury prevention and performance optimization to address different populations, different environments, and the different needs of the study population by adding *Task and Demand Analysis*. The goal of the *Task and Demand Analysis* is to determine the specific functional needs of the population to be examined. The information gathered in this step drives the specific methodology for examining *Predictors of Injury and Optimal Performance* and is also incorporated into *Design and Validation of Interventions*. These analyses are performed in the field and include qualitative and quantitative study of tasks that the specific population has to perform as part of their daily duties.

The task analysis described was based on exiting a vehicle and includes landing forces that can potentially increase joint loading forces. The vertical component of the landing forces (vertical ground reaction force) can increase joint loading significantly as these forces are transmitted up the lower extremity kinetic chain. The individual Soldier is at potential risk for injury if he or she is unable to efficiently absorb and distribute these forces.[44] The horizontal component which is typically measured as anterior-posterior ground reaction forces in a laboratory setting is a significant predictor of proximal anterior tibia shear force,[29] the most direct loading mechanism of the anterior cruciate ligament.[45, 46] Combined, these different forces place significant demands on the individual Soldier that require sufficient strength, efficient movement patterns, and appropriate timing/activation of the muscular restraints necessary for dynamic joint stability. These demands can be compounded when carrying additional load[30] and landing on unlevel terrain. The task analysis presented in the current manuscript was the driving factor for including a simulated landing (vertical drop landing) in the laboratory testing (see *Predictors of Injury and Optimal Performance*). The investigation of this task in a controlled laboratory environment provides insight into the kinematic and kinetic characteristics necessary for maintenance of dynamic joint stability.

During the O-Course training, physiological responses were calculated for each individual run, total run time, as well as the entire 24 minute training activity. The Solider studied expended 196 kcals (~10 kcals per minute) during the entire O-course training session which is equivalent to 10 METs, requiring energy similar to activities such as walking and carrying a 50-74 pound load upstairs, swimming freestyle vigorously or running six miles per hour.[47] The O-Course is a relatively high intensity activity, where approximately 67 % of the time was spent exercising greater than or equal to 60% of VO_{2max} (moderate to high intensity), of that 32% of time was spent at power outputs greater than or equal to the anaerobic threshold. The first run was completed at a high intensity (at or above the lactate threshold) for ~62% of the run; however, during the second run the ability to achieve and sustain a high intensity power output dropped to approximately ~11% and run time increased by 2 minutes and 20 seconds. Further, the subjects heart rate did not return to baseline between runs and both average and peak heart rate were higher during the second run. The performance decrement observed in the second run may be the result of inadequate adaptations of the aerobic energy system to buffer and clear lactate and to facilitate recovery during multiple bouts of high intensity exercise. Activities performed above the lactate threshold rely predominantly on anaerobic metabolism, including the phosphagen and glycolysis energy systems. These energy pathways utilized phosphocreatine and glucose (carbohydrate) exclusively to resupply ATP for muscle contraction. Training at intensities below the lactate threshold rely predominantly on aerobic metabolism and thus the remainder of time during the O-course the Soldier relied on a combination of carbohydrate and fat to supply to fuel muscle contraction. Thus, it appears that both anaerobic and aerobic energy systems are important for meeting the demands of the O-Course training. Knowing the metabolic and physiologic demands enables physical training programs and feeding strategies to be developed that adapt and fuel the muscles to optimally perform and expedite recovery between bouts of strenuous exercise. Additionally, all of the observations and measurements made across all of the task and demand analyses performed facilitated the design of both the methodology and protocols utilized in *Predictors of Injury and Optimal Performance* and the training strategies to be employed in the *Design and Validation of Intervention.* There are some limitations to this approach. First, the tasks analyzed must be specific to the population studied and specific to the tasks performed by the individuals within that population, otherwise these analyses may not applicable and their usefulness in protocol and intervention design would be diminished. Second, these analyses do not take into account the cognitive aspects of the tasks analyzed. Unfortunately, the analyses of the cognitive aspects of functional tasks do not provide the objective measures necessary to drive protocol and intervention development.

Predictors of Injury and Optimal Performance

The goal of the laboratory testing of Soldiers is to identify *Predictors of Injury and Optimal Performance*. The specific laboratory tests included in this study were based on the task and demand analyses performed on Soldiers of the 101st. The current study is a descriptive comparison of Soldiers of the 101st compared to triathletes. The data presented is part of a larger ongoing study in which each of the Soldiers are enrolled in a prospective study during which injuries will be tracked in order to match the neuromuscular, biomechanical, physiological, and nutritional characteristics to risk of injury. The comparisons performed in the current manuscript between Soldiers of the 101st and triathletes demonstrated numerous, significant differences across many of the testing variables. Although these comparisons are descriptive and retrospective in nature, they do reveal the need for a revision of current training regimes in order to prevent injury and optimize performance. Examples can be found for both injury prevention and performance optimization for both genders and across all of the testing areas (range of motion, flexibility, strength, balance, physiology, and biomechanics).

Range of motion (ROM) and flexibility has traditionally been the target of physical training programs in order to decrease the risk of injury. The comparisons between groups in the current study revealed significant differences across many of the variables. For some of the variables, the Soldiers of the 101st (both genders) demonstrated better ROM/flexibility than the triathletes, but there were a few instances where the Soldiers demonstrated decreased flexibility. For example, both genders within the 101st group demonstrated significantly higher (represented by lower scores) posterior shoulder tightness than the triathletes. Tightness of the posterior capsule of the shoulder has been implicated as a contributor to abnormal kinematics of the scapula and shoulder impingement.[48, 49] Correction of this tightness utilizing stretching and mobilization has been demonstrated to be capable of resolving symptoms observed in individuals diagnosed with internal shoulder impingement.[50]

Measurement of strength characteristics provides insight into both injury prevention and performance optimization. Our previous research has demonstrated that athletes who perform at elite levels typically have developed greater strength than those athletes who perform at recreational levels and that strength is significantly correlated to performance.[23] Additionally, our research examining female athletes who are at greater risk for ACL injury demonstrate decreased quadriceps and hamstrings strength compared to male athletes.[51] Other individuals have demonstrated that inadequate agonist/antagonist strength ratios (quadriceps/hamstrings) can predict both ligamentous injury[52] and muscular injury such as hamstring strains.[53-55] In the current study, the 101st Soldiers (both males and females) had lower knee flexor, knee extensor, and flexion/extension strength ratios compared to the triathletes, all of which may indicate a propensity for injury. The analysis utilized in the current study was based on a comparison of means which may not be as important as a subject by subject examination of data. Within each variable data set there are individuals who had very low strength values compared to both the mean of the triathletes and also the mean of the 101st Soldiers. For instance, 17% of the male Soldiers and 19% of the female Soldiers had hamstring strength values that were lower than one standard deviation below the respective means of the male and female triathletes. These individuals will particularly benefit from an intervention program as they theoretically may have greater potential for improvement.

Overall, there were no significant differences in balance between Soldiers of the 101st and the triathletes. Balance testing has been previously utilized to examine risk of injury and or potential risk of injury.[56-62] Although the mean of the Soldiers tested is not significantly different than those triathletes tested, there remains a subgroup of Soldiers who may be at greater risk for injury. A systematic review of studies examining the relationship between ankle injuries and balance demonstrated that poor balance is associated with lateral ankle sprains.[63] Those individuals with the lowest balance scores were more likely to suffer an ankle injury than those with the best scores. Although methodological differences exist between the previous studies and the current manuscript, with prospective data it will be possible to set a criterion below which an individual would be at greater risk for injury. It is more than likely that with such a large group of individual tested in the current study, there are individuals who will suffer ankle injuries and likely their scores on the balance test would reveal this potential risk. For example, McGuine et al., examined, prospectively, 210 individuals balance and demonstrated that the 23 individuals who suffered an ankle sprain had balance scores that were 15% worse than the mean.[64] Willems et al., performed a similar study that demonstrated that the 44 individuals (out of 241) who suffered an ankle sprain had balance scores that were 24% worse than the mean.[65] Within the current study's Soldier group, 23% (61/266) of the males and 20% (10/51) of the females were worse than 15% of the mean and 19% (51/266) of the males and 14% (7/51) of the females who were worse than 25% of the mean (eyes open balance test).

The majority of physiological comparisons revealed that the triathletes had greater aerobic and anaerobic capacity as well as less body fat than the 101st Soldiers. Without appropriate context it is difficult to determine the clinical relevance of these results for the 101st Soldiers, but overall, the results do reveal a need to revise current training activities in order to optimize these physiological systems and characteristics to meet the demands placed on the individual Soldier. Our *Task and Demand Analysis* step provides the bridge between the physiological and physical demands of 101st Soldiers and the physical training necessary to meet those demands. For example, the data presented for the *Task and Demand Analysis* section in the current manuscript demonstrated the need for anaerobic training based on the Soldier's reliance on the anaerobic energy system as a significant contributor to the muscle fuel requirements during the O-Course training.

Although there were no significant differences in the biomechanical characteristics between the 101st Soldiers and the triathletes, a more careful examination of the data indicates that the Soldiers may display characteristics that could predispose them to injury. Prospective studies have demonstrated that landing with high vertical ground reaction forces and with a large knee valgus angle predict knee ligament injury.[58] Additionally, although not demonstrated prospectively, landing with a low flexion angle can increase anterior cruciate ligament strain significantly.[46, 67-70] Both male and female Soldiers had a subset of individuals who landed with a knee valgus angle greater than five degrees, which has been identified as a predictor of anterior cruciate ligament (ACL) injury.[66] Additionally, the mean values for peak vertical ground reaction force in the Soldiers (both genders) was approximately 365% body weight which is much higher than those values observed in a group of athletes who suffered ACL ruptures (210% body weight).[44] Finally, the knee flexion angle at landing in the male Soldiers was less than 20 degrees which can increase strain considerably in the ACL compared to greater knee flexion angles.[46, 67-70] The comparisons above are limited based on slightly different protocols between the current study and the referenced studies. They only indicate the potential for injury and not necessarily risk for injury. Regardless, it demonstrates that there are Soldiers who demonstrate potentially injurious biomechanical characteristics during tasks when knee injuries occur that indicate the need for training activities that target modification of motion patterns and strength. This potential for injury may be exacerbated while wearing body armor as our previous study has demonstrated that the addition of body armor significantly increases ground reaction forces and landing kinematics.[30]

In summary the laboratory data collected including the comparisons to the *Task and Demand Analysis* data and the comparisons to triathletes provides the part of the framework for the design of the intervention. Triathletes were used as a comparison for the current manuscript, but other groups of athletes (hockey, football, soccer, and basketball) have also been tested in order to benchmark the 101st Soldiers to individuals who have optimized different physical characteristics. For example, the group of triathletes in the current study have all competed in accredited full-length triathlons and have qualified (age group) for world championship events. Presumably, this group of athletes has optimized aerobic conditioning as well as anaerobic capacity. Depending on the target study group, Soldiers of the 101st in the current manuscript, this data can serve as a benchmark for specificity of training. Other groups of athletes can serve a similar purpose related to other characteristics. Although the laboratory tests utilized in the current study may not be functional tasks that Soldiers perform, we contend that the characteristics (strength, aerobic capacity, anaerobic capacity, balance, and flexibility) measured describe the underlying components/processes necessary for the performance of functional tasks of the Soldier. Therefore, improvements in these characteristics should provide the foundation for improvements in functional tasks of the Soldier. The injury data (currently being tracked and part of the ongoing investigation) combined with the prospective testing of Soldiers will also dictate specific activities for the intervention. One potential limitation for the comparison group in the current study is the age of the triathletes. The mean age of the triathletes was approximately seven years older than the Soldiers mean age. This difference in age may confound the comparisons and subsequent results. Age was not controlled in the current manuscript due to the low subject numbers in the triathlete group. Other potential confounding were also not controlled (nutrition, tobacco use, sleep (quality and amount), and supplementation and may warrant further investigation

Conclusions

Unintentional musculoskeletal injuries are preventable with scientifically driven and culturally-specific interventions. Our approach is based on a conventional public health model of injury prevention. The model of research described in the current paper and Part II of these companion papers describes a specific application to the 101st Airborne Division (Air Assault). This model, by design, can be implemented in any population of military personnel, including Special Operations Forces. It may be particularly suited to application in Special Operations Forces due to the elite athlete benchmarking and the ability to individualize to the specific needs of each Operator. Through *Injury Surveillance*, we have demonstrated that Soldiers of the 101st continue to suffer common and preventable injuries during physical training, tactical training, sports, and recreational activities. Our *Task and Demand Analysis*, which is the hallmark of our comprehensive approach, drives the specificity of the testing methodology and contributes to the *Design and Validation of Interventions*. The task and demand analyses performed for this study demonstrated the need to test multiple flexibility, range of motion, strength, physiological, and biomechanical variables in order to determine risk factors for injury. The data analysis identified a number of characteristics of 101st Soldiers that should be targeted with specific physical training. Part II of these companion papers outlines the *Design and Validation of Interventions* for the 101st, the process of *Program Integration and Implementation*, and the methods to *Monitor and Determine the Effectiveness of the Program*.

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Warrior Model for Human Performance and Injury Prevention: Eagle Tactical Athlete Program (ETAP) Part II

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Abstract

Introduction: Physical training for United States military personnel requires a combination of injury prevention and performance optimization to counter unintentional musculoskeletal injuries and maximize warrior capabilities. Determining the most effective activities and tasks to meet these goals requires a systematic, research-based approach that is population specific based on the tasks and demands of the Warrior. **Objective**: The authors have modified the traditional approach to injury prevention to implement a comprehensive injury prevention and performance optimization research program with the 101st Airborne Division (Air Assault) at Fort Campbell, KY. This is second of two companion papers and presents the last three steps of the research model and includes *Design and Validation of the Interventions, Program Integration and Implementation, and Monitor and Determine the Effectiveness of the Program*. **Methods**: An 8-week trial was performed to validate the Eagle Tactical Athlete Program (ETAP) to improve modifiable suboptimal characteristics identified in Part I. The experimental group participated in ETAP under the direction of a ETAP Strength and Conditioning Specialist while the control group performed the current physical training at Fort Campbell under the direction of a Physical Training Leader and as governed by FM 21-20 for the 8-week study period. **Results**: Soldiers performing ETAP demonstrated improvements in several tests for strength, flexibility, performance, physiology, and the APFT compared to current physical training performed at Fort Campbell. **Conclusions**: ETAP was proven valid to improve certain suboptimal characteristics within the 8-week trial as compared to the current training performed at Fort Campbell. ETAP has long-term implications and with expected greater improvements when implemented into a Division pre-deployment cycle of 10-12 months which will result in further systemic adaptations for each variable.

Introduction

This paper is the second of two companion papers detailing the systematic and data driven injury prevention and performance optimization training program (Eagle Tactical Athlete Program- ETAP) to reduce the risk of unintentional musculoskeletal injuries and improve physical readiness in Soldiers of the 101st Airborne Division (Air Assault). This six step injury prevention and performance model was developed based on the conventional public health approach to injury prevention and control[1-3] and was modified to include *Task and Demand Analysis*. The first three steps of the model were detailed in Warrior Model for Injury Prevention and Human Performance: Eagle Tactical Athlete Program (ETAP) – Part I and included *Injury Surveillance*, *Task and Demand Analysis*, and *Predictors of Injury and Optimal Performance*. The current paper describes the last three steps of the model and includes *Design and Validation of the Interventions, Program Integration and Implementation, and Monitor and Determine the Effectiveness of the Program*.

At the initiation of this research with 101st Airborne Division (Air Assault), the standard physical training guideline used at Fort Campbell was Field Manual (FM) 21-20, published by the Department of the Army.[4] Although this manual covers the fundamental principles of cardiovascular fitness, body composition, muscular endurance, strength, and flexibility, anecdotal reports suggest daily physical training still emphasizes training for performance on the Army Physical Fitness Test (APFT): push-ups, sit-ups, and two-mile run. This assessment encompasses few of the characteristics critical to achieve optimal physical readiness and performance, or reduce injury risk.[5] Unfortunate consequences of such isolated training increase the risk of certain musculoskeletal injuries.[6]

Several military and civilian based training programs have been developed and/or marketed as training programs specific to U.S. Army Soldiers.[7-9] Common to these programs is the concept of treating the Soldier as a "tactical athlete." Consequently, these physical training programs are similar to strength and conditioning programs developed for athletes at the university and/or professional level, incorporating aerobic and anaerobic components as well as muscular strength, endurance, and agility. While a few programs have been based on predictors of injury and optimal performance,[10] none of the programs were developed based on injury surveillance of military populations in which the program was implemented or the physiologic, musculoskeletal, and biomechanical demands associated with military-specific training and tactical operations. Many of the programs target individual Soldiers rather than units, potentially making it difficult to implement the program on a larger scale.[7-9] Additionally, few studies have designed and validated an intervention program using Soldiers in regular Army combat units, whose training schedule is largely influenced by deployment cycles and their associated preparatory activities. Only a few of these training programs have been evaluated to determine if the risk of injury is reduced while maintaining or improving physical performance, including the APFT.[11] Consistent with the public health approach to injury prevention and control,[1-3] it is imperative to monitor and determine the effectiveness of these training interventions to reduce injury and optimize performance.

The purpose of this paper is to describe the last three steps of the research model- *Design and Validation of the Interventions, Program Integration and Implementation, and Monitor and Determine the Effectiveness of the Program*,. It was hypothesized that performance of ETAP would result in favorable adaptations to laboratory, field, and APFT performance compared to the current training performed at Fort Campbell as governed by FM 21-20.

Design and Validation of Interventions

<u>Methods</u>

Subjects

A sample of 60 male and female Soldiers from the 101st Airborne Division (Air Assault) were recruited from a single Brigade through posted advertisements and information sessions arranged by the investigators. All subjects were cleared for active duty without any injury profile prescribed throughout the study period or within the three months prior to enrollment. Subjects were matched on age, gender, and two-mile run time from their last APFT and then one member of each pair was randomly assigned to either an experimental group- ETAP (N: 30, Age: 24.6 ± 5.2 years, Height: 168.5 ± 24.5cm, Mass: 68.3 ± 3.3kg) or control group- current PT (N: 30, Age: 25.1 ± 5.8 years, Height: 168.5 ± 25.5cm, Mass: 69.1 ± 3.3kg). Human subject protection for the current study was approved by the University of Pittsburgh, Dwight D. Eisenhower Army Medical Center, Army Clinical Investigation Regulatory Office, and Army Human Research Protection Office. All tests were conducted at the Human Performance Research Center, Fort Campbell, KY, a remote research facility operated by the Neuromuscular Research Laboratory, University of Pittsburgh.

ETAP Overview

ETAP is a cyclic program which allows for modifications to the individual training cycles according to unit schedules and missions. When implemented, each cycle is separated by one to two weeks of tapered activity to ensure proper recovery and to reduce the risk of overtraining. Each cycle is designed to build upon the previous cycle and varies in intensity and duration. ETAP is designed for implementation with little to no equipment and can be easily executed in garrison or while deployed. Overall volume, intensity, rest, and distance varies across the phases: phase I focuses on general adaptation and introduction to the exercises; phase II focuses on gradual increase in volume; phase III focuses on gradual increase in intensity with less volume, and phase IV focuses on taper prior to the post-test, deployment, or cycle reset. The program consisted of five main workout sessions per week over eight weeks, each with a specific fitness component focus (Table 1). Each workout session began with a dynamic warm-up and finished with a cool-down and static stretching. Each session was dedicated to one of the following training objectives: Day-1) speed, agility, and balance; Day-2) muscular strength; Day-3) interval training; Day-4) power development; and Day-5) endurance training. The total workout duration for each daily physical training session was consistent with the guidelines published in FM 21-20 and as instructed at Fort Campbell.

The Day-1 workout session was designed to improve anaerobic power and capacity (which were identified as suboptimal during *Predictors of Injury and Optimal Performance*) and incorporated speed and agility exercises. Interval training with approximately a 1:3 or 1:2 work to rest ratio was incorporated for anaerobic system enhancement. Activities included shuttle runs, sprints, lateral movement drills, and agility drills. Shuttle runs and sprints used a funnel design, with the volume (total distance) progressing from high (274 meters (m)) to low (27 m) which dictated that the intensity progresses from low to high. Sprint training has been reported to induce neural adaptations, specifically increased nerve conduction velocity and motor-neuron excitability.[12] Agility and lateral movement (line, cone, and ladder) drills progressed from simple patterns with shorter duration, distance, or volume to more complex patterns with longer duration, distance, or volume. Agility drills included line, cone, ladder drills, and advance shuttle and combined skills activities.

The Day-2 workout session was designed to improve muscular strength and muscular endurance, with the focus of increasing total body muscular strength. Strength training consisted primarily of resistance exercises that required no to a minimal amount of equipment and therefore

TABLE 1 **ETAP Design/Overview**

DAY 1: Anaerobic Conditioning Shuttle runs, sprints, lateral movement, and agility Shuttle runs and sprints use a funnel design through an eight week cycle. The longest distance (274 m) will be performed early progressing to the shortest (27 m) distance. The volume (total distance) progresses from high to low which dictates that the intensity must progress accordingly, from relatively low to high. Agility and lateral movement drills will progress from simple patterns and shorter duration or distance to more complex patterns and longer duration or distance.	DAY 2: Resistance I Strength training consist of performing exercises using no equipment to a minimal amount of equipment, that can be executed anywhere. The goal is to increase total body muscular strength. The workouts are balanced for total body development; front/back, left/right, and top/bottom.
DAY3: Aerobic Intervals/Balance drills Aerobic intervals include running distances ranging from 800 – 1200 meters, individual dependent, for time followed by active or passive recovery. Interval run time goals is from 3:30 – 5:00 minutes. The number of aerobic intervals progresses from 3 – 5 depending on group and program length. Interval running recovery duration will progress from a longer to shorter time period, initially a 1:1 work to rest ratio. Static and dynamic balance drills are performed with eyes open and eyes closed. Progression is dependent on group ability.	DAY 4: Resistance II Builds on Day 2, Resistance I workout. Strength training consist of performing exercises using no equipment to a minimal amount of equipment, that can be executed anywhere. Includes basic resistance training exercises along with upper and lower body plyometric exercises. The goal is to improve muscular strength and power.
DAY 5: Aerobic Conditioning Distance runs and foot marches are performed. Runs and foot marches can be executed in formation or in ability groups. The goal is to increase VO_{2max} and foot march efficiency and progresses from shorter to longer distances.	

could be executed anywhere. Equipment employed included the following: Interceptor Body Armor (IBA), body weight, sandbags, partner resistance, resistance tubing, and dumbbells. Exercise intensity, volume and rest were prescribed according to a recommendation by the American College of Sports Medicine[13] and the volume was manipulated throughout the cycle by altering the duration the exercises were performed. The workout session incorporated full body strength training to ensure a well balanced program and exercises were selected specifically to address muscle weaknesses and/or imbalances as identified during *Predictors of Injury and Optimal Performance*. Targeted muscles included hip adductor/abductor, hamstrings, the rotator cuff and trunk rotators.

The Day-3 workout session was designed to improve aerobic capacity through interval runs.[14, 15] The distance for the interval run ranged from 800-1200m, with the interval run lasting between four to five minutes and performed at or near VO_{2max}. Running faster than VO_{2max} pace does not necessarily produce a greater aerobic benefit; therefore, the interval distance was carefully monitored and adjusted individually.[16] Initially subjects were assigned to one of three interval distances based on APFT two-mile run times (≤ 15:00, 1200m; 15:01 - 17:59, 1000 m; ≥ 18:00, 800m). When a subject consistently finished the interval run in less than four minutes or greater than five minutes, then he/she was moved into a longer or shorter distance group, respectively. Prior to the workout, each Soldier was given an individualized goal time to complete the interval runs, based on the average time for his/her interval runs from the previous week. The work to rest ratio was designed to be close to 1:1, but varied by individual due to group size and individual finishing times. Early in the eight-week cycle, the rest time was slightly higher than the work time. As the cycle progressed, the rest time decreased slightly (with a minimum of 4:30 minutes). Also, the cycle began with two to three intervals with five minutes of rest/recovery and gradually progressed to four to five intervals with 4.5 minutes of rest/recovery. Static and dynamic balance drills also were performed at the completion of this workout. Several variation of one leg balance drills with eyes open and eyes closed were also performed.

The Day-4 workout session was designed to improve muscular strength and explosive power. This session built on the main workout session from Day-2. As with Day-2, the volume was manipulated throughout the cycle by altering the time that the exercises were performed. During the first four weeks of the cycle, circuit training which incorporated full body exercises along with upper and lower body plyometric exercises was performed. During weeks five and seven, the IBA was worn during the circuit, with no IBA during weeks six and eight to allow for rest/recovery. Proper landing technique was taught and landing drills executed to decrease ground reaction forces, which were identified in the companion paper as suboptimal. Intensity and volume of plyometric exercises were carefully monitored and introduced according to safety recommendations.[17, 18] Lower body plyometric exercises have been shown to reduce GRF due to a strength increase in the hamstring muscles accompanied by an improvement in the flexion/extension ratio.[19-22] Teaching and utilizing proper landing techniques also reduces the impact forces, therefore decreasing the risk of injury.[23] Training volume for lower body plyometric exercise was limited to 40-60 landings (4-6 exercises) per session and the jump intensity was limited to vertical jumps, tuck jumps, lateral and front-to-back line and cone hops/jumps, jumping rope, five dot drill and small box drills and landings. Upper body plyometric activities included APFT speed pushups, clapping pushups, and a variety of medicine ball exercises.

The Day-5 workout session was designed to improve aerobic endurance. Distance runs and foot marches were performed on alternate weeks. The goal was to increase aerobic capacity (VO_{2max}) and foot march efficiency and therefore progressed from shorter to longer distances. For the foot march, the minimum pace was set at three miles per hour (20 min/mile) as per Fort Campbell standards. The initial distance was three miles and was increased by a half mile each march. Additionally, the load carried was gradually increased as follows: no load, IBA/Advance Combat Helmet (ACH), IBA/ACH with a 6.8 kg rucksack, and IBA/ACH with a 11.4 kg rucksack. Distance runs began with two to three miles at a steady pace and gradually progressed up to six miles.

Experimental Design

A pretest/post test randomized controlled design was used for this study. All subjects reported to the Human Performance Research Center for pre- and post-intervention testing. The experimental group participated in ETAP under the direction of an ETAP Strength and Conditioning Specialist while the control group performed current physical training at Fort Campbell as governed by FM 21-20 for the eight-week study period under the direction of the groups Physical Training Leader. Subjects reported each morning, Monday through Friday, at the regularly scheduled physical training time, for eight weeks. The ETAP Strength and Conditioning Specialist and Physical Training Leader were solely responsible for instructing physical training and were not involved with the data collection procedures.

Table 2
Pre- and Post-Static/Dynamic Balance (Mean ± SD)
101st Airborne Division (Air Assault)

	Exp - Pre	Exp - Post	Control - Pre	Control - Post
A/P EO (NM)	2.5 ± 0.6	2.3 ± 0.5	2.5 ± 0.6	2.5 ± 0.8
M/L EO (NM)	3.0 ± 1.0	2.9 ± 0.8	3.2 ± 0.8	3.4 ± 1.1
V EO (NM)†	4.3 ± 1.7	4.1 ± 1.6	4.5 ± 1.7	4.6 ± 2.2
A/P EC (NM)†	6.7 ± 3.5	5.1 ± 1.5	7.0 ± 3.6	6.2 ± 2.1
M/L EC (NM)†	9.5 ± 3.8	7.8 ± 2.1	10.1 ± 3.7	9.5 ± 3.1
VEC (NM)	14.2 ± 10.1	10.3 ± 4.0	15.2 ± 11.2	12.7 ± 5.6
MLSI (NM)	0.03 ± 0.01	0.03 ± 0.01	0.03 ± 0.01	0.03 ± 0.01
APSI (NM)	0.15 ± 0.01	0.15 ± 0.01	0.15 ± 0.01	0.15 ± 0.01
VSI (NM)†	0.38 ± 0.04	0.36 ± 0.04	0.38 ± 0.05	0.37 ± 0.05
DPSI (NM)†	0.41 ± 0.04	0.39 ± 0.04	0.41 ± 0.04	0.40 ± 0.05

*Significant pre/post intervention between group differences ($p < 0.05$)
†Significant pre/post intervention experimental group differences ($p < 0.05$)
#Significant pre/post intervention control group differences ($p < 0.05$)

Laboratory Testing

The laboratory testing procedures used to evaluate the effectiveness of ETAP to modify biomechanical, musculoskeletal, and physiological characteristics were identical to those described in *Predictors of Injury and Optimal Performance* of Warrior Model for Injury Prevention and Human Performance: Eagle Tactical Athlete Program (ETAP) – Part I. For the sake of brevity and repetitiveness any protocol deviations from the companion paper and related variables are described below.

A low back and hamstring flexibility protocol was assessed with the Novel Products Acuflex® I Sit and Reach Box (Rockton, IL). With shoes removed, the subject sat on the floor with the knees straight and feet flat against the box. The subject placed one hand on top of the other with the fingers aligned and then reached out as far as possible without jerking or bouncing while ensuring the hands stayed in proper position and paused momentarily for measurement. The average of three trials was recorded.

Field Testing

Maximum vertical jump height was determined using the Vertec (Questtek Corp, Northridge, CA). Standing reach was obtained and recorded by having the subject stand directly under the Vertec and extend the dominant arm and hand to gently touch the highest vane possible. Each subject performed a standing countermovement jump for maximum height, reaching the highest vane on the Vertec. Vertical jump was obtained by determining the difference of the maximum jump height and standing reach. A 30-60 second (s) rest was provided between trials. The average of three trials was recorded.

The standing broad jump was measured as the subject performed a countermovement and a two legged forward jump for maximal distance (standing broad jump). Subject's arms were free to move throughout performance of the standing broad jump. Subjects were allotted approximately 30-60 s rest between trials. Distance was measured between the starting position and the most posterior heel-ground contact without the subject falling. The average of three trials was recorded.

The agility task was performed as the subject started in a two point stance straddling the middle cone of three cones, each separated by 4.6m. The subject sprinted (either direction) to the adjacent cone, touched the line with the outside hand and changed direction (ensuring not to pivot all the way around), sprinting past the middle cone to the far cone. The subject touched the line with the outside hand, changed direction, and sprinted past the middle cone, which was the finish line. The time to complete the drill was averaged across three trials. Subjects were allotted approximately 30-60 s rest between trials.

The shuttle run was performed in a straight line between two

Table 3
Pre- and Post-Flexibility (Mean ± SD)

	101st Airborne Division (Air Assault)			
	Exp - Pre	Exp - Post	Control - Pre	Control - Post
Active Knee Extension (deg)*#	21.6 ± 8.1	20.7 ± 8.8	24.4 ± 8.6	28.5 ± 9.2
Ankle Plantarflexion (deg)	54.4 ± 7.5	51.5 ± 8.3	55.6 ± 5.7	52.5 ± 5.5
Ankle Dorsiflexion (deg)*†	9.2 ± 6.0	10.7 ± 4.7	10.6 ± 5.0	9.5 ± 4.7
Low Back/Hamstring (cm)*†	17.2 ± 2.7	18.6 ± 2.4	15.6 ± 4.1	15.6 ± 4.0
Torso Rotation (deg)*†#	68.7 ± 11.7	77.6 ± 12.4	72.3 ± 7.7	68.2 ± 7.9

*Significant pre/post intervention between group differences ($p < 0.05$)
†Significant pre/post intervention experimental group differences ($p < 0.05$)
#Significant pre/post intervention control group differences ($p < 0.05$)

Table 4
Pre- and Post-Strength (Mean ± SD)

	101st Airborne Division (Air Assault)			
	Exp - Pre	Exp - Post	Control - Pre	Control - Post
Knee Flex (%BW)†	119.1 ± 29.3	128.0 ± 29.5	118.1 ± 25.4	122.6 ± 19.5
Knee Ext (%BW)*†#	236.0 ± 48.9	244.1 ± 42.3	243.3 ± 50.6	223.4 ± 31.8
Knee Flex/Ext Ratio	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.6 ± 0.1
Shoulder Int Rot (%BW)	54.0 ± 15.1	53.0 ± 16.0	53.4 ± 12.7	52.8 ± 9.9
Shoulder Ext Rot (%BW)	42.4 ± 9.1	38.1 ± 7.3	42.3 ± 7.7	39.8 ± 6.1
Shoulder ER/IR Rot Ratio	1.3 ± 0.3	1.4 ± 0.4	1.3 ± 0.2	1.3 ± 0.2
Torso Rotation (%BW)*†	128.5 ± 33.5	137.6 ± 27.4	137.7 ± 26.8	136.9 ± 30.5

*Significant pre/post intervention between group differences ($p < 0.05$)
†Significant pre/post intervention experimental group differences ($p < 0.05$)
#Significant pre/post intervention control group differences ($p < 0.05$)

Table 5
Pre- and Post-Physiology (Mean ± SD)

	101st Airborne Division (Air Assault)			
	Exp - Pre	Exp - Post	Control - Pre	Control - Post
Body Fat (%BF)	19.0 ± 7.5	18.9 ± 7.9	18.7 ± 7.3	19.3 ± 7.1
Anaerobic Power (W/kg)*†#	11.9 ± 2.3	14.0 ± 2.4	11.7 ± 2.2	12.7 ± 2.2
Anaerobic Capacity (W/kg)†#	7.5 ± 1.2	8.1 ± 1.0	7.2 ± 1.3	7.6 ± 1.0

*Significant pre/post intervention between group differences ($p < 0.05$)
†Significant pre/post intervention experimental group differences ($p < 0.05$)
#Significant pre/post intervention control group differences ($p < 0.05$)

Table 6
Pre- and Post-Field Tests (Mean ± SD)

	101st Airborne Division (Air Assault)											
	Exp - Pre			Exp - Post			Control - Pre			Control - Post		
Vertical Jump (cm)*†#	54.4	±	11.9	56.6	±	11.7	55.6	±	10.2	56.6	±	10.4
Horizontal Jump (cm)†#	194.1	±	33.3	201.9	±	32.8	192.0	±	27.4	197.1	±	29.7
Pro Agility (s)*†	5.4	±	0.5	5.3	±	0.4	5.4	±	0.5	5.4	±	0.4
Shuttle Run (s)*†	69.2	±	6.2	66.8	±	6.3	71.0	±	8.0	71.3	±	8.5

*Significant pre/post intervention between group differences ($p < 0.05$)
†Significant pre/post intervention experimental group differences ($p < 0.05$)
#Significant pre/post intervention control group differences ($p < 0.05$)

Table 7
Pre- and Post-APFT (Mean ± SD)

	101st Airborne Division (Air Assault)											
	Exp - Pre			Exp - Post			Control - Pre			Control - Post		
Pushup (reps)	51.7	±	13.0	53.3	±	9.0	53.6	±	13.9	54.4	±	12.3
Situp (reps)*†#	58.9	±	13.3	68.0	±	10.0	58.6	±	8.6	62.5	±	9.8
2 Mile (min)*†#	16.6	±	2.4	15.4	±	2.0	16.6	±	2.6	16.0	±	2.0

*Significant pre/post intervention between group differences ($p < 0.05$)
†Significant pre/post intervention experimental group differences ($p < 0.05$)
#Significant pre/post intervention control group differences ($p < 0.05$)

Table 8
Pre- and Post-Biomechanics (Mean ± SD)

	101st Airborne Division (Air Assault)											
	Exp - Pre			Exp - Post			Control - Pre			Control - Post		
HipFlexIC (°)	39.7	±	11.5	41.6	±	11.7	40.3	±	10.0	42.2	±	9.9
HipAbdIC (°)	-5.1	±	3.5	-4.3	±	3.8	-4.4	±	3.8	-4.6	±	3.4
KneeFlexIC (°)	24.3	±	8.2	25.1	±	7.5	23.4	±	8.3	24.7	±	7.7
KneeVVIC (°)	3.2	±	5.0	2.9	±	4.8	4.1	±	6.6	1.5	±	5.7
KneeFlexMax (°)	89.0	±	12.0	87.9	±	10.5	85.4	±	14.3	86.4	±	9.7
PeakvGRF (%BW)	209.9	±	49.0	197.0	±	48.1	254.7	±	71.2	232.3	±	60.6
AnkleFlexIC (°)	-7.1	±	14.2	-5.4	±	14.9	-5.9	±	16.1	-7.2	±	15.6
AnkleFlexMax (°)	26.2	±	5.7	25.3	±	5.0	25.9	±	5.1	25.2	±	4.1

*Significant pre/post intervention between group differences ($p < 0.05$)
†Significant pre/post intervention experimental group differences ($p < 0.05$)
#Significant pre/post intervention control group differences ($p < 0.05$)

FIGURE 1

ETAP ICS CURRICULUM

Day 1	
0930 - 0945	Introduction to ETAP ICS
0945 - 1000	Paperwork: Informed Consent
1000 - 1130	ETAP Day 1 Workout
	· Anaerobic intervals
	· Energy pathways
	· Cone drills
1130 - 1300	Lunch break
1300 - 1330	Introduction to ETAP Basic exercise physiology presentation
1330 - 1345	Dynamic warm up: Classroom presentation
1355 - 1405	Static stretching: Classroom presentation
1405 - 1415	Break
1415 - 1425	Dynamic warm up: Practice and corrections in gym
1425 - 1450	Anaerobic conditioning: Classroom presentation
1450 - 1515	Agility, balance, & coordination: Walkthrough/Interactive presenation in gym
1515 - 1530	Agility ladder drills: Practice and setup

Day 2	
0930 - 0945	Performance testing information: Classroom brief
0945 - 0950	Transition to gym for Day 2 workout
0950 - 1120	ETAP Day 2 Workout
	· Full body resistance training day
1120 - 1130	Question and Answer period
1130 - 1300	Lunch break
1330 - 1430	Nutrition for athletes: Classroom presentation
	· Basic nutrition concepts
	· Sports nutrition concepts
	· Weight control information
	· Supplements: Use of and cautions
1430 - 1440	Break
1440 - 1520	Resistance I/Strength Training: Classroom presentation
	· Principles/guidelines and proper techniques
	· Muscle contraction
	· Partner resisted exercise
	· Alternative forms of resistance
	· Alternative forms of workouts
	· Workout considerations
1520 - 1525	Aerobics intervals (Day 3 Preview): Classroom
1525 - 1530	Question and Answer period

Day 3	
0930 - 1100	ETAP Day 3 Workout
	· Aerobic intervals
	· Static balance drills
1100 - 1120	Balance drills discussion: Static and dynamic
1120 - 1130	Question and Answer period
1130 - 1300	Lunch break
1300 - 1400	Aerobic intervals/interval running: Classroom presentation
	· Interval running concepts
	· Energy pathways
	· VO2max and LT concepts/theories
	· LT improvement concepts
	· Measuring intensity: RPE & heartrate
	· Using heartrate monitors and software
	· Field measures of aerobic
1400 - 1410	Discussin & interpreting heartrate graphs
1410 - 1420	Break
1420 - 1510	Partner resisted exercise: Practice in gym
1510 - 1520	Proper squat technique: Discussion and practice
1520 - 1530	Question and Answer period

Day 4	
0930 - 1110	ETAP Day 4 Workout
	· IBA Workout
	· Medicine ball exercises
1110 - 1120	Alternative forms of resistance: Show and tell
1120 - 1130	Question and Answer period
1130 - 1300	Lunch break
1300 - 1320	Landing and IBA Workout: Classroom presentation
1320 - 1325	Discussing & interpreting heartrate graphs
1325 - 1400	Resistance II: Classroom Presentation
1400 - 1410	Break
1410 - 1420	Exercise demonstrations and suggestions from Physical Training observations: in gym
1420 - 1430	Push press: Discussion and demonstration Medicine ball and push press: Practice in gym
1430 - 1500	Functional and agility training: Discussion, demonstration, and practice various forms of:
	· Hops: line and cone
	· Vertical jumps
	· Jump rope intensities
	· Unstable surface training
1500 - 1515	Putting it all together: Classroom presentation
1515 - 1525	Workout cards and DVD: Explanation
1525 - 1530	Course evaluation and distribution of Certificates of Completion

cones, separated by 22.9m and timed for a total completion of 274.3m (six laps). Subjects were instructed to touch the end lines with their hands prior to change in direction. One trial was completed and recorded.

The APFT was conducted by a non-commissioned officer in charge responsible for administering and scoring the individual components of the APFT. Subjects were allotted two minutes to perform maximum repetitions of sit-ups, two minutes to perform maximum repetitions of push-ups, and timed two mile run according to APFT standards as outlined in FM 21-20. A 10-minute rest period was allowed between each testing component.

Statistical Analysis

Data were examined to assess the assumptions of normality and of equality of variance. These assumptions were not met in the case of some variables. Descriptive statistics (measures of central tendency and measures of dispersion) were estimated for all variables. The absolute differences from pre- and post-testing for the experimental and control group were calculated for all variables. Both parametric tests for normally distributed data and non-parametric tests were used to compare absolute differences from baseline between the experimental and the control group. The results of the non-parametric test (Wilcoxon rank-sum test) agreed with the results of the corresponding parametric test (independent samples t-test) with respect to direction of change and significance of the results in the majority of the variables and reported as parametric analysis. Statistical significance was set at $p < 0.05$ for all variables.

Results

The 8-week trial was comprised of 35 training sessions and accounted for five days of no scheduled activities according to the Fort Campbell operating schedule. The average attendance for the experimental group was 89% (31 sessions) with a range of 54-100%. A minimum attendance of 80% of the training sessions was achieved by 80% of the subjects in the experimental group. The average attendance for the control group was 94% (33 sessions) with a range of 71-100%. A minimum attendance of 80% of the training session was achieved by 96% of the subjects in the control group.

Flexibility/range of motion, strength, and balance data are presented in Tables 2- 4. Compared to the control group, the experimental group demonstrated improved active knee extension ($p < 0.001$), ankle dorsiflexion ($p = 0.018$), lumbar/hamstring flexibility ($p < 0.001$), and torso rotation flexibility ($p < 0.001$). No significant group differences were demonstrated in ankle plantar flexion ($p > 0.05$). Compared to the control group, the experimental group demonstrated significant improvements in knee extension strength ($p < 0.001$) and torso rotation strength ($p = 0.036$). No significant group differences were demonstrated in knee flexion or shoulder strength ($p > 0.05$). No significant group differences were demonstrated in eyes open or eyes closed balance ($p > 0.05$).

Physiological, field assessment, and APFT data are presented in Tables 5- 7. No significant group differences were demonstrated for percent body fat ($p > 0.05$). Compared to the control group, the experimental group demonstrated significant improvements in anaerobic power ($p = 0.019$). Compared to the control group, the experimental group demonstrated significant improvements in the sit-up ($p = 0.022$) and two mile timed run ($p = 0.039$) portions of the APFT, vertical jump ($p = 0.042$), agility ($p = 0.019$), and 300 yard shuttle run ($p = 0.005$).

Biomechanical data are presented in Table 8. No significant differences were demonstrated for the biomechanical variables ($p > 0.05$).

Discussion

The purpose of this paper was to detail the last three steps of the injury prevention and performance optimization model: *Design and Validation of the Interventions, Program Integration and Implementation, and Monitor and Determine the Effectiveness of the Program*. The Eagle Tactical Athlete Program (ETAP) is a comprehensive physical training program for performance optimization and injury mitigation and was based on the tasks and demands of the 101st Airborne Division (Air Assault) Soldiers. It was demonstrated to induce favorable adaptations to a significant number of modifiable characteristics following eight weeks of training as indicated by improvements in strength, flexibility, balance, power, field tests, and APFT. Although several variables did not demonstrate improvements, the authors acknowledge limited exposure with an 8-week program may have contributed to such results. The program duration will be accounted for when periodized to meet the pre-deployment training cycle of 10-12 months. The effectiveness of ETAP to reduce the risk of unintentional musculoskeletal injuries and optimize physical readiness and performance in Soldiers of the 101st Airborne will be assessed over the next year.

Flexibility/range of motion of the hamstring, calf, and torso improved in the experimental group relative to the control group. The results indicate that dynamic stretching with warm-up and static stretching with cool-down as incorporated with ETAP are effective ways to improve flexibility compared to static stretching with warm-up typically seen in the traditional PT. Improvements in flexibility and range of motion may be important in decreasing the risk of musculoskeletal injuries. Hartig and Henderson[24] reported that hamstring flexibility improved in military infantry basic trainees who participated in a stretching intervention and that these trainees also sustained significantly fewer lower extremity overuse than the controls during a 13-week infantry basic training course. It has also been reported that individuals with less hamstring flexibility, measured using a variety of techniques, are significantly more likely to develop hamstring and quadriceps muscle injuries, low back pain, and patellar tendinitis.[25-27] Decreased flexibility of the gastroc-soleus complex (either alone or in conjunction with other variables) has also been identified in increasing the risk of patellofemoral pain syndrome, achilles tendinitis, ankle sprains, and medial tibial stress syndrome.[28-31]

Knee extension, knee flexion, and torso rotation strength improved in the experimental group relative to the control group. Lower levels of strength may be associated with an increased risk of injury or may be a residual effect from a previous injury. In a prospective study of Australian footballers, Orchard et al. reported that hamstring injury was significantly associated with hamstring weakness as measured by peak torque at 60°/sec.[32] Decreased hamstring strength has also been identified in female athletes who subsequently sustained an injury to the anterior cruciate ligament as compared to male matched controls.[33] Individuals with a history of low back pain demonstrate significantly lower trunk strength than controls.[34] As a general guideline for resistance training, the intensity of 70-80% of one repetition maximum for eight to twelve repetitions and three sets for two to three times a week is recommended for novice athletes.[35] The volume and intensity utilized in ETAP were similar to these recommendations. No significant improvements were seen in shoulder strength, which may be the result of an increased focus of lower body strength and endurance.

Single-leg balance with eyes closed was improved in the experimental group; however, no significant differences with eyes open or group differences were demonstrated. Several studies analyzed biomechanical and neuromuscular characteristics after neuromuscular training (typically a combination of plyometric, resistance, balance, perturbation, and agility training) and reported increases in balance performance.[21, 36, 37] Myer et al.,[21] included several dynamic balance exercises on an unstable disc three times a week for seven weeks. The current study incorporated balance exercises once per week and the balance exercises were performed on a stable surface, which was sufficient to improve single-leg balance with the eyes closed. It is possible the lack of significant group differences in the current study may be multifactorial such that both the low frequency and intensity/difficulty of balance exercises were not sufficient to induce large enough changes. In addition, balance, particularly with the eyes open, may be positively impacted by other training modalities (e.g., squats, lunges, ruck marches on an uneven surface) to which both groups may have been exposed.

Neither group demonstrated a significant change in body weight nor percent body fat. Although exercise training increases energy expenditure which may contribute to a negative energy balance and thus body weight loss, numerous studies have found that exercise alone results in little if any weight loss[38-40] This is explained in part by the fact that moderate exercise does not create a large enough energy gap to promote body weight loss.[38] ETAP training was intended to induce adaptations to promote aerobic fitness, anaerobic power and capacity, muscular strength, flexibility, and balance, not necessarily to promote body weight loss. Also, none of the Soldiers in the current study received any instructions on modifying their diets. There is little evidence to suggest exercise alone will provide the amount of weight loss similar to that generally achieved by diet restriction.[38, 39] Research has shown that higher levels of exercise and or the addition of energy restriction may be necessary to promote significant body weight and fat loss[39, 41-43]

Relative to the control group, the experimental group demonstrated significant improvements in anaerobic power. During the Wingate test, higher anaerobic power is a function of pedaling speed and torque. It is possible that this improvement in anaerobic power resulted from training effects induced by the sprinting and agility exercises along with resistance exercises performed during ETAP. The experimental group also demonstrated a significant improvement in anaerobic capacity. These improvements may be the result of interval training and the varied intensity of exercise that was provided during ETAP. Significant improvements in agility and the shuttle run were seen in the experimental group as compared to the control group. These adaptations may be the result of the targeted training provided by ETAP. Many athletic movements and tactical maneuvers rely on anaerobic capacity, power, and a combination of agility-type activities.

In terms of the APFT, the cardinal assessment of fitness in the U.S. Army, the experimental group demonstrated significant improvements in the sit-ups and two mile run relative to the control group. The key finding is that ETAP was able to improve two mile run performance without the high running mileage typical seen with Army PT. The results of the current study, when combined with previous epidemiological studies, indicate that it may be possible to reduce the incidence of injury during military training by reducing running mileage without compromising fitness as assessed by the APFT.[44-46]

No significant improvements in any of the biomechanical characteristics were seen in either group. Previous research that investigated the effect of plyometric programs coupled with resistance programs on lower extremity kinematics has produced conflicting results.[21, 43, 48] Myer et al.,[21] reported an increase in hip abduction angle and no changes in knee valgus/varus angle after seven weeks of a plyometric training program and a balance training program. Lephart et al.,[47] reported an increase in knee flexion and hip flexion following an eight-week program that incorporated resistance, balance, and plyometric training. However, no changes in knee valgus/varus and hip abduction angle were observed. Similarly, Chappell et al.,[48] reported an increase in knee flexion angle and no changes in knee valgus/varus and hip abduction angle after six weeks of neuromuscular training. The validation trial of ETAP was based on an 8-week trial and may not have been a sufficient duration to induce biomechanical adaptations during landing activities as ETAP was designed to improve multiple areas throughout the 8-week trial with the understanding of eventual expansion to a pre-deployment cycle.

There are several limitations to the current study. Although the U.S. Army provides field manuals to guide physical training, physical training is administered at the discretion of the unit leader and can vary extensively within a Division. It was requested of the Physical Training Leader that he instruct physical training for the control group as he would if not participating in the trial. Within the Division this could suggest an overlap in training or similar training being performed relative to the experimental group. In addition, many military personnel train on an individual basis to supplement unit PT but were instructed to restrict outside exercise/training beyond morning physical training while enrolled in the 8-week trial. This was not monitored in the current study, however if performed, this training may have enhanced the results of the control group to improve certain characteristics. Soldiers performing ETAP demonstrated significant improvements in several variables that are vital to optimizing physical readiness and performance and potentially reducing the risk of unintentional musculoskeletal injuries. Implementation of ETAP into the Division should have long-term implications to improve physical readiness of the Soldier when periodized across a 10-12 month pre-deployment cycle when sufficient exposure and duration is achieved for all components of physical training to allow for complete adaptation of the suboptimal characteristics.

The Department of the Army has recognized the need for updated physical training guidelines to better address more aspects of physical fitness in order to improve performance and physical readiness while reducing the risk of injury. The Army replaced FM 21-20, which was the guideline that governed physical training being performed at Fort Campbell at the time of this study, with TC 3-22.20, *Army Physical Readiness Training*.[10] Epidemiological studies have demonstrated the effectiveness of PRT to reduce injuries while maintaining or improving APFT during Basic Combat Training (BCT) and Advanced Individual Training (AIT).[44-46]

Future studies and programs should incorporate more upper body training. No changes in upper body strength were demonstrated in either group. However, previous studies have reported a high incidence of shoulder instability, dislocation, and rotator cuff tears in the military population[49-51] and that reduced shoulder internal and external rotation peak torque is typically seen with shoulder impingement syndrome and instability.[52-54] Future studies should also monitor and attempt to further control for physical training performed outside of daily Army PT. Finally, it is important to incorporate meal planning and nutritional educational sessions in any injury prevention and performance optimization program if body composition changes are desired.

The final two steps of the public health approach to injury prevention and control: *Program Integration and Implementation* and *Monitor and Determine the Effectiveness of the Program* are currently ongoing and will be completed over the next year. *Program Integration and Implementation* includes the ETAP Instructor Certification School (ICS). ICS is a four-day program designed to teach physical training leaders (NCOs) how to implement and effectively instruct ETAP at the unit level and is based on the Army concept of "train-the-trainer". The final step: *Monitor and Determine the Effectiveness of the Program* will test the effectiveness of ETAP to mitigate musculoskeletal injuries and optimize physical readiness and performance. A parallel approach has been adopted to include injury surveillance both during garrison and deployment and prospective interval testing of laboratory, performance, and APFT variables.

To date, 952 Soldiers have participated in ICS. Soldiers enrolling in ICS are non-commissioned officers (NCO) who regularly instruct morning physical training. Part of each graduate's responsibility is to teach ETAP to other Soldiers who are unable to attend ICS and instruct at the unit level. Two NCOs (a senior and junior NCO) per platoon participated. To recruit an equal number of Soldiers from each Brigade and accelerate Division-wide implementation, six to eight ICS sessions (weeks) were scheduled for each Brigade, with the unit assignment based on the Brigade's and Division's pre-deployment training cycle. The goals of ICS include: 1) experience and understand a comprehensive physical fitness program, 2) understand the components and underlying principles of ETAP to effectively adapt it to individual or unit situations, and 3) develop a working understanding of how to implement ETAP with little to no equipment to ensure that the program is deployable. Daily activities over the four-day course allow for participants to achieve these goals through a multifaceted learning approach. The Soldiers were familiarized with the exercises and the program through participation in ETAP training sessions; interactive sessions including traditional lectures and presentations as well as open discussion to ensure proper understanding of the theory behind the program. Proper technique, progressions, and corrections for the exercises, and alternative exercises and/or training that can be employed while still accomplishing the same goals are covered during "hands on" practice sessions to implement and instruct ETAP. A course outline for ICS is summarized in Table 9. Day 1 covered basic exercise physiology, warm-up/cool-down, stretching, anaerobic conditioning, and agility exercises. Day 2 covered nutrition and resistance exercises. Day 3 covered aerobic interval workouts, balance exercises, partner resistance exercises, and proper lifting techniques. Day 4 covered plyometric exercises, IBA workouts, medicine ball exercises, landing techniques, and PT program design. At the completion of ICS, students received the eight week ETAP workout cards along with the corresponding DVD. The DVD contains all of the lecture slides, a written description and videos of all exercises performed, exercise progression guidelines, perceived exertion and heart rate guidelines as well as information to develop alternative ETAP exercises given the deployment environment. The validated 8-week ETAP program has been extended according to each Brigade's pre-deployment training schedule with repeated cycles of increasing intensity. The training cycles contain the same principles by which the 8-week model was developed, but modified the progression of each training modality. The weekly training format is identical with individual days dedicated to different components of fitness, yet allowing for combat focus training. Based on ICS enrollment, 40 Soldiers per platoon, and an instructor to Soldier ratio of 2:40 or 1:20 per platoon, approximately 19,500 Soldiers have been exposed to ETAP at the unit level. This ratio allows for adequate supervision of Soldiers performing ETAP, ensuring that proper technique and progressions are maintained. In addition, quality control audits are conducted by personnel from the University of Pittsburgh, ensuring proper delivery of ETAP by the NCOs to their respective units and allowing for implementation-related questions to be answered and assessment of exercise performance/technique of the Soldiers at the unit level.

To date, 1478 out of a projected 2000 Soldiers have been enrolled in step six, *Monitor and Determine the Effectiveness of the Program*. Soldiers from a representative Brigade performing ETAP are participating in this aim as the experimental group while Soldiers from a separate Brigade which performs comparable tactical operations and is deployed to a similar location/environment are serving as the control group. To participate, Soldiers must spend a minimum of six months at garrison and 12 months deployed during participation. History of injuries prior to the study start date will be used to compare the frequency of injuries at baseline between the ETAP and regular Army PT groups. The proportion of subjects with unintentional injury will be compared between the ETAP group and the regular Army PT group at the end of 18 months of follow up, by Chi-square tests. A Kaplan-Meier survival analysis will be used to compare time to injury between the two groups. A Cox regression will be used to adjust for variables such as gender, age, number of months of exposure to the ETAP, years of service, and deployment status.

Summary

The purpose of this paper was to describe the last three steps of the injury prevention and control model: *Design and Validation of the Interventions, Program Integration and Implementation, and Monitor and Determine the Effectiveness of the Program* as studied with the 101st Airborne Division (Air Assault). ETAP is a research-based, comprehensive program developed specifically for the 101st Airborne Division (Air Assault) based on inherent injury epidemiology, task and demand analyses, identification of suboptimal physical and physiological characteristics compared to an athletic benchmark, and previously established injury risk factors.

Although it has been demonstrated that ETAP can positively impact physical readiness in a controlled trial, prospective injury surveillance must occur to properly and accurately assess the effectiveness of ETAP to reduce the risk of unintentional musculoskeletal injuries in Soldiers performing ETAP. Additionally the prospective analysis of performance is necessary to determine the effectiveness of ETAP to optimize physical readiness when delivered by the Soldiers of the 101st Airborne Division (Air Assault). The effectiveness of ETAP to be implemented into the Division and resultant mitigation of unintentional musculoskeletal injuries and performance optimization is ongoing and will be completed over the next year.

The application of the public health model of injury prevention and control is an effective tool to scientifically develop and implement injury prevention and performance optimization programs for the tactical athlete, regardless of tactical demands. The research model described for the development of ETAP and 101st Airborne Division (Air Assault) is adaptable to culturally-specific units and driven by the task and demand analysis by which the entire injury prevention and performance research model can be implemented within different Special Operations Forces units.

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Air Force Preventive Medicine's Role in the War Against Terrorism: New Missions for the Global Counterinsurgency

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Disclaimer: The views expressed in this paper are those of the author and do not reflect the official policy or position of the Department of the Air Force, Department of Defense, or the U.S. Government.

Abstract

Since 2005, the call for the military to conduct "softer" missions, such as humanitarian assistance and partner training, has increased. These "medical stability operations" are in fact to be given comparable priority to combat operations. Military leadership understands their the value of Medical Stability Operations across the range of military operations from shaping through post-disaster or post-conflict operations.[1] Air Force Preventive Medicine (AFPM) teams, given more education, are suited to these medical stability operations and should be tasked.

What is the Air Force Medical Service contribution to the United States military? Many thoughts immediately turn to the Expeditionary Medical Systems and air evacuation deployments directly supporting operations in Afghanistan and Iraq or to medical humanitarian relief in response to natural disasters such as those in Haiti. Similarly, military medical personnel would be critical first responders if the U.S. were attacked with chemical, biological, radiological, nuclear, or conventional explosive (CBRNE) weapons on its own soil or overseas bases. There is, however, a relatively little-known aspect that bears examining: how the United States Air Force (USAF) Medical Service's Preventive Medicine (AFPM) teams can further combatant commanders' efforts in building capacity within partner nations. This article analyzes how the AFPM teams are uniquely suited for building partner nation capacity and offers recommendations as to how better structure the units for even greater utility.

Nigeria, a country from which the United States now gets seven percent of its oil, and will get 25 percent of its oil by 2015, is crippled by rampant corruption and organized crime. The central government lacks the ability to control the borders, stop corruption, improve the religious division between the Christians and the Muslims, fairly distribute the country's oil wealth, or stop organized crime.[2] The citizens in northern Nigeria have little security; it is dangerous for the average person to leave home to go to work or attend school for fear of bandits attacking them or their families who stay home during the day. This is a great example of what happens when governments cannot maintain their capacity—the people are vulnerable to outside extremists instituting shadow governance — thus there is the need to help them build and maintain capacity.

In addition to the Nigerian example, in a broader sense, some extremist actions take on the nature of a global insurgency. This is aimed at "subverting the existing political and social order of both the world of Islam and the broader world," in order to redefine the global balance of power.[3] This sort of activity is happening in pockets all over the world, including eastern Africa and South America. (an example may be helpful here)

The United States' overarching security plan is the *National Security Strategy*, that states the United States must engage with, build relationships with, and pursue development in our partners.[4] The 2010 *Quadrennial Defense Review* (QDR) also states the U.S. military must engage with partner nations and build capacity in order to reduce the threat to the United States.[5] The QDR states it may be in the U.S. interest to support civil authorities in providing essential services, restoring emergency infrastructure, and supplying humanitarian relief.[5] The logic is that if governments cannot provide basic services like sanitation, medical care, drinking water, or other public health needs, it is easier for terrorist groups and insurgents to move in and spread violent ideologies.[5] In essence, a weak state may be more of a security threat to the U.S. than a strong state.[5] In support of U.S. National Security Strategy, U.S. Military Civil Affairs personnel conduct capacity-building missions in weak states. The Air Force, either alone or as a joint effort with other services, must prepare to support and conduct medical capacity-building missions.

The U.S. *National Strategy for Combating Terrorism*, a subordinate document to the *National Security Strategy*, lists four goals: 1) defeat terrorists and their organizations; 2) deny sponsorship, support, and sanctuary to terrorists; 3) diminish the underlying conditions that terrorists seek to exploit; and 4) defend U.S. citizens and interests at home and abroad.[6] To achieve these objectives, the full complement of diplomatic, informational, military, and economic tools are used by the U.S. government. The U.S. military's contribution to the effort is explained in the *National Military Strategic Plan for the Global*

War on Terrorism, which lists as its goals:

- Deny terrorists what they need to operate and survive.
- Enable partner nations to counter terrorism.
- Deny Weapons of Mass Destruction/Effects (WMD/E) proliferation.
- Defeat terrorists and their organizations.
- Contribute to the establishment of conditions that counter ideological support for terrorism:
- Security
- Humanitarian assistance
- Military-to-military contacts
- Conduct of operations
- Military information operations[7]

Regarding the military contributions to the global counterinsurgency (COIN) for preventive medicine (PM) personnel, some of these such as "denying WMD/E proliferation" (part of which entails being prepared to sample for WMD agents after an attack) are somewhat familiar to military personnel. Others, like "enabling partner nations to counter terrorism" may not at first seem to be a capability PM staffs possess. However, as outlined below if PM personnel increase involvement in enabling partner nations, the global COIN can be conducted more effectively.

To "enable partner nations to counter terrorism" encompasses U.S. forces training partner nation (PN) military forces to conduct combat and internal security missions more effectively. The U.S. government sees this successfully carried out in the Operation Enduring Freedom-Philippines (OEF-P), where Joint Task Force (JTF)-510 forces train Philippine forces to counter the Abu Sayyaf insurgency.[8] The Abu Sayyaf group's goal is to "establish an Islamic state based on Sharia law on the islands of Mindanao and the Sulu Archipeligo."[9] U.S. forces advise and assist the Philippine military but are not involved in direct action. The U.S. teaches the Philippine military new tactics, techniques, and procedures to fight more effectively and provide better medical care. JTF-510 personnel also dig wells, build clinics and schools, and improve the infrastructure and government presence in order to deny terrorists as base of operations. . Part of this effort includes improving the government's ability to prevent infectious and hygiene-related disease and waterborne illnesses. Ideally, this enhances the local populations' view of the central government and allows its citizens to see a better future for themselves. It brings credibility to the government in the eyes of the citizens while wearing down terrorists. According to Peter Brooks, former deputy assistant secretary of defense responsible for OEF-P policy, as a result of these efforts, the radical insurgency is all but dead.[10] Operation Enduring Freedom-Philippines is a successful model for conducting a counterinsurgency strategy. It will not work everywhere, but elements of it can work in many places where an extremist threat exists.

Another example in the category of "enabling partner nations to counter terrorism" is the deployment of Air Force Special Operations Command's (AFSOC) 6th Special Operations Squadron (SOS) to partner nations. The mission of the 6th SOS is Foreign Internal Defense (FID), which is defined as "participation by civilian and military agencies of a government in any of the action programs taken by another government to free and protect its society from subversion, lawlessness, and insurgency."[11] The 6th SOS does this by training and advising PN air forces on how to conduct more effective operations. The PN air force can then better help their government maintain security, halt extremists, and be a more capable ally to the U.S.[12] Another military mission in the global COIN is "contributing to the establishment of conditions that counter ideological support for terrorism," – a mission where PM personnel will excel. An example is the medical work U.S. military Civil Affairs units perform. Civil affairs supports "both conventional and Special Operations missions, and are capable of assisting and supporting the local government" of the country in which the CA works.[13] Medical, Dental, and Engineering Civil Action Programs (MEDCAPS, DENTCAPS, and ENGCAPS) are missions many Air Force Medical Service (AFMS) personnel are familiar with. By teaching partner nation health authorities how to set up medical infrastructure and plan for medical emergencies (to include hazardous materials mishap, natural disaster, and pandemic flu planning,), the partner nation government is better able to care for its people, thus taking steps in preventing terrorists from gaining a foothold in that country or region.

Another military function in the global COIN is conducting humanitarian assistance, which has both short and long-term benefits for America's security. The Indonesian tsunami relief operation of 2005 is an example. PM personnel contributed significantly to this operation by identifying harmful insects and other disease spreading animals, sampling drinking water for potability, and teaching Indonesians other methods to remain healthy during the tsunami's aftermath. After the U.S. assisted Indonesia for tsunami relief, the favorable rating of Indonesians toward the U.S. went from 15 percent to 39 percent, with 59 percent of the Indonesian population agreeing with the statement that "the United States paid a great deal or fair amount of attention to their country's interest." The operation definitively furthered the goals of the global war on terror and of regional cooperation, especially since Indonesia is the country with the largest Muslim population in the world.[14] Due to these and other similar successes, the U.S. Navy is increasing emphasis on humanitarian missions and improving international cooperation as a way to prevent conflicts.[15] During the summer of 2010, the Naval hospital ship USNS Mercy (T-AH 19) conducted Pacific Partnership, the fifth in a series of annual U.S. Pacific Fleet humanitarian and civic assistance endeavors aimed at strengthening regional relationships with host nations and partner nations. AFPM teams should be involved in missions like these. Bioenvironmental engineers (BEs) and public health (PH) personnel can assist in planning operations to identify health threats before personnel deploy and assist with site selection to ensure forces remain healthy on the ground. BEs conduct occupational and environmental health site assessments to ensure U.S. forces remain healthy. They also conduct water sampling for bacteria, pesticides, volatile organic compounds, and metals after engineers drill wells in local villages. PH personnel advise allied forces on disease prevention, sanitation, personal hygiene, and veterinary issues.

In addition to helping plan COIN operations, BEs, and PH personnel can establish direct contact with the partner nation and its citizens, interacting with the partner nation medical community and officials (both military and civilian) to promote and train on basic community and industrial health exposure assessments. These include assessing noise, radiation, and chemical exposures, developing vector control and disease prophylaxis recommendations, providing clean water, and assisting local public health agencies to develop occupational health, disaster preparedness, and other preventive medicine programs. These fit perfectly with FID and COIN doctrine, which explicitly state FID and COIN can comprise training across the range of military operations.[16] It also meshes with humanitarian assistance doctrine and two AF deployment teams mission capability: 1) the Preventive Aerospace Medicine (PAM) Team (a deployment team comprising a flight surgeon, Public Health officer, and Bioenvironmental Engineer), and 2) the AF Special Operations Command Medical Stability Operations team. These types of missions will teach partner nations ways to provide for themselves, providing better long-term results than providing the typical one-time care associated with most medical exercises. By requesting AF PAM Teams for partner missions with Civil Affairs teams, the geographic combatant commanders are able to increase the number of missions.

One must understand most of our PNs are generally not as well-equipped as the U.S., so high-tech environmental health solutions must boil down to basics like building fences around well heads to keep livestock away, washing hands, boiling water, standing upwind while painting, shooting x-rays away from other people, isolating or staying away from loud noise sources, and not exposing people to heavy metals, and teaching small business operators safe industrial operations (e.g., it is common practice in developing nations to work out of the home, so teaching people to not melting lead in living quarters and then cook with the pan just used for lead melting would go a long way in improving health). Other examples where, PH personnel can make a lasting impact may include: administering vaccines, advising local leaders on vector control, teaching citizens about good hygiene and sanitation, and advising local farmers on animal herd health issues. Conducting PM operations outside of traditional Air Force thinking would immensely benefit the global COIN.

Is the preventive medicine community ready for these missions? Partially, if one conducts a Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities analysis.

Air Force Doctrine

The current AF COIN doctrine, AF Doctrine Document 2-3, covers the value of civil engineering and emergency management well, but falls short from a medical perspective. It allows for PMs as part of larger efforts in building partner nations but inadequately addresses PMs unique contributions.[17] The AFMS needs to incorporate changes to this (AFDD) upon revision.

Organization

There are two main shortfalls in the PM organization. One is in the International Health Specialist (IHS) program which is designed to "support the geographic combatant commander's medical surveillance, planning, coordination, and execution of Military Operations Other Than War (MOOTW) missions."[18] Only a fraction of PM personnel with language skills have self-identified and/or applied to the IHS program. In addition the IHS has not consistently incorporated PM into its operations. The IHS program needs to have a robust pool of PM personnel with the appropriate language training from which to draw. For example, the Air Force's small PAM deployment teams and equipment are well suited to deploy with a small footprint and accomplish a lot with few people. The second is that while FID units are more than doubling in size, the complimentary medical elements are remaining virtually the same. Ideally, designated PM personnel would be adjunct for these missions to engage with and assist partner nation militaries.

The PAM Unit Type Code and AF Special Operations Command Medical Stability Operations deployment teams are perfect for building partner capacity "outreach" missions. A three-person package of a Public Health Officer, Flight Surgeon, and Bioenvironmental Engineer provides a robust public health, epidemiology, field hygiene, industrial hygiene, environmental science, disease vector control, medical intelligence, disaster preparedness, and primary care skill set unmatched for interacting with partner nations. The complementary equipment package allows the team to train and educate partner nation personnel at an effective level.

Training

The technical training the PM community receives is robust and thorough, but may need to be improved in some areas. For instance, BE personnel do not get much training in intelligence analysis to determine industrial hazards or other community health hazards in a region. This is important because a team needs to tailor training and education for a particular audience. If a team knows an area has specific industries and/or has a propensity for certain natural disasters, it can prepare for and teach to the health issues of those specific associated hazards. Another shortfall is in culture and language training. If PM personnel are to interact with host nation personnel, PM specialists must be able to speak some of the language and know the culture. Like the 6th SOS, PM personnel should be earmarked for a global region and receive language and culture immersion for that region, so when a humanitarian, military-to-military, or Civil Affairs assistance deployment occurs in that region, those PM people are taken from that given list of personnel.

Materiel

AF PM has the most of the materiel needed to perform the full spectrum of missions. On one hand, the Hapsite, a portable gas chromatograph, is a powerful tool that is not used to its full potential; for instance, one can use it to search for volatile organic chemicals in groundwater after drilling a well or in air near an industrial plant or operation. On the other hand, the Hapsite or other sampling equipment may be *too* complicated for tasks such as educating partner nation health officials. The AF has a shortfall in items like pictorial flash cards and small posters or flip charts that tell a story or educate about keeping water clean and keeping healthy (with captions in the native language(s)) are beneficial and needed.

Leadership and Education

Theater surgeons should be educated on PM capabilities and what these medical professionals bring to the table. PM personnel are well-suited to MEDCAPs, ENGCAPS, and similar missions. An additional education gap is the field of COIN. PM (and all AFMS) personnel should have a standard reference library and teach themselves basic COIN principles if one cannot attend formal courses. AFDD 2-3 and FM 3-24, *Counterinsurgency*, are good places to start. Additionally, line leadership should be educated on what preventive medicine teams can do to help further larger operations and achieve the strategic goals for a nation or region.

Personnel

The AF PM community does not have extra manning for additional humanitarian, military-to-military, Civil Affairs, or exchange missions. However, conducting these missions is, , important enough to find ways to do all the missions required. PM personnel at home station have to prioritize to ensure they do what is really important. PM leadership must develop methods to assist BE personnel in the field accomplish all their missions. Plus, since many global COIN missions like MEDCAPS are shorter than the typical 4-6 month AF deployment, National Guard and Reserve Component personnel might be considered.

The U.S. strategy to prevent and defeat extremists from gaining ground entails a whole of government approach, whether diplomatic, military, or economic. In many cases, direct military action is necessary, but sometimes a softer touch is needed.[19] The AFMS and preventive medicine personnel play an important role in countering the CBRNE threat at home and abroad and in preventing illnesses among the U.S. and its allies. Interacting with partner nations and their people in need of assistance, though, is an ever-increasing role in the military strategy to prevent extremism from forming. The AFMS and PM career field should seek out opportunities for these "non-traditional" or "irregular warfare" missions, welcome these roles and prepare for them.

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Acetazolamide or Not, Prior To Ascent?

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Abstract

Special Operation Soldiers must be prepared to work in all environmental extremes, frequently with little or no preparation time. While working in extreme heat or cold is uncomfortable, little preparation is necessary as long as reasonably fit Soldiers remain properly nourished, hydrated, or clothed. Working at high altitude poses additional risks that can be pharmacologically mitigated. While new prophylactic therapies are appearing on the scene in mountaineering and high-altitude climbing circles, acetazolamide still appears to be the preferred drug for the prevention of altitude related illness.

Each climbing season alpinists around the world attempt to tackle the highest summits on the face of the earth. Many of them cling to traditional training methods, using prophylactic medications and dietary supplements to enhance their odds of success. Occasionally, the military and the Special Operations community must work at physiologically challenging altitudes, sometimes for prolonged periods. There is good anecdotal evidence supporting traditional use of prophylactic acetazolamide prior to and during ascent for the prevention of high altitude syndromes.

In January 2010 an expedition of 20 healthcare providers attempted to climb Cerro Aconcagua in Argentina. Among the expedition members were three Special Operations healthcare providers including two physicians and a physician assistant. Standing 22,841 feet tall (6962m), Aconcagua is the highest peak in the world outside of the Himalayas.

Statistically, a smaller percentage of climbers successfully summit Aconcagua each climbing season than reach the summit of Mt Everest. While most climbers train extensively and prepare well in advance for an Everest attempt, many consider Aconcagua a “beginner’s mountain”. Since there is a non-technical route to Aconcagua’s summit (the Aconcagua Normal Route), many assume that they can simply “hike” to the summit. However, the fact remains that Aconcagua’s summit rests at 22,841 feet tall; due to its latitude, the summit is ravaged by foul weather, deep snow and high winds even during the summer-only climbing season (typically December through February). On summit day the team enjoyed temperatures of minus 27 degrees Fahrenheit (2.8C), a steady 35 knot wind and over a foot of fresh snow.

The expedition ascended at a very conservative rate over 10 days, with several rest days and day-hikes to higher altitudes for acclimatization. Daily health checks were performed on each expedition member by their guides. Each member’s blood oxygen saturation (SaO_2) and pulse were checked daily. Any symptoms of ill health, including headache, nausea, vomiting, diarrhea, and cough, as well as medication and doses were recorded for each member daily. Despite the conservative pace, the team lost four of the twenty members to acute mountain sickness (AMS), high altitude pulmonary edema (HAPE), high altitude cerebral edema (HACE) or gout prior to reaching Camp-2 (Camp Nido de Condores) at 17,582 feet (5359 m). At Camp-2 an additional member was evacuated due to a spontaneous retinal detachment. Unfortunately, the records for those five expedition members were evacuated with the victims.

Of the fifteen remaining climbers, six successfully reached the summit. A review of the medical data showed that those who reached the summit took an average dose of 168.7mg of acetazolamide, while those who did not reach the summit took an average of 95.5mg daily. The symptom score over ten days for those who reached the summit was 29 compared with 42 symptoms among the non-summiteers. There was little difference in average SaO_2 and pulse between groups. The successful group had an average SaO_2 and pulse of 83.3% and 86 beats per minute (bpm) respectively, while the unsuccessful group had an average SaO_2 of 82.5% and a pulse of 84.5 bpm.

Interestingly, each group had a member with high altitude bronchitis (HAB): the successful 44 year-old male member, who took acetazolamide as recommended, had an average SaO_2 and pulse of 82% and 98.6 bpm respectively, with a symptom score of 11; while the unsuccessful 43 year-old female member, who took no acetazolamide, had an average SaO_2 and pulse of 79.2% and 83.3 bpm, and a symptom score of 10. The average age of those who reached the summit was 42 years, while the average age of those that did not reach the summit was 37 years.

Symptom scores were based on daily data collection by the guides. Each member was asked if they were currently experiencing, or had experienced cough, headache, nausea, vomiting, malaise, or decreased appetite in the last 24 hours. Of the six successful members, five reported at least two symptoms during the 10-day expedition, with an average of 4.8 symptoms per member. One successful member had a symptom score of zero. All unsuccessful members reported at least two symptoms over the 10 days, with an average of 4.9 symptoms. Incidentally, both members with HAB claimed cough as a symptom on all 10 days; their symptom scores alone accounted for 30% of all reported symptoms throughout the expedition.

While physiologic changes in blood oxygen saturation and pulse rate, and average symptom scores were similar in both groups, there was a significant difference in prophylaxis between the successful group and those who

Successful Members											
Acetazolamide			Symptoms								
Avg daily mg dose	Daily freq.	Duration in days	Headache	Nausea	Vomiting	Diarrhea	Cough	Anorexia	Malaise/ Fatigue	Heart rate	O2 Sat
62.5	QD	6	3	0	0	2	0	0	8	94.7	86.7
125	QD	10	1	0	0	0	10	0	9	83.7	84.7
225	BID	10	4	0	0	1	0	0	8	75	82.6
187.5	BID	10	0	0	0	0	0	0	0	80.9	84.8
200	BID	10	0	0	0	2	9	0	7	98.6	82
250	BID	10	0	0	0	1	1	0	5	83.3	79.2

Unsuccessful Members											
Acetazolamide			Symptoms								
Avg daily mg dose	Daily freq.	Duration in days	Headache	Nausea	Vomiting	Diarrhea	Cough	Anorexia	Malaise/ Fatigue	Heart rate	O2 Sat
156.25	BID	8	2	0	0	0	1	0	3	80	89.4
0	n/a	0	3	0	0	3	0	0	3	79.9	79.8
125	QD	5	1	0	0	1	1	0	3	92.8	87.2
225	BID	9	2	0	0	2	2	3	6	89.4	80.7
125	QD	10	3	0	0	2	2	0	7	85	81.6
0	n/a	0	0	0	0	0	0	2	10	75.8	79.1
81.25	QD	9	1	0	0	1	1	2	8	91.8	84.2
87.5	QD	8	1	0	0	1	1	0	2	74.1	86
75	QD	9	1	0	0	2	2	1	6	89.7	82.4

failed to reach the summit. All members who reached the summit took acetazolamide. Four of the six successful members took a twice daily dose; one member took a single daily dose. Five of the six successful members began prophylaxis below 11,000 feet (3353m) and one member began at Camp Confluencia at 11,112 feet (3387m). Of the nine that did not summit, two took no acetazolamide, five members took it once daily and two took it twice daily. None of the successful members skipped doses, while five of the seven unsuccessful members who took acetazolamide skipped at least one dose.

The CDC and the Institute for Altitude Medicine at Telluride recommends 125mg of acetazolamide twice daily, beginning the day prior to ascent and continuing that dosing schedule through the second day at the highest sleeping altitude, as the drug of choice. (http://www.altitudemedicine.org/providers.php). The Centers for Disease Control's (CDC) Yellow Book explains that acetazolamide works by acidifying the blood, thereby increasing the rate of respiration, resulting in improved acclimatization. While allergic reactions to acetazolamide are rare, patients who have sulfa or penicillin allergies may have an allergic reaction to acetazolamide. (http://wwwnc.cdc.gov/travel/yellowbook/2010/chapter-2/altitude-illness.aspx).

While new prophylactic medications and supplements, such sildenafil and ginko biloba, are becoming more commonplace in mountaineering and high-altitude climbing circles, acetazolamide still appears to be the preferred drug for the prevention of altitude related illness. This data suggests that those climbers that took acetazolamide at the recommended dosing schedule were better prepared to fend off the ill-effects of altitude. For example, those that took regular doses of acetazolamide, at or near the recommended dose of 125mg twice daily, had a greater chance of success at reaching the summit despite differences in age or pre-existing illness, than those who did not take acetazolamide or skipped doses (six successful versus fourteen unsuccessful).

All of our expedition members were in average shape for their age. A few were experienced and accomplished alpinists and a few were altitude naïve. One of our more experienced members that failed to summit spends a significant part of each year at 17,000 feet in the Himalayas. She was not taking acetazolamide. One successful team member, whose climbing experience was all sea-level, technical rock climbing had never been to altitude greater than that of a pressurized commercial airplane. He was taking the recommended 125mg of acetazolamide twice daily.

Acetazolamide is a reasonable choice for prophylaxis for even short trips to altitude. The ability to begin dosing the day prior to ascent makes acetazolamide a good choice even for unplanned or spontaneous forays to altitude. The members of the expedition who took acetazolamide at or near the recommended prophylactic dose and were compliant in their dosing schedule, including a team-mate with a pre-existing upper respiratory infection, were successful. The members of the expedition who opted to not take acetazolamide, skipped doses, or took sub-therapeutic doses failed to summit. Our expedition was not intended to serve as a study of acetazolamide as a prophylaxis for altitude sickness. However, our statistics favor acetazolamide as a reasonable choice for those that must work at altitude.

Special thanks to Dr. Andre Pennardt; mentor, friend, climbing partner and editorial reviewer. Likewise, special thanks to Dr. J. Craig Taylor for his editorial review.

Photo 1: *The author and team-mates on summit day*

Photo 3: *The author on summit day*

Photo 2: *High Camp at 19,000 ft*

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Scapula Fracture Secondary to Static Line Injury in a 22 year-old Active Duty Soldier

LTC W. David Thompson, MPAS, PA-C

Abstract

This radiological case study of scapula fracture is reported in a 22 year-old active duty male Soldier who sustained a static line injury during an airborne operation at Fort Bragg, North Carolina. This is the first reported scapula fracture secondary to this mechanism since a 1973 report by Heckman and Levine. The fracture was neither identified by Emergency Department nor Orthopedic Surgery providers, and was reported in the radiologist's formal read. Ten emergency physicians and emergency medicine physician assistants reviewed the radiographical studies and none successfully identified the injury. Because this injury was uniformly missed by experienced emergency medicine providers it is presented as a radiographic case study in hopes that this injury will not go undiagnosed, potentially causing increased morbidity and mortality in this patient population. The patient was treated with a posterior splint and immobilization and seen by the orthopedic service the next day. Interestingly, the orthopedic surgeon also did not recognize this fracture. This mechanism of injury is rarely seen in clinical practice outside of the airborne community. Scapula fractures can be an indicator of serious thoracic trauma and may prompt the need for further diagnostic studies. The fact that so many providers missed the injury reinforces the need to evaluate the patient as a whole and to be ever suspicious of missing concomitant injuries in the trauma patient.

Key Words: Scapula Fracture, Emergency Department, Orthopedic, Radiograph, Airborne

Background

A static line injury to the military parachutist's arm usually results in a closed transaction of the belly of the bicep's brachii muscle. This is an uncommon injury in the civilian community, but one that is seen several times a year in military treatment facilities that provide care to units conducting static line parachute operations. In United States military airborne operations, the vast majority of personnel are delivered to the battlefield by exiting, usually from a United States Air Force aircraft flying over a drop zone utilizing a T-10 or MC-1 series parachute. Prior to exiting the aircraft, each parachutist "hooks up" his static line to an anchor line cable running from the forward to aft section of the aircraft. As the parachutist exits and falls away from the aircraft, a 15 foot (4.572m) universal static line constructed of yellow nylon (with a tensile strength of 3,600 pounds [1632.9kg]) deploys the main canopy of the parachute away from the parachute pack tray. The parachute elongates, a break cord tie securing the apex of the canopy to the static line end loop breaks and the parachute begins to inflate, slowing the parachutist's rate of descent and ideally delivering the parachutist safely to the ground to complete his mission.[1]

Static line injuries occur when a static line wraps around the arm of the parachutist as he exits the door of the aircraft. Generally this occurs when a parachutist exits the aircraft with the static line misrouted under his arm (Figure 1). The misrouted static line wraps around the arm of the jumper causing injury. This may also occur if the preceding jumper throws his static line at the "safety" (member of the jumpmaster team responsible for ensuring static lines are safely pushed to the rear of the aircraft and are clear of the doorway as jumpers exit). When this occurs, the static line tends to ride low in the trail edge of the door. As the next jumper hands his static line to the safety and turns to exit the aircraft, the preceding jumper's static line, now rising to the upper portion of the trail edge of the paratroop door wraps around the arm of the second parachutist, causing injury (Figure 2).

Case Report

A 22 year-old white male presented to the Emergency Department after transport by ambulance from Sicily Drop Zone after participating in a nighttime, mass tactical parachute jump during a Joint Forced Entry Exercise conducted at Fort Bragg, North Carolina. The patient was the twentieth jumper to exit from the right paratroop door of a U.S. Air Force C-130 aircraft. The patient was equipped with a rucksack and M-4 Carbine. The static line wrapped around his right bicep. The

Figure 1: *Static line misrouted under arm.*

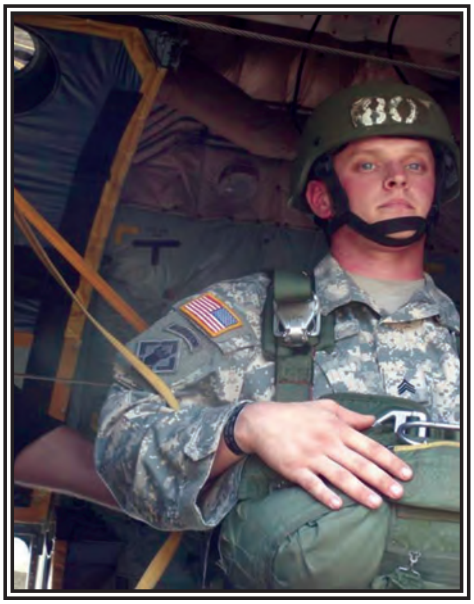

Figure 2: *Previous jumpers static line looped around jumpers arm. This occurs when the previous jumper drops or throws his static line to the safety or when the safety loses control of the static line.*

patient did not recall hitting the side of the aircraft. He did not recall landing on his shoulder. The patient was unable to pack up his parachute, gather his equipment or move to his unit's assembly area. The patient was found by medics on the drop zone, placed in a SAM splint and sling and transported to the Emergency Department at Womack Army Medical Center.). He was complaining of right arm and shoulder pain. He did not complain of back pain. He denied other injury. Vital signs were: temperature 98.1, Pulse 61 bpm, blood pressure 128/90 mmHg, respiratory rate 20 bpm, and oxygen saturation 100%. The patient was alert, in no acute distress, but in obvious pain. His physical examination demonstrated markedly decreased range of motion of the right shoulder and elbow. He had an area of ecchymosis that measured approximately 20 centimeters long by 10 centimeters wide over the mid portion of his right bicep. He had an area of ecchymosis and abrasion to his anterior chest just inferior to his right clavicle. His clavicle was non-tender to palpation. His forearm was non-tender. All of his forearm compartments were soft. His mid bicep was very tender to palpation. He had no bony tenderness over his shoulder, neck or back. His wrist and hand were normal in appearance, non-tender to palpation and moved normally. Capillary refill was less than two seconds. The remainder of his physical examination was within normal limits.

Conventional radiographs of the chest, shoulder, humerus, and forearm were ordered and performed in the radiology department. A peripheral IV was established and he was given 1mg of hydromorphone and 4mg of ondansetron intravenously for pain and nausea with partial relief. A repeat dose of 1mg hydromorphone was given that relieved his remaining pain.

The patient's radiographs were reviewed by the ED clinician. No obvious fractures were identified and orthopedic surgery was consulted. The diagnosis of biceps rupture secondary to static line injury was made. The patient was placed in a long arm splint in flexion with the hand in pronation to unload the biceps muscle. He was discharged with instructions to follow up the next morning with orthopedic surgery. The radiologist later over-read the images, and identified a cortical irregularity of the lateral aspect of the mid scapula (Image 1). This was read as a possible fracture of the lateral aspect of the mid-scapula. At this point, the attending orthopedic surgeon was consulted by the ED provider. On review of the patient's radiographs, the orthopedist agreed with the radiologists findings and did not think the biceps injury was operative in nature; the patient was referred to occupational therapy for treatment. He did not feel the scapula fracture would need any treatment other than pain management and observation. The patient continues to follow with occupational therapy and is doing well. Follow up radiographs (Image 2 and 3) show a healing scapula fracture with well defined bony callous.

Discussion

Static line injuries to the upper extremity can be manifest as several different types of injury, from fractures of both bones of the arm to partial amputation of the hand. The most common site of injury is to the anterior, mid portion of the arm over the bicep muscle. The skin will show some contusion and abrasion, but generally no laceration. There is marked swelling and localized pain over the belly of the bicep immediately following injury. A palpable defect is usually felt with the mid bicep.[2]

Static line injuries have previously accounted for 2.2% of all parachuting injuries in one study involving U.S. Army Rangers by Kragh et al., in 1996.[3] This is quite different than Hughes' study of 4th Battalion Royal Australian reg-

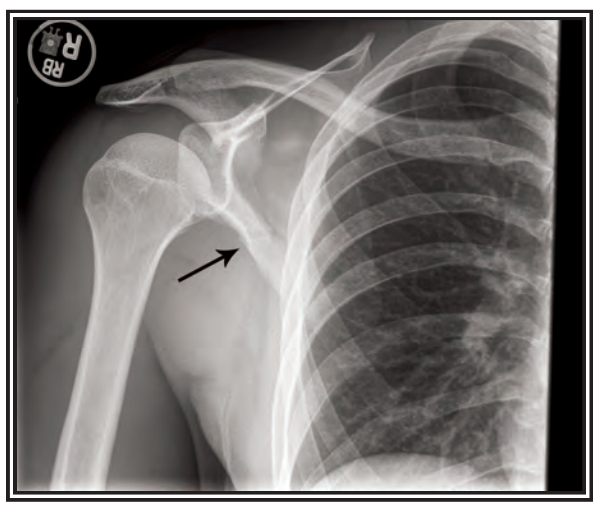

Image 1: *Anterior-posterior view of patient's right shoulder. Note the non-displaced fracture of the body of the scapula. This is very hard to see. Notice the cortical irregularity and radiolucent line extending from the lateral border of the scapula.*

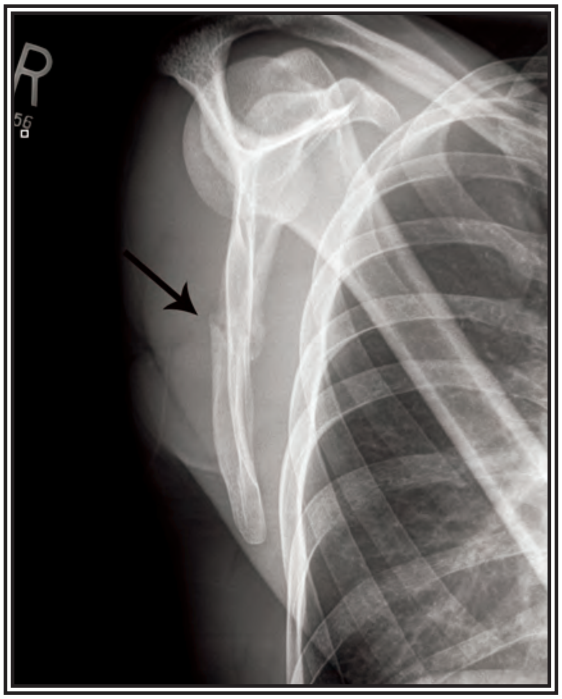

Image 2: *Scapular-Y view taken approximately three weeks post injury. Note the obvious fracture and bony callous formation.*

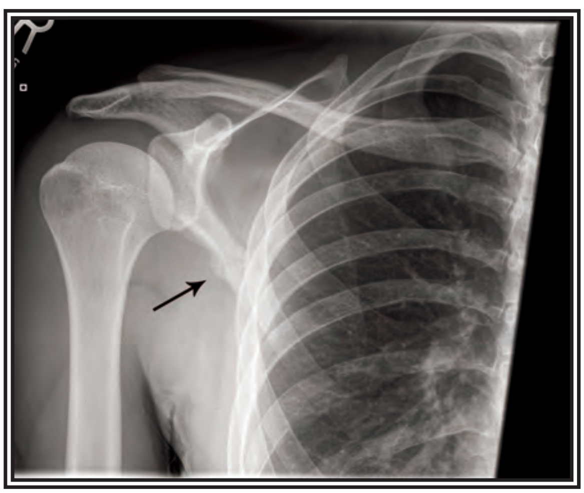

Image 3: *Three week post injury anterior posterior view of the shoulder demonstrates a healing scapular body fracture with bony callous formation.*

iment (Commando) in which no soldiers sustained a static line injury. The smaller rate of injury is likely secondary to a relatively small number of overall jumps (706 jumps by 254 paratroopers, only 49.5% of which were with combat equipment). The fact that this injury was one of two static line injuries from the same aircraft during a summer time JFEX (nighttime, mass tactical, combat equipment, high ambient temperature with follow-on mission) supports the claim by Knapik in his 2003 paper that more complex operations tend to have higher casualty rates overall.[4] Bricknell and Craig conducted a literature review of military parachuting injuries in their 1999 paper. Review of the literature at that time listed Neel's 1951 study of 1,012 parachuting injuries as having a 0.4% rate of scapula fracture, but it does not state whether this injury was caused by a static line injury or not.[5,6] Ciccone and Richmann's 1948 study reports a scapula fracture rate of 0.2% in 3,015 parachute jumps, again, not stating whether these injuries were secondary to static line injuries or not.[7]

The Department of Emergency Medicine of Womack Army Medical Center saw a total of 429 patients with jump injuries coded by ICD 9 code. Of these 429 patients, 22 or 19.5% had a shoulder or biceps injury. A review of ICD 9 codes related to jump injury showed 647 total jump injuries in all Fort Bragg clinics combined. Two scapula fractures secondary to jump injuries were seen in 2009, but both were the result of hard landings, rather than static line injuries.

Emergency Department Management

Isolated static line injuries can usually be managed as an outpatient. Initial evaluation in the Emergency Department begins with a complete history and physical examination. The examination should especially focus on identifying concomitant injuries as well as motor and sensory neurological deficits. Physical examination should especially focus on the entire affected extremity, neck, back, and chest. Close attention to neurovascular status and confirmation of soft compartments is critical. Radiographs should include anterior/posterior views of the shoulder as well as lateral and scapula-Y views. Humerus and elbow films are needed. A chest radiograph is absolutely required. A scapula fracture can be well visualized on CT. Outpatient management of pain can usually be controlled with oral medications such as oxycodone/acetaminophen combinations, acetaminophen with codeine or ibuprofen. Patients with transected biceps muscles secondary to static line injury should be placed in a posterior splint with the elbow flexed to 45 degrees and the forearm in pronation to unload the bicep. Consultation with orthopedics in the emergency department may be indicated. Patients definitely should be seen by orthopedics in follow-up within the next several days.

Scapula Fracture Management

This case is unique in that the patient sustained a scapular body fracture in addition to his transected biceps brachii. This injury is especially significant because it appears that this injury occurred from a distraction type injury. Most scapula fractures occur from blunt force trauma and usually this trauma is almost always point focused. There is only one prior reported case of scapula body fracture secondary to a static line injury, reported by Heckmann in 1978.[8] Scapula fractures are clinically significant in that up to 80-90% of patients will have an associated injury (Table 1).[9] The importance of evaluating multi-trauma patients with scapula fractures cannot be over-emphasized. Veysi et al., found in one retrospective study that presence of scapula fracture was a significant marker for severe underlying trauma, with an Injury Severity Score (ISS) of 27.12 in trauma patients with scapula fracture versus 22.8 in patients without scapula fracture.[10] CT Scanning is an excellent tool for evaluation of the scapula as well as for imaging underlying pathology, especially injuries to the chest that may otherwise be missed. All patients diagnosed with scapula fracture on plain film should undergo CT scanning of the chest and abdomen with oral and intravenous contrast to rule underlying pathology.

The vast majority of scapular body fractures can be treated non-surgically. Closed reduction of these fractures is usually not possible. Treatment usually consists of a sling for support and early motion. Most of these fractures will heal in six weeks.[11] Indications for surgical management of scapular fractures includes: fracture of the scapular neck with greater than one centimeter of displacement, fractures of the glenoid lip or fossa, fracture with acromial involvement, fracture of the scapula neck with associated coracoid involvement.

Conclusion

Static line injury is a preventable occurrence. Unfortunately, it continues to cause significant morbidity amongst some of the nation's most outstanding warriors every year. As this unusual case shows, not all static line injuries simply affect the biceps brachii muscle. The provider must consistently search for associated injuries and look at the patient as a whole rather than concentrating on what appears to be an isolated injury.

Scapula fracture is a significant indicator of serious underlying pathology in trauma patients. These patients should undergo CT scanning of the chest to rule out underlying injury as well as further define the extent of the scapula fracture. Other injuries associated with static line injury include pectoralis major tear, biceps tendon avulsion, and fractures of the long bones of the upper extremity. Prompt evaluation of patients by orthopedics is a must, but may be done as an outpatient.

Table 1: Injuries Associated with Scapula Fractures

Pulmonary Injuries	
Pneumothorax and Pulmonary Contusion	23%
Clavicle Fracture	
Floating Shoulder Injury	23%
Shoulder Dislocation	
Brachial Plexus Injury	
Axillary Artery Injury	

Military healthcare providers assigned to airborne units should monitor pre-jump training and ensure that static line injury prevention is particularly stressed by the jumpmaster team. Individual paratroopers are responsible to themselves and their unit to ensure they practice good technique when conducting airborne operations to ensure that their actions do not cause injury to their fellow Soldiers.

Acknowledgements

Photos with the permission of the individual Soldiers. The author would like to thank COL Frank Christopher, MD, CPT (P) George Barbee, DSc, PA-C, Dr. Paul Kleinschmidt, MD, FACEP and Dr. James Santangelo and Mr. Thomas Butler PA-C for their assistance in reviewing this article.

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Public Health Foodborne Illness Case Study During a Special Operations Forces Deployment to South America

MAJ Michael McCown, DVM; SFC Benjamin Grzeszak, 18D

Abstract

Although many public health articles have been published detailing foodborne illness outbreaks, a medical literature search revealed no articles that detail a case study or a specific response of a deployed U.S. military unit to a potential foodborne illness. This article describes a recent public health case study of a U.S. Special Operations Forces (SOF) team sickened while deployed to South America. It highlights public health factors which may affect U.S. personnel deployed or serving overseas and may serve as a guide for a deployed SOF medic to reference in response to a potential food- or waterborne illness outbreak. **Methods:** Eight food samples and five water samples were collected. The food samples were obtained from the host nation kitchen that provided food to the SOF team. The water samples were collected from the kitchen as well as from multiple sites on the host nation base. These samples were packaged in sterile containers, stored at appropriate temperatures, and submitted to a U.S. Army diagnostic laboratory for analysis. **Results:** Laboratory results confirmed the presence of elevated aerobic plate counts (APCs) in the food prepared by the host nation and consumed by the SOF team. **Discussion:** High APCs in food are the primary indicator of improper sanitation of food preparation surfaces and utensils. **Conclusion:** This case study concluded that poor kitchen sanitation, improper food storage, preparation, and/or holding were the probable conditions that led to the team's symptoms.

These results emphasize the importance of ensuring safe food and water for U.S. personnel serving overseas, especially in a deployment or combat setting. Contaminated food and/or water will negatively impact the health and availability of forces, which may lead to mission failure. The SOF medic must respond to potential outbreaks and be able to (1) critically inspect food preparation areas and accurately advise commanders in order to correct deficiencies and (2) perform food/water surveillance testing consistently throughout a deployment and at any time in response to a potential outbreak.

Introduction

The health of U.S. men and women is of the utmost importance to the success of U.S. missions abroad, as well as to national security. This case study focuses on specific public health factors that affect SOF health in a combat or noncombat overseas deployment setting. These lessons learned can apply to larger units and other U.S. agencies serving outside of the U.S. (e.g., U.S. State Department personnel at U.S. Embassies).

Disease and Non-Battle Injury (DNBI) is an aspect of a unit's deployment safety and health that must receive ongoing surveillance and have continuous preventive measures applied. The entire public health picture must be fully developed through the use of public health factors that may negatively impact force health. Such factors include infectious disease, zoonotic disease, environmental hazards, and food/water contamination, among many others.

This article examines the unintentional contamination (e.g., bacterial, viral, chemical, etc.) of food and water, which leads to food/waterborne illness. The importance of food and water safety and quality assurance has been discussed previously in this Journal.[1] The SOF leadership, both command and medical, must emphasize the mandatory requirement of safe food and water procurement and use by forward deployed personnel. Procuring, storing, preparing, and holding safe food and water in a deployment setting is ensured through knowledgeable mission planning, education of team members, and surveillance testing in the field. The SOF medic must be the team's food/water safety subject matter expert (SME). He or she must be ever vigilant and ensure the team employs preventive medicine countermeasures to prevent disease and illness. By using his food/water surveillance skill-set, he must be ever vigilant for a potential foodborne illness outbreak and then be able to act swiftly in response to an outbreak. This article presents a specific case of a SOF team sickened while deployed and describes techniques and procedures for the SOF medic to reference and apply in the future if presented with a similar situation.

Situation

An entire SOF team/element became intermittently and recurrently ill while deployed five months to South America. The team's symptoms included intermittent nausea, vomiting, profuse watery diarrhea, stomach aches, malaise, mild dehydration, and headache. These symptoms recurred over the five month deployment and seemed to begin in the evenings hours, and sometimes days, after ingesting food prepared by the host nation. The effects were lost duty days and interference with the accomplishment of the team's specialized missions. The public health investigation was initiated to determine the cause of these symptoms and to preserve mission accomplishment.

Case Study

Problem: The entire SOF team/element became ill with gastrointestinal symptoms, which caused general malaise for the deployed SOF personnel and mission delay/disruption.

Methods: The affected SOF team members were the case study subjects. Host nation personnel who had close contact with the SOF team and who ate at the same host nation dining establishments were included in the study population to determine the extent of the illness and to compare and contrast their health with that of the SOF team members.

Findings: All U.S. SOF personnel experienced the previously described symptoms. Approximately 50% of selected host nation personnel described similar symptoms over this time period.

Case study: The study initially focused on obtaining a clear clinical picture and overall history on each subject. The study team obtained clinical signs and symptoms, as well as their duration. All of the SOF team members had experienced gastrointestinal symptoms at least once over the course of the five months while deployed in-country. Most also had recurrence of the same symptoms over the five month period. Team members reported most of the gastrointestinal symptoms occurred in the evenings soon after eating at the host nation dining establishment. Given the symptoms, duration, and recurrence of the symptoms associated with food ingestion from similar sources, the case study then focused on food and water analysis.

Other public health considerations associated with an austere South American deployment environment were examined. Close living conditions are factors associated with the spread of infectious diseases (e.g. respiratory). Interaction with animals or exposure to certain vectors or reservoirs (e.g. ticks) may implicate a zoonotic disease (e.g. rickettsial infections). Infectious and zoonotic diseases were ruled out through examination, history, and study. Examinations determined the team was healthy and free of infectious disease. A thorough history and description of the gastrointestinal symptoms implicated foodborne or waterborne illness as the probable cause.

Eight food samples and five water samples were collected. The food samples were obtained from the host nation kitchen that prepared food for the SOF team. The water samples were collected from the kitchen as well as from multiple sites on the host nation base. Ice and water sources used to make tea, coffee, and juices were collected and are critical components to the sampling process. All of the collected samples were packaged in sterile containers, stored at appropriate temperatures, and submitted to a U.S. Army diagnostic laboratory for analysis.

Results

The U.S. Army diagnostic laboratory conducted multi-analysis laboratory testing on all of the food, water, and ice samples we collected. The results confirmed the presence of elevated aerobic plate counts (APC) in the food prepared by the host nation and consumed by the SOF team. The major bacterial pathogens such as *E. coli* O157:H7, Salmonella, Campylobacter, Clostridium, Shigella, Bacillus, Staphylococcus, Streptococcus, and Listeria usually implicated in foodborne illness cases were ruled out by the laboratory analysis. Likewise, complete microbial, chemical, and radiological analyses of the water from multiple sources on the base ruled out water contamination as a cause.

Discussion

Aerobic plate counts are used as an indicator of bacteria levels in foods. APCs are used to evaluate the sanitary condition of foods and the utensils and surfaces used in the food.[2] Elevated APCs directly correlate with inadequate sanitation and food time-temperature abuse; in our case, poor kitchen sanitation and improper food storage, preparation, and holding were the probable causes of the team's symptoms. Food is considered time-temperature abused when it has remained in the temperature danger zone of 41°F to 140°F [which is ideal for the rapid growth of dangerous bacteria] for more than four hours.[3] This can also occur if food is not cooked, cooled, reheated or held appropriately. Additionally, appropriate food surface and processing sanitation chemicals were not used. Cross contamination occurred from unsanitary hands, utensils, counter tops, and/or cutting boards.

Without exception, in a deployment setting, the SOF medic must critically inspect food and water sources and educate host nation food handlers and cooks. This should occur on an ongoing basis with focus on proper sanitary procedures and proper food storage, cooking, and holding. The SOF medic should evaluate the entire cooking and cleaning processes and assist the host nation in developing standard operating procedures (SOPs) and training to better decrease the risk of food and waterborne illness.

The Centers for Disease Control and Prevention (CDC) estimates that 76 million foodborne illness cases occur each year in the US. This estimate equates to one in four Americans becoming ill after eating contaminated foods. While most foodborne illness cases go unreported to local health departments, nearly 13.8 million food poisoning cases are caused by known agents—30% by bacteria, 67% by viruses, and 3% by parasites.[4] The major foodborne illness caused by bacterial pathogens include *E. coli* including O157:H7, Salmonella, Campylobacter, Clostridium, Shigella, Bacillus, Staphylococcus, Streptococcus, and Listeria. The major viruses include Enterovirus, Hepatitis A and E, Norovirus, and Rotavirus. The major parasitic causes of foodborne illness are various species of flatworms, roundworms, and protozoa.[5] The major infectious causes of waterborne diseases are protozoa (Cryptosporium, Giardia), viruses (Adenovirus, Hepatitis A), bacteria, or parasites.[6] It is important for the SOF medic to review and know the signs and symptoms, incubation periods, and usual duration of illness resulting from each of these pathogens.

The following is a food- and waterborne illness outbreak guide for the SOF medic to reference: *(This guide was developed after referencing the Kansas Department of Health and Environment Division of Health's Foodborne Illness and Outbreak Investigation Manual[7] Another reference is Technical Guide 188, US Army Food and Water Vulnerability Assessment Guide)*

1. Determine that an outbreak has occurred (know the symptoms of food- and waterborne illness)
2. Contact and coordinate with key personnel (Group medical or host nation medical)
3. Obtain clinical specimens and food/water samples for laboratory analysis
4. Define cases and conduct case study/findings
5. Describe the outbreak by time, place, and person
6. Develop possible hypotheses
7. Plan and conduct the food/water case study to test hypotheses
8. Analyze the data collected and interpret results
9. Report the findings of the outbreak investigation to the affected unit, higher headquarters, and the host nation's liaison.
10. Consult with the host nation's authorities to emplace preventive measures to ensure outbreak does not recur

Conclusion

Bottom line, the SOF medic must possess an effective preventive medicine skill-set in order to be knowledgeable of the devastating impacts of food and water contamination leading to food/waterborne illness outbreaks, how to prevent them, and how to educate personnel to implement appropriate countermeasures.

These study results reinforce the importance of ensuring safe food and water for deployed U.S. personnel. Further, the critical nature of the SOF medic's involvement with the host nation's food preparation and sanitation SOP development is clear. Food and water testing and surveillance studies can and should be performed by the SOF medic. Such surveillance will decrease risk factors associated with food- and waterborne illness outbreaks. If an outbreak is suspected, the SOF medic should follow a clear and focused investigative procedure to determine the cause or causal factors to medically respond quickly based on the clinical picture. The use of appropriate food- and waterborne illness outbreak investigative procedures should be developed into a team, company, or battalion SOPs prior to a deployment.

Blood, urine, and fecal testing is indicated when signs and symptoms dictate in order to definitively rule out infectious and parasitic diseases. The SOF medic should obtain these samples and submit them to a U.S. Army diagnostic laboratory or work with a local host nation hospital and laboratory. The latter may be more appropriate in an austere deployment site due to packaging/shipping limitations.

Food and water analyses are also critical to the public health of the host nation military populations and civilian communities in areas that SOF personnel are deployed. The goal of this article is to provide the SOF medic a guide for evaluating or investigating possible food or waterborne illnesses in a SOF team or a host nation community. The importance to SOF is that these efforts and preventive measures help to ensure ensures U.S. mission success by conserving troop health and by improving the local population's health. It is the SOF medic's duty to understand the critical nature of food and water safety, how to test its safety, and then to utilize the test findings and respond appropriately to protect and promote the health of SOF and other U.S. military forces, associated host nation forces, and local civilians in the area.

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Dr. McCown enlisted in the U.S. Army in 1993. Following graduation from the University of Florida College of Veterinary Medicine, he obtained a commission in 2001. He has had the distinct honor and privilege to work with SOF medics and other SOF NCOs while serving on active duty with Special Forces thru 2005. He served one combat tour in Afghanistan in support of Operation Enduring Freedom, three deployments to South America, and a series of other missions to Central and South America.

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Case Review

Case Report: Use of the Immediate Post Concussion Assessment and Cognitive Testing (ImPACT) to Assist with Return to Duty Determination of Special Operations Soldiers who Sustained Mild Traumatic Brain Injury

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Case Report

A team of Special Operations Soldiers in Iraq and their Host Nation (HN) counterparts were enroute to a target in a convoy of High Mobility Multi-Wheeled Vehicles (HMMWVs) when one of their vehicles swerved and violently flipped. The result was the death of one host nation occupant, and the ejection of two U.S. Soldiers. Both U.S. casualties were confused but responded appropriately to questions, with only minor complaints, and no life-threatening injuries. Due to the mechanism of injury, they were immediately evacuated to a Role 3 facility for further evaluation.

After arrival at the Role 3, both casualties were evaluated with a detailed neurological exam, a trauma panel of labs, x-rays, and a head CT. All exams and tests were unremarkable. Both casualties were discharged later that day back to their unit.

Within hours of returning to their unit, both Soldiers began experiencing symptoms of headache, fatigue, "feeling foggy", and balance problems. Both attempted to minimize their symptoms in order to continue with missions. The medic recognized the signs of mild traumatic brain injury (mTBI) which prompted him to conduct further evaluation in order to elicit the true severity of their condition.

The medic had access to a computer-based neuropsychological test called the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) exam which he administered to both Soldiers. Because their unit had the ImPACT program as a tool for this type of situation, both Soldiers already had pre-injury, or "baseline", exams available for comparison. Initial results highlighted a significant difference between the baseline and post-injury tests, which suggested ongoing cognitive sequelae that may have been underappreciated by both the medical providers who had initially cleared them, as well as the patients themselves. As a result, the medic recommended that both Soldiers be restricted from missions and strenuous activity in order to manage their injury properly.

The medic then emailed the results to and consulted with his medical officer and a task force psychologist by phone for further interpretation of the test results. Both agreed that the test revealed deficits in several areas, and agreed the medic's management plan was clinically appropriate. Over the next week, the Soldiers' conditions improved and their symptoms subsided. A subsequent ImPACT exam given 48 hours after the initial post-injury test confirmed their improvement. One Soldier had a complete resolution of symptoms and his ImPACT results returned to baseline within a couple of days, while the other took almost a week to see a return to baseline across all cognitive domains.

In both cases, if the ImPACT program and its objective data were not available to demonstrate the extent of their injuries, it is most likely that these Special Operations Soldiers would have immediately returned to duty. Their impaired mental status ("fogginess" or decreased executive functioning, fatigue, and difficulty concentrating on tasks) during subsequent combat missions could have caused unnecessary injury to themselves or other team members. In addition, by recognizing their condition early and initiating proper management, these Soldiers were returned to duty when it was appropriate and minimized their risk for potentially chronic symptoms of Post Concussive Syndrome and Post Traumatic Stress Disorder (PTSD), which could have not only interfered with the remainder of their deployment, but could have affected them and their families for the rest of their lives.

Introduction

Traumatic Brain Injury (TBI) has had an unprecedented impact on Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) veterans, and has become one of the "signature" injuries of the current conflicts. According to the Joint Trauma Theater Registry (JTTR), mTBI cases have substantially risen since 2002. This may be somewhat attributable to increased awareness and detection of these cases. In particular, the initiation of the DOD Policy on Theater Screening and Management of Mild Traumatic Brain Injury (Concussion) Clinical Practice Guideline (CPG), distributed in 2007, may have caused a spike in the numbers.[1] For example, less than 10% of the total number of casualties admitted to Role 3 medical facilities in OEF in 2002 were diagnosed with mTBI. For both OEF and OIF, the average went above 10% in 2005, climbed above 30% in 2007, and above 50% in 2009.[2] (Figure 1) Despite the improvement of systems to protect the Soldier, it is almost impossible to shield Soldiers from blast overpressure and other mechanisms that cause mTBI.

As this is likely to remain a significant battlefield management issue, awareness, early recognition, and proper management are vital.

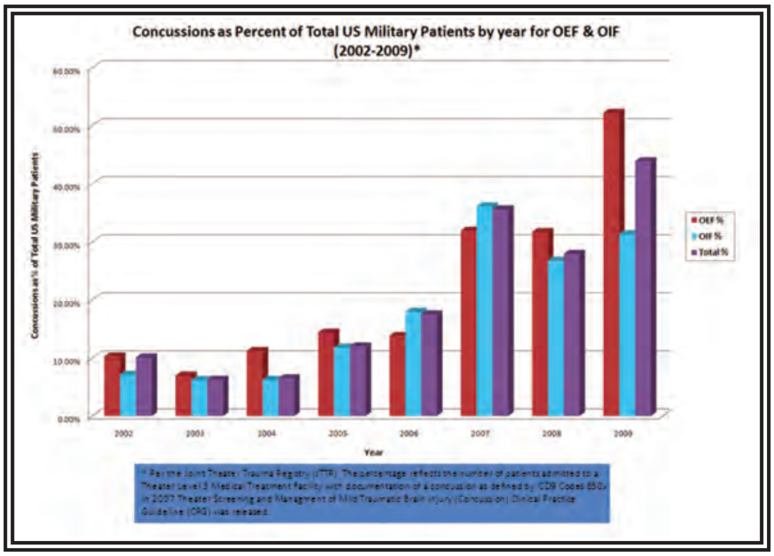

Figure 1: ***Joint Theater Trauma Registry (JTTR) Concussion Statistics from 2002 to 2009.*** *Mild Traumatic Brain Injury results in a variety of subtle signs and symptoms that can be difficult to identify. This condition often occurs with no detectable pathologic change; traditional neurodiagnostic tests such as CT, MRI, and EEG are usually unable to identify the subtle neurologic changes after injury.[3] Although management of mTBI is relatively basic, focusing on physical and cognitive rest plus protection from subsequent injury, the detection of mTBI can be complicated.*

The medical provider is often consulted to make return to duty decisions based on a Soldier's self report of symptoms, limited observation, and often with only a basic neurocognitive screening evaluation, such as the Military Acute Concussion Evaluation (MACE), as the sole objective data point. In contrast, the sports medicine community has included the use of more robust neuropsychological screening measures as an essential element in return-to-play decisions at the high school, collegiate, and professional roles. As the cognitive effects of concussion are often the last to resolve and in many cases be recognized), this added information helps to ensure the risk of persistent post concussion syndrome and/or PTSD is minimized. Detailed neuropsychological evaluation can be time consuming and costly. In addition, there are a limited number of trained neuropsychologists in the Army. Computer-based neuropsychological screening tests, such as the ImPACT, can serve as a way to identify more subtle cognitive deficits without initially requiring a neuropsychologist. A second benefit is that the ImPACT allows for the evaluation of large numbers of individuals with minimal manpower, which translates well to the military. In addition, tests can be easily disseminated to other medical specialists, often in other geographic locations, for their review and consultation. In this case, the authors asked Dr. Kratz, a clinical neuropsychologist and former Army psychologist, to review the ImPACT results for this case review.

As outlined in the Winter 2010 *Journal of Special Operations Medicine*, the United States Army Special Operations Command (USASOC) has provided specific guidelines for the diagnosis and management of mTBI, to include the use of the ImPACT program, as part of their new CPG. The purpose of this article is to use a case review as the background for how the ImPACT may be used in the field for early detection of mTBI in Special Operations Soldiers.

Mild Traumatic Brain Injury Overview

The terms Mild Traumatic Brain Injury (mTBI) and "concussion" are interchangeable terms with many definitions. Currently there are no universal standard criteria for those definitions and the diagnosis is primarily based on the characteristics of the immediate sequelae following the event. The Defense and Veterans Brain Injury Center (DVBIC) convened an expert panel regarding the management of mTBI in 2006. The result of deliberation included this operational definition of mTBI:

"Mild TBI in military operational settings is defined as an injury to the brain resulting from an external force and/or acceleration/deceleration mechanism from an event such as a blast, fall, direct impact, or motor vehicle accident which causes an alteration in mental status typically resulting in the temporally related onset of symptoms such as: headache, nausea, vomiting, dizziness/balance problems, fatigue, insomnia/sleep disturbances, drowsiness, sensitivity to light/noise, blurred vision, difficulty remembering, and/or difficulty concentrating."[4]

The diagnosis of mTBI is challenging and the use of all available tools for detection is necessary, to include a thorough history, a focused physical exam, and a neurocognitive assessment.

An extensive history, to include a detailed mechanism of injury, is an important part of the evaluation of a patient with mTBI. Providers should maintain a high index of suspicion regardless of how minimal the insult seems, or the lack of subjective symptoms. The diagnosis of mTBI in the military has traditionally relied on a Soldier's self report. However, research has suggested that exclusive reliance on individual report of symptoms can result in an overlooked diagnosis and further injury.[5] Many times Soldiers minimize symptoms in order to stay with their team and continue with the mission. Symptoms of mTBI, in addition to those listed in the definition above, can include are feeling sluggish or slowed down, feeling "foggy", memory problems, and change in sleep patterns. Headache is the most commonly reported symptom, and may be observed in as many as 70% of individuals, but mTBI may occur without headache.[6]

The physical exam is also an important part of mTBI evaluation. Signs and symptoms that may be observed by medical providers include being dazed or stunned, confused, or disoriented to time and place, clumsy movement, cognitive slowing, loss of consciousness, personality change, memory loss of events prior to incident (retrograde amnesia), and memory loss of events after incident (anterograde amnesia).[7] Inclusive to the exam should be an assessment of postural stability and the vestibular system, which is often affected soon after sustaining an mTBI.[8] Fellow teammates may be the first to recognize these signs, which underscores the need for basic education and general awareness of this subtle injury at the lowest Role.

Although neuroimaging studies are often used to rule out severe injury, such as epidural hematoma, it is rarely useful in detecting mTBI, which is a metabolic rather than structural brain injury.[9] Functional MRI (fMRI) has been shown to be a viable tool for the assessment of neural processes after mTBI, but they are not readily portable or cost effective to use in the field. On the other hand, fMRI has correlational data that confirms that the uses of neuropsychological tests provide objective and accurate assessment regarding deficits in memory, reaction time, and processing speed.[7,10]

Although the discussion regarding the management of mTBI is beyond the scope of this article, the fact that there are no curative medical treatments for mTBI emphasizes the importance of early and proper identification of mTBI. In addition to a comprehensive history and detailed physical exam, neurocognitive testing is the third leg in the proper evaluation of mTBI.

Neurocognitive Testing

The use of neuropsychological testing as a diagnostic tool for mTBI began in the mid 1980s and became more popular in the 1990s after a number of high-profile athletes prompted their employment.[11] Now, neuropsychological testing is the "cornerstone" of mTBI evaluation endorsed by most major athletic associations.[12,13] Neuropsychological testing allows a baseline versus post-injury analysis of the subtle aspects of cognitive function likely affected by mTBI, thus providing objective data to make a more informed return to duty decision. Traditional neuropsychological testing is time consuming, costly, and complicated by the limited number of neuropsychologists available to oversee and interpret the process. Thus, computer-based neuropsychological programs developed over the past 20 years help alleviate some of those issues.[7]

The computer-based programs allow for the evaluation of large numbers of individuals with minimal manpower. The data can be easily stored in a specific computer or network and easily accessed later. The computer promotes a more accurate measurement of the cognitive process to within 1/100th of a second. This accuracy increases the validity of the test by detecting subtle changes. The computer also allows for randomization of test stimuli to improve reliability and minimize "practice effects". Finally, computer-based programs allow for rapid dissemination of clinical information into a coherent clinical report that can be interpreted by trained medical personnel.[7]

Due to the significant number of mTBI cases in OIF and OEF, the Defense and Veterans Brain Injury Center (DVBIC) assembled 32 key military and civilian experts in November 2006 to gather the best practice evidence regarding the assessment and management of mTBI in the military.[4] One of the areas reviewed was neurocognitive assessment. The group reached broad consensus that baseline testing should be performed on all servicemembers in an effort to enhance the clinical interpretation and overall utility of post-injury neuropsychological testing. Although they did not recommend a specific computer-based test, they did recommend specific criteria that the test should encompass. First, they recommended that the test should take 20 minutes or less to administer. Second, they recommended that five cognitive domains be assessed: Attention/Concentration, Memory, Processing Speed, Reaction Time, and Executive Function. In addition, they recommended several factors related to the applicability, utility, and practicality of the test which include:

- Reliability, Validity, Sensitivity, Specificity, and Clinical Utility
- Availability and applicability of a normative data base and reliable change index
- Internet access and portability
- Time to administer metrics
- Ease of administration and training required
- Ease of speed of interpretation
- Ease of speed of data comparison across test administration
- Alternate forms for multiple administrations
- Flexibility of adding test modules or questions
- Ease of data transfer
- Cost per test and for maintenance and training
- Direct clinical application of results to return to duty recommendations

There are four computer-based models detailed in the scientific literature: ImPACT,[12] CogState,[13] Headminders,[14] and the Automated Neuropsychological Assessment Metrics (ANAM).[15] Of these, only the ANAM and ImPACT have been used in military research. Despite the data collected using the ANAM, no scientific evidence associates poor ANAM performance with a history of mTBI.[16] In addition to this, the psychometric properties of ImPACT appear to be better for clinical samples than the ANAM. Moreover, some of the key components recommended by the DVBIC consortium[4] are not featured in the ANAM. The lack of features is mostly related to availability, applicability, and practicality.

The other computer-based test used in military research is the ImPACT program, which is the most scientifically validated neuropsychological testing program. It was developed by sports concussion researcher Mark Lovell, PhD, who is now the director of the University of Pittsburgh Medical Center (UPMC) Sports Medicine Concussion Program. It is the most widely used computerized evaluation system to objectively assess the severity and effects of concussion and injury recovery progression following mTBI.[17] The ImPACT is comprised of seven test modules that assess eight neurocognitive abilities within 20 minutes. Several modules are designed to simultaneously evaluate multiple cognitive domains. The ImPACT is scientifically proven to be extremely sensitive. The probability that a concussion is present when the test is positive (Positive Predictive Value) is 89.4%. The probability that a concussion is not present when the test is negative (Negative Predictive Value) is 81.9%.[18] The ImPACT meets all of the criteria recommended by the DVBIC expert panel. As a result, USASOC has adopted the ImPACT as the primary neurocognitive test for the evaluation of mTBI in its personnel.

INTERPRETING THE IMPACT

The ImPACT does not yield one summary score that concludes a "yes" or "no" indication of mTBI, but rather a series of indicators that have been demonstrated to be sensitive to mTBI. The interpretation of the ImPACT should ideally follow a multi-Role path of analysis.[19] Remember that the ImPACT is not a stand-alone tool; it is meant to be used in conjunction with a detailed history and physical exam as outlined in the USASOC CPG.[20] The CPG recommends that the ImPACT be administered 24 hours post-injury, then 72 hours post-injury, and finally when complete symptom resolution occurs (just prior to return to duty), approximately 7-10 days post-injury in most cases of mTBI.

According to the ImPACT Clinical Interpretation Manual,[19] the first step in the clinical interpretation of the ImPACT is an evaluation of the *Composite Score Summary*. A quick glance can reveal subtle deficits in five areas: *Verbal and Visual Memory*, which test attention and memory; *Reaction Time* and *Visual Motor Processing*, which test cognitive speed; and *Impulse Control*. In addition, the program determines whether or not an individual's scores deviate beyond that which is expected given a typical test-retest situation. This is referred to as the Reliable Change Index (RCI) (Figures 2 & 6). This helps ensure that any changes in an individual's scores reflect clinically meaningful change and not just variability in scores due to the reliability of the test. If there is no individual baseline for comparison, normative comparisons are made based on the individual's age and gender, which determines where they would fall in comparison to a matched peer group. These percentile scores are also reported on the report for comparison. The results of the *Composite Score Summary* are also represented by graphs which illustrate the differences in each of the five composite scores using multi-colored bars for comparison (Figures 4 & 8).

The *Composite Score Summary* and associated graphs can be quickly analyzed by medics and other providers who have only elementary training on the ImPACT. However, occasionally there is not clear evidence of mTBI from evaluation of those scores alone. Therefore, further test analysis by a neuropsychologist or a medical provider with advanced training and familiarization of the ImPACT is recommended.

The second step of test analysis involves a more specific evaluation of each individual score that comprises the five composite scores (Figures 5 & 9). This requires that each individual module be analyzed in order to identify a "pattern" of strengths and weaknesses in each area of performance. This is important because many of the ImPACT modules are multi-dimensional, measuring both speed and memory. In many cases, the Soldier with mTBI may sacrifice performance in one dimension for added performance in another. These subtleties are recognized by an astute clinician who has advanced training and experience with the ImPACT.[19]

Another feature of the ImPACT is the symptom scale. The *Symptom Score Summary* is viewed in the same section as the *Composite Score Summary*. The scale lists 22 symptoms and allows the injured Soldier to rate each symptom from 0 (none) to 6 (severe), producing a combined score. This procedure promotes the quantification of the severity of symptoms and also allows the injured Soldier, medical provider, and commander to accurately track the recovery process and alert them to any potential post-concussive symptoms. (Figures 3 & 7)

According to the USASOC CPG[20] regarding the diagnosis and management of mTBI, results from the ImPACT stratify the Soldier into one of four categories: 1) **No evidence of mTBI**: No ImPACT subcomponent scores outside of the RCI, minimal symptoms at most. 2) **Simple mTBI**: ImPACT symptom score range below 30 and/or only one ImPACT subcomponent score outside of the RCI or two subcomponent scores below the 25th percentile. 3) **Complex mTBI**: ImPACT symptom score above 30 and two or more ImPACT subcomponent scores outside of the RCI or below the 16th percentile. 4) **Severe or potentially severe head injury**: Evidence of more severe injury requiring imaging, potential need for neurosurgical intervention, or potential for further deterioration and need for supportive care such as airway management.

Along with Soldiers who try to minimize mTBI symptoms in order to be with their team and continue operations, there is a potential for some Soldiers to "sandbag" or perform poorly on the ImPACT to purposely establish a low baseline, thus making it easier to exceed this Role of performance after sustaining an mTBI. "Sandbagging" during baseline testing is usually evident by an extremely high Impulse Control Composite of greater than 30. In this case the Soldier should be asked to retake the baseline test.[19]

The most common causes of test invalidity during baseline testing are: 1) Failure to properly read directions, 2) Attention deficit hyperactivity disorder (ADHD), 3) Excessive fatigue, 4) Horseplay, 5) Left-right confusion, mostly seen during the X's and O's distracter task, and 6) "Sandbagging" as discussed above.[19] In order to ensure a Soldier performs their best on the ImPACT, it is important that they are tested in a secluded environment that is not distracting. It is essential that they know to read the directions carefully and comprehend them thoroughly before starting each test module; once the module starts there is no stopping, and speed and accuracy are vital in each phase. Finally, it is recommended that the test administrator review all scores in an attempt to identify Soldiers who did not extend good effort or who misunderstood directions. These Soldiers should be asked to complete an additional baseline evaluation.

Case Discussion

Casualty 1

The first factor to consider in reviewing the ImPACT scores following an injury is the validity of the test results. At times, residual confusion or a misunderstanding of test directions may make some scores invalid. In this case, the intra-test indicators demonstrated valid baseline and post-injury ImPACT assessments. Cognitive test results within 24 hours of the concussion suggest a significant decline in visual recognition memory (immediate and delayed), visuomotor speed, and reaction time. Reaction time was the primary deficit, which fell from the very superior range to the severely impaired range. Of note, this is readily identifiable by the highlighted scores on his ImPACT score report. Highlighted scores demonstrate a statistically significant change in performance in that domain, and that this change exceeds the normal variability in scores that take place when you give someone the test a second time; this is referred to as reliable change index (RCI). In addition to the cognitive data, his total Post-Concussion Symptoms (PCS) clearly exceeded that which he had reported at baseline, thereby providing additional support for both physical and cognitive postconcussive symptomatology at that time.

Two days later, Casualty 1's visual memory and visuomotor speed returned to baseline Roles, although his reaction time remained impaired. In comparison to his baseline, reaction time remained about 2.6 standard deviations below his baseline expectation. As his baseline reaction time fell in the very superior range, a full recovery in this cognitive domain would likely have resulted in scores closer to the average to high average range (50th to 75th percentiles). As such, this suggested ongoing cognitive sequelae two days after the injury despite other indicators of a possible return to baseline (i.e., self report).

According to the USASOC CPG, this Soldier was considered a "Complex mTBI". He had a symptom score of 30. Additionally, he had three composite scores outside of the RCI: Visual memory, Visual motor speed, and Reaction time.

Casualty 2

For casualty number 2, intra-test indicators demonstrated valid baseline and post-injury assessments. Cognitive test results on the day of the concussion suggest significant deficits in verbal and visual recognition memory (trended toward greater difficulty with delayed memory versus immediate memory, which was determined by subtest scores). Two

Composite Scores *			
Memory composite (verbal)	93 73%	99 98%	98 95%
Memory composite (visual)	91 96%	**71** 62%	83 92%
Visual motor speed composite	44.25 97%	**31.83** 31%	47.63 99%
Reaction time composite	0.52 98%	**0.86** <1%	**0.70** 26%
Impulse control composite	2	1	1
Total Symptom Score	16	30	7
PTSD Score		0	0
PITT Score	2		

* Scores in **bold** type indicate scores that exceed the Reliable Change Index score (RCI) when compared to the baseline score. However, scores that do not exceed the RCI index may still be clinically significant. Percentile scores, if available, are listed in small type. Please consult your ImPACT User Manual for more details.

Figure 2: *Casualty 1 Composite Score Summary; Baseline, 24 & 72 hours post-injury.*

Symptom Inventory (at time of exam)			
Headache	1	4	0
Nausea	0	3	0
Vomiting	0	0	0
Balance Problems	0	2	0
Dizziness	0	1	0
Fatigue	2	2	1
Trouble falling asleep	2	3	2
Sleeping more than usual	0	0	0
Sleeping less than usual	2	0	0
Drowsiness	3	3	1
Sensitivity to light	0	0	0
Sensitivity to noise	0	0	0
Irritability	0	0	0
Sadness	0	0	0
Nervousness	0	3	1
Feeling more emotional	0	0	0
Numbness or tingling	0	0	0
Feeling slowed down	3	3	1
Feeling mentally foggy	2	2	1
Difficulty concentrating	0	2	0
Difficulty remembering	1	1	0
Visual problems	0	1	0
Total Symptom Score	**16**	**30**	**7**

Figure 3: *Casualty 1 Symptom Inventory; Baseline, 24 & 72 hours post-injury.*

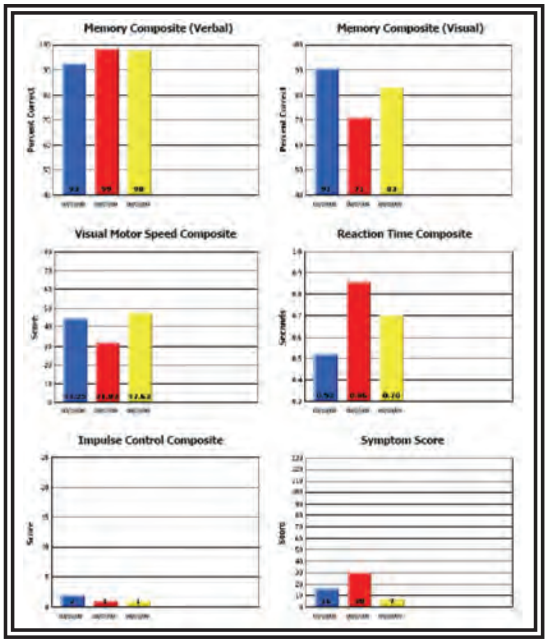

Figure 4: *Casualty 1 Composite Score Graphs*

days later, these abilities had returned to baseline, as did his total symptom scores.

According to the USASOC CPG, this Soldier was considered a "Complex mTBI". He had a symptom score greater than 30 (39). He had two composite scores outside of the RCI: Verbal memory and Visual memory.

Implementation of the ImPACT in USASOC

In November 2009, a representative from the USASOC Surgeon's Office briefed the ImPACT Neurocognitive Testing and Clinical Practical Guidelines to medical personnel from several USASOC units in order to begin its implementation. The goal was to have select United States Army Special Forces Command (USASFC) units begin ImPACT baseline testing by December 2009, prior to their upcoming deployments. The 4th Battalion, 5th Special Forces Group (Airborne) was the first unit to incorporate the ImPACT prior to its deployment to Iraq in early 2010. Initially, accessibility was a concern for such a large community in such a short period of time. In response, the University of Pittsburg developed a USASOC specific online test site.

Composite Scores *								
Memory composite (verbal)	88	65%	**73**	16%	82	49%		
Memory composite (visual)	84	96%	**60**	25%	93	99%		
Visual motor speed composite	30.88	29%	33.15	42%	36.68	56%		
Reaction time composite	0.55	88%	0.59	69%	0.55	88%		
Impulse control composite	1		3		3			
Total Symptom Score	4		**39**		0			
PTSD Score			0		0			
PITT Score	12							

Scores in **bold** type indicate scores that exceed the Reliable Change Index score (RCI) when compared to the baseline score. However, scores that do not exceed the RCI index may still be clinically significant. Percentile scores, if available, are listed in small type. Please consult your ImPACT User Manual for more details.

Figure 6: *Casualty 2 Composite Score Summary; Baseline, 24 & 72 hours post-injury*

Exam Type	Baseline	Post-injury	Post-injury
Date Tested	03/19/2008	09/07/2009	09/09/2009
Last Concussion		09/07/2009	09/07/2009
Word Memory	*WG = 1*	*WG = 2*	*WG = 3*
Hits (immediate)	12	12	9
Correct distractors (immed.)	12	12	12
Learning percent correct	100%	100%	88%
Hits (delay)	12	12	12
Correct distractors (delay)	12	10	12
Delayed memory pct. correct	100%	92%	100%
Total percent correct	100%	96%	94%
Design Memory			
Hits (immediate)	11	10	11
Correct distractors (immed.)	11	7	11
Learning percent correct	92%	71%	92%
Hits (delay)	11	9	11
Correct distractors (delay)	10	6	11
Delayed memory pct. correct	88%	63%	92%
Total percent correct	90%	67%	92%
X's and O's			
Total correct (memory)	11	9	9
Total correct (interference)	138	113	129
Avg. correct RT (interference)	0.36	0.55	0.42
Total incorrect (interference)	2	1	1
Avg. incorrect RT (interfer.)	0.23	0.36	0.50
Symbol Match			
Total correct (visible)	27	27	27
Avg. correct RT (visible)	1.40	1.84	2.01
Total correct (hidden)	7	9	9
Avg. correct RT (hidden)	1.97	2.33	2.12
Color Match			
Total correct	9	9	9
Avg. correct RT	0.75	1.41	1.01
Total commissions	0	0	0
Avg. commissions RT	0.00	0.00	0.00
Three Letters			
Total sequence correct	5	5	5
Total letters correct	15	15	15
Pct. of total letters correct	100%	100%	100%
Avg. time to first click	2.34	3.20	1.78
Avg. counted	18.0	14.0	21.6
Avg. counted correctly	18.0	11.8	21.0

Figure 5: *Casualty 1 Individual Module Scores; Baseline, 24 & 72 hours post-injury*

Symptom Inventory (at time of exam)			
Headache	0	4	0
Nausea	0	3	0
Vomiting	0	0	0
Balance Problems	0	3	0
Dizziness	0	3	0
Fatigue	0	3	0
Trouble falling asleep	0	0	0
Sleeping more than usual	0	0	0
Sleeping less than usual	0	0	0
Drowsiness	2	4	0
Sensitivity to light	0	0	0
Sensitivity to noise	0	0	0
Irritability	2	0	0
Sadness	0	0	0
Nervousness	0	3	0
Feeling more emotional	0	0	0
Numbness or tingling	0	0	0
Feeling slowed down	0	2	0
Feeling mentally foggy	0	4	0
Difficulty concentrating	0	3	0
Difficulty remembering	0	4	0
Visual problems	0	3	0
Total Symptom Score	**4**	**39**	**0**

Figure 7: *Casualty 2 Symptom Inventory; Baseline, 24 & 72 hours post-injury*

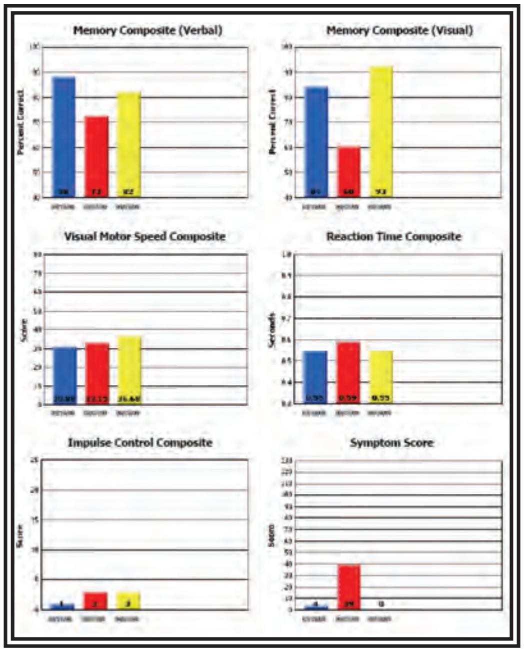

Figure 8: *Casualty 2 Composite Score Graphs*

Word Memory	WG = 1	WG = 2	WG = 3
Hits (immediate)	12	12	12
Correct distractors (immed.)	12	12	11
Learning percent correct	100%	100%	96%
Hits (delay)	12	12	11
Correct distractors (delay)	11	10	10
Delayed memory pct. correct	96%	92%	88%
Total percent correct	98%	96%	92%
Design Memory			
Hits (immediate)	9	9	9
Correct distractors (immed.)	10	8	11
Learning percent correct	79%	71%	83%
Hits (delay)	12	10	10
Correct distractors (delay)	10	7	11
Delayed memory pct. correct	92%	71%	88%
Total percent correct	85%	71%	85%
X's and O's			
Total correct (memory)	10	6	12
Total correct (interference)	127	126	135
Avg. correct RT (interference)	0.43	0.43	0.37
Total incorrect (interference)	1	3	3
Avg. incorrect RT (interfer.)	0.36	0.36	0.29
Symbol Match			
Total correct (visible)	27	27	27
Avg. correct RT (visible)	1.52	1.39	1.38
Total correct (hidden)	6	2	5
Avg. correct RT (hidden)	4.22	1.89	3.98
Color Match			
Total correct	9	9	9
Avg. correct RT	0.70	0.87	0.81
Total commissions	0	0	0
Avg. commissions RT	0.00	0.00	0.00
Three Letters			
Total sequence correct	5	5	5
Total letters correct	15	15	15
Pct. of total letters correct	100%	100%	100%
Avg. time to first click	2.83	3.21	1.99
Avg. counted	10.0	11.8	13.2
Avg. counted correctly	10.0	11.6	13.2

Figure 9: *Casualty 2 Individual Module Scores; Baseline, 24 & 72 hours post-injury*

The USASOC ImPACT site is accessible from any modern, non-secure computer that has a broadband internet connection and uses a mouse. The link allows more flexibility in administrating baseline and post injury screenings without having to rely on a designated computer loaded with ImPACT software. In addition, there are two separate links, one for testing (https://wwwimpacttestpro.org/military/), and the other for credentialed providers to review results (https://www.impacttestpro.org/resultsMilitary/). Ease of accessibility for multiple providers allows for quick review of test results and consultation throughout the echelons of care.

The 4/5th SFG (A) implemented a modified plan to conduct baseline screening for all assigned personnel. USASOC recommended administering baseline screening in a controlled environment, ideally using a computer bank to conduct supervised tests to multiple individuals. The computer facilities at Fort Campbell at that time did not support this requirement, and the unit had less than 30 days to complete the baseline exams. A train the trainer and decentralized testing approach was adopted. Each Special Operations Medical Sergeant (MOS 18D) was briefed on the USASOC testing guidelines and then given a baseline exam themselves. The goal was to emphasize the importance of conducting the screening in a quiet, controlled environment and to avoid some of the more common mistakes that resulted in invalid tests. Each 18D then administered baseline exams to their respective team or section. Headquarters and Support personnel were tested by the Battalion Medical section. The majority of exams were administered either in the team room during periods of limited activity or at home using personal computers that met the minimal support requirements. Despite the operational constraints of limited time and less than ideal testing circumstances, only 2% of the baseline tests were invalid with the first attempt. Invalid results were identified on the ImPACT website with an annotation of (++). These individuals were retested, resulting in valid baseline exams.

Using a decentralized screening method, 4/5th SFG (A) achieved 100% valid baseline screening prior to its OIF deployment within less than 30 days. While deployed, the ImPACT website was accessible through both military and civilian web servers. This type of access proved to be very beneficial to the 4/5th SFG(A) mission, which often required elements to be spread out over a large geographic area with varied base communication support.

During 4/5th SFG (A) deployment, only one hostile incident resulted in the need for post injury ImPACT evaluation. An Operational Detachment was conducting convoy operations when they were struck by an Improvised Explosive Device (IED). The IED struck a Partner Force vehicle resulting in non-life threatening injuries and minimal damage to other vehicles in the convoy. Due to the proximity of the explosion to detachment members, each received immediate MACE exams and then ImPACT screening within 24 hours. Fortunately, no detachment members had evidence of mTBI and returned to duty after a 24 hour United States Forces-Iraq (USF-I) mandatory post explosion exposure stand down. Utilizing the ImPACT website, the Special Operations Task Force (SOTF) Surgeon was able to review baseline and post injury results and make timely recommendations to the commander that resulted in proper patient management as well as minimal interruption to operations.

The approach that 4/5th SFG (A) took to administer the pre-deployment baseline ImPACT was not ideal, but it demonstrated the true reality that most deploying SOF units face. Despite the challenges, they completed their mission by testing over 450 Soldiers in less than 30 days. In the future, baseline screening for 4/5th SFG (A) will be conducted during initial Battalion in-processing in a controlled environment. Another solution may be to implement baseline testing during the Special Forces Qualification Course.

Conclusion

Mild Traumatic Brain Injury is the "signature" injury of the current wars. The diagnosis of mTBI is challenging and the use of all available tools for detection is necessary, to include a thorough history, a focused physical exam, and a neurocognitive assessment. The ImPACT is the most widely used computerized evaluation system to objectively assess the severity and effects of concussion and injury recovery progression following mTBI. USASOC has implemented the use of the ImPACT in its Clinical Practice Guidelines for the diagnosis and management of mTBI. It is imperative that all USASOC medical personnel are familiar with the ImPACT in order to ensure their personnel have valid baseline tests prior to deployment. The proper implementation of the ImPACT, along with the other USASOC CPG recommendations, allows for early and accurate identification of mTBI and initiation of proper management to reduce morbidity and mortality of Special Operations Soldiers and protect against further insult.

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Editorial Review

Letter to the Editor

Gentlemen, it is with great interest that I read the article by SGM Bowling and COL Pennardt entitled “The Use of Fresh Whole Blood Transfusions by the SOF Medic for Hemostatic Resuscitation in the Austere Environment” and COL Pennardt’s editorial review “The Time to Field Freeze Dried Plasma is Now” published in the (Summer 2010 issue).

The use of pro-coagulants in the pre-hospital combat setting has been increasing as we strive to improve mortality and morbidity from combat wounds. Recombinant Factor VIIa has been fielded for prehospital use by several SOF units. Now we are looking at lyophilized plasma for the treatment of hemorrhage.

I am concerned that we are trying to recreate the wheel with lyophilized plasma as there are still other pro-coagulant agents that are cheap, tested, and readily available. In June 2010, the CRASH-2 trial was published in the Lancet. It studied the use of Tranexamic acid for hemorrhage control in the trauma setting. The results of this study were very promising. It showed a significant decrease in mortality and morbidity when using Tranexamic acid in trauma. By comparison, rFVIIA has yet to show decreased mortality and morbidity when used for traumatic hemorrhage control.

The CRASH-2 trial was a randomized, double-blinded, placebo controlled study that was undertaken in 274 hospitals worldwide, with an enrollment of 20,211 patients. They gave two 1 gram doses (cost $9 per dose) to experimental patients and the control patients were given saline placebo. The primary outcome was death in hospital within four weeks of injury. The all cause mortality was significantly reduced in the experimental group vs. the control group, 1463(14.5%) vs. 1613 (16.0%); $p = 0.0035$. The conclusion from the trial was “Tranexamic acid safely reduced the risk of death in bleeding trauma patients in this study.”

If the community has not yet looked at using Tranexamic acid, then this agent merits further study. It is already in use by orthopedic surgeons and CT surgeons in the US under the trade name Cyklokapron. We have certainly used other agents with a lot less evidence to back their use.

Very Respectfully,
Theodore Redman, M.D.

Reply from
ANDRE PENNARDT, MD, FACEP
COL, MC, MFS, DMO

I would like to thank Dr. Redman for his comments. I agree with him that the CRASH-2 trial demonstrated a significant mortality reduction in bleeding trauma patients who received tranexamic acid when compared to placebo. This antifibrinolytic agent may well play a future role in the damage control resuscitation of SOF casualties. At the time of this writing, senior medical experts are working to develop an optimal strategy for the employment of tranexamic acid by U.S. forces. It is important to note that patients in the CRASH-2 trial received tranexamic acid as part of hospital based, non-standardized trauma care. Additionally, since few received the drug less than one hour after injury, it may be difficult to fully ascertain the potential impact of its use in point of injury care without further studies. The use of tranexamic acid in combat casualties is also not currently an approved FDA indication, which means that SOF medics could only use it off label under physician-directed protocols.

I must disagree with the notion that tranexamic acid can be considered a substitute for plasma or fresh whole blood on the battlefield. While this drug may be beneficial in addressing certain aspects of the coagulopathy of trauma (although CRASH-2 did not measure fibrinolytic activity in the enrolled patients), it does not restore the depleted intravascular volume seen in shock. The purpose of my editorial was to address the SOF requirement for a resuscitation fluid that does not contribute to the dilutional coagulopathy often seen with crystalloid or colloid administration and is not associated with the logistical burden of products such as fresh frozen plasma. The optimal management of combat wounds requires comprehensive solutions. We must continue to explore and evaluate all therapies that have the potential to reduce death on the battlefield.

Medical History

Notes on the Establishment of the United States Army Special Warfare Center (Airborne) Surgeon's Office

LTC Louis T. Dorogi, MSC (Ret)

Abstract

In the early 1960s, LTC Richard L. Coppedge, Medical Corps, expanded the functions of the Office of the Surgeon for the Special Warfare Center at Fort Bragg, North Carolina. He drew upon the then recent Special Forces experience in Laos and the beginnings of Special Forces experience in Vietnam to reorient the Special Forces medical mission from guerilla warfare to counterinsurgency. With improved training, development of new equipment, coordination with civilian and military medical agencies, collection of medical intelligence data, and an increase of key staff within his office, he left a huge legacy for other Special Forces Surgeons to emulate.

Establishing the Center Surgeon's Office

Since the 1952 relocation to Fort Bragg, North Carolina, the United States Army Special Warfare Center (Airborne) (hereinafter SWC) lacked the authorization for a full time Surgeon to direct its medical activities. Over eight years later, a physician was finally given the function merely as an additional duty. Captain (CPT) David Paulsrud, Medical Corps (MC), the Surgeon of the 7th Special Forces Group (Airborne), was assigned those perfunctory duties on 2 December 1960. Outside of the title, the functions of the position were undefined. The duties of the 7th Special Forces Group; however, were real and CPT Paulsrud recalled that his additional duties as the Special Warfare Center Surgeon rarely exceeded that of recruiting enlisted personnel at Fort Sam Houston in Texas or proselytizing medical officers from the 82nd Airborne Division.[1]

Finally, with the strong endorsement of the Surgeon of the XVIII Airborne Corps, positions for the SWC Surgeon and a Medical Service Corps (MSC) officer were established on the SWC Tables of Distribution and Allowances (TDA).[2] Until the return of CPT Paulsrud from a mission in Laos and his subsequent appointment as the first full time SWC Surgeon, little could be done. CPT Helmer W. Thompson, MSC, whose assignment preceded CPT Paulsrud's by two months, remembered that initially "The only thing that came our way was if we went to staff meetings and something came in requiring action in the medical area, most often it was shifted our way. Oftentimes, we had to run around and find it. However, as things progressed, we got involved in the training."[3] The position of the SWC Surgeon was now placed under the SWC G-3 for staff supervision, predicated on the realities of needed medical involvement in virtually every phase of operations and training.[4]

The Coppedge Era

Lieutenant Colonel (LTC) Richard L. Coppedge, MC, brought about a new era in Special Forces (SF) medical support.

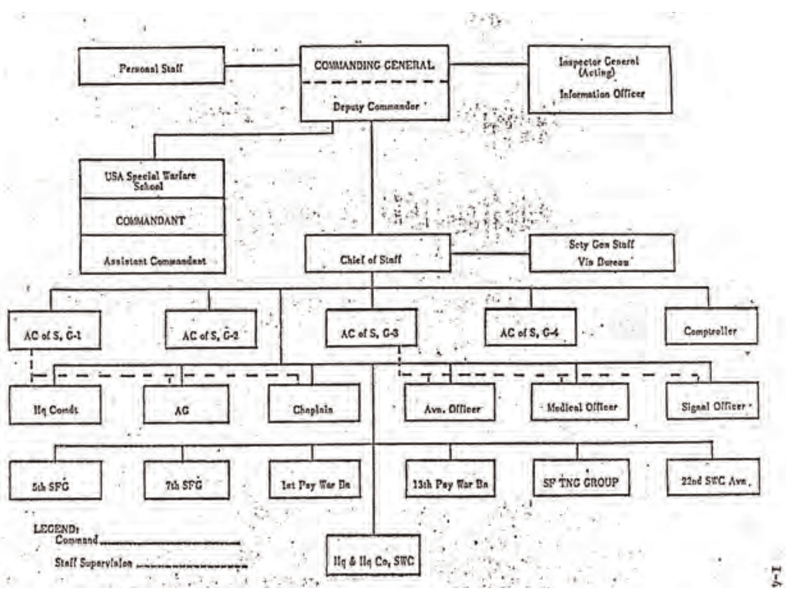

CHART 1—- Organization Chart of the Special Warfare Center (Airborne)

LTC Coppedge was an energetic, as well as articulate, salesman for upgrading the medical posture within SF. A medical degree from the University of Pennsylvania, a post doctoral fellowship at the National Cancer Institute, a previous commission as an Infantry officer, an internal medicine and physiology background, as well as his previous association with training SF aidmen at Fort Sam Houston, were all positive factors for Coppedge in addressing future training needs at the SWC. Assigned on 2 August 1962 from his position as Division Surgeon of the 82nd Airborne Division to replace CPT Paulsrud, he found a small office with an NCO, a clerk and an MSC officer. Barely able to acclimatize himself with the current parameters of his job, Coppedge faced his first crisis. Two medical officers were sent from the Office of The Surgeon General (OTSG) on 21-22 August 1962 to shed light on the rumors that reached OTSG from Laos and Vietnam about SF aidmen practicing medical procedures considered to be solely within the realm of trained physicians. "These rumors included statements to the effect that SF aidmen were being trained to do and were doing bowel surgery, appendectomies, craniotomies, thoracotomies, and obstetrics, including pre and post natal care." Additionally, the OTSG visitors were inquiring into possible adjustment problems of highly trained aidmen being suited for subsequent hospital assignments since "Doubts had been raised that the SF aidmen would fit into the less responsible and relatively subservient hospital role after his training and experience on SF missions."[5]

A visit to the training laboratory, as well as interviews with veteran aidmen returning from Laos and Vietnam, vindicated the SF medical training program. None of the allegations of illicit surgery were sustained. It was noted however; that at various hospitals on the job training (OJT) experience in obstetrics was offered for SF aidmen. The primary benefit of the visit was familiarizing the OTSG representatives with the SF medical training requirements. The visiting officers also offered recommendations to assist the program. They espoused more dispensary level training for aidmen for sharpening their diagnostic capabilities, as well as increased coordination with OJT facilities to assist those facilities in becoming familiar with the unusual nature of SF medical training. They felt that a thorough understanding by the professional medical personnel at each OJT facility would enhance acceptance of the training program.[5]

LTC Coppedge's interest in expanding the SF medical role was based on an acute appreciation of the changing patterns of medical support requirements for a counterinsurgency, versus solely a guerilla environment that existed in Laos and Vietnam. His efforts at first were limited only by the lack of sufficient staff to tackle the myriad projects he generated. Coppedge established immediate liaison with appropriate military and civilian medical authorities for assistance in focusing on the very real medical problems encountered by SF personnel on overseas missions. Arrangements were made to evacuate wounded or ill SF personnel to Womack Army Hospital at Fort Bragg (if not medically contraindicated or objectionable to the individual concerned) to facilitate medical follow up, as well as collection of medical data/intelligence.

Subsequently, in November, the SWC hosted the fall meeting of the Armed Forces Epidemiological Board (AFEB). Coppedge's emphasis on this area rapidly led to a positive program for medically debriefing all pre- and post-mission SF personnel. Actively seeking suitable lightweight field medical equipment for SF Tables of Organization (TOEs), Coppedge was responsible for a wide ranging program in design and field testing of potential equipment in cooperation with the U.S. Army Special Warfare Combat Development Agency, the Limited War Laboratory and other similar organizations.

His office published a semi-official monthly Medical Information Letter. It became a useful medium for communications with overseas SF units and though designed primarily to disseminate technical/administrative information; it no doubt served admirably to publicize the SF medical role. During Exercise "Devil Arrow", conducted during September-October 1962, new insight was gained by the SWC via design of realistic casualty play regarding treatment and evacuation of casualties in a counterinsurgency environment. Experience gained in Southeast Asia was used to recommend a revision and increase within the SF Group TOE. Commensurately, Coppedge requested an increase in his own staff.[6] Approval of nine additional personnel spaces in 1963 provided the necessary manpower to accomplish the medical mission. Recommended medical personnel increases at the SF Group level were also approved. An OTSG sanctioned recruiting trip to Fort Sam Houston produced the requisite increase in physician volunteers. Formal mission changes now incorporated the concept of collection, evaluation, and dissemination of medical information pertaining to the areas of Special Warfare operations, as well as the remainder of the programs recommended by Coppedge.

Liaison with the civilian, Federal, and the military medical community, as well as the American Medical Association, was further enhanced by two seminars held at the SWC in April

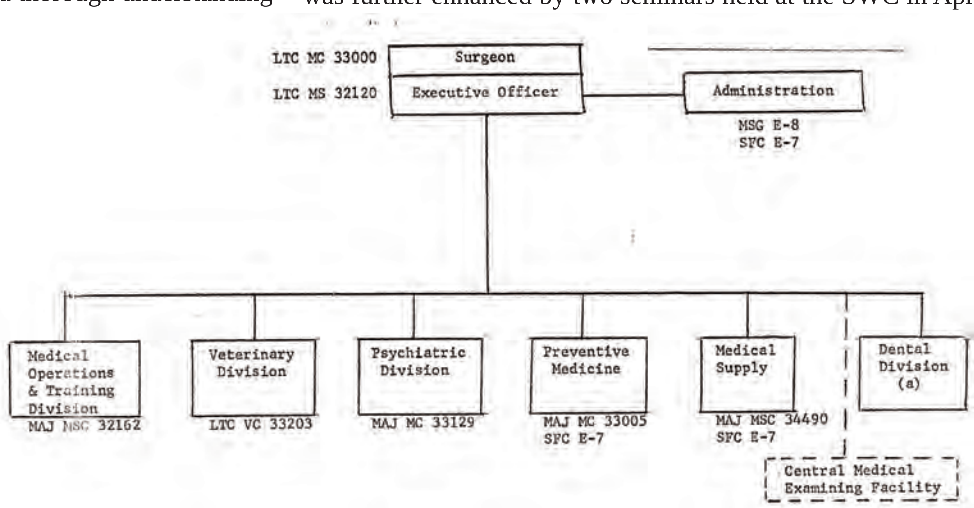

CHART 2—-Office of the Surgeon

1964 and January 1966. The seminars explored the complexities and the common trends within the medical aspects of counterinsurgency. Comparison of government overseas medical programs with the military medical efforts in Southeast Asia focused on the inherent difficulties of exporting Western medicine to underdeveloped countries, especially those facing local insurgencies.[7]

Coppedge was also an avid proponent of increased hospital training for his medics with the specific proviso that training be more doctor than nurse-oriented. He saw the need for physician substitutes. This was a logical reflection of the Laos and Vietnam experience, wherein independent action by the SF aidman was the rule, not the exception. This operational reality juxtaposed the SF aidman against the nurse-oriented programs conducted at Fort Sam Houston.

Accordingly, he set up an OJT program at Womack Army Hospital. Under the supervision of physicians, selected SF aidmen received three to six weeks of training in a variety of areas that Coppedge felt was necessary for those expected to serve in Vietnam, namely pediatrics, dermatology, orthopedics, and laboratory procedures.

Coppedge's views on increased clinical training for the aidmen were properly balanced by his acute awareness of its limitations. With the encouragement of Major General William Yarborough, he formulated a guidance code entitled the *Special Forces Aidman's Pledge*. Of particular significance was the wording of the third tenet in the *Pledge* "I confess the limitations of my skill and knowledge in caring for the sick and injured."[9] Coppedge also maintained a close relationship with academia in exploring the need for a physician assistance concept. This led to support of the development of a formal Physician's Assistant (PA) program at Duke University, patterned to a great extent on the SF experience.[10]

Under Coppedge's direction, the SF medical program expanded. Most of the projects were directly or peripherally related to the growing SF presence in Vietnam. The assignment of the first veterinarian to SF added a welcome dimension to SF medical support. LTC Bjourne Folling, Veterinary Corps (VC), undertook a pilot program to revive training in the use and care of pack animals and published a local manual on the subject. More directly related to the Vietnam needs of SF, he began to examine ramifications of dealing with locally procured foods and the feasibility of animal husbandry programs, both useful to the growing counterinsurgency efforts.

With the addition of a SWC psychiatrist position, Major (MAJ) Karl A. Zener, MC, assumed a rather unusual military role as a "tactical anthropologist", focusing on the proper methods of dealing with primitive societies and cultures. Awareness of this area was often the key to proper introduction of Western medicine. His studies on the psychological stresses of isolated and hazardous operational areas allowed him to instruct A Team commanders on recognizing and coping with interpersonal problems likely to be encountered.[11]

Additional Enlisted Medical Training

The SWC Surgeon was a proponent of additional training for the aidmen. As the TO&E was being revised, authorization for some ancillary medical skills for aidmen, such as pharmacy, X-ray, laboratory, preventive medicine, veterinary, medical records, and medical supply were added for the first time. Since the Surgeon's Office also developed a TO&E for an air-droppable/portable guerilla hospital, these medical skills were added. There was no new demand for initiation of courses to provide the necessary training for most of these skills, since the Medical Field Service School in Texas already had appropriate training courses and the overall authorization within SF for these positions was limited. Despite this, there was a chronic shortage of personnel within these Military Occupational Specialties (MOSs) in Vietnam SF units. The gaps were generally filled by SF aidmen with MOS 91B, thereby straining available assets within those ranks. Perhaps the most successful MOS addition was that of preventive medicine (91S), wherein those aidmen who failed the advanced SF medical training could be retrained as preventive medicine specialists.

Coppedge interviewed SF veterans who served in Laos and responded to their recommendations, as well as those found in after action reports from Laos. He was instrumental in the design of a field laboratory kit being made available to SF medics. With the addition of MOS 93B (Laboratory Specialist) positions to the SF TOE and the introduction in late 1964 of the prototype Portable Medical Laboratory Equipment and Supply Set (Civic Action), there arose an obvious need to further sharpen the laboratory skills of SF aidmen. The set was now expected to be issued to each A Team.

The ultimate result was the initiation of a new, but informal laboratory course by two enterprising SF medical NCOs, Sergeants Edward Palow and Johnnie Wills. Another highly qualified laboratory NCO, MSG J.V. Hickman took over the course soon after its inception. The four-week long course opened in October of 1966. It offered intensive training in diagnostic medical laboratory procedures, supplementing any limited laboratory training received in the basic SF 300F1 Course at Fort Sam Houston.[12]

Training of the SF AMEDD Officers

The SWC Surgeon's Office accelerated the recruitment of Army Medical Department (AMEDD) officers. The existing training requirements for qualifying AMEDD officers for SF duty were on the average far shorter than those for the enlisted aidmen. This was due to the AMEDD officer career patterns in the 1960s, which made it prohibitive for extended or multiple SF tours. There appeared to be a major reluctance at OTSG level to provide MC and MSC officers for more than one SF tour of duty. Additionally, the low authorized grade structure, as well as the limited availability of openings or positions, created assignment problems for AMEDD officers. In contrast, enlisted personnel could legitimately expect multiple assignments to SF units.

Under Coppedge, the AMEDD officer (regardless of Branch) once he was selected for SF, was expected to complete airborne training either en route to his assignment or shortly thereafter. His next hurdle was attendance at the Special Forces Officer Course or the Counterinsurgency Officer Course. Either of these twelve week courses was similarly required for Combat Arms officers – a necessity for awarding the Special Forces designator Prefix-3 to their Military Occupational Specialties, signifying completion of the above courses. For AMEDD officers, the Prefix-3 could only be awarded by OTSG. Many AMEDD officers also volunteered for further training that was not medically oriented, such as Ranger School, Jungle Operations, HALO (High Altitude Low Opening) and SCUBA.[13]

Later there were a number of AMEDD officers who were able to obtain their SF Prefix-3 without direct attendance at resident courses of instruction at Fort Bragg. As to further medical training, the physicians could attend a variety of courses offered by OTSG. Of significant value to Vietnam-bound SF doctors was the Tropical Medicine Course offered at Walter Reed Army Institute of Research (WRAIR).

SF AMEDD officer replacements for the 5th Special Forces Group (Airborne) in Vietnam were generally selected and recommended to OTSG by the SWC Surgeon's Office. Many of these officers left Fort Bragg for Vietnam right after completion of their SF training, while others remained at Fort Bragg awaiting openings within the 5th SFG. If possible, pre-mission and language training were attended by these AMEDD officers along with other Combat Arms officers. There were a number of exceptions to the above, wherein physicians transferred from units already in Vietnam or were assigned by United States Army Vietnam (USARV).

The Central Medical Examining Facility

The integrated surveillance of the medical experience of SF personnel in overseas operational areas is rooted in the Laotian experience. The rudimentary post-mission medical procedures performed on White Star Mobile Training Team personnel toward the latter stage of the U.S. involvement in Laos showed possibilities for systemic collection of medical intelligence. The very fact that deployed personnel returned to Fort Bragg upon completion of their overseas mission, presented an unusual opportunity to observe the results of exposure to medical problems in operational areas of SF. This surveillance was beneficial not only towards protection of returning troops, but also dependents and civilians.

LTC Coppedge greatly expanded on the fledgling program that was in effect upon his arrival.

With the Laotian involvement still underway, LTC Coppedge wasted no time in drafting a staff study in September 1962, seeking command approval to develop a broad program for collection of medical information/intelligence. The program was to utilize the medical expertise of Walter Reed Army Institute of Research (WRAIR) to help analyze the data acquired by SF aidmen returning from missions, as well as the post-mission debriefing to be conducted on each SF returnee, in accordance with a set protocol. Coppedge also went with Major General William P. Yarborough on a number of fact finding tours to other countries, including South Vietnam.[14]

Coppedge recognized that the SF efforts in Vietnam were confronted with a medical situation calling for a critical examination and an unorthodox response. In his own words "The very nature of the counterinsurgency operation places the Soldier in intimate contact with a primitive environment; in some instances without benefit to the preventive measures that are available to conventional forces. At times, he may be required to eat native foods with local villagers, exposing himself to dysentery, hepatitis, cholera, and parasitic infections; may be required to participate in daily operational patrols which necessitate immersion in swamp paddy water, resulting in exposure to such diseases as leptospirosis and melioidosis; at all times, must live and work in intimate contact with animal and human reservoirs in infection for that particular area. Like the conventional Soldier, the SF Soldier arrives in the operational area without the advantage of natural immunity to many of the diseases endemic to the area. He may in truth, be described as an immunologic virgin."[15]

Consulting with experts from WRAIR, Coppedge issued a regulation by March of the following year, standardizing the policy and procedural aspects of pre- and post-mission medical examinations. Under the technical guidance of the SWC Surgeon, baseline medical data were to be obtained prior to mission departure, with the assumption that any acute symptoms occurring in the zone of operations resulted from exposure to the area. The SF Group Surgeons were to be responsible for the conduct of the pre-mission physical examinations and the necessary laboratory tests for their assigned personnel. Urinalysis, white blood cell counts, as well as blood differential counts, serology, chest X-ray, hemoglobin and three consecutive stool examinations were required. Additionally, 50cc of post-mission serum from each man was sent to the serum bank at Fort Bragg and made available to WRAIR in Washington, DC for more sophisticated studies, in correlation with additional disease history obtained from unit members operating in the same geographical vicinity.[16]

The SWC Surgeon conducted an extensive pre-mission briefing for medical personnel scheduled for overseas deployments, providing the necessary direction for collection of data. As a result, the aidman's abilities were enhanced to look for and observe significant factors related to disease and its transmission in each specific operational area. A compact pocket-sized document entitled "*Medical Guide for Special Forces Aidmen*" was developed. It incorporated the medical Essential Elements of Information (EEI) and established a standard guide for collection of medical and medically related data in operational areas. The Department of Biostatistics, WRAIR, assisted in developing standard encoding methods on IBM cards for the acquired data. Essentially, the same studies were repeated in post-mission physicals upon the return of SF personnel. Post-mission sera were examined at WRAIR for a battery of diseases. For example, the British military medical experience in Malaya and the French experience in Indochina suggested a strong need for comparable studies on leptospirosis in Vietnam, while examinations for suspected drug resistant strains were performed at the University of Chicago. Returning medical personnel also underwent a detailed medical intelligence debriefing. Synthesis of all the gathered data was expected "over a period of time … (to) suggest areas where on-the-spot epidemiologic investigations are appropriate, should the etiology, the mode of transmission, ecology of an operationally significant disease remain obscure."[17]

By 1964, voluminous data had been collected, revealing the potential for extensive morbidity if large numbers of American troops were to be introduced into certain areas of Vietnam. Preliminary findings were formally discussed at a medical seminar on counterinsurgency held by the SWC Surgeon at Fort Bragg in April of 1964. Key military, Federal, and civilian medical leaders were briefed on the medical experiences of SF. With over a year and a half's accumulation of collected data, certain trends emerged. Diarrheal diseases and hepatitis were found to be the most significant cause of morbidity and non-effectiveness. Diarrhea caused evacuation from the operational area for 4.8% of those affected. Of the first 902 personnel sent to Vietnam from Fort Bragg, 510 recalled having diarrhea sometime during their six-month tour.[18]

Recurring symptoms of high fever were found in over 25% and bloody stools in 11.9% of those suffering attacks. Infectious hepatitis was found to be localized in the Delta area of Vietnam, with an attack rate of 4.1 per 100. The administration of 0.05cc/lb of body weight of gamma globulin gave indication of effective prophylaxis, though a second re-immunization was indicated five months after the initial administration. This was deemed to be of great importance among SF troops, since their tours at that time were six months long and the potential for bringing hepatitis back to the Continental United States (CONUS) increased towards the latter part of their tours.

In a joint paper presented at the seminar, LTC Coppedge and his Preventive Medicine Officer, MAJ Llewellyn J. Legters, MC, cited the evident increase in drug resistant strains of malaria, though at the time, malaria was not felt to be as militarily important as in subsequent years. Also tropical sprue (malabsorption syndrome) was found in enough returning SF personnel to give rise to concern.[19]

A variety of serologic tests confirmed that antibody titers on returnees showed scattered exposure to many militarily significant diseases. Positive antibody responses to cholera, plague, rickettsial organisms, dengue and *Pseudomonas pseudomallei*, indicated a need for more sophisticated studies of their impact. Acquired intestinal parasitic infections were common.

LTC Coppedge and MAJ Legters entertained few illusions about the acquired data. They realized that their efforts needed far more sophisticated assistance. Through Legters' perseverance, WRAIR backed and funded a field epidemiologic survey team composed entirely of SF medical personnel. Conceived originally by Legters, the team was formed in the fall of 1965 and after extensive training, deployed to Vietnam in September of the following year.[20]

By early 1966, the SWC Surgeon realized that, as conducted, the pre- and post mission medical examinations were not completely satisfactory. SF Groups were far too short of personnel to maintain effective administrative and clinical standards. The permanent change of station (PCS) requirements versus the previous temporary duty (TDY) assignments changed workloads as well as screening requirements. SF troops were no longer routinely returning to Fort Bragg, so post-mission physicals and tests could not be conducted with any regularity. The previously utilized facilities at Womack Army Hospital were now not available, since Vietnam was no longer considered to be an "area with limited medical facilities" in accordance with Army Regulation 40-501. No one bothered, regretfully, to ask the SF troops in remote Vietnam locations whether they had adequate medical facilities and routine and adequate medical care available.

In June of that year, all previous procedures were standardized under the direct control of the SWC Surgeon with the creation of the Central Medical Examining Facility (CMEF). A suitable building was acquired in the process. The CMEF quickly proved its worth by demonstrating that under previous procedures, as many as a quarter of the examinees required further follow up examinations at specialty clinics at Womack Army Hospital.[21]

The formalization of data collection by the SWC was not effected until the Commander of the SWC requested from Continental Army Command (CONARC) a revision of the mission statement to include "operation of a medical examining facility which both monitors the health of the personnel deployed to remote areas of the world and serves as a collection agency for vital medical intelligence data."[22]

Command backing of the CMEF generated a new flurry of activities. A number of new procedures were tried. Post-mission psychological interviews by the SWC Psychiatrist became an integral part of CMEF testing procedures. The objectives were to determine the effects of psychological stresses peculiar to SF operations in remote areas, as well as appropriate preventive psychological measures. A secondary expectation was the collection of data for the development of improved criteria in the selection of SF personnel. Special immunodiagnostic studies determined by geographical exposures, nature and length of deployment, medical history and physical examinations were performed at the discretion of the CMEF. The outdated, as well as the impractical initial manual encoding system available at the CMEF was scheduled for replacement via linkup with the more sophisticated computer facilities at Fitzsimons General Hospital in Denver, Colorado. After a promising start, however, the transfer was never satisfactorily completed.[23]

Epilogue

LTC Coppedge was reassigned from the USA John F. Kennedy Special Warfare Center (Airborne) in 1967. He received a Legion of Merit for his work and left behind a tremendous legacy of activism and a refocus of the SF medical mission from guerilla warfare to counterinsurgency. He was responsible for the definition of the SWC Surgeon's role and the expansion of the Surgeon's Office to properly support SF medical efforts. His focus on the problems initially encountered by SF medics in Laos and Vietnam resulted in a systemic approach to medically debriefing overseas returnees and linking those findings to a more successful preventive medicine effort. His visionary efforts, leadership and accomplishments raised the bar for all future SF training and medical support in the years to come.

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10. Op. cit., Interview, Coppedge, p. 47 and telephone conversation with COL Coppedge on 2 June 2010.
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Louis T. Dorogi, LTC, MSC (USAR Ret) received a BA in history from Bowdoin College and an MAPA in public administration from the University of Oklahoma. He entered active duty in 1963 with a Regular Army Commission through ROTC. Among others, his military assignments included the 82nd Airborne Division, 7th Special Forces Group (Abn), the U.S. Army Special Forces-Walter Reed Army Institute of Research Field Epidemiological Survey Team (Abn), service in Vietnam attached to the 5th Special Forces Group (Abn), USA JFK Center for Military Assistance, XVIII Airborne Corps, and Medical History Division of the USA Center for Military History. In 1978 he became a Reserve officer, retiring from the military in 1990 as the Director of Officer Instruction for the 1033d U.S Army Reserve Forces School. As a civilian, he served as the Assistant Director Health Programs for the Passamaquoddy Indian Tribe, then as Director of Licensing and Medicare/Medicaid Certification for the State of Maine, retiring in 2007. He was an instructor on the Vietnam War for Southern New Hampshire University during 1992-95. His publications include articles in *Special Warfare* and the *Journal of Special Operations Medicine*.

Vitamin D in Preventive Medicine: Are We Ignoring the Evidence?

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Abstract
Vitamin D is metabolised by a hepatic 25-hydroxylase into 25-hydroxyvitamin D (25(OH)D) and by a renal 1α-hydroxylase into the vitamin D hormone calcitriol. Calcitriol receptors are present in more than thirty different tissues. Apart from the kidney, several tissues also possess the enzyme 1α-hydroxylase, which is able to use circulating 25(OH)D as a substrate. Serum levels of 25(OH)D are the best indicator to assess vitamin D deficiency, insufficiency, hypovitaminosis, adequacy, and toxicity. European children and young adults often have circulating 25(OH)D levels in the insufficiency range during wintertime. Elderly subjects have mean 25(OH)D levels in the insufficiency range throughout the year. In institutionalized subjects 25(OH)D levels are often in the deficiency range. There is now general agreement that a low vitamin D status is involved in the pathogenesis of osteoporosis. Moreover, vitamin D insufficiency can lead to a disturbed muscle function. Epidemiological data also indicate a low vitamin D status in tuberculosis, rheumatoid arthritis, multiple sclerosis, inflammatory bowel diseases, hypertension, and specific types of cancer. Some intervention trials have demonstrated that supplementation with vitamin D or its metabolites is able: (i) to reduce blood pressure in hypertensive patients; (ii) to improve blood glucose levels in diabetics; (iii) to improve symptoms of rheumatoid arthritis and multiple sclerosis. The oral dose necessary to achieve adequate serum 25(OH)D levels is probably much higher than the current recommendations of 5–15 μg/d.

Why is Preventive Medicine Exempted From Ethical Constraints?

P Skrabanek
J Med Ethics 1990;**16**:187-190 doi:10.1136/jme.16.4.187

Abstract
It is a paradox that medical experimentation on individuals, whether patients or healthy volunteers, is now controlled by strict ethical guidelines, while no such protection exists for whole populations which are subjected to medical interventions in the name of preventive medicine or health promotion. As many such interventions are either of dubious benefit or of uncertain harm-benefit balance, such as mass screening for cancers or for risk factors associated with coronary heart disease, there is no justification for maintaining the ethical vacuum in which preventive medicine finds itself at present.

A Prospective Study of Plasma Homocyst(e)ine and Risk of Myocardial Infarction in U.S. Physicians

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JAMA. 1992;268(7):877-881

Abstract
Objective: To assess prospectively the risk of coronary heart disease associated with elevated plasma levels of homocyst(e)ine. **Design:** Nested case-control study using prospectively collected blood samples. **Setting:** Participants in the Physicians' Health Study. **Participants:** A total of 14916 male physicians, aged 40 to 84 years, with no prior myocardial infarction (Ml) or stroke provided plasma samples at baseline and were followed up for 5 years. Samples from 271 men who subsequently developed Ml were analyzed for homocyst(e)ine levels together with paired controls, matched by age and smoking. **Main Outcome Measure:** Acute Ml or death due to coronary disease. **Results:** Levels of homocyst(e)ine were higher in cases than in controls (11.1±4.0 [SD] vs 10.5±2.8 nmol/mL; *P*=.03). The difference was attributable to an excess of high values among men who later had MIs. The relative risk for the highest 5% vs the bottom 90% of homocyst(e)ine levels was 3.1 (95% confidence interval, 1.4 to 6.9; *P*=.005). After additional adjustment for diabetes, hypertension, aspirin assignment, Quetelet's Index, and total/high-density lipoprotein cholesterol, this relative risk was 3.4 (95% confidence interval, 1.3 to 8.8) (*P*=.01). Thirteen controls and 31 cases (11%)

had values above the 95th percentile of the controls. **Conclusions:** Moderately high levels of plasma homocyst(e)ine are associated with subsequent risk of Ml independent of other coronary risk factors. Because high levels can often be easily treated with vitamin supplements, homocyst(e)ine may be an independent, modifiable risk factor.

Epidemiologic Assessment of Chronic Atrial Fibrillation and Risk of Stroke: The Fiamingham Study

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Neurology 1978;28:973

Chronic atrial fibrillation (AF) as a precursor of stroke was assessed over 24 years of follow-up of the general population sample at Framingham, Massachusetts. Persons with chronic established AF, with or without rheumatic heart disease (RHD), are at greatly increased risk of stroke, and the stroke is probably due to embolism. Chronic AF in the absence of RHD is associated with more than a fivefold increase in stroke incidence, while AF with RHD has a 17-fold increase. Stroke occurrence increased as duration of AF increased, with no evidence of a particularly vulnerable period. Chronic idiopathic AF is an important precursor of cerebral embolism. Controlled trials of anticoagulants or antiarrhythmic agents in persons with chronic AF may demonstrate if strokes can be prevented in this highly susceptible group.

Psychological Predictors of Hypertension in the Framingham Study: Is There Tension in Hypertension?

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JAMA. 1993;270(20):2439-2443.

Abstract

Objective: To test the hypothesis that heightened anxiety, heightened anger intensity, and suppressed expression of anger increase the risk of hypertension, using the Framingham Heart Study. **Design:** A cohort of men and women without evidence of hypertension at baseline were followed up for 18 to 20 years. Baseline measures of anxiety (tension), anger symptoms, and expression of anger (anger-in and anger-out) were taken, along with biological and behavioral predictors of hypertension (initial systolic blood pressure, heart rate, relative weight, age, hematocrit, alcohol intake, smoking, education, and glucose intolerance). **Participants:** A total of 1123 initially normotensive persons (497 men, 626 women) were included. Analyses were stratified by age (45 to 59 or 60 years) and gender. **Main Outcome Measures:** Hypertension was defined as either taking medication for hypertension or blood pressures higher than 160/95 mm Hg at a biennial examination. **Results:** In univariate analyses, middle-aged men who went on to develop hypertension had greater baseline anxiety levels than men who remained normotensive (P=.04). Older hypertensive men had fewer anger symptoms at baseline (P=.04) and were less likely to hold their anger in (P=.01) than normotensives. In multivariate Cox regression analysis including biological predictors, anxiety remained an independent predictor of hypertension in middle-aged men (P=.02). Among older men, anger symptoms and anger-in did not remain significant predictors in the multivariate analysis. Further analysis showed that only middle-aged men with very high levels of anxiety were at increased risk (relative risk, 2.19; 95% confidence interval, 1.22 to 3.94). No psychological variable predicted hypertension in middle-aged or older women in either univariate or multivariate analyses. **Conclusions:** The results indicate that among middle-aged men, but not women, anxiety levels are predictive of later incidence of hypertension.

Sick Individuals and Sick Populations

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International Journal of Epidemiology 2001;30:427-432; *International Journal of Epidemiology* 1985;14:32–38.

Abstract

Aetiology confronts two distinct issues: the determinants of individual cases, and the determinants of incidence rate. If exposure to a necessary agent is homogeneous within a population, then case/control and cohort methods will fail to detect it: they will only identify markers of susceptibility. The corresponding strategies in control are the 'high-risk' approach, which seeks to protect susceptible individuals, and the population approach, which seeks to control the causes of incidence. The two approaches are not usually in competition, but the prior concern should always be to discover and control the causes of incidence.

Effects of Interventions In Healthcare Settings on Physical Activity or Cardiorespiratory Fitness

Denise G Simons-Morton, MD, PhD; Karen J Calfas, PhD; Brian Oldenburg, PhD; Nicola W Burton (MPsych)
*American Journal of Preventive Medicine*Volume 15, Issue 4 , Pages 413-430, November 1998

Abstract

Introduction: This paper reviews studies of physical activity interventions in healthcare settings to determine effects on physical activity and/or fitness and characteristics of successful interventions. **Methods:** Studies testing interventions to promote physical activity in healthcare settings for primary prevention (patients without disease) and secondary prevention (patients with cardiovascular disease [CVD]) were identified by computerized search methods and reference lists of reviews and articles. Inclusion criteria included assignment to intervention and control groups, physical activity or cardiorespiratory fitness outcome measures, and, for the secondary prevention studies, measurement 12 or more months after randomization. The number of studies with statistically significant effects was determined overall as well as for studies testing interventions with various characteristics. **Results:** Twelve studies of primary prevention were identified, seven of which were randomized. Three of four randomized studies with short-term measurement (4 weeks to 3 months after randomization), and two of five randomized studies with long-term measurement (6 months after randomization) achieved significant effects on physical activity. Twenty-four randomized studies of CVD secondary prevention were identified; 13 achieved significant effects on activity and/or fitness at twelve or more months. Studies with measurement at two time points showed decaying effects over time, particularly if the intervention were discontinued. Successful interventions contained multiple contacts, behavioral approaches, supervised exercise, provision of equipment, and/or continuing intervention. Many studies had methodologic problems such as low follow-up rates. **Conclusion:** Interventions in healthcare settings can increase physical activity for both primary and secondary prevention. Long-term effects are more likely with continuing intervention and multiple intervention components such as supervised exercise, provision of equipment, and behavioral approaches. Recommendations for additional research are given.

Developing a Framework For Assessment of the Environmental Determinants of Walking and Cycling

Terri Pikora, Billie Giles-Corti, Fiona Bull, Konrad Jamrozik, Rob Donovan
S*ocial Science & Medicine* Volume 56, Issue 8, April 2003, Pages 1693-1703

Abstract

The focus for interventions and research on physical activity has moved away from vigorous activity to moderate-intensity activities, such as walking. In addition, a social ecological approach to physical activity research and practice is recommended. This approach considers the influence of the environment and policies on physical activity. Although there is limited empirical published evidence related to the features of the physical environment that influence physical activity, urban planning and transport agencies have developed policies and strategies that have the potential to influence whether people walk or cycle in their neighborhood. This paper presents the development of a framework of the potential environmental influences on walking and cycling based on published evidence and policy literature, interviews with experts and a Delphi study. The framework includes four features: functional, safety, aesthetic and destination; as well as the hypothesized factors that contribute to each of these features of the environment. In addition, the Delphi experts determined the perceived relative importance of these factors. Based on these factors, a data collection tool will be developed and the frameworks will be tested through the collection of environmental information on neighborhoods, where data on the walking and cycling patterns have been collected previously. Identifying the environmental factors that influence walking and cycling will allow the inclusion of a public health perspective as well as those of urban planning and transport in the design of built environments.

Special Ops Crew Recognized For Life-Saving Afghan Mission

TSgt Samuel King Jr.
919th Special Operations Wing Public Affairs
10/5/2010 - DUKE FIELD, FL

On a runway cut into the side of a mountain, four critically wounded Afghan National Police waited in the cold for a medical evacuation aircraft to land and rescue them from a fate determined by a suicide bomber, hours earlier.

That aircraft was an MC-130E Combat Talon I from the 711th Special Operations Squadron. The crew flew through mountainous terrain in a heavy snow storm with no visibility to recover the wounded and save their lives. The aircrew, part of the 919th Special Operations Wing, was recently awarded the Air Force Association's Lt Gen. William H. Tunner Award for their efforts in the snowy rescue.

In February 2009, the aircrew of "Daddy 05" was enjoying its first day off in weeks when they received word they were on alert.

Aircraft commander Lt Col Daniel Flynn thought it was a joke at first since they hadn't had a break in a while. It wasn't, however. The situation was gravely serious and the mission was a medical evacuation.

A suicide bomber had detonated an improvised explosive device at a ceremony, wounding ten and killing one. Four ANPs were injured in the blast. One victim had ball-bearing shrapnel in his chest and skull. The hospital at Bagram Air Field was the only hospital capable of saving him.

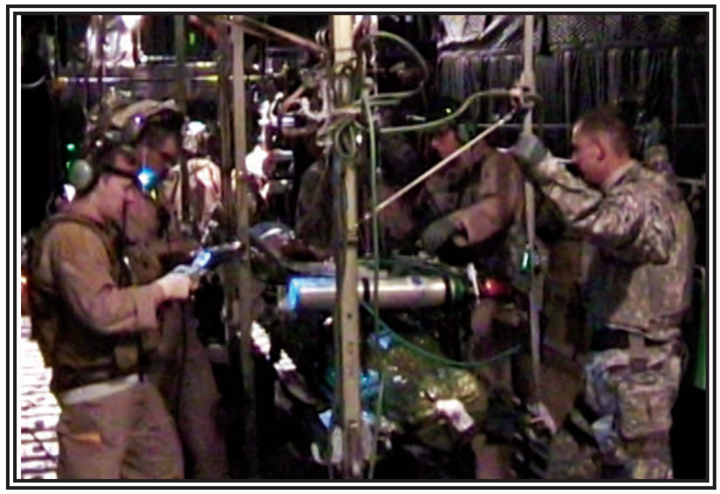
"We were bringing a team of docs with us," said MSgt Bruce Callaway, Talon loadmaster on the rescue. "The medics could not handle that much trauma at that location." The aircrew quickly began preparing the flight plan, calculating aircraft performance requirements and studying approaches.

"We gathered all the information and we'd worked enough that everybody did his own part, so we met at the airplane and did a brief," said Colonel Flynn. "Tactically, there wasn't a lot involved, but because of the weather, the medics in the back and the guys we were going to rescue made for a lot of unknown variables."

In less than an hour, 919th maintainers had the previously bed down aircraft completely reconfigured for a casualty evacuation mission. They also shoveled snow so the aircraft could taxi out.

"The maintenance guys got the same call we did," said CMSgt Mike Klausutis, 919th Special Operations Wing command chief and airborne mission systems specialist on the flight. "When we got there, the plane was almost ready to go fly this mission. The actions they took in that first hour were critical to saving those guys' lives."

Daddy 05 left Bagram and into the dark and snowy mountains. Without the ability to climb above the mountains on takeoff, the aircrew relied on their instruments and their navigators to guide them through.



Air Force combat medics hover around critically wounded Afghanistan National Police aboard an MC-130E Combat Talon I during a medical evacuation mission in 2009. The Duke Field Talon was crewed by deployed 711th Special Operations Squadron reservist Airmen. The medical evacuation mission was a success in that all the wounded passengers survived after suffering injuries from a suicide bomber. (Photo still from video source)

"We had to climb around the mountains without being able to see them," Col Flynn said. "Just using the instruments, we had to climb up above them because of the weather we were in."

An hour flight brought them to their destination – a 60-foot wide runway at an altitude of 8,000 feet. They relied on a precision approach to bring them in. To land, the pilot and co-pilot used night vision goggles.

"We didn't break out (of the weather) to see the runway until about 200 feet above it," Col Flynn said. "We touched down on what looked like the runway. You could barely see it, but on NVGs, I could see a couple of lights."

Upon touchdown, Daddy 05 began to slide sideways on the ice. Col Flynn brought the engines back up thinking he would have to take back off and make another approach, but with the renewed thrust, the plane righted itself and was able to stop.

"There was about three seconds of serious drama and was done, so there was really no time to think about what's going to happen," said Col Flynn. "I just said, 'Wow, I hope we don't fall off this runway, uh, well, looks like we have control again', and we just stopped there. It happened that quick."

The aircrew was told they could park on the apron, but all that could be seen was a blanket of snow. Instead of taking the Talon onto the fresh snow on an unfamiliar airfield, the team stayed on the runway.

"We tried to turn around from the end of the runway and the aircraft actually just skidded around," said Col Flynn. "It just did a 180 on its own, just using the engines. It just flipped around."

While waiting on the ANPs, the crew ensured stretchers and equipment were in place for their arrival. They also kept the aircraft as warm as possible for their new passengers. The wounded were brought out and the medics immediately went to work.

"The docs swarmed them," said MSgt Callaway. "They were literally working on them as they were getting them on the airplane."

The take off was much easier than the landing, but there was still another touchdown to go and the snow storm had not let up. Back at Bagram, the runway was shut down due to the weather and poor visibility. Because of the urgency of the situation, they were granted a waiver to land.

Colonel Flynn radioed to the Bagram air traffic controller and let them know they'd perform their own contained approach, but needed to know if there were any other aircraft in the airspace.

"He jokingly said there was only one plane that took off a couple of hours ago, and that was the only guy crazy enough to be up there flying," said Col Flynn. "I said to him, 'that's us and we're coming back home.'"

Daddy 05 landed without incident this time. Snowplows drove in front of the Talon to clear a path to the parking ramp closest to the hospital. The crew was informed later all four of the Afghan police lived, even the officer with the severe shrapnel wounds.

"Within a week, he was sitting up in bed and was responsive," said Chief Klausutis.

Upon reflection, the aircrew sees how significant their actions were, but in the "cold" of the moment, it was business as usual.

According to Col Flynn, very little was any different than a standard 711th SOS mission.

"It sounds amazing, but this is what we train for and what we do," said Col Flynn, thinking back on it. "It was exciting though, because we were doing something for real. We weren't just carrying equipment; we were going to save somebody."

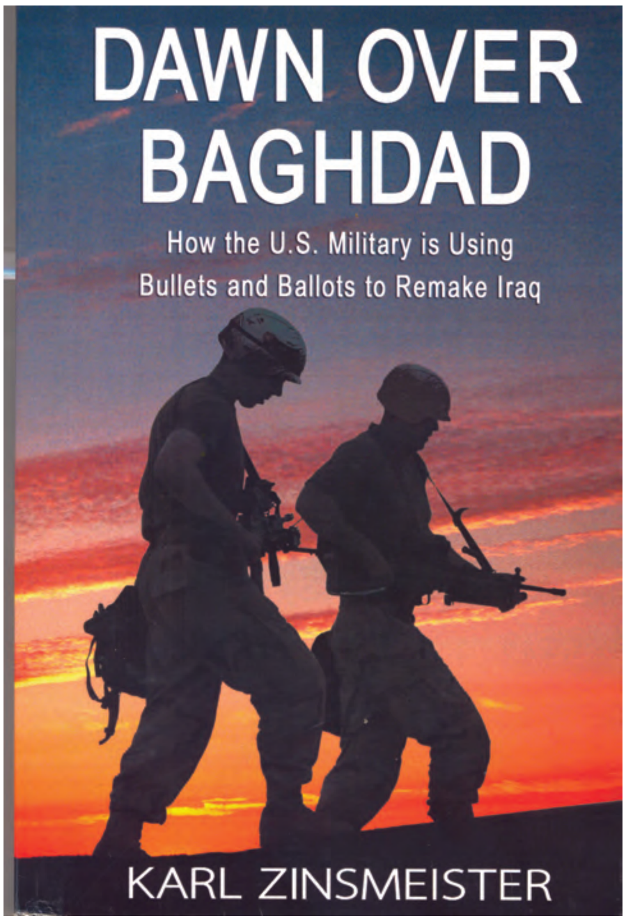
Air Force combat medics watch the vital signs of a critically wounded Afghanistan National Policeman during a medical evacuation mission in 2009. The mission was flown by a deployed 711th Special Operations Squadron aircrew from Duke Field on their MC-130E Combat Talon I. The perilous medical evacuation mission, flown at night through blinding snowstorms, was a success in that all the wounded passengers survived after suffering injuries from a suicide bomber. (Photo from video source)

Book Review

Dawn Over Baghdad: How the U.S. Military is Using Bullets and Ballots to Remake Iraq

By Karl Zinsmeister. New York, New York: Encounter Books. 2005. ISBN 1-59403-090-1.

Review by LTC Craig A. Myatt



Karl Zinsmeister's *Dawn Over Baghdad: How the U.S. Military is using Bullets and Ballots to Remake Iraq* is a good historical reference of Operation Iraqi Freedom in 2004. The text provides readers with a global framework on the presence of U.S. forces in Iraq following the 2003 Coalition invasion and ouster of Saddam Hussein from power. Zinsmeister highlights how the emergence of democracy in Iraq was dependent on the will of American enterprise and central control over Baghdad.

In the early chapters of the book, the author depicts the heart of a formidable United States armed with the spirit of courage, resilience, and fraternity in the aftermath of terrorists' attacks against the United States on September 11, 2001. He next details the tactical and operational challenges faced by American soldiers in 2004 as they attempted to stabilize tensions in Iraq fueled with hit-and-run attacks from an obstructionist minority. Zinsmeister implies that central control over Baghdad destabilized social tensions in Iraq that could have fueled civil war or a full-blown insurgency.

Throughout the text, Zinsmeister shares a hope and vision that Iraq will emerge as a sovereign and stable country. He predicts that Iraq will become an enduring strategic partner with the United States. In 2010, as Operation New Dawn marks the official end to Operation Iraqi Freedom and combat operations by United States forces in Iraq, Zinsmeister's six-year old text provides strategic and global reasoning for the U.S. commitment to the government and people of Iraq relevant in 2004 and now. The success of Operation Iraqi Freedom in 2004 set the stage for an eventual shift in U.S. presence from one that was predominantly military to one that is now predominantly civilian.

Under harsh conditions of war in 2004, the Iraqi people garnered the hope and resilience to build a democratic nation free of autocratic influences. Zinsmeister discusses how the cross-section of America's warrior class sustained the presence of U.S. forces in Iraq during the unfolding of guerilla warfare, counterinsurgency, and reconstruction. The prescribed use of hard and soft tactics stimulates his discussion on the disciplined forbearance exercised by American soldiers. The flexibility and inventive problem solving critical in battlefield operations is what Zinsmeister claims militarily jumpstarted Iraqi society to invest in its newly formed democratic nation.

The will of American enterprise reflected itself in the overall temperate, controlled, and ethical style of engagement by American military forces as the Departments of Defense and State worked together with governmental and non-governmental agencies to help build Iraq's governing capacity. The discipline of American military forces paid dividends that Zinsmeister envisioned would benefit the United States, the Government of Iraq, and the people of both sovereign nations. In the end, Zinsmeister suggests that the cost of war in Iraq will yield a new international partner that may be critical in stabilizing social tensions throughout that region of the world. The dawn over Baghdad depicted in Zinsmeister's text is now a new dawn for all of Iraq.

From the Command Surgeon

Virgil “Tom” Deal, MD
COL, USA
Command Surgeon
HQ USSOCOM

Greetings All,

This time I writing from NATO HQs where they are hosting the annual NATO SOF Medical Operations Conference. There is a lot to discuss this year, from review of current med ops, to the latest advances in wound care, to how we train our own medical personnel, and how we train with host nation medics. Although the challenges continue to evolve, the one constant is the dedication and courage of the medic taking his skills to the sick and wounded in our areas of operation.

So for those who have a moment to spare between combat operations and other deployments, this December’s SOMA will likewise give us some great opportunities for exchange of information, of lessons learned from the conflicts at hand, of news from the research and development communities and industry. Just the number and quality of active hemostatic agents that you’ll see demo’ed and discussed this year bears eloquent testimony to the effect that you’ve all had in looking for the best ways to take care of our wounded. Please take some time to look and listen and tell us in Tampa what we need to be researching and acquiring to help you guys at the pointy end of the spear in taking care of your wounded.

I have to commend each of you for how well the SOF medical community is doing in recognizing the less visible wounds of the wars and continuing to take care of each member of every team. Although the technology that will help us diagnose and treat occult brain injury and PTSD and better detect and catalog environmental hazards is rapidly evolving, the best tool in our toolbox remains the SOF medic who sees and interacts with his teammates on a daily basis.

Thanks for all that you do and God Bless.

COMPONENT SURGEON

USASOC

Peter J. Benson, MD
COL, USA
Command Surgeon

This past summer has proven to be the most costly in terms of casualties since the start of Operation Enduring Freedom. The current intensity of ongoing combat operations highlights the necessity to maintain the fielding of the best trained, best equipped Army Special Operations medical providers possible. Looking back across nearly a decade of combat, the developments in Tactical Combat Casualty Care (TCCC), and advances in medical products and devices have been phenomenal. The direct result of the continuous training and refinement of TCCC within USASOC has been the fundamental decrease in the number of USASOC Soldiers who die as a result of combat injuries.

Special Operations medicine must keep pace with innovations in clinical "best practices," use of the latest in drugs and medical devices, and insure that medical training is on the cutting edge. It is vitally important that USASOC's Programs of Instruction for didactic, simulation and practical exercise training, as well as the equipment sets for ARSOF medical providers, are continually updated. To do this requires the input of USASOC's Soldier-Providers, as well as the support of commanders at all levels. Now is the time to set conditions for the next 20 years of ARSOF's engagement in the National Defense Strategy. There may be uncertainties regarding future U.S. policy for engagement, but there is little doubt that Army Special Operations Forces (ARSOF) will be a major force in the future.

USASOC providers must remain ready to plan, provide, and manage Health Service Support in remote, austere forward locations. The robust conventional medical infrastructure of OEF and OIF will not be the model for future SOF operations. Operational emphasis will certainly require maximizing internal HSS capacity, but may include indigenous medical resources and leveraging other conventional or Theater HSS resources. Operations by smaller elements with minimal external support will probably be the norm.

The upcoming ARSOF Medic (formerly the USASOC Surgeon's Conference) and SOMA Conferences in December will be great venues for the exchange of information, experiences, and new ideas. The USASOC Surgeon's Staff has worked hard to revamp the USASOC Conference to be more applicable and useful to our enlisted providers, with relevant briefings and hands-on training events. I look forward to seeing many of you at the Conferences and I hope as many USASOC providers who are able can make the trip.

Sine Pari.

COMPONENT SURGEON

AFSOC

Timothy D. Robinette, MD, CFS
Col, USAF
Command Surgeon

The editors, and contributors of this issue of the *Journal of Special Operations Medicine* are to be commended for boldly highlighting the unsung champion of modern healthcare – Preventive Medicine. It is difficult to prove the negative, a disease that did not happen or a death prevented, but over the past one hundred years, according to the Centers for Disease Control and Prevention, the average lifespan of Americans has increased by 30 years; 25 years of this gain are attributable to advances in public health (Bunker JP, Frazier HS, Mosteller F. Improving health: measuring effects of medical care. *Milbank Quarterly* 1994;72:225-58). Undoubtedly, preventive medicine is as vital to our future as it was to our past. And as the 2010 National Security Strategy (NSS) so clearly emphasizes, the application of preventive medicine is also essential to our security. Aligning with the NSS, the Air Force Special Operations Command (AFSOC) is focused on continued development and improvement of our preventive medicine capabilities in three broad areas: force health protection, humanitarian assistance, and medical stability operations.

(W)e are improving our public health and medical capabilities on the front lines, including domestic and international disease surveillance, situational awareness, rapid and reliable development of medical countermeasures to respond to public health threats … (NSS, May 2010, pg 49)

AFSOC ensures the health protection of our deployed Airmen, Soldiers, Sailors, and Marines by several means; one of these is through the Special Operations Forces Medical Element (SOFME) team. This primary deployable medical asset consists of one flight surgeon and two Independent Duty Medical Technicians (IDMTs). In addition to combat health support and trauma care, SOFME teams have extensive training in bare base preventive medicine. The SOFME teams are frequently led by a residency-trained physician in Aerospace Medicine and Preventive Medicine and Board Certified by the American Board of Preventive Medicine. The SOF Medical Element Augmentation Team, typically consisting of a Physician Assistant, Bioenvironmental Engineering technician, Public Health technician, and medical plans officer, is designed to enhance the operations of the SOFME team, bringing additional expertise in food and water safety, industrial hygiene, radiation safety, field sanitation, vector surveillance, communicable disease control, and medical logistics and operational planning.

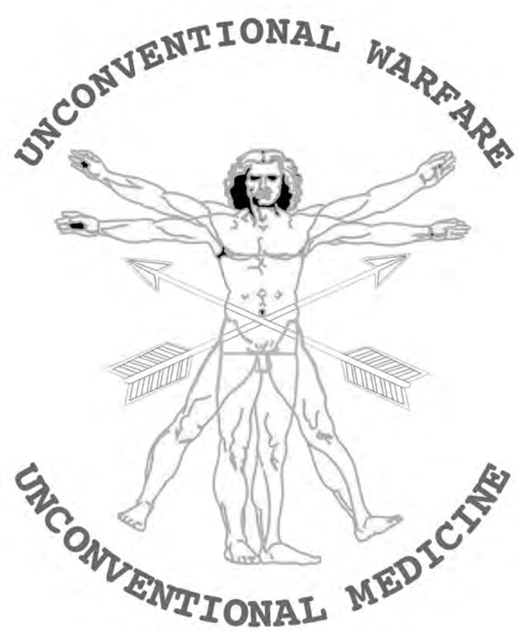
(W)e will continue to respond to humanitarian crises to ensure that those in need have the protection and assistance they need. (ibid, pp 39-40)

When the recent tragedy of the Haitian earthquake demanded a rapid and comprehensive response from fully trained and equipped medics, AFSOC delivered. Our medical teams, led by a preventive medicine physician, Col Lee Harvis, and including a SOFME and their preventive medicine augmentation team, were in-country within three days. From disease outbreak investigations to site assessments to water quality testing, these professionals had the flexibility to provide public heath support to both deployed Department of Defense personnel and displaced Haitian citizens.

We will continue to rebalance our military capabilities to excel at counterterrorism, counterinsurgency, stability operations… (ibid, pg 14)

Stability operations are a core U.S. military mission (DoDI 3000.05) and AFSOC is a leader in developing and fielding medical stability operations forces. The very nature of this doctrine is predicated on a long-term, preventive medicine approach to improved healthcare for our Partner Nations (PN). In 2009, AFSOC established the Irregular Warfare/Medical Stability Operations division within the command surgeon directorate; this division oversees the development and implementation of a comprehensive array of medical teams that provides expertise and mentoring to PN professionals, enabling them to build the healthcare capacity that will help lead to internal stability. For an in-depth discussion on employing Air Force preventive medicine assets in medical stability operations, I invite you to read Lt Col Philip Goff's article on page 34 of this issue.

Preventive Medicine has momentum; we will add to this impetus by standing on sound principles and applying aggressive innovation. Thanks to all the preventive medicine personnel, medics and their families for the work and sacrifice given in defense of this great nation.



COMPONENT SURGEON NAVSPECWARCOM

Gary Gluck, MD
CAPT, USN
Command Surgeon

Greetings Colleagues,

This month's article addresses Naval Special Warfare Command's (NSW's) proposed use of Immediate Post-Concussive and Cognitive Testing (ImPACT) tool in the detection of mild traumatic brain injury (MTBI) discussion of a Sea-Air-Land / Special Warfare Combatant-Craft Crewman (SEAL/SWCC) Independent Duty Medic capability and planning for the NSW Medical Conference before the Special Operations Medical Association (SOMA) conference in December.

Naval Special Warfare will be the second U.S. Special Operations Command (USSOCOM) component to initiate the use of ImPACT internet based assessment tool. Our funding has been approved and our contract has been initiated to offer ImPACT across the NSW Force as a forward deployed assessment tool for our medics and corpsmen in the evaluation of mTBI or "concussion." This is an exciting development and we are confident it will directly benefit our forward deployed units as they assess our operators for mTBI.

Currently, NSW follows all Department of Defense (DoD) algorithms and guidance in the evaluation of mTBI. As such, any servicemembers who experienced a potential TBI exposure are referred to the first line of medical care for evaluation. This may have been exposure to an improvised explosive device (IED) or other munition, or even a head injury from a motor vehicle accident or sporting injury. The first line of care in NSW is the SEAL or SWCC Medics, Hospital Corpsmen and Independent Duty Corpsmen (IDC) assigned to forward deployed NSW units. Under current recommendations, these providers will evaluate the service member, administer the Military Acute Concussion Evaluation (MACE) test and determine if a higher level of care evaluation is warranted or if the member can return to the fight. Commander Jack Tsao is the Bureau of Medicine and Surgery (BUMED) "TBI Subject Matter Expert" who is making his rounds across NSW Commands, providing training on the Navy's approved approach to initial evaluation of potential mTBI. Thank you for participating in this training and making it a part of your practice as an NSW medical provider.

An additional tool for helping determine the proper disposition of potential mTBI victims is the ImPACT mTBI assessment tool. ImPACT is a commercially available product that has been used by nearly every major professional sports organization including the NFL, NHL, NASCAR as well as amateur sports, in the detection of concussion. It has also been in use by our brethren at U.S. Army Special Operations Command (USASOC) for over three years and has proven highly effective and useful for Special Operation Forces (SOF) in the detection of mTBI. Like the USASOC version of ImPACT, the NSW version will also incorporate 17 questions that help detect Post Traumatic Stress and will aid in the disposition and treatment plan for each service member taking the ImPACT. Initially and approximately every five years, all deployers will need to perform a "baseline" test for comparison totheir post injury test. Available via the internet, ImPACT can then be administered soon after exposure to the concussive event and produce a report that is easily interpreted by our first-line medics and corpsmen. All clinical data, including the history, physical exam, MACE test results and ImPACT results can be discussed with an NSW Medical Officer and we can determine the appropriate care for each case.

Per the Assistant Secretary of Defense for Health Affairs directive, we are still required to administer the Automated

Neuro-cognitive Assessment Metrics (ANAM) to all deploying service members. In my opinion, it is more difficult to administer and interpret than ImPACT and provides questionable results. As such, use of the ANAM is falling out of favor in many realms within the DoD. While hundreds of studies proved the validity and effectiveness of ImPACT, designed specifically to detect concussion (mTBI), surprisingly few studies validate the effectiveness of ANAM in the detection of concussion. The good news is that several studies are currently underway to evaluate ANAM compared to ImPACT, and many experts believe ImPACT will outperform the ANAM in the diagnosis of mTBI. Even if ANAM remains the neuro-cognitive test of choice for the DoD, NSW will continue to utilize ImPACT to help our medics and corpsmen evaluate the potential mTBI patient. We look forward to the research comparing these two tools and we're proud to be leading the Navy in the use of ImPACT in mTBI.

An additional initiative in my office involves how we administer medical care at the smallest operational unit level. Several years ago, NSW lost a very valuable asset, the SEAL/SWCC Independent Duty Corpsmen. Before the advent of the Special Warfare Operator (SO) and Naval Special Warfare Boat Operator (SB) enlisted rating, Hospital Corpsmen who completed Basic Underwater Demolition / SEAL (BUD/S) or SWCC training could attend the Joint Special Operations Medical Training Center (JSOMTC) "SO IDC" course and earn the title of NEC 5391, or SEAL/SWCC IDC. Now NSW operators no longer carry the Hospital Corpsman (HM) designation and the program or pipeline that supported the SEAL/SWCC IDC (NEC 5391) withered away. We have now come to a place and time when the only SEAL/SWCC IDC's are in senior leadership roles and an entire generation of NSW operators have completed only the JSOMTC short course and provide combat medic capability for NSW as a Special Operations Combat Medic (SOCM). This resulted in an immediate demand for "US Navy Surface Warfare Independent Duty Corpsmen" augmenting NSW forward deployed units down to the platoon level and assigned to forward operating bases to provide the primary care capability and more in-depth medical expertise to our operators.

This model of employing non-operator IDC's in small operational NSW units has been challenging as our units become smaller and are involved in direct action and over the horizon intelligence surveillance and reconnaissance. The IDC will have variable if any training and is not an "operator" capable of accompanying these small NSW units during remote "disaggregated" operations. Currently, we operate in "mature theatres" with robust military medical assets. This has helped to alleviate the stress of relying on IDC's to provide our primary care and advanced medical care to our forward operating bases. Future "ridge lines" dictate more disaggregated operations conducted without the luxury of mature theatre military medical assets. Likewise, the Surface Warfare IDC community is becoming increasingly constrained as we ask for more and more resources from a limited pool of IDC's.

Emerging from the dust of NSW's past is the SEAL or SWCC operator trained as an Independent Duty Medic (IDM). As we begin to operate in smaller and smaller units and deploy to more austere locations, it is imperative that we operate more efficiently by having more skill sets organic to the small operational unit. An obvious solution is the SEAL/SWCC IDM. Not yet formally approved by NAVSPECWARCOM leadership, we hope to initiate training of our first pool of IDM's in 2011. It will take four years of training 12 NSW operators per year to reach full operating capacity with one SEAL IDM per Platoon. Additional numbers will be needed to train our SWCC's as IDM's. We are eager to get started on this initiative as we continue to develop the governing instructions and programs to support this invaluable NSW medical asset. We will keep you informed of our progress in the weeks and months ahead.

The annual SOMA Conference is just around the corner (December 12-16) and we are busy planning our NSW Medical Conference in the two days preceding the SOMA conference. Currently, we are scheduled for December 10 and 11 at the Tampa Marriott Waterside Hotel, Tampa, Florida. We are developing an ambitious conference schedule and hope to add important educational topics for our NSW medical team to include guidance on Dietary Supplements and Sleep Disorders from experts within NSW. We will have important updates on the NSW Tactical Athlete Program, as well as our Combat Operational Stress Control Program. Breakout sessions will include medical equipment and supply and Authorized Medical Allowance List (AMAL) review and changes, the newly formed NSW Medical After Action Report Working Group and a special session on use of the ImPACT. It's also time to submit your packages for the NSW Medic of the Year up your chains of command. We know our NSW Medics do amazing things downrange, so submit their names and accomplishments for recognition! If selected, both the NSW SEAL and SWCC Medics of the Year will have a paid trip to this year's SOMA Conference to compete for the USSOCOM Medic of the Year title. If you have not already made your reservations, time is of the essence! We look forward to seeing you in Tampa!

COMPONENT SURGEON

MARSOC

Anthony M. Griffay, MD
CAPT, USN
Command Surgeon

Due to the topic of this edition, this Surgeon's input is submitted by CDR Gene Garland, MSC, Force Health Protection Officer.

Fall ushers in a new season and a time that is rich in tradition for the Navy/Marine Corps Team. I would like to congratulate the following new Marine Special Operations Command (MARSOC) Chief Petty Officers (CPOs) who were selected and underwent CPO initiation in September: HMC (FMF/SW) Jason Adams, HMC (FMF/PJ/DV) Ryan Christensen, HMC (FMF) Seth Matteson, HMC (FMF/PJ/PJ/DV) Dexter Raysor, and HMC (DSW/SW) Bryan Smith. Advancement to Chief Petty Officer is the most significant promotion within the enlisted naval ranks. At the rank of Chief, the Sailor takes on more administrative duties. Chief Petty Officers serve a dual role as both technical experts and as leaders, with the emphasis being more on leadership as they progress through the CPO ranks. Congratulations, Chiefs!

As MARSOC continues to move forward, it is most appropriate that this edition of JSOM focuses on Preventive Medicine. Having our first Preventive Medicine Technician downrange with Special Operations Task Force (SOTF) 81 was a groundbreaking accomplishment which demonstrated significant value-added to the mission. He spent a significant amount of the deployment conducting base camp health assessments as well as addressing many reoccurring preventive medicine issues such as potable water, septic systems, and food service safety, not to mention dealing with the occasional issue of the feral "camp dogs" at the various locations.

The current rotation with SOTF-82 finds our Preventive Medicine Technician continuing with the base camp assessment mission in addition to conducting Occupational Environmental Health Site Assessments (OEHSAs) in the area of operation. In many cases, this is the first time OEHSAs have been conducted at these locations. With the establishment of Village Stability Operations in the Helmand and Baghdis Provinces of Afghanistan, these sites were completely untouched by military preventive medicine assets and will surely offer challenging and unique opportunities to overcome in order to maintain the operational medical readiness of our forces. It will be critical to maintain a pro-active preventive medicine presence in SOTF-West to ensure that we provide adequate force health protection to our forces on the ground.

We must keep in mind that despite remarkable advances in public health and preventive medicine, disease and non-battle injuries remain a significant threat to the operational capability of our force.

CDR Gene Garland, MSC

TSOC SURGEON

SOCCENT

Warner D. "Rocky"Farr, MD
COL USA
SOCCENT Surgeon

SOF Language Training or Even Old Dogs Must Learn New Tricks

In olden days when giant Green Berets walked the earth and language training was not part of the Special Forces Qualification Course, one found language training when and where one could. This usually meant the much-coveted permanent change of station (PCS) to the Defense Language Institute (DLI) in Monterey, California. So Special Forces was soon divided into the language "haves" and the language "have nots." I was lucky enough to get the coveted permanent change of station to the Defense Language Institute on my way back from 5th Special Forces Group (Airborne) in Vietnam, but it was to the east coast branch in the District of Columbia (which I didn't even know existed before I was sent there) for German. I was going to PCS further to Detachment "A" in the Berlin Brigade. I recieved twenty-three weeks of excellent instruction and came out of that experience speaking and reading at the 3/3 level.

When language training was finally placed in the Special Forces Qualification Course every one received region/group appropriate language training but the result was not at the 3/3 level of expertise like one received at the Defense Language Institute. At least everyone had some knowledge. This meant that language sustainment rose in importance. Also over the years, the languages of interest changed. As example, the Defense Language Institute does not even support German sustainment training any more.

So, when I decided to put aside my 1971 German and take something else, I settled on Dari, which is Farsi (Persian), which is Tajik. What I had found before I started this was the USSOCOM "Special Operations Forces Teletraining System" website: https://www.softsonline.org/. This Special Operations Forces Teletraining System (SOFTS), is a program that takes advantage of commercial off-the-shelf technology to deliver real-time language & culture training to SOF Soldiers anywhere in the world. This means those who are unable to attend traditional classes at traditional training institutions on a full time basis (like me-I got a day job) can master a language. The difference between this computer based method and the average computer based training drill is that this technology enables all of the usual instructional functions of a regular, real classroom: face-to-face interaction of students and instructors; speaking, reading, and writing in script; one-on-one drills; after hours tutoring; individual and group activities. It's not just "here's the CD, have at it."

How does this work? You basically sit in class at your computer, usually at home in the evening if in CONUS, for two hours, and see, speak, and interact with the instructor and the other three or four students by your own video teleconfence (VTC) link on your home computer. Some of the great benefits of this are greater flexibility in setting class hours (of course you have to convince the other students of a cooperative time), instant access to online content, ease of saving sound, video, and other content for later study, and ***portability***. This portability means that students and teachers can train regardless of their geographic location as long as the individual has access to broadband internet. I usually take class from somewhere in the Middle East at morning hours my time which are evening hours for my instructor. They run courses with class members in different countries and hence, different time zones. So, Soldiers "attended" even when in transit on TDY or PCS via Wi-Fi hot spots and hotel internet connections. I have done this many times. The SOFTS help desk is great in tweaking computer links to help connect. This method extends training to remote sites where finding an instructor would be nearly impossible. SOFTS enables assembling a class of students with like needs rapidly since they no longer have to limit the search to a single site.

If you go to the website https://www.softsonline.org/ you will see a list of ongoing and planned classes that start at "Absolute Beginner," (that is 0/0) or "High Novice" (1/1) or "Low Intermediate." (1+/1+) all the way to "High Intermediate" which is 2+/2+. The languages they cover are quite wide, all the ones of SOF interest and I have found the help desk, the instructors and the SOF Language Office staff great to work with. So, BLUF, as we say: *If I can learn as new language at age 62, what is your excuse not to do it too?*

USSOCOM Psychology

LTC Craig A. Myatt, PhD
HQ USSOCOM Psychologist

Commentary on Military Decision-Making

The role of psychology capability support in the Department of Defense (DOD) is expanding, especially in Special Operations Forces (SOF) units. At the close of fiscal year 2010 (FY 10), the Special Operations Forces Resilience Enterprise Program (SOF REP) obtained its initial funding. The program remains resourced throughout 2011. Funding for the SOF REP is being applied toward offering additional tools to component psychologists, leaders, and commanders in the SOF community. One of those tools will assist in military decision-making associated with operations tempo behavioral effects (OTBE) and associated risks.

In a rapid fashion, the SOF REP will work with the Services and components to gather data useful in identifying behavioral trends in SOF personnel and their families associated with a high operations tempo (optempo). The SOF REP is postured to gather metrics for assessing and monitoring OTBE. Distinct behavioral trends in SOF personnel and their families will be identified and shared through command channels.

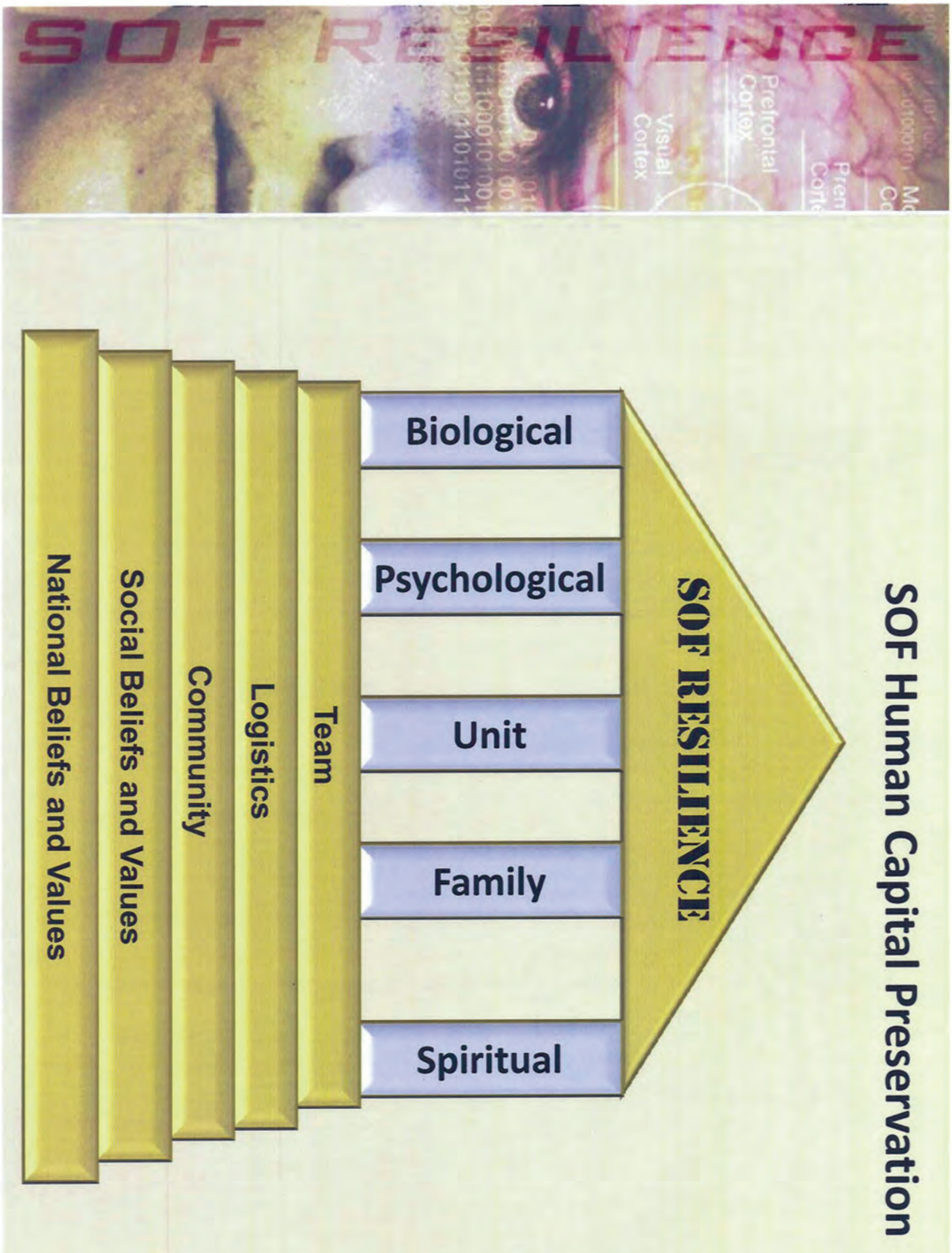
Additionally, the SOF REP will develop tools that support mission planning efforts for units and commanders. One such tool will be a concise psychometric instrument with a limited number of questions (i.e., not to exceed 40 items). Modular in design, the instrument will provide a servicemember module (SM), a family member module (FM), and a service provider module (SP). It will also be component command specific with separate editions for, USASOC, NSWCOM, AFSOC, and MARSOC.

Another tool that the SOF REP will develop is a mechanism for disseminating summaries of human factors useful in the mission planning process. Taking advantage of pre-existing staff processes used in the mission planning process, such as identification of commander's critical information requirements (CCIRs), along with risk assessment and risk management, this new mechanism will support military decision-making associated with changing behavioral trends and can be presented to the command operations staff by a multi-disciplinary team (e.g., psychologist, social worker, and chaplain) serving as special staff to the commander.

For example, a command group may have an embedded psychologist and chaplain who support one or more unit programs on behalf of the commander that involve servicemember and family member support. In the course of mission planning, the psychologist and chaplain can function as a multi-disciplinary element to provide the operations staff (e.g., J3, G3, N3, or A3) with a concise summary of OTBE. This summary could be presented simply by using a green-amber-red reporting status.

The commander and staff would define green, amber, and red based on command intent and situational awareness. In this instance, green could be "no meaningful OTSE risks", amber could be "minimal OTBE risks with no impact on mission planning and execution", and red could be "significant OTBE risks that impact mission planning and execution." Such a process is supported by the Joint Planning Process, the Military Decision-Making process (MDMP), the Naval Planning Process, the Marine Corps Planning Process, and the Air Force Planning Process.

Subordinate units and teams would implement a synchronized process for planning and execution that could offer first-line supervisor input on OTBE in much the same way as critical information is disseminated through, in the case of the Army, Troop Leading Procedures, as a parallel planning process for the Army's MDMP. The development of such a mechanism is intended to take advantage pre-existing decision-making processes that support mission execution allowing leaders, command staffs, and commanders to adjust the time and focus applied to OTBE in the planning process based on command intent.


SOF RESILIENCE
Prefrontal Cortex
Visual Cortex
SOF Human Capital Preservation
SOF RESILIENCE
Biological
Psychological
Unit
Family
Spiritual
Team
Logistics
Community
Social Beliefs and Values
National Beliefs and Values

Excerpts from the Committee on Tactical Combat Casualty Care Meeting Minutes

3-4 August 2010
Denver, Colorado
Attendance

Tuesday 03 August
CoTCCC Public Session

Administrative Remarks presented by Dr. Frank Butler

The next CoTCCC meeting is planned for November 16th and 17th at the Chateau Bourbon in New Orleans, LA. The next DHB Core Board meeting will be at West Point on August 18th and 19th.

Dr. Frank Butler presented the 2010 TCCC Award to MSG Harold Montgomery of the 75th Ranger Regiment in recognition of his numerous contributions to TCCC and his long history of leadership in military prehospital medicine. MSG Montgomery is the Senior Medic for the Regiment. He has served the Rangers for 19 of his 23 years in the Army and has deployed to combat 10 times, once for Operation Desert Storm, once for Operation Uphold Democracy, four for Operation Enduring Freedom, and four for Operation Iraqi Freedom. MSG Montgomery has been a member of the Committee on Tactical Combat Casualty Care since 2006. He is also on the subcommittees for membership and bylaws, hemostatics, and new technology.

Far- Forward Use of Fresh Whole Blood was presented by CPT Chris Cordova.

CPT Cordova presented a casualty scenario from OEF where 70 Soldiers in two observation posts in the Kamdesh District of Afghanistan were attacked by approximately 350 hostiles. Medical support included one physician assistant (PA), and three medics. The operating plan for casualty response included air evac to the nearest Field Surgical Team. A total of 43 U.S. and Afghani casualties were treated that day. Sixteen were evacuated, and eight were fatalities.

CPT Cordova reviewed the treatment of a casualty that received fresh whole blood (FWB) in the field. This casualty had sustained an open fracture of his left distal tibia and fibula as well as multiple shrapnel and gunshot wounds (GSWs) to his proximal left thigh, pelvis, left lower abdominal quadrant, and right arm. Helicopter CASEVAC was delayed for nine hours (requested at 1200, arrived at 2100) because of the threat of hostile fire to the aircraft. After initial care per the TCCC guidelines, including resuscitation for hemorrhagic shock with Hextend, the casualty was transfused with 5 units of FWB. The buddy donors were matched to the casualty's ABO blood type by medical history and dog tags. The transfusion set had been left in the Aid Station by the post's previous occupants. After each unit transfused, the casualty's clinical status improved. The casualty was still alive when eventually evacuated by helicopter, but later died during surgery. CPT Cordova had never before managed a blood product transfusion in any setting, yet he was able to keep a severely wounded casualty alive for over five hours by transfusing FWB from donors in the field during combat.

CPT Cordova's comments, observations and lessons learned included:
1) Medic training and rehearsals proved vital for successful casualty care in battle;
2) Routine fielding of blood transfusion kits and training for buddy transfusions should be considered; and
3) Data on field transfusions should be collected to monitor the frequency of this procedure and the casualty outcomes.

TCCC Update

Dr. Frank Butler stated the revised TCCC curriculum that incorporates the recently approved changes on management of burns in TCCC has now been posted on both the Military Health System and the Prehospital Trauma Life Support (PHTLS) websites.

In May 2010, the Center for Army Lessons Learned published a TCCC Handbook that incorporates the TCCC Guidelines into an Army publication that can be used to train and educate Army medics and other combatants.

The CoTCCC maintains a Journal Watch to ensure that current publications relating to TCCC are reviewed. Recent publications of interest include:
1) Grape, et al: *Formulations of Fentanyl for the Management of Pain (Drugs, 2010).*

2) CRASH-2 Collaborators: *Effect of Tranexamic Acid on Death, Vascular Occlusive Events, and Blood Transfusions in Trauma Patients with Significant Hemorrhage (Lancet Online article 2010).*

For committee comments related to these two publications, please go to the PHTLS website at http://www.naemt.org/education/PHTLS/TCCC.aspx.

The Combat Medic Presentation was presented by SFC Alex Alvarez.

In this OEF operation, a night assault was conducted against a Taliban compound. After an offset helicopter insertion followed by a two-hour patrol, mission personnel arrived at the compound and secured the location. The compound was later attacked at daybreak by a large enemy force moving in from several sides.

SFC Alvarez treated a casualty who had sustained a gunshot wound (GSW) to the abdomen that entered in the left lower quadrant and exited in the right upper quadrant. The ongoing firefight delayed CASEVAC for 2.5 hours and the casualty had to be sustained in the field. A Halo dressing was applied to the wound. The casualty was given 5mg of recombinant factor VIIa intravenously for his presumed non-compressible intra-abdominal hemorrhage. This was the first documented administration of rVIIa by a medic in the field. The casualty's pain was treated with oral transmucosal fentanyl citrate (OTFC), which was not effective, possibly because of his very dry mouth. The casualty was in extreme pain and was becoming agitated as a result of the pain. He was then treated with 7.5mg of morphine IV and Versed. Hypothermia prevention was accomplished and 1gm of Invanz was given.

The casualty was then moved to the casualty collection point, which took about 5 minutes, after which the Halo dressing was removed, a ChitoGauze was used to control external bleeding, and the Halo dressing was replaced. He was given another 7.5mg of morphine IV with unsatisfactory results. The casualty was then treated with 20mg of IV ketamine with prompt relief of pain. The ketamine succeeded where OTFC and repeated doses of IV morphine had failed. The casualty was also treated for nausea with Zofran. While waiting for evacuation, he went into shock (lost his radial pulse) and was given 500cc of Hextend. The casualty was found at surgery to have both liver and bowel injuries. He survived after a long and complicated recovery. There were no thromboembolic complications.

SFC Alvarez provided the following observations, comments and lessons learned:

1) Rapid evacuation of combat casualties is not always possible. Medics will continue to care for severely wounded casualties in austere locations in situations where evacuation is delayed. They should be trained and equipped with multiple agents for the management of non-compressible hemorrhage. In SFC Alvarez's opinion, the battlefield use of rVIIa saved this casualty's life.

2) Medics should carry more rVIIa to provide for multiple casualties and multiple doses during delayed or prolonged evacuation.

3) Ketamine worked better than narcotics in this casualty and is less likely to cause hypotension. This agent should be used early when it is indicated.

4) Abdominal wounds are hard to pack with HemCon. A gauze-type agent or a hemostatic agent that could be injected into the abdomen would be helpful.

5) The Halo chest seal would have worked better if it had been larger.

Evaluation of Combat Gauze vs ChitoGauze was presented by Dr. Richard Schwartz.

These two hemostatic agents were compared in a study funded by HemCon, the manufacturer of ChitoGauze. Combat Gauze works as a pro-coagulant; ChitoGauze acts as a tissue adherent. In this bleeding model, a 6mm arteriotomy was created in the right femoral artery in a porcine bleeding model. A total of fourteen animals were studied – seven in the ChitoGauze group and seven in the Combat Gauze group. All of the animals survived. Note that the higher survival rate seen in this study as compared to other studies that used a 6mm femoral arteriotomy may be explained by the fact that the animals in this study were not splenectomized, allowing the potential for autotransfusion. Blood loss after application of the hemostatic agent was found to be 796cc for Combat Gauze animals and 304cc for ChitoGauze animals. Less volume was needed for resuscitation in the ChitoGauze group.

This study had a relatively small number of animals and differences between groups were not statistically significant, though trends favored ChitoGauze. Clinically, both products have been observed to work well. In Dr. Schwartz's Emergency Department at the Medical College of Georgia, ChitoGauze is the first choice for a hemostatic agent, with Combat Gauze used as the back-up.

The Preferred Features for Intraosseous Devices was presented by Ms. Jan Skadberg, RN.

The Defense Medical Material Program Office (DMMPO) and the CoTCCC are working together to develop a list of preferred features for intraosseous infusion devices. Some points that have emerged from this effort include:

- The Infusion Nursing Society Guidelines now state: "Recently published ACLS guidelines direct IO medication administration as a preferred route over the endotracheal route (AHA, 2006a,b). The new guidelines also support IO as the preferential placement versus that of a central VAD during CPR if peripheral access is unobtainable."

- Multiple IO devices are fielded by the services. Are the services able to maintain proficiency in all these devices?
- Although no specific IO device has been identified in the TCCC Guidelines, the upcoming Tactical Field Care chapter in the Seventh Edition of the PHTLS Manual notes that the Pyng F.A.S.T. 1 has been widely used with good success on the battlefield.
- DMMPO research has found that the Pyng F.A.S.T. 1 posted $4.9 million in military sales in the past 12 months (33,000 units). Other IO devices have sold far less.

Surgical Airways – A Case Series was presented by MAJ Bob Mabry.

MAJ Mabry presented his unpublished data on 72 cricothyroidotomies (crics) in casualties from OEF & OIF (U.S., host nation military, police, and allied forces). The wounds sustained were mostly explosion injuries and GSWs. Of the crics attempted, 26% were unsuccessful. Sixty-two per cent of the crics were performed in the field, 38% in Aid Stations. There were 40 total complications in the data set, with some casualties having more than one. Ten of the crics followed failed Rapid Sequence Intubations (RSI). Data on the total number of RSIs attempted were not available. A thorough analysis of the data will be published in a series of planned journal articles.

MAJ Mabry also presented preliminary data on trauma outcomes when flight paramedics are present on the evacuation aircraft as compared to flights with non-paramedic flight medics. This observational data came from a comparison of two units operating out of Baghram. Both units were operating in the same area and transporting similar types of casualties in the same time period; one unit had paramedics, the other did not. In the data, outcomes at 48 hours were recorded because Afghani casualties could not be tracked further out. Approximately 600 casualties were included in the study. Initial analysis shows mortality was reduced by half in the group attended by flight paramedics. The data has not yet been analyzed for severity of injury and other descriptive data. MAJ Mabry will present this information again when analysis is complete.

DMMPO-AFME Feedback to the Field was presented by Col (sel) Douglas Hodge.

Col (sel) Hodge presented a case from the ongoing DMMPO-AFME process improvement review of fatalities examined at autopsy. This case involved a perforation of the sternum by an IO infusion device. This individual had polytrauma and was noted to have multiple IO devices present at autopsy. The IO device in his sternum was located on the right side of the sternal body, and penetrated completely through the sternum into the mediastinum. The IO was a device intended for use at large bone insertion sites and was marked as such. It had a blue hub and a 25mm needle. The clinical circumstances and specific details surrounding the delivery of emergency treatment in this case are not known, but this occurrence does raise questions regarding packaging, labeling, and user training in the use of IO devices.

DMMPO recommends that the Services review training programs for IO devices to ensure that medics have mastered the skills required to insert them correctly and know which sites are specified for each device. DMMPO's Joint Medical Testing and Evaluation Department is working with the FDA and manufacturers to improve labeling, package insert warnings, and contraindication statements for medical devices.

PHTLS TCCC Training Program was presented by Mr. Mark Lueder.

The Prehospital Trauma Life Support (PHTLS) office of the National Association of Emergency Medical Technicians (NAEMT) now offers TCCC courses in the U.S. and in other countries. These courses are available to medical, law enforcement, and military personnel. The PHTLS-sponsored TCCC courses feature certification and registration for providers, instructors, and courses. They also use the standard TCCC curriculum as posted on the PHTLS and Military Health System websites. Mr. Lueder reviewed the history of the program, starting with the PHTLS National Faculty TCCC training course in San Antonio in December 2009 at the Army Department of Combat Medic Training. He also presented the schedule of recently completed and currently planned training courses, both in the U.S. and in allied countries.

Proposed Change - Hypothermia Prevention was presented by Mr. Don Parsons.

Mr. Parsons presented his position paper on changing the TCCC guidelines that deal with hypothermia prevention. The primary problems noted with the current recommendations are: 1) the Hypothermia Prevention Cap in the current Hypothermia Prevention and Management Kit (HPMK) tends to be blown off when casualties are being loaded into helicopters; 2) the Blizzard Rescue Blanket provides no easy access to the casualty to perform medical interventions or to check the status of IV sites and tourniquets; and 3) a new passive warming device called the Heat Reflective Shell (HRS) has been developed to overcome the problems with the Blizzard Blanket. The HRS is now included in the HPMK.

The recommended changes replace the Blizzard Survival Blanket™ with the Heat Reflective Shell™, which has a Velcro® opening down each side to allow for exposure of IVs and tourniquets. It also has a built-in hood to replace the separate cap. Heating a 500cc bag of Hextend™ with 2 MRE heaters as a field expedient measure was also proposed for

Tactical Field Care. Furthermore, there are now several small, light commercial IV fluid warmers that can readily be carried in vehicle kits and helicopters for use in TACEVAC care.

A Proposed Change – Fluid Resuscitation in TACEVAC was presented by CAPT Jeff Timby.

CAPT Timby pointed out in his position paper on changing the fluid resuscitation guidelines in Tactical Evacuation Care that the current recommendations: 1) do not call for use of blood pressure measurements where these may be available during TACEVAC; 2) could be interpreted to call for use of more than 1000ml of Hextend when this has not been recommended; 3) do not reflect the current theater practice of giving PRBCs and thawed plasma in a 1:1 ratio; 4) call for Hextend to be used initially instead of plasma and PRBCs if both are available; and 5) should be modified to base decisions on fluid resuscitation in casualties with TBI on pulse character or measured blood pressure, not mental status.

Wednesday 4 August

The Committee revisited the preferred features for cricothyroidotomy sets, and approved the following clarifications to the list:

- The set or its individual components must be FDA-approved
- Scalpel: #10 blade
- Should include a trach hook or other instrument to help define and expose the opening
- Tube features:
    - 6-7 mm internal diameter
    - Balloon cuff
    - Flanged
    - 5-8cm intratracheal length
- 5cc syringe to inflate cuff
- Ruggedized IAW Mil Std 8.10G

The Committee also revisited the preferred features for chest seals and approved the following clarifications to the list:

- FDA-approved
- Ruggedized IAW Mil Std 8.10G
- Non-valved
- Packaged two per package

The Potential Changes to the CoTCCC Guidelines were discussed by Dr. Frank Butler.

1) Maximum amount of Hextend to be used:

Several committee members noted that the evidence that 1000ml is the maximum volume of Hextend that can be used without risking a Hextend-related coagulopathy is limited – the paper by Gan et al., suggests that larger volumes might be safe. Dr. Butler noted that the patients in the Gan paper may have received blood component therapy in addition to the reported volumes of Hextend.

2) Fluid resuscitation in controlled vs uncontrolled hemorrhage:

Drs. Otten and Gandy noted that a specific goal for fluid resuscitation in controlled hemorrhage should be established. The best example of this type of hemorrhage on the battlefield is isolated extremity hemorrhage that has been effectively controlled with a tourniquet. Dr. Champion noted that shock may be considered to exist at a blood pressure lower than 105 systolic in trauma patients.

3) King LT Airways:

An e-mail was received from LTC Marty Schreiber, the Deployed Director of the Joint Theater Trauma System (JTTS) asking that the CoTCCC review the possible use of the King LT airway in light of the failed surgical airways that have been noted in the weekly JTTS Trauma Teleconferences. Surgical airways have emerged as the most technically challenging lifesaving intervention that medics and corpsmen (and other prehospital providers) are undertaking on the battlefield at present. Committee members noted that while the King LT has been found to be effective in cardiac arrest patients in the civilian sector, most airway deaths in combat casualties are related to maxillofacial and/or neck trauma and that the efficacy of the King LT in preventing deaths in these types of casualties has not been established. Casualties who are not unconscious from profound hypovolemic shock or severe head trauma do not tolerate King LTs well. MAJ Mabry also noted that there is a significant incidence of trismus in traumatic brain injury (TBI) casualties that makes insertion of the King LT difficult. Proposed actions included: a) modifying the Lessons Learned presentation in the TCCC curriculum to emphasize that unconsciousness alone is not an indication for a surgical airway and that in casualties who have sustained maxillofacial trauma and are having trouble maintaining their airway, the first measure that should be used, if feasible, is the sit-up and lean-forward airway position; b) CoTCCC tracking of surgical airways in the weekly Trauma teleconferences; and c) a research effort was proposed to evaluate various training methodologies for surgical airways with successfully accomplished cadaver procedures to be used as the definitive outcome measure.

4) Pyng FAST-X:

HMCM Sine noted that the Pyng FAST-X might be a preferred IO device once it is approved by the FDA.

The Preferred Features – Intraosseous Devices was revisited by the committee. The following features were approved:

- FDA approved
- Sternal insertion site as the primary (Clearly labeled for site of insertion and needle size)
- Big bone insertion site if desired as a backup (Clearly labeled for site of insertion and needle size)
- Easily inserted without the need for powered devices
- Supports infusion of all prehospital resuscitation fluids
- Latex-free
- Minimum flow rate of 125cc/min
- Self-retaining once inserted
- Able to be removed without the need for a removal tool
- Easily trained for battlefield or simulated battlefield environments
- Compatible with other systems via a standard luer-lock
- Able to be left in place for up to 24 hours
- Sterile, trauma-resistant packaging
- Meets MILSTAN 8.10G
- Shelf life: three years minimum; five years goal
- Used with high rate of success in battlefield reports when available
- Includes attachments and instructions to facilitate training
- High rate of user acceptance when data is available
- Device facilitates ease of use in low light environments
- Minimal chance for provider injury
- Minimal chance for retained parts of device after removal
- Unlikely to be traumatically displaced
- Bag friendly – minimal weight and cube - malleable
- Low rate of complications from battlefield use

Additional comments from the group on this topic were:

- It is more important that the device stay in than that it be easily removed;
- Other sites besides the sternum should be included as options;
- The provider may be unsuccessful in his first attempt and should have an alternate site as a backup;
- The casualty's body armor must be removed in order to use a sternal IO insertion site;
- Tibial IOs are very painful during fluid infusion;
- It is harder for medics to do tibial insertions than sternal insertions;
- There have been multiple reports from AFME of tibial IO placements being done in the wrong location;
- Humeral IO devices are more likely to be traumatically displaced than sternal IOs;
- There will not be any power drills in my aid bag.

Proposed Change - Hypothermia Prevention was discussed by the Committee and the following changes to the TCCC Guidelines were approved by a unanimous vote: **(changes in bold red text on page 87 &90)**

g. Protect the casualty from wind if doors must be kept open.

Proposed Change – Fluid Resuscitation in TACEVAC presented by CAPT Jeff Timby. The Committee unanimously approved the following changes to the TCCC Guidelines: **(changes in bold red text on page 87 & 90)**

For the following supporting attachments please go to the PHTLS website at http://www.naemt.org/education/PHTLS/TCCC.aspx.

1) Position Paper for Hypothermia Prevention Change to the TCCC Guidelines
2) Position Paper for Fluid Resuscitation Change to the TCCC Guidelines

Tactical Combat Casualty Care Guidelines

18 August 2010

* All changes to the guidelines made since those published in the 2010 Seventh Edition of the PHTLS Manual are shown in **bold text**. The new material on hypothermia prevention is shown in **red text**.

Basic Management Plan for Care Under Fire

1. Return fire and take cover.
2. Direct or expect casualty to remain engaged as a combatant if appropriate.
3. Direct casualty to move to cover and apply self-aid if able.
4. Try to keep the casualty from sustaining additional wounds.
5. Casualties should be extricated from burning vehicles or buildings and moved to places of relative safety. Do what is necessary to stop the burning process.
6. Airway management is generally best deferred until the Tactical Field Care phase.
7. Stop *life-threatening* external hemorrhage if tactically feasible:
   - Direct casualty to control hemorrhage by self-aid if able.
   - Use a CoTCCC-recommended tourniquet for hemorrhage that is anatomically amenable to tourniquet application.
   - Apply the tourniquet proximal to the bleeding site, over the uniform, tighten, and move the casualty to cover.

Basic Management Plan for Tactical Field Care

1. Casualties with an altered mental status should be disarmed immediately.
2. Airway Management
   a. Unconscious casualty without airway obstruction:
      - Chin lift or jaw thrust maneuver
      - Nasopharyngeal airway
      - Place casualty in the recovery position
   b. Casualty with airway obstruction or impending airway obstruction:
      - Chin lift or jaw thrust maneuver
      - Nasopharyngeal airway
      - Allow casualty to assume any position that best protects the airway, to include sitting up.
      - Place unconscious casualty in the recovery position.
      - If previous measures unsuccessful:
         - Surgical cricothyroidotomy (with lidocaine if conscious)
3. Breathing
   a. In a casualty with progressive respiratory distress and known or suspected torso trauma, consider a tension pneumothorax and decompress the chest on the side of the injury with a 14-gauge, 3.25 inch needle/catheter unit inserted in the second intercostal space at the midclavicular line. Ensure that the needle entry into the chest is not medial to the nipple line and is not directed towards the heart.
   b. All open and/or sucking chest wounds should be treated by immediately applying an occlusive material to cover the defect and securing it in place. Monitor the casualty for the potential development of a subsequent tension pneumothorax.
4. Bleeding
   a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a CoTCCC-recommended tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet application or for any traumatic amputation. Apply directly to the skin 2-3 inches above wound.
   b. For compressible hemorrhage not amenable to tourniquet use or as an adjunct to tourniquet removal (if evacuation time is anticipated to be longer than two hours), use Combat Gauze as
   the hemostatic agent of choice. Combat Gauze should be applied with at least 3 minutes of direct pressure. Before releasing any tourniquet on a casualty who has been resuscitated for hemorrhagic shock, ensure a positive response to resuscitation efforts (i.e., a peripheral pulse normal in character and normal mentation if there is no traumatic brain injury (TBI).
   c. Reassess prior tourniquet application. Expose wound and determine if tourniquet is needed. If so, move tourniquet from over uniform and apply directly to skin 2-3 inches above wound. If a tourniquet is not needed, use other techniques to control bleeding.

d. When time and the tactical situation permit, a distal pulse check should be accomplished. If a distal pulse is still present, consider additional tightening of the tourniquet or the use of a second tourniquet, side by side and proximal to the first, to eliminate the distal pulse.

e. Expose and clearly mark all tourniquet sites with the time of tourniquet application. Use an indelible marker.

5. Intravenous (IV) access

- Start an 18-gauge IV or saline lock if indicated.
- If resuscitation is required and IV access is not obtainable, use the intraosseous (IO) route.

6. Fluid resuscitation

Assess for hemorrhagic shock; altered mental status (in the absence of head injury) and weak or absent peripheral pulses are the best field indicators of shock.

a. If not in shock:

- No IV fluids necessary
- PO fluids permissible if conscious and can swallow

b. If in shock:

- Hextend, 500mL IV bolus
- Repeat once after 30 minutes if still in shock.
- No more than 1000mL of Hextend

c. Continued efforts to resuscitate must be weighed against logistical and tactical considerations and the risk of incurring further casualties.

d. If a casualty with an altered mental status due to suspected TBI has a weak or absent peripheral pulse, resuscitate as necessary to maintain a palpable radial pulse.

7. Prevention of hypothermia

a. Minimize casualty's exposure to the elements. Keep protective gear on or with the casualty if feasible.

b. Replace wet clothing with dry if possible. **Get the casualty onto an insulated surface as soon as possible.**

c. Apply the Ready-Heat Blanket from the Hypothermia Prevention and Management Kit (HPMK) to the casualty's torso (not directly on the skin) and cover the casualty with the Heat-Reflective Shell (HRS).

d. If an HRS is not available, the previously recommended combination of the Blizzard Survival Blanket and the Ready Heat blanket may also be used.

e. If the items mentioned above are not available, use dry blankets, poncho liners, sleeping bags, or anything that will retain heat and keep the casualty dry.

f. Warm fluids are preferred if IV fluids are required.

8. Penetrating Eye Trauma

If a penetrating eye injury is noted or suspected:

a. Perform a rapid field test of visual acuity.

b. Cover the eye with a rigid eye shield (NOT a pressure patch.)

c. Ensure that the 400mg moxifloxacin tablet in the combat pill pack is taken if possible and that IV/IM antibiotics are given as outlined below if oral moxifloxacin cannot be taken.

9. Monitoring

Pulse oximetry should be available as an adjunct to clinical monitoring.

Readings may be misleading in the settings of shock or marked hypothermia.

10. Inspect and dress known wounds.

11. Check for additional wounds.

12. Provide analgesia as necessary.

a. Able to fight:

These medications should be carried by the combatant and self- administered as soon as possible after the wound is sustained.

- Mobic, 15mg PO once a day
- Tylenol, 650mg bilayer caplet, 2 PO every 8 hours

b. Unable to fight:

Note: Have naloxone readily available whenever administering opiates.

- Does not otherwise require IV/IO access
- Oral transmucosal fentanyl citrate (OTFC), 800ug transbuccally
- Recommend taping lozenge-on-a-stick to casualty's finger as an added safety measure
- Reassess in 15 minutes
- Add second lozenge, in other cheek, as necessary to control severe pain.
- Monitor for respiratory depression.

- IV or IO access obtained:
    - Morphine sulfate, 5mg IV/IO
        - Reassess in 10 minutes.
        - Repeat dose every 10 minutes as necessary to control severe pain.
        - Monitor for respiratory depression
    - Promethazine, 25mg IV/IM/IO every 6 hours as needed for nausea or for synergistic analgesic effect

13. Splint fractures and recheck pulse.
14. Antibiotics: recommended for all open combat wounds
    a. If able to take PO:
        - Moxifloxacin, 400mg PO one a day
    b. If unable to take PO (shock, unconsciousness):
        - Cefotetan, 2g IV (slow push over 3-5 minutes) or IM every 12 hours or
        - Ertapenem, 1g IV/IM once a day
15. Burns
    a. Facial burns, especially those that occur in closed spaces, may be associated with inhalation injury. Aggressively monitor airway status and oxygen saturation in such patients and consider early surgical airway for respiratory distress or oxygen desaturation.
    b. Estimate total body surface area (TBSA) burned to the nearest 10% using the Rule of Nines.
    c. Cover the burn area with dry, sterile dressings. For extensive burns (>20%), consider placing the casualty in the Blizzard Survival Blanket in the Hypothermia Prevention Kit in order to both cover the burned areas and prevent hypothermia.
    d. Fluid resuscitation (USAISR Rule of Ten)
        – If burns are greater than 20% of Total Body Surface Area, fluid resuscitation should be initiated as soon as IV/IO access is established. Resuscitation should be initiated with Lactated Ringer's, normal saline, or Hextend. If Hextend is used, no more than 1000ml should be given, followed by Lactated Ringer's or normal saline as needed.
        – Initial IV/IO fluid rate is calculated as %TBSA x 10cc/hr for adults weighing 40- 80kg.
        – For every 10kg ABOVE 80kg, increase initial rate by 100ml/hr.
        – If hemorrhagic shock is also present, resuscitation for hemorrhagic shock takes precedence over resuscitation for burn shock. Administer IV/IO fluids per the TCCC Guidelines in Section 6.

    e. Analgesia in accordance with the TCCC Guidelines in Section 12 may be administered to treat burn pain.
    f. Prehospital antibiotic therapy is not indicated solely for burns, but antibiotics should be given per the TCCC guidelines in Section 14 if indicated to prevent infection in penetrating wounds.
    g. All TCCC interventions can be performed on or through burned skin in a burn casualty.
16. Communicate with the casualty if possible.
        - Encourage; reassure
        - Explain care
17. Cardiopulmonary resuscitation (CPR)
    Resuscitation on the battlefield for victims of blast or penetrating trauma who have no pulse, no ventilations, and no other signs of life will not be successful and should not be attempted.
18. Documentation of Care
    Document clinical assessments, treatments rendered, and changes in the casualty's status on a TCCC Casualty Card. Forward this information with the casualty to the next level of care.

Basic Management Plan for Tactical Evacuation Care

* The new term "Tactical Evacuation" includes both Casualty Evacuation (CASEVAC) and Medical Evacuation (MEDEVAC) as defined in Joint Publication 4-02.

1. Airway Management
    a. Unconscious casualty without airway obstruction:
        - Chin lift or jaw thrust maneuver
        - Nasopharyngeal airway
        - Place casualty in the recovery position
    b. Casualty with airway obstruction or impending airway obstruction:
        - Chin lift or jaw thrust maneuver

- Nasopharyngeal airway
- Allow casualty to assume any position that best protects the airway, to include sitting up.
- Place unconscious casualty in the recovery position.
- If above measures unsuccessful:
    - Laryngeal Mask Airway (LMA)/intubating LMA or
    - Combitube or
    - Endotracheal intubation or
    - Surgical cricothyroidotomy (with lidocaine if conscious).

c. Spinal immobilization is not necessary for casualties with penetrating trauma.

2. Breathing

a. In a casualty with progressive respiratory distress and known or suspected torso trauma, consider a tension pneumothorax and decompress the chest on the side of the injury with a 14-gauge, 3.25 inch needle/catheter unit inserted in the second intercostal space at the midclavicular line. Ensure that the needle entry into the chest is not medial to the nipple line and is not directed towards the heart.

b. Consider chest tube insertion if no improvement and/or long transport is anticipated.

c. Most combat casualties do not require supplemental oxygen, but administration of oxygen may be of benefit for the following types of casualties:
- Low oxygen saturation by pulse oximetry
- Injuries associated with impaired oxygenation
- Unconscious casualty
- Casualty with TBI (maintain oxygen saturation > 90%)
- Casualty in shock
- Casualty at altitude

d. All open and/or sucking chest wounds should be treated by immediately applying an occlusive material to cover the defect and securing it in place. Monitor the casualty for the potential development of a subsequent tension pneumothorax.

3. Bleeding

a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a CoTCCC-recommended tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet application or for any traumatic amputation. Apply directly to the skin 2-3 inches above wound.

b. For compressible hemorrhage not amenable to tourniquet use or as an adjunct to tourniquet removal (if evacuation time is anticipated to be longer than two hours), use Combat Gauze as the hemostatic agent of choice. Combat Gauze should be applied with at least 3 minutes of direct pressure. Before releasing any tourniquet on a casualty who has been resuscitated for hemorrhagic shock, ensure a positive response to resuscitation efforts (i.e., a peripheral pulse normal in character and normal mentation if there is no TBI.)

c. Reassess prior tourniquet application. Expose wound and determine if tourniquet is needed. If so, move tourniquet from over uniform and apply directly to skin 2-3 inches above wound. If a tourniquet is not needed, use other techniques to control bleeding.

d. When time and the tactical situation permit, a distal pulse check should be accomplished. If a distal pulse is still present, consider additional tightening of the tourniquet or the use of a second tourniquet, side by side and proximal to the first, to eliminate the distal pulse.

e. Expose and clearly mark all tourniquet sites with the time of tourniquet application. Use an indelible marker.

4. Intravenous (IV) access

a. Reassess need for IV access.
- If indicated, start an 18-gauge IV or saline lock
- If resuscitation is required and IV access is not obtainable, use intraosseous (IO) route.

5. Fluid resuscitation

Reassess for hemorrhagic shock (altered mental status in the absence of brain injury and/or change in pulse character.) **If BP monitoring is available, maintain target systolic BP 80-90mmHg.**

a. If not in shock:
- No IV fluids necessary.
- PO fluids permissible if conscious and can swallow.

b. If in shock and blood products <u>are not</u> available:
- Hextend 500ml IV bolus
- Repeat after 30 minutes if still in shock.
- **Continue resuscitation with Hextend or crystalloid solution as needed to maintain target BP or clinical improvement.**

c. If in shock and blood products are available under an approved command or theater protocol:
- Resuscitate with 2 units of plasma followed by packed red blood cells (PRBCs) in a 1:1 ratio. If blood component therapy is not available, transfuse fresh whole blood. Continue resuscitation as needed to maintain target BP or clinical improvement.
d. If a casualty with an altered mental status due to suspected TBI has a weak or absent peripheral pulse, resuscitate as necessary to maintain a palpable radial pulse. If BP monitoring is available, maintain target systolic BP of at least 90mmHg.

6. Prevention of hypothermia
a. Minimize casualty's exposure to the elements. Keep protective gear on or with the casualty if feasible.
b. Replace wet clothing with dry if possible. **Get the casualty onto an insulated surface as soon as possible.**
c. Apply the Ready-Heat Blanket from the Hypothermia Prevention and Management Kit (HPMK) to the casualty's torso (not directly on the skin) and cover the casualty with the Heat-Reflective Shell (HRS).
d. If an HRS is not available, the previously recommended combination of the Blizzard Survival Blanket and the Ready Heat blanket may also be used.
e. If the items mentioned above are not available, use poncho liners, sleeping bags, or anything that will retain heat and keep the casualty dry.
f. Use a portable fluid warmer capable of warming all IV fluids including blood products.
g. Protect the casualty from wind if doors must be kept open.

7. Penetrating Eye Trauma
If a penetrating eye injury is noted or suspected:
a. Perform a rapid field test of visual acuity.
b. Cover the eye with a rigid eye shield (NOT a pressure patch).
c. Ensure that the 400mg moxifloxacin tablet in the combat pill pack is taken if possible and that IV/IM antibiotics are given as outlined below if oral moxifloxacin cannot be taken.

8. Monitoring
Institute pulse oximetry and other electronic monitoring of vital signs, if indicated.

9. Inspect and dress known wounds if not already done.

10. Check for additional wounds.

11. Provide analgesia as necessary.
a. Able to fight:
- Mobic, 15mg PO once a day
- Tylenol, 650mg bilayered caplet, 2 PO every 8 hours

b. Unable to fight:
Note: Have naloxone readily available whenever administering opiates.
- Does not otherwise require IV/IO access:
  - Oral transmucosal fentanyl citrate (OTFC) 800ug transbuccally
    - Recommend taping lozenge-on-a-stick to casualty's finger as an added safety measure.
    - Reassess in 15 minutes.
    - Add second lozenge, in other cheek, as necessary to control severe pain.
    - Monitor for respiratory depression.
- IV or IO access obtained:
  - Morphine sulfate, 5mg IV/IO
    - Reassess in 10 minutes
    - Repeat dose every 10 minutes as necessary to control severe pain.
    - Monitor for respiratory depression.
- Promethazine, 25mg IV/IM/IO every 6 hours as needed for nausea or for synergistic analgesic effect.

12. Reassess fractures and recheck pulses.

13. Antibiotics: recommended for all open combat wounds
a. If able to take PO:
- Moxifloxacin, 400mg PO once a day

b. If unable to take PO (shock, unconsciousness):
- Cefotetan, 2g IV (slow push over 3-5 minutes) or IM every 12 hours, or
- Ertapenem, 1g IV/IM once a day

14. Burns
    a. Facial burns, especially those that occur in closed spaces, may be associated with inhalation injury. Aggressively monitor airway status and oxygen saturation in such patients and consider early surgical airway for respiratory distress or oxygen desaturation.
    b. Estimate total body surface area (TBSA) burned to the nearest 10% using the Rule of Nines.
    c. Cover the burn area with dry, sterile dressings. For extensive burns (>20%), consider placing the casualty in the Blizzard Survival Blanket in the Hypothermia Prevention Kit in order to both cover the burned areas and prevent hypothermia.
    d. Fluid resuscitation (USAISR Rule of Ten)
        – If burns are greater than 20% of Total Body Surface Area, fluid resuscitation should be initiated as soon as IV/IO access is established. Resuscitation should be initiated with Lactated Ringer's, normal saline, or Hextend. If Hextend is used, no more than 1000 ml should be given, followed by Lactated Ringer's or normal saline as needed.
        – Initial IV/IO fluid rate is calculated as %TBSA x 10cc/hr for adults weighing 40-80kg.
        – For every 10kg ABOVE 80kg, increase initial rate by 100ml/hr.
        – If hemorrhagic shock is also present, resuscitation for hemorrhagic shock takes precedence over resuscitation for burn shock. Administer IV/IO fluids per the TCCC Guidelines in Section 5.
    e. Analgesia in accordance with TCCC Guidelines in Section 11 may be administered to treat burn pain.
    f. Prehospital antibiotic therapy is not indicated solely for burns, but antibiotics should be given per TCCC guidelines in Section 13 if indicated to prevent infection in penetrating wounds.
    g. All TCCC interventions can be performed on or through burned skin in a burn casualty.
    h. Burn patients are particularly susceptible to hypothermia. Extra emphasis should be placed on barrier heat loss prevention methods and IV fluid warming in this phase.
15. The Pneumatic Antishock Garment (PASG) may be useful for stabilizing pelvic fractures and controlling pelvic and abdominal bleeding. Application and extended use must be carefully monitored. The PASG is contraindicated for casualties with thoracic or brain injuries.
16. Documentation of Care
    Document clinical assessments, treatments rendered, and changes in casualty's status **on a TCCC Casualty Card**. Forward this information with the casualty to the next level of care.

Incorporating Tactical Combat Casualty Care (TCCC) Course Curriculum Updates into Air Force Medical Training

The United States Air Force Surgeon General Lt Gen Charles B. Green, USAF, MC, sent a memorandum to all MAJCOM/SGs on 21 August 2010 regarding incorporating Tactical Combat Casualty Care (TCCC) Course Curriculum Updates into Air Force Medical Training.

HQ USAF/SG sent a memorandum from Lt Gen Charles B. Green, USAF, MC, CFS Surgeon General to all MAJCOM/SGs on 21 August 2010 regarding incorporating Tactical Combat Casualty Care (TCCC) Course Curriculum Updates into Air Force Medical Training.

The Air Force is committed to providing the most comprehensive training to Airmen, which includes care of injuries sustained in the field. The TCCC course is the military counterpart to the Prehospital Trauma Life Support Course and is designed for military personnel who are preparing to deploy in support of combat operations. The TCCC program was developed to customize the principles of good trauma care for successful use on the battlefield.

The curriculum is reviewed on a regular basis by the Committee on TCCC (CoTCCC), which is comprised of experts with extensive theatre experience in the fields of Surgery, Medicine, and Prehospital Care. Proposed curriculum changes are analyzed to ensure that they reflect evidence-based advances in prehospital medicine and battlefield experience. Changes are initially researched with a review of any scientific data in favor or against them. After debate in an open forum, CoTCCC members vote on the changes, and if approved, they must be examined by the Trauma and Injury Subcommittee of the Defense Health Board (DHB) and the Core Board of the DHB. If all three groups approve the changes, the updated guidelines are posted on the following websites: the Air Force Readiness Community of Practice (CoP) on the Air Force Knowledge Now at https://www.my.af.mil/afknprod/community/views/home.aspx?Filter=OO-SG-AF-83; and on the Military Health System website at http://www.health.mil/Education_And_Training/TCCC.asp.

Effective immediately, all applicable Air Force training courses and programs will incorporate the most current TCCC guidelines consistent with their level of knowledge and proficiency instruction related to battlefield medical care. Point of contact is Lieutenant Colonel Pamela Lucas, AFMSA/SGXT, (703) 588-7276, DSN 425-7276, or pamela.lucas@pentagon.af.mil.

Tactical Combat Casualty Care Burn Management Guidelines

Memorandum to Charles L. Rice, President, Uniformed Services University of the Health Sciences Regarding: Tactical Combat Casualty Care Burn Management Guidelines

The initial Tactical Combat Casualty Care (TCCC) guidelines were included in the fourth Edition of the American College of Surgeons (ACS)-sponsored Pre-Hospital Trauma Life Support (PHTLS) Manual published in 1998. TCCC guidelines are periodically reviewed by subject matter experts to comply with the most current evidence-based practices. This memorandum outlines the newly endorsed TCCC Burn Treatment guidelines, and recommends that this curriculum be implemented in-theater, across all military Services.

The Committee on Tactical Combat Casualty Care (CoTCCC), an expert advisory Subpanel to the Trauma and Injury Subcommittee of the DHB, performs a quarterly review of the TCCC Guidelines and recommends updates for these guidelines as needed. Based on recent studies conducted by the United States Army Institute of Surgical Research (USAISR), a new chapter on the Management of Burn Injuries in TCCC will be included in the next edition of the PHTLS Manual.

Following a brief on 03 November 2009, the CoTCCC recommended revisions to the TCCC Guidelines to address the management of burns in TCCC. These changes were presented to the DHB Trauma and Injury Subcommittee and unanimously approved on 04 November 2009. The recommendations were then presented on behalf of the Subcommittee at the DHB meeting on 13 November 2009, and subsequently deliberated and passed unanimously by the Board in open session on 01 March 2010.

Background

The TCCC Guidelines have been used by Special Operations units since 1997. As stated in the Marines Administrative Message (MARADMIN), on 30 October 2009, they became the preferred standard of care for the management of trauma in the prehospital tactical environment after studies noted that training all combatants in TCCC could prevent up to 20% of combat fatalities. On 06 August 2009, the Defense Health Board recommended these guidelines be implemented across all military Services as required advanced training for all deploying combatants, medical department personnel, and combat leaders.

Burn treatment has not been included in TCCC Guidelines in the past because burns have not historically been a major cause of preventable deaths on the battlefield. The increasing incidence of burns resulting from improvised explosive device (IED) attacks on vehicles and the proposed new fluid resuscitation plan for burns recently advanced by the United States Army Institute of Surgical Research (USAISR) were the primary reasons for adding this section to the TCCC Guidelines at this time.

Burn injuries have been present in approximately 5-20 percent of combat casualties during OPERATION IRAQI FREEDOM (OIF) and OPERATION ENDURING FREEDOM (OEF). Among these patients, approximately 20 percent suffered severe burns, greater than 20 percent of total body surface area (TBSA), and would thus require life-saving intravenous resuscitation. Furthermore, combined burn and trauma (multisystem) injuries correlate with increased mortality rates, and contribute to a two to three-fold increase in the incidence of inhalation injury; currently, 5-15 percent of burn patients experience inhalation injury.

Findings

USAISR studies have documented that successful resuscitation of burn casualties can be accomplished with lower initial fluid volumes. Over-resuscitation of burns can contribute to complications such as abdominal compartment syndrome (ACS) and Acute Respiratory Distress Syndrome (ARDS).

The USAISR has, therefore, proposed a modified burn resuscitation protocol that is simpler for medical personnel to use and that provides for a somewhat lower initial fluid resuscitation, called the Institute of Surgical Research (ISR) Rule of Tens. Both this updated fluid resuscitation formula and recommendations for such aspects of care as analgesia and hypothermia prevention in bum patients have been incorporated into the revised TCCC Guidelines.

Conclusions

The Board recognizes the importance of TCCC Guidelines in optimizing the pre-hospital management of burns sustained in combat. The Board approves and endorses the following TCCC burn management strategies and recommends the Department endorse the use of the following guidelines across the Services.

Recommendations

Based on these findings, the Board submits the recommendations below to the ASD(HA), for consideration and endorsement of the TCCC Burn Management guidelines, as proposed actions that are expected to immediately improve the survival of burn casualties in-theater. These updated guidelines and the revised TCCC curriculum that supports them are now available to military medical training facilities in the Training and Education section of the Military Health System website.

a. Basic Management Plan for Care Under Fire

1. Casualties should be extricated from burning vehicles or buildings and moved to places of relative safety. Do what is necessary to stop the burning process.

b. Basic Management Plan for Tactical Field Care

1. Facial burns, especially those that occur in closed spaces, may be associated with inhalation injury. Aggressively monitor airway status and oxygen saturation in such patients and consider early surgical airway for respiratory distress or oxygen desaturation.
2. Estimate total body surface area (TBSA) burned to the nearest 10% using the Rule of Nines.
3. Cover the burn area with dry, sterile dressings. For extensive burns (>20%), consider placing the casualty in the Blizzard Survival Blanket in the Hypothermia Prevention Kit in order to both cover the burned areas and prevent hypothermia.
4. Fluid resuscitation (USAISR Rule of Ten)

– If burns are greater than 20% of Total Body Surface Area, fluid resuscitation should be initiated as soon as IVIIO access is established. Resuscitation should be initiated with Lactated Ringer's, normal saline, or Hextend. If Hextend is used, no more than 1000ml should be given, followed by Lactated Ringer's or normal saline as needed.
– Initial IVIIO fluid rate is calculated as %TBSA x 10cc/hr for adults weighing 40-80kg.
– For every 10kg ABOVE 80kg, increase initial rate by 100ml/hr.
– If hemorrhagic shock is also present, resuscitation for hemorrhagic shock takes precedence over resuscitation for burn shock. Administer IV/IO fluids per the TCCC Guidelines in Section 6 (PHTLS Manual, Sixth Edition).

5. Analgesia in accordance with the TCCC Guidelines in Section 12 (PHTLS Manual, Sixth Edition) may be administered to treat burn pain.
6. Pre-hospital antibiotic therapy is not indicated solely for burns, but antibiotics should be given per the TCCC guidelines in Section 14 (PHTLS Manual, Sixth Edition) if indicated to prevent infection in penetrating wounds.
7. All TCCC interventions can be performed on or through burned skin in a burn casualty.

c. Basic Management Plan for Tactical Evacuation Care

1. Facial burns, especially those that occur in closed spaces, may be associated with inhalation injury. Aggressively monitor airway status and oxygen saturation in such patients and consider early surgical airway for respiratory distress or oxygen desaturation.
2. Estimate total body surface area (TBSA) burned to the nearest 10% using the Rule of Nines.
3. Cover the burn area with dry, sterile dressings. For extensive burns (>20%), consider placing the casualty in the Blizzard Survival Blanket in the Hypothermia Prevention Kit in order to both cover the burned areas and prevent by hypothermia.
4. Fluid resuscitation (USAISR Rule of Ten)

– If burns are greater than 20% of Total Body Surface Area, fluid resuscitation should be initiated as soon as IV 110 access is established. Resuscitation should be initiated with Lactated Ringer's, normal saline, or Hextend. If Hextend is used, no more than 1000 ml should be given, followed by Lactated Ringer's or normal saline as needed.
– Initial IVIIO fluid rate is calculated as %TBSA x 10cc/hr for adults weighing 40-80 kg.
– For every 10kg ABOVE 80kg, increase initial rate by 100ml/hr.
– If hemorrhagic shock is also present, resuscitation for hemorrhagic shock takes precedence over resuscitation for bum shock. Administer IV/IO fluids per the TCCC Guidelines in Section 5 (PHTLS Manual, Sixth Edition).

5. Analgesia in accordance with TCCC Guidelines in Section 11 (PHTLS Manual, Sixth Edition) may be administered to treat burn pain.
6. Pre-hospital antibiotic therapy is not indicated solely for burns, but antibiotics should be given per TCCC guidelines in Section 13 (PHTLS Manual, Sixth Edition) if indicated to prevent infection in penetrating wounds.

7. All TCCC interventions can be performed on or through burned skin in a burn casualty.
8. Burn patients are particularly susceptible to hypothermia. Extra emphasis should be placed on barrier heat loss prevention methods and IV fluid warming in this phase.

The above recommendations were unanimously approved.
FOR THE DEFENSE HEALTH BOARD:
Wayne M. Lednar, MD PhD
DHB Co-Vice-President

Gregory A. Poland, MD
DHB Co-Vice-President

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Closed Loop Control of Inspired Oxygen Concentration in Trauma Patients

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Abstract

Background: Transport of mechanically ventilated patients in a combat zone presents challenges, including conservation of resources. In the battlefield setting, provision of oxygen supplies remains an important issue. Autonomous control of oxygen concentration can allow a reduction in oxygen usage and reduced mission weight. **Methods:** Trauma patients requiring ventilation and inspired oxygen concentration (FIO2) _ 0.40 were evaluated for study. Patients were randomized to consecutive 4-hour periods of closed loop control or standard care. The system for autonomous control consisted of a ventilator, oximeter, and a portable computer. The computer housed the control algorithm and collected data every 5 seconds. The controller goal was to maintain pulse oximetry (SpO2) at 94 _ 2% through discrete changes of 1% to 5% every 30 seconds. Ventilator settings and SpO2 were recorded every 5 seconds for analysis. **Results:** Forty-five patients were enrolled in this study. Oxygen saturation was maintained in the92%to96% saturation range 33_36% of the time during clinician control versus 83_21% during closed loop control. Time spent at the target SpO2 92% to 96% was 193.3_59.18 minutes during closed loop control and 87.08 _87.95 minutes during clinician control (p _0.001). Hyperoxemia was more frequent during clinician control (144.29 _ 90.09 minutes) than during closed loop control (38.91_55.86 minutes; p_0.001). There were no differences in the number of episodes of SpO2 _ 88%. Oxygen usage was reduced by 32% during closed loop control. **Conclusion:** Closed loop control of FIO2 offers the opportunity for maximizing oxygen resources, reducing mission weight, and providing targeted normoxemia without increasing risk of hypoxemia in ventilated trauma patients.

Early Predictors of Massive Transfusion in Patients Sustaining Torso Gunshot Wounds in a Civilian Level I Trauma Center

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Abstract

Background: Early prediction of the need for massive transfusion (MT) remains difficult. We hypothesized that MT protocol (MTP) utilization would improve by identifying markers for MT (_10 units packed red blood cell [PRBC] in 24 hours) in torso gunshot wounds (GSW) requiring early transfusion and operation. **Methods:** Data from all MTPs were collected prospectively from February 1, 2007, to January 31, 2009. Demographic, transfusion, anatomic, and operative data were analyzed for MT predictors. **Results:** Of the 216 MTP activations, 78 (36%) patients sustained torso GSW requiring early transfusion and operation. Five were moribund and died before receiving MT. Of 73 early survivors, 56 received MT (76%, mean 19 units PRBC) and 17 had early bleeding control (EBC), (24%, mean 5 units PRBC). Twelve transpelvic and 13 multicavitary wounds all received MT regardless of initial hemodynamic status (mean systolic blood pressure: 96 mm Hg; range, 50–169). Of 31 MT patients with low-risk trajectories (LRT), 18 (58%) had a systolic blood pressure _90 mm Hg compared with 3 of 17 (17%) in the EBC group (*p* _ 0.01). In these same groups, a base deficit of __10 was present in 27 of 31 (92%) MT patients versus 4 of 17 (23%) EBC patients (*p* _ 0.01). The presence of both markers identified 97% of patients with LRT who requiring MT and their absence would have potentially eliminated 16 of 17 EBC patients from MTP activation. **Conclusions:** In patients requiring early operation and transfusion after torso GSW: (1) early initiation of MTP is reasonable for transpelvic and multicavitary trajectories regardless of initial hemodynamic status as multiple or difficult to control bleeding sources are likely and (2) early initiation of MTP in patients with LRT may be guided by a combination of hypotension and acidosis, indicating massive blood loss.

Critical Care Credentials for the SOF Advanced Tactical Practitioner

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Special Operations medics are expected to provide superior care to critically ill and injured casualties in the most austere environments. Successful stabilization of these casualties often requires knowledge and application of various critical care skills by the SOF medic in the field. Proposals or initiatives to introduce new diagnostic and therapeutic capabilities into this far forward setting often result in controversy and significant debate among senior SOF medical personnel. Examples over the past several years include rapid sequence intubation, combat sedation, recombinant Factor VIIa, fresh whole blood transfusion, and the battlefield use of ultrasound.

While attaining certification as an Advanced Tactical Practitioner (ATP) demonstrates that a SOF medic possesses the minimum amount of medical knowledge required to successfully care for patients in combat and austere environments, it does not guarantee the presence of critical thinking skills that typically develop from clinical practice and experience. Exhibiting sound clinical judgment and critical reasoning is one of the best ways SOF medics can counter the arguments of detractors who might seek to limit the medics' scope of practice. Internationally recognized critical care credentialing exams, such as Certified Flight Paramedic (FP-C®) and Critical Care Paramedic (CCP-C®), are awarded in part on the basis of successful demonstration of critical reasoning and are currently being pursued by some SOF units as a means to further enhance the clinical credibility of ATPs.

In 2008, Colonel Warner F. "Rocky" Farr, who was the U.S. Special Operations Command (USSOCOM) Surgeon at the time, and members of the USSOCOM Curriculum and Examination Board (CEB) strongly felt that the ATP should have additional opportunities to obtain advanced credentials based on the extensive knowledge, skills, and critical reasoning of the typical SOF medic. It should be noted that in order to be eligible to take these exams, applicants had to possess a state license or certification as a paramedic. In October of that year, Colonel Farr and select members of the CEB therefore met with representatives of the Board for Critical Care Transport Paramedic Certification (BCCTPC®). The intent of this meeting was to demonstrate to the BCCTPC® that the current ATP curriculum developed superior medics with extensive training in casualty care in the most challenging settings, well above existing Department of Transportation (DOT) standards. The BCCTPC® granted eligibility and two months later the first cohort of ATPs took the FP-C® examination at the 2008 Special Operations Medical Association Conference.

For years, civilian flight paramedics in the United States have performed above the DOT baseline paramedic scope of practice. Despite this level of proficiency and expertise, the specific scope of practice for flight paramedics varied significantly among different geographical regions. Some states had statutes that specified a very narrow scope of practice, while others delegated the scope of practice entirely up to the discretion of the local medical director. This variability translated into inconsistent and potentially inadequate knowledge and skill levels in different areas of the country. Consequently, levels of care and outcomes of patients could not be standardized, and successful medical intervention partly depended on the geographic location of patients when injured.

The BCCTPC® recognized the need for a national standard that would require civilian flight paramedics to demonstrate a minimum acceptable baseline of expertise within their field. Flight Paramedics were surveyed throughout the U.S. requesting key critical concepts and knowledge that were used while performing their job. The respondents were also asked to prioritize or "weight" their responses in order to evaluate the importance of the concepts. What resulted was a blueprint for an examination that reflected benchmarked level of knowledge the flight paramedic should possess. In 2000 the FP-C exam became a reality.

The vast majority of questions coming from SOF ATPs involve the perceived differences between the Critical Care Emergency Medical Transport Program (CCEMT-P) and credentials such as the FP-C®. The CCEMT-P certification represents the successful completion of the course and passing the final exam. The knowledge necessary to pass the examination is provided for the student during the course much like other completion courses such as Advanced Cardiac Life Support, or Pre-hospital Trauma Life Support.

Credentialing examinations, such as the FP-C® exam and the Certified Flight Registered Nurse (CFRN®) exam, are not intended as a course completion test like the CCEMT-P, but are instead established to accurately assess current knowledge and critical thinking skills for individuals practicing in a specific role. By doing so, they establish benchmarks for employers and the practitioners regardless of where care is provided. To date, over 1,700 paramedics in North America and Europe have earned the FP-C® credential. Currently many civilian air medical programs require this advanced certification upon date of hire or within a specified time frame. The Commission on Accreditation of Medical Transport Systems (CAMTS) highly recommends the FP-C® credential for paramedics in the industry.

Experience and critical thinking skills are very important for the ATP and other SOF medical personnel as the expected time period for care can range from near immediate tactical evacuation (TACEVAC) to multiple days due to various operational factors. Historically, the primary focus of the ATP has been on trauma care and the initial stabilization of the combat casualty. The ability to meet or exceed the knowledge and critical thinking skills required for FP-C® indicates that the ATP likely also possesses the requisite expertise and capabilities in critical care and extended resuscitation.

Initially the primary interest in the FP-C® credential came from special operations aviation units and their medical personnel. The 160th Special Operations Aviation Regiment (Airborne) (SOAR(A)) has made attaining FP-C® status a prerequisite for becoming “fully mission qualified”. To date over 60% of the ATPs and 11 of the medical officers in the 160th SOAR(A) have achieved FP-C® status. Senior medical leaders in the 160th SOAR(A) noted that since the inception of the FP-C® as a benchmark standard, the unit’s medical capabilities are at a higher level than previously seen. Individual 160th SOAR(A) medics reported that they are more confident in their ability to provide extended care.

Attaining FP-C® and/or CCP-C® status is not easy. Success requires extensive experience and development of sound critical thinking skills. As SOF medicine continues to become more complex, medics must have an avenue to demonstrate a level of knowledge that cannot be provided in the classroom. The BCCTPC® will conduct an FP-C® and a CCP-C® exam at the SOMA Conference in Tampa, Florida on 13 December 2010. A specific time and location will be posted on the SOMA website and announced at the conference. For more information on these examinations, please visit their web site at www.BCCTPC.org.

BCCTPC®
Board For Critical Care
Transport Paramedic
Certification

Meet Your JSOM Staff

EXECUTIVE EDITOR

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Prior to becoming the USSOCOM Command Surgeon, COL "Tom" Deal served in staff positions at USASOC, JSOC, 7th SFG, and XVIII Airborne Corps. He has commanded field and stateside hospitals and served as Chief of Surgery in the 86th Evac Hospital in ODSS and at Army and civilian community hospitals.

COL Deal obtained his medical degree from University of Tennessee College of Medicine, Memphis, Tennessee, 1974. He completeted his general surgery residency at Brooke Army Medical Center 1977-1981 and is certified by the American Board of Surgery.

COL Deal competed his Flight Surgeon's Course – 2003, Army War College – 1997, Command & General Staff College – 1994, AMEDD Officer Advanced Course – 1991, Military Free Fall School – 1977, Special Forces Officers Course – 1976, and Airborne School – 1975.

COL Deal has also completed Combat Casualty Care Leadership Course (C4A) –1991, Pre-Command Course, Fort Leavenworth – 1994, Senior Officer's Legal Orientation, Charlottesville -- 1994, Combatant Commander's Surgeons Course – 1996, AMEDD Pre-Command Course, Fort Sam Houston – 1998, Basic Life Support – current, Advanced Cardiac Life Support, Advanced Trauma Life Support, and Pilot, single engine, land, instrument.

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Lt Col Landers joined the Army Reserve in 1987 and served as a nurse in a Combat Support Hospital unit for three years before switching services in 1990 to become an Air Force C-130 Flight Nurse. She is currently an IMA reservist assigned to HQ AF Reserve Command/SG and is attached to the SOCOM/SG office where she has been in charge of management, production, publication, and distribution of the JSOM since its inception in Dec 2000. Lt Col Landers has a Bachelors in Nursing and a Masters in Business Administration/Management. Her 24 year nursing career includes being a flight nurse in both the military and private sector, 15 years of clinical experience in emergency and critical care nursing, as well as being an EMT and a legal nurse consultant. She also served as the military liaison to the FL 3 Disaster Medical Assistance Team (DMAT). Prior to the SG office, Lt Col Landers' experience at USSOCOM includes an assignment in the Center for Force Structure, Resources, Requirements, and Strategic Assessments.

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The JSOM is your journal and serves as a unique opportunity for you to pass your legacy to the SOF medical community!

Special Forces Aidman's Pledge

As a Special Forces Aidman of the United States Army, I pledge my honor and my conscience to the service of my country and the art of medicine. I recognize the responsibility which may be placed upon me for the health, and even lives, of others. I confess the limitation of my skill and knowledge in the caring for the sick and injured. I promise to follow the maxim "Primum non- nocere" ("First, thou shalt do no harm"), and to seek the assistance of more competent medical authority whenever it is available. These confidences which come to me in my attendance on the sick, I will treat as secret. I recognize my responsibility to impart to others who seek the service of medicine such knowledge of its art and practice as I possess, and I resolve to continue to improve my capability to this purpose. As an American Soldier, I have determined ultimately to place above all considerations of self the mission of my team and the cause of my nation.

Pararescue Creed

I was that which others did not want to be. I went where others feared to go, and did what others failed to do. I asked nothing from those who gave nothing, And reluctantly accepted the thought of eternal lonliess ... should I fail. I have seen the face of terror; felt the stinging cold of fear, and enjoyed the sweet taste of a moment's love. I have cried, pained and hoped...but most of all, I have lived times others would say best forgotten. Always I will be able to say, that I was proud of what I was: a PJ It is my duty as a Pararescueman to save a life and to aid the injured. I will perform my assigned duties quickly and efficiently, placing these duties before personal desires and comforts.

These things I do,

"That Others May Live."

A Navy Poem

I'm the one called "Doc"... I shall not walk in your footsteps, but I will walk by your side. I shall not walk in your image, I've earned my own title of pride. We've answered the call together, on sea and foreign land. When the cry for help was given, I've been there right at hand. Whether I am on the ocean or in the jungle wearing greens, Giving aid to my fellow man, be it Sailors or Marines. So the next time you see a Corpsman and you think of calling him "squid," think of the job he's doing as those before him did. And if you ever have to go out there and your life is on the block, Look at the one right next to you...

I'm the one called "Doc".

~ Harry D. Penny, Jr. USN Copyright 1975

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