Strategy Research Project

Strategies for Enhancing Military Physical Readiness in the 21st Century

by

Bradley C. Nindl, Ph.D.
Department of Army Civilian

United States Army War College
Class of 2012

The U.S. Army War College is accredited by the Commission on Higher Education of the Middle States Association of Colleges and Schools, 3624 Market Street, Philadelphia, PA 19104, (215) 662-5606. The Commission on Higher Education is an institutional accrediting agency recognized by the U.S. Secretary of Education and the Council for Higher Education Accreditation.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
22-03-2012	Strategy Research Project	

Strategies for Enhancing Military Physical Readiness in the 21st Century

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Bradley C. Nindl, Ph.D.

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Thomas J. Williams, Ph.D.

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army War College
122 Forbes Avenue
Carlisle, PA 17013

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

Distribution: A

13. SUPPLEMENTARY NOTES

14. ABSTRACT Military readiness is negatively impacted by the near-epidemic incidence rate of musculoskeletal injuries (MSIs). MSIs represent a major threat to the health and fitness of our Soldiers and a risk to our Nation's ability to project military power. This risk is both financial (i.e. economic burden from medical, healthcare and disability costs) and personnel readiness (i.e. Soldiers medically unable to optimally perform their duties and to deploy). For example, MSIs represent: 1) 45% of the medically not-ready, non-deployable population, 2) the major cause of medical evacuation from a combat theater; the majority resulting from physical training, 3) an annual cost of half a billion dollars for diagnosing and treating more than 1 million Soldiers with MSIs and 6 billion dollars in salary and 4) the major reason annual VA compensation paid for musculoskeletal disabilities is $5.5 billion (26% of total paid compensation). It is imperative for military leaders to understand that physical-training related MSIs are largely preventable. There is a need for a strategic paradigm shift in the military's approach to physical readiness policies, in training and doctrine which should include institutionalizing best practices and processes, and establishing stronger linkages across all military stakeholders.

15. SUBJECT TERMS
Musculoskeletal Injury, Physical Performance, Fitness, Tactical Athlete, Human Performance Optimization, Injury Prevention

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. TELEPHONE NUMBER** *(include area code)*
UNCLASSIFED	UNCLASSIFED	UNCLASSIFED	UNLIMITED	32	

USAWC STRATEGY RESEARCH PROJECT

STRATEGIES FOR ENHANCING MILITARY PHYSICAL READINESS IN THE 21ST CENTURY

by

Bradley C. Nindl, Ph.D.
Department of Army Civilian

Thomas J. Williams, Ph.D.
Project Adviser

This SRP is submitted in partial fulfillment of the requirements of the Master of Strategic Studies Degree. The U.S. Army War College is accredited by the Commission on Higher Education of the Middle States Association of Colleges and Schools, 3624 Market Street, Philadelphia, PA 19104, (215) 662-5606. The Commission on Higher Education is an institutional accrediting agency recognized by the U.S. Secretary of Education and the Council for Higher Education Accreditation.

U.S. Army War College
CARLISLE BARRACKS, PENNSYLVANIA 17013

ABSTRACT

AUTHOR: Bradley C. Nindl, Ph.D.

TITLE: Strategies for Enhancing Military Physical Readiness in the 21st Century

FORMAT: Strategy Research Project

DATE: 22 March 2012 WORD COUNT: 5,133 PAGES: 32

KEY TERMS: Musculoskeletal Injury, Physical Performance, Fitness, Tactical Athlete, Human Performance Optimization, Injury Prevention

CLASSIFICATION: Unclassified

Military readiness is negatively impacted by the near-epidemic incidence rate of musculoskeletal injuries (MSIs). MSIs represent a major threat to the health and fitness of our Soldiers and a risk to our Nation's ability to project military power. This risk is both financial (i.e. economic burden from medical, healthcare and disability costs) and personnel readiness (i.e. Soldiers medically unable to optimally perform their duties and to deploy). For example, MSIs represent: 1) 45% of the medically not-ready, non-deployable population, 2) the major cause of medical evacuation from a combat theater; the majority resulting from physical training, 3) an annual cost of half a billion dollars for diagnosing and treating more than 1 million Soldiers with MSIs and 6 billion dollars in salary and 4) the major reason annual VA compensation paid for musculoskeletal disabilities is $5.5 billion (26% of total paid compensation). It is imperative for military leaders to understand that physical-training related MSIs are largely preventable. There is a need for a strategic paradigm shift in the military's approach to physical readiness policies, in training and doctrine which should include institutionalizing best practices and processes, and establishing stronger linkages across all military stakeholders.

STRATEGIES FOR ENHANCING MILITARY PHYSICAL READINESS IN THE 21ST CENTURY

Knowing is not enough; we must apply. Willing is not enough; we must do.

—Johann Wolfgang von Goethe
German Playwright, Poet, Novelist, and Dramatist
1749-1832

The military is being transformed as the current deployments in Iraq and Afghanistan come to end and the Department of Defense (DoD) faces budget cuts and personnel drawdowns. The chairman of the Joint Chiefs of Staff, General Martin Dempsey, has stated that consideration of strategies and capabilities are key factors in cutting $450 billion from DoD's budget over the next 10 years.[1] Further, on 26 January 2012, the strategic guidance from the Pentagon, presented from Secretary of Defense, Leon Panetta, and Chairman of the Joint Chiefs of Staff, General Martin Dempsey, have recommended current Army personnel strength reductions from 570,000 to 490,000 over the next five years.[2] Second order effects from this decline in troop strength superimposed upon the persistent and significant percentage of Soldiers considered medically not ready (MNR) to deploy could have catastrophic consequences if the manned force structure is not able to meet military operational requirements to protect our Nation's vital and important interests.

A large percentage of the MNR population is attributed to musculoskeletal injuries (MSIs). These MSIs represent a major threat to the health and fitness of our Soldiers and subsequently place at risk our Nation's ability to project military power.[3] This risk posed is both financial (i.e., economic burden from medical, healthcare and disability costs) and impacts on personnel readiness (i.e., Soldiers medically unable to optimally perform their duties and to deploy).

Minimizing injuries among military personnel and continued reductions in injury rates depend on institutionalizing existing best practices and establishing stronger linkages across commands, operators, researchers, medical providers, public health, and safety officials.[4] With an emphasis documented on the health and fitness of the total force in the 2010 Quadrennial Defense Review Report[5] and a healthy, enhanced, and protected force in the 2007 Joint Force Health Protection Concept of Operations[6], now is the time for an energized sense of urgency from senior military leadership to critically review military physical readiness practices (i.e. both human performance optimization (HPO) and injury prevention (IP)) within the Army with the goal of implementing policies and strategies that promote and sustain military physical readiness. Such action will contribute to force readiness and align with a fundamental premise within the DoD and the Military Healthcare System that the human is the center of our Warfighter capability; that is, the human is the prime resource and key enabler of all Warfighting systems.[7]

This paper presents the case that a new strategic paradigm is required in the way the military approaches military physical readiness. For the purposes of this paper, the term military physical readiness is an umbrella term referring to both HPO and IP efforts. This paper will describe 1) the scope and impact of the Army's musculoskeletal injury problem, 2) etiology and risk factors of physical-training related musculoskeletal injuries, 3) an assessment of current Army Physical Readiness Training Doctrine, 4) injury risk mitigation strategies and efforts, 5) current HPO/IP efforts in Army and 6) recommendations for the way ahead for implementing organizational, communication, scientific and operational change through strategic planning.

Scope and Impact of the Army's Musculoskeletal Injury Problem

Former Army Surgeon General Lieutenant General Eric Schoomaker has identified that the Army's deployment readiness stands at just 85% for active duty and only 70% for Guard and Reserve forces.[8] Brigadier General Lein, command surgeon at U.S. Forces Command, has warned that if the non-deployable status remains at the current level, the Army would find it difficult to maintain unit-manning levels in the future. "If we don't get our arms around the non-deployable population, and the biggest population is the MNR population, we're going to have a significant problem manning our units to get them to go downrange," he said. "The Soldier is the center of our formations, so if the Soldier is not ready to go, then the unit is not ready to go."[9]

The incidence rate for MSIs in the Army is nothing short of alarming. Injuries result in over 1.8 million medical encounters annually across the military services and affects more than 800,000 individual service members.[10] In comparison, the second leading cause of medical encounters, mental disorders, results in 750,000 encounters annually, affecting 190,000 service members.[11] Published research has demonstrated that the physical training-related injury incidence rate during U.S. Army basic combat training ranges from 19-40% for men and 40-67% for women.[12] For advanced individualized training ranging from 9-16 weeks, the literature reports training-related injury incidence rates spanning 24-40% for men and 30-60% for women.[13] Further, injury incidence rates for operational units range from 5-13%.[14] Physical training and sports are the activities associated with the largest proportion of these injuries: 53-63% for Ordnance Soldiers, 40% for armor Soldiers, 38% for garrison Soldiers, 42% for senior officers at the U.S. Army War College, 58% for light infantry Soldiers, 53% for military policeman, and 34% for wheel vehicle mechanics.[15]

Downstream effects from the MSI epidemic in the Army profoundly impact hospitalizations and outpatient visits, lost/limited duty time and disabilities. Acute MSIs and chronic musculoskeletal conditions arising from injuries are consistently the leading cause of hospitalizations and outpatient visits in the Army. Of the 2,473,327 outpatient visits to Army medical treatment facilities in the Army reported in 2003, 750,505 (30%) were injuries and other musculoskeletal conditions.[16] The Army diagnoses and treats more than 1 million Soldiers with MSIs each year, which equates to 400,000 medical profiles annually, more than 25 million limited duty days, and the equivalent of 68,000 Soldiers on limited duty.[17] The actual health costs to those 68,000 are half a billion dollars. The cost of salaries is just under $6 billion annually in salary given to Soldiers who cannot deploy.[18] The time lost to commanders and organizations, is incalculable.

The long-term effects are just as sobering. Disabilities from MSIs have also been dramatically and disproportionally increasing over time. From 1982-2002, the disability discharge rates specifically for MSIs have increased from less than 15 for both men and women to 140 per 10,000 female Soldiers per year (9 fold increase) and to 81 per 10,000 male Soldiers per year (5 fold increase).[19] Such disproportionate disability discharge rates among men and women will need to be a policy consideration as more military occupational specialties are considered being opened to women. The Veteran's Administration reported in 2001 that the annual compensation paid to disabled service members totaled over $21 billion with over $5.5 billion to service members with musculoskeletal disabilities.[20] While it is understood that Soldiering is a physically demanding occupation, it is difficult to fathom how the Army as an enterprise

organization can tolerate these strikingly high injury incidence rates and medical costs as an apparently acceptable risk of doing business.

Etiology and Risk Factors of Physical-Training Related Musculoskeletal Injuries

The rigor of physical training, particularly preparing for physically demanding occupations such as those in the military, places great demands on the musculoskeletal system. The many beneficial outcomes of effective physical training are well documented.[21] Conversely, maladaptations from physical training can also occur leading to MSIs. For example, many of the injury-related musculoskeletal conditions result from cumulative effects of repetitive micro-trauma forces from overreaching/training, overuse injuries, overexertion, and repetitive movements experienced during both occupational duties and physical training.[22] Of the 743,547 MSIs reported in 2006 from military medical surveillance data using active duty, non-deployed service members, 82% were classified as overuse.[23] As stated previously, typically 30-50% of these injuries are specifically attributable to physical training and sports activities.[24]

The physical-training MSI epidemic in the military training/garrison environment, is arguably under recognized by military leaders and policy makers, while it has actually been well documented in the scientific literature for some time. Perhaps even more compelling for senior leaders to understand is that the major cause of over 30,000 medical evacuations from 2001-2006 from Iraqi Freedom and Enduring Freedom were not-battle injuries, but those stemming from sports and physical training activities. Hauret et al. reported that medical evacuations for non-battle injuries (36%) were twofold greater than for battle related injuries (18%).[25] (The major causes for these non-battle related medical evacuations were from physical training and sports (19-21%)).

Further, in another study Cohen et al. also reported medical evacuations from Iraqi Freedom and Enduring Freedom were greater for musculoskeletal related injures (24%) vs. combat injuries (14%).[26] Hence, effective physical training injury mitigation strategies will facilitate keeping more people “in the fight” and decreasing the number needed to send “to the fight” as replacements for those injured.

Numerous intrinsic and extrinsic risk factors for MSIs have been identified. Intrinsic risk factors include: female gender, low aerobic fitness, low levels of physical activity prior to military entrance, cigarette smoking prior to military entrance, past ankle sprains, low muscular endurance, older age, and low levels of muscle strength.[27] Extrinsic risk factors include running mileage, age of running shoes, seasonal variations (higher overall rates in summer).[28] With the exception of considering aerobic fitness levels in assigning basic trainees into groups for ability group runs,[29] there is currently no systemic Army-wide policy of using known intrinsic risk factors to stratify Soldiers based upon injury risk potential and tailor their physical readiness training accordingly.

An Assessment of Current Army Physical Readiness Training Doctrine

The Army has improved its physical training curriculum by implementing evidence-based physical training policy and doctrine to address the balance between human performance optimization (HPO) and injury prevention (IP). The Training and Doctrine Command’s Army Physical Fitness School has released an updated and authoritative doctrine in the form of a training circular (Army Training Circular – TC 3-22.20: Army Physical Readiness Training (August 2010)). This document replaced FM 3-22.20 (Army Physical Readiness Manual) which was an update to the old FM 21-20 (Physical Fitness Training). Starting in the early 2000s, the U.S. Army Physical Fitness School (USAPFS) initiated efforts to redesign Army physical training. In consultation

with subject matter experts from the USACHPPM and the U.S. Army Research Institute of Environmental Medicine, a program was designed to improve Warfighter's capability for military operations and to reduce musculoskeletal injury. This was achieved by examining the standard list of warrior tasks and determining 1) the physical requirements, 2) the fitness components involved, and 3) the training activities that most likely could improve the military tasks. Injury prevention features included reduced running mileage, exercise variety (cross-training), and gradual, progressive training.[30] This program was subsequently validated in field and laboratory studies.[31,32,33] These studies demonstrated that the overall adjusted injury risk was 1.5-1.8 times higher in groups of Soldiers performing traditional military physical training when compared with groups using physical readiness training (PRT). Scores on the APFT and physical performance were similar or higher in groups using the PRT programs.[34,35] The Army adopted PRT as official doctrine as a result of these studies.

Even given the advantages and benefits of the current evidence-based Army PRT, there are several areas of concern and limitations with the current doctrine. First, the PRT program was only assessed over a relatively short time period (approximately 8 weeks). Kraemer et al. have shown that the incorporation of resistance training provides superior gains in strength, power, muscle hypertrophy and military task performance over a 6 month training period when compared to conventional military field training.[36] There is a paucity of research that has considered physical performance adaptations over the “life cycle spectrum” of the Warfighter, particularly among operational units. It is difficult to determine the optimal physical training programs to implement without additional validation studies. Second, the majority of the field

validations utilized the APFT as the performance outcome measure. There is a great deal of debate among military physical training subject matter experts with regard to the appropriateness of the APFT to assess the capability of a Warfighter to perform occupational and/or combat duties.[37] While there is no other established and accepted metrics of "combat or functional performance," the Army is currently fielding two different tests for consideration to accept as doctrine: an Army Physical Readiness Test (APRT) consisting of a 60 yard shuttle run, 1 minute rower, standing long jump, 1-minute push-up, and 2 mile run to replace the APFT and an Army Combat Readiness Test (ACRT) to complement the APRT with actual battlefield task evaluations. It is clear that more efforts are required to identify and establish the most valid metrics for military physical performance assessment.

Injury Risk Mitigation Strategies and Efforts

In a 2003 policy memorandum, Secretary of Defense Donald Rumsfeld challenged the DoD to reduce the incidence rate of preventable accidents. This memo stated, "World-class organizations do not tolerate preventable accidents. Our accident rates have increased recently, and we need to turn this situation around. I challenge all of you to reduce the number of mishaps and accident rates by at least 50% in the next two years. These goals are achievable, and will directly increase our operational readiness. We owe no less to the men and women who defend our nation."[38] In response to this memorandum, the Defense Safety Oversight Council (DSOC), chaired by the Under Secretary of Defense for Personnel and Readiness, was formed to provide governance on DoD-wide efforts to reduce preventable injuries. The Military Training Task Force (MTTF), comprised of civilian and military injury experts from Johns Hopkins Center for Injury Research and Policy and the U.S. Army Center for Health Promotion

and Preventive Medicine (USACHPPM), was chartered to support this accident and injury prevention directive with a focus on interventions that relate to all aspects of military training.[39] The Joint Services Physical Training Injury Prevention Working Group (JSPTIPWG) was created under the MTTF in September 2004 to evaluate military physical training injury prevention programs, policies, and research for recommendations to reduce physical training-related injuries.[40] An expedited systematic review process was used by the working group to establish the evidence base for making recommendations to prevent physical training-related injuries, to prioritize the recommendations for prevention programs and policies; and to substantiate the need for further research and evaluation of interventions and programs likely to reduce physical training-related injuries.[41]

From this systematic review, only six intervention strategies had the requisite evidence-based scientific support to recommend for immediate implementation across the military to reduce physical training-related injuries. These interventions in order of priority were: 1) prevent overtraining (i.e., excessive running mileage), 2) perform multiaxial, neuromuscular, proprioceptive, and agility training, 3) wear mouthguards during high-risk activities, 4) wear semi-rigid ankle braces for high risk activities, 5) consume nutrients to restore energy balance within 1 hour following high-intensity activity, and 6) wear synthetic-blend socks to prevent blisters.[42] It is important to note that not all of these evidence-based interventions have been implemented as doctrine. Of equal interest, 23 intervention strategies that had some theoretical basis for efficacy were identified that lacked sufficient evidence to recommend at the current time.[43] The JSPTIPWG recommended more research before policies and programs are

implemented when systematic reviews determine that scientific information is scant and where gaps exist in knowledge about prevention exist.[44] The following recommendations are made to establish a comprehensive, evidence-based approach to military injury prevention.[45]

- Use readily available military surveillance databases to identify the largest and most severe military injury problems.
- Commission systematic reviews of prevention and safety literature to determine what has been shown to work for prevention of the largest, most-serious military injury problems.
- Establish committees of medical and safety SMEs to routinely assess and set priorities for both injury prevention research and program/policy implementation.
- Implement or adapt proven prevention strategies in a prioritized manner.
- Evaluate effectiveness of all implemented policies, procedures, and interventions/ countermeasures.
- Establish routine channels for disseminating information from each of the steps of the public health and evidence-based decision making processes to ensure that key stakeholders receive the information and training necessary to effectively reduce the impact of injuries of the health and readiness of military personnel.

Current Human Performance Optimization (HPO)/Injury Prevention (IP) Efforts in the Army Targeting Military Physical Readiness

In May 2010, Headquarters, Department of the Army published a TB MED 592: Prevention and Control of Musculoskeletal Injuries Associated with Physical Training.[46]

This is an important and comprehensive document that serves to translate state-of-the-art guidance to military and civilian health care providers and allied medical personnel to understand and implement evidence-based preventive principles to protect U.S. Army personnel from musculoskeletal injuries associated with physical training.

Specifically, this document serves as an authoritative source on human performance optimization/injury preventions and helps military leaders:

- to understand the physiologic and pathophysiologic responses to exercise
- to understand the risk factors associated with training-related musculoskeletal injuries, to understand interventions with varying levels of evidence for effectiveness in preventing training-related injuries
- to understand the presentation and acute treatment of Soldiers with training-related musculoskeletal injuries
- to implement appropriate evaluation and acute treatment for Soldiers with training-related musculoskeletal injuries
- to advise commanders on planning, implementing, and evaluating a comprehensive program to reduce musculoskeletal injuries related to physical training

A common trend among Warfighters is extreme conditioning programs (ECPs; e.g. CrossFit, Insanity, Gym Jones™, and others) which are characterized by high-volume, aggressive training workouts. These well-marketed and popularized conditioning programs continue to generate interest and support among military and civilian communities. This increasing acceptance is reinforced by anecdotal reports of marked gains in physical performance. However, physicians and other primary care and

rehabilitation providers have identified a potential emerging problem of disproportionate MSI risk, particularly for novice participants. Muscle strains, torn ligaments, stress fractures, and mild to severe cases of potentially life threatening exertional rhabdomyolysis are reportedly occurring at increasing rates as the popularity of ECPs grows. Unfortunately, to date, the short- and long-term physiological, functional, and readiness outcomes or safety of ECPs has not been carefully studied.

On September 13 and 14, 2010, a workshop on ECPs, composed of the Consortium for Health and Military Performance (CHAMP), other members of the Department of Defense (DoD), and representatives of the American College of Sports Medicine (ACSM), was convened at the Uniformed Services University of the Health Sciences (USUHS), Bethesda, MD to begin a critical dialog on this important issue.[47] From this workshop, it was the consensus that further research was needed to affirm or negate the purported undue injury risk from participating in ECPs and to clarify other modifiable contributing factors.[48] Research and education priorities included the following:

- collecting comprehensive prospective injury surveillance data with broad representation from around the world from those participating in ECPs, including surrounding circumstances, potential contributing factors (e.g., training status, fatigue, environment, nutrition/hydration), and impact on combat readiness for each injury;
- assessing the physiological demands and biomechanical stresses of various ECPs and similar workout designs, as well as the efficacy and magnitudes of

increase (or decrease) in key performance metrics (e.g., functional strength, power, and endurance, agility, mobility); and

- promoting evidence-based conditioning programs that are safe, effective, and attractive to war fighters, so operational readiness is optimized and musculoskeletal injury risk is minimized.

The most recent example of a high-level initiative germane to HPO/IP efforts in the military is the U.S. Army Medical Command's (MEDCOM) Soldier Medical Readiness Campaign Plan (SMR-CP), the number one priority of the U.S. Army Surgeon General.[49] MEDCOM is partnering with HQDA, U.S. Army Forces Command, U.S. Army Training and Doctrine Command, Installation Management Command, U.S. Army Reserve Command, U.S. Army Special Operations Command, Director, Army National Guard, U.S. Army Human Resource Command, HQDA G-1, and HQDA G3/5/7 to execute this coordinated, synchronized, and integrated comprehensive SMC-RP to increase the medical readiness of the Army. Through the execution of this campaign, MEDCOM expects to support the deployment of healthy, resilient, and fit Warfighters; increase the medical readiness of the Army, and effectively manage the Medically Not Ready (MNR) population to return the maximum number of Warfighters to deployable status. These will be accomplished through three primary lines of effort (LOE): LOE 1.0 Medically Not Ready (MNR) Soldier Identification; LOE 2.0 MNR Management Programs; and LOE 3.0 Evidence-Based Health Promotion, Injury Prevention, and Human Performance Optimization Programs. Of the most interest for HPO/IP efforts, LOE 3.0 has the key task to coordinate, synchronize, and integrate health promotion, injury prevention, and human performance optimization programs across the Army with

an objective of improved health and fitness, and reduced injury rates.[50] Table 1 lists the SMR-CP LOE 3.0 strategic objectives, objective statements, measures, targets and initiatives. The main goals of this line of effort are to 1) provide evidence-based health promotion and services to enable healthy lifestyle choices and eliminate preventable health issues contributing to MNR Soldiers, 2) implement, support and evaluate promising injury prevention and performance optimization best practices, 3) capture existing best practices, assess the evidence base, and evaluate incorporation of standardized best practices to improve management of injuries and optimize Soldier Medical Readiness, and 4) identify research programs within Army Medicine that contribute to injury prevention/performance optimization, and communicate evidence-bases lesson learned from these studies.

Table 2 provides more detailed description for the current HPO/IP initiatives listed under the strategic objective: Improve Soldier Injury Prevention/Human Performance. There are a number of innovative HPO/IP initiatives currently on-going. However, most of these initiatives are largely “stovepiped” and unknown beyond where they are being locally conducted as they are not part of a larger synchronized, integrated and coordinated HPO/IP effort. An opportunity exists to use these examples to adopt lessons learned and move forward with a more global, unified and focused approach leading to published research findings providing militarily feasible, suitable and acceptable HPO/IP interventions and performance outcome measures.

A strengths, weaknesses, opportunities, and threats (SWOT) analysis for the current state of HPO/IP initiatives in the Army is provided in Table 3.There are clear strengths of the current state of HPO/IP programs in the military and opportunities to

exploit in order to facilitate further progress. However, Army senior leader action is required to review current HPO/IP policies and consider strategic action to improve upon weaknesses and to neutralize growing threats.

Recommendations for the Way Ahead: Implementing Organizational, Communication, Scientific, and Operational Change through Strategic Planning

The need for a strategic paradigm shift in the military's approach to physical readiness policies, training and doctrine is clear and has been increasingly acknowledged. In January 2004 the deputy secretary of defense directed the Joint Staff to "develop the next generation of…programs designed to optimize human performance and maximize fighting strength."[51] Subsequently, a new Joint Human Performance Enhancement Joint Capabilities Document addressed human-performance standards, metrics, capabilities, and gaps.[52] It should also be pointed out that joint human performance enhancement (JHPE) capabilities outlined in Joint Force Health Protection Concept of Operations include 1) manage Warfighter fatigue, 2) optimize human-systems integration, 3) enhance Warfighter sensory, cognitive, and motor capabilities, 4) enhance Warfighter learning, communications, and decision making, 5) enhance physiological capability, 6) provide/maintain ability to operate across the full range of environments, and 7) provide a healthy and fit force.[53]

In 2005, the director of the Office of Net Assessment published a report entitled "Human Performance Optimization and Military Missions."[54] This report spawned a request from the Assistant Secretary of Defense, Health Affairs (ASD/HA) to the Uniformed Services University of the Health Sciences (USUHS) to host a conference in June 2006. The goal of the conference was to initiate the development of a strategic

plan for human performance optimization within the military and was entitled Human Performance Optimization in DoD: Charting a Course for the Future."[55]

This conference included subject matter experts from over 56 different DoD stakeholder groups: senior leaders (Admiral Michael Mullen, Chairman of the Joint Chiefs of Staff was the Keynote speaker), Warfighters/operators, unit commanders, allied health professionals, scientists and researchers, and safety officers.[56] Eighty-nine attendees from 56 different DoD organizations and representing the Army, Air Force, Navy, Marines, and Coast Guard participated. This conference was considered a large success as it facilitated critical dialogue and exchange and resulted in specific recommendations for a way ahead. Recommendations from the workshop were published in a report forwarded to ASD/HA and a special supplement published in Military Medicine.[57] In response to this report, the ASD/HA convened a HPO Integrated Product Team to review the USUHS report, collect relevant data from the services, and initiate recommendations for a novel comprehensive HPO program. Among these was a directive to the Army Surgeon General to incorporate key HPO requirements into a Joint Medical Research Command under the U.S. Unified Medical Command as a key focus area. The plan of a U.S. Unified Medical Command was later rejected in December 2006 primarily due to resistance from Air Force senior leadership.[58] With the current federal budgetary constraints and the potential to reduce redundancies, conserve resources, and implement interoperability and collaboration among the services, it would be prudent to revisit the concept of a Unified Medical Command.[59,60]

This workshop categorized the major issues/challenges to achieving HPO as 1) organizational, 2) communication, 3) scientific, and 4) operational, based upon the type

of strategic action required to resolve identified obstacles within DoD.[61] With regard to organizational issues, existing policies need to be reviewed with guidance to ensure consistency of HPO approaches in response to new research and technology developments.[62] Another important issue related to operational translation and dissemination of knowledge and research directly to commanders and Warfighters.[63] One suggestion is for the establishment of Joint Center for Human Performance Optimization to focus on translating existing knowledge into the DoD standard of Doctrine, Organization, Training, Material, Leadership, Personnel, and Facilities.[64]

Communication remains a large barrier to the achievement of HPO. A common concern is that commanders and clinicians in the field are typically unaware of current HPO information and research efforts. Operators at the highest levels often do not have adequate visibility of laboratory research projects and existing biomedical solutions. There are also concerns that valid and reliable important information may not be reaching the Warfighter, but rather, information is derived from commercial venues.[65] Opportunities for scientists to actively interact with operators about evidence-based and developing scientific findings should also be encouraged. Future communication efforts should focus on coordination within and across services. Ideally, organizations that conduct HPO research need to be teamed with representatives from acquisition, operators, and medical personnel from the field to discuss current research efforts, provide opportunities for cooperation, and direct future HPO needs.[66]

The scientific issues raised by the workshop centered on the need to develop operationally relevant and standardized metrics to meet joint military requirements. The development of these metrics is considered the single most important issue for research

and application of HPO.[67] Accepted, reliable, and valid metrics that relate to combat effectiveness for all of the above capabilities are limited and remain an area that joint consensus needs to garner. Ideally, research efforts should consider the Warfighter through his/her entire life cycle as an integrated program of preparation, training, and monitoring from accession to retirement/separation.[68]

From an operational perspective, collaboration between operators and medical researchers is essential for the development and fielding of feasible, acceptable, and suitable (FAS) HPO approaches.[69] Functional fitness, performance nutrition, cognitive and psychological readiness options through predeployment, deployment/engagement, and post deployment are greatly desired and needed.[70] HPO programming should preserve human capital by addressing individual weaknesses and minimizing susceptibility to injury, disease, and other factors influencing performance.[71]

The vision moving forward is that HPO be conceived as joint, interagency, combined and coalition, to create an interdisciplinary Center for investigating human performance optimization in operational settings, establish translational research and education agendas that address barriers and approaches to optimal performance, and to develop effective communication networks that cross research, medical and operational boundaries.[72] The recommended course of action to provide HPO functionality is to establish a unified Joint Medical Research Program with a core HPO function. The specific objectives of such an option would be to 1) advocate for HPO within DoD, 2) coordinate and integrate all DoD extramural and intramural HPO medical research, 3) align HPO initiatives to DoD priorities, 4) collaborate with the line HPO research functions to ensure synergy toward common endpoints, 5) establish HPO

standards, 6) establish a clearinghouse function, 7) continue to leverage the HA HPO IPT as a community of interest, 8) recommend HPO policy and doctrine to ASA(HA).[73] A concerted and integrated strategic HPO effort will serve to 1) enhance the mental and physical resilience of the Warfighter, 2) reduce injury and illness or more rapid recovery, 3) provide seamless information and knowledge transfer from the laboratory to line, 4) improve the human weapons system's ability to accomplish the mission, and 5) allow the United States to remain at the leading/cutting edge in this area.[74]

Conclusion

It is imperative for military leaders to understand that physical-training related MSIs are largely preventable by adherence to composite risk management principles and by considering pragmatic strategy and policy changes. Within the Army Medical Command, the Medical Research and Materiel Command and the Public Health Command have reputable and cutting-edge research and development programs that provide evidence-based information products and recommendations for safe and effective physical training and injury reduction programs. From a strategic perspective, an organizational unity of effort approach that aligns the research and development programs with many of the on-going initiatives is recommended. This would allow for better synchronization, integration and communication of current HPO/IP efforts across Army Commands and across operators, health practitioners, researchers, and leaders. These efforts must continue with a focus on the Soldier from accession to separation/retirement as HPO/IP initiatives have not been systematically applied or researched across the Warfighter's entire Life cycle.

We must move beyond the historical research efforts on developing physical training doctrine that have been mainly concentrated within the initial entry training (IET)

environment of the Training and Doctrine (TRADOC). This focus should shift more toward operational forces within Forces Command (FORSCOM) in support of the Army Force Generation (ARFORGEN) model. This requires continued efforts to establish validated and agreed upon performance metrics with regard to HPO/IP.

The establishment of an unified Joint Medical Research Command/Program with a core HPO/IP functionality could align and facilitate these recommendations. In the absence of a Joint Medical Research Command, greater liaison is needed among AMEDD, TRADOC, and FORSCOM to identify gaps and to translate existing knowledge into the DoD standard of Doctrine, Organization, Training, Material, Leadership, Personnel, and Facilities (DOTMLPF) domains. This would also establish the foundation for a noticeable reduction in the injured, MNR Soldier population toward a more physiologically resilient Warfighter capable of dominating in the full spectrum of operations.

As our military transforms and responds to the current and emerging threats, it is increasingly clear that we must ensure optimal human performance of our military. By leveraging the science and applications of physical fitness and injury prevention, we will maintain a higher level of readiness in our Soldiers and reduce the risk of injuries from the readiness processes we use to maintain them as “Army strong!”

Strategic Objective: Synchronize Medical Readiness Related Research
Objective Statement: Communicate Commander's and public health research needs, collaborate with Army partner's on HPO/IP projects, and enhance communication of evidence-based lessons to Commanders, policy makers and the health promotion community ultimately contributing to a reduction in MNR Soldiers. *Measures*: 1) # of scientific publications on musculoskeletal injury (MSI); 2) # of scientific presentations on MSIs; 3) # of agreements that leverage Army partners *Target:* 1) >50% manuscripts on MSI per year in peer-reviewed publications; 2) 5 talks/presentations per year specifically on MSI research; 3) 1 agreement with an Army partner to disseminate MSI research lessons NLT 30 Sep 11 *Initiatives:* 1) Complete research inventory; 2) complete list of suggested future HPO/IP research; 3) develop communication/coordination strategy
Strategic Objective: Improve Integration of Musculoskeletal Injuries Rehabilitation Research
Objective Statement: Synchronize, coordinate, and improve unit-based and MTF-based musculoskeletal injury rehabilitation programs to enable Soldier medical readiness. *Measures:* # of Soldier profile days due to musculoskeletal injury in FORSCOM units evaluated. *Target:* 15% decrease in profile days due to MSI in FORSCOM units evaluated. *Initiatives:* 1) unit-based medical management; 2) unit-based rehab program; 3) musculoskeletal action plan; 4) aquatic rehabilitation pilot program; 5) aquatic warrior exercise program standardization.
Strategic Objective: Improve Soldier Injury Prevention/Human Performance
Objective Statement: Coordinate and synchronize evidence-based HPO/IP policies and programs that support ARFORGEN in each of its phases in order to improve the medical readiness of the Army. *Measures:* 1) % pass APFT in FORSCOM units evaluated; 2) % of Soldier injury rate in FORSCOM units evaluated; 3) recommendations for injury prevention provided to FORSCOM units evaluated. *Target:* 1) >85% pass rate on current APFT in FORSCOM units evaluated; 2) 15% decrease in injury rate in FORSCOM units evaluated; 3) recommendations for injury prevention targets provided to FORSCOM units evaluated (25th ID, 4th ID) . *Initiatives:* 1) conduct inventory of ongoing Army HPO/IP programs and initiatives; 2) conduct review of evidence-based support for HPO/IP initiatives & ID best practices and gaps; 3) implement, support, review and evaluate promising Army HPO/IP initiatives; 4) IET Soldier Athlete initiative; 5) 101st Eagle Tactical Athlete Program Research study; 6) 4th ID Iron Horse Performance Optimization MEDCOM/FORSCOM; 7) USASOC THOR3 initiative; 8) USASOC Ranger Athlete Warrior Program; 9) 25th ID Advanced Tactical Athlete Conditioning initiative; 10) implement policy and guidance, education and training and incorporate these into HPO/IP initiatives. **For a more detailed description of HPO/IP initiatives listed above refer to Table 2**

Table 1. Soldier Medical Readiness Campaign Plan (SMR-CP) LOE 3.0: Evidence-Based Health Promotion, Injury Prevention, and Human Performance Optimization Programs Balanced Scorecard.[75]

Initiative Title: Ranger, Athlete, Warrior (RAW) Program *Proponent*: 75th Ranger RGT *Description/Comments*: Uses Army physical therapist led train-the-trainer course and is a conglomeration of several physical performance techniques focusing on body mechanics, strength, speed, agility, and military task performance. Includes a RAW physical performance assessment as a metric.
Initiative Title: Eagle Tactical Athlete Program (ETAP) *Proponent*: 101st Airborne/Air Assault & University of Pittsburgh *Description/Comments*: Extramural funded (via MRMC's Telemedicine and Advanced Technology Research Center) research effort comprehensively evaluating aspects of HPO/IP: injury surveillance, task and demand analysis, predictors of injury and optimal performance, design and validation of interventions, program integration and implementation, and monitoring to determine effectiveness of program.[76]
Initiative Title: Mountain Athlete Program (MAW) *Proponent*: 4th ID/FORSCOM *Description/Comments*: HPO program team consists of an Army physical therapist, CrossFit certified trainers, and power lifting coaches who focus on muscular strength, muscular and cardiovascular endurance, speed, agility, and flexibility. The goal is to reduce non-deployable injury rates and unit readiness.
Initiative Title: Iron Horse Performance Optimization Program *Proponent*: 4th ID/FORSCOM *Description/Comments*: Utilizes an embedded musculoskeletal action team (MAT) in a Brigade Combat Team through a full ARFORGEN cycle focusing on optimizing performance, minimizing injuries, identifying/treating injuries early, reconditioning rehabilitated Soldiers.
Initiative Title: Soldier Athlete Initiative (SAI) *Proponent*: TRADOC *Description/Comments:* Utilizes a musculoskeletal action team (MAT) at TRADOC initial entry sites to address injury incidence rates.
Initiative Title: Tactical Human Optimization Rapid Rehabilitation & Reconditioning (THOR3) Program *Proponent*: USASOC *Description/Comments*: Program incorporates a team consisting of physical therapists, strength and conditioning coaches, and a dietician to reduce injury, improve functional performance, and optimize proper fueling. Each team sets program priorities and performance metrics.
Initiative Title: Advanced Tactical Athlete Conditioning (ATAC) *Proponent*: MEDCOM/25th ID *Description/Comments*: Provides tools (train-the-trainer) and information necessary to lead Soldiers through a tactical, battle-focused approach to PT. Includes high-intensity aquatic training, tactical agility physical training, combat core conditioning, interval speed training, and running form analysis. Public Health Command is conducting a program evaluation.
Initiative Title: Military Power, Performance and Prevention (MP3) *Proponent*: MEDCOM/AMEDD C&S *Description/Comments*: This program measures multiple performance metrics such as mobility, power, and balance and injury surveillance in 2/75th Ranger Battalion, 1st Special Forces, a Stryker Brigade and a support Brigade from 2nd ID. The goal is to identify those performance metrics that are predictive of injury. A special and unique feature of the initiative is the use of technology as a leveraging tool for the assessment and data collection.

Table 2. Human Performance Optimization and Injury Prevention Initiatives Tracked by the Office of the Surgeon General.[77]

Strengths
1. Current doctrine provided in TC 3-22.20 adheres to guidelines established by the American College of Sports Medicine and the National Strength and Conditioning Association and has been validated by peer-reviewed published research. 2. Numerous intrinsic injury risk factors have been identified via evidence-based and peer-reviewed research findings. 3. Innovative research efforts are occurring with the U.S. Army Medical Command (i.e. Medical Research and Materiel Command) that prioritizes human performance optimization and injury prevention research. 4. Many examples of human performance optimization and injury prevention initiatives currently on-going across Army. 5. Increasing senior leader awareness with regard to the impact of musculoskeletal injuries on military readiness and national security. 6. Current and future science and technology advances hold great promise with regard to human performance optimization and injury prevention research.
Weaknesses
1. The incidence rate for musculoskeletal injuries remains unacceptably high. 2. Lack of physical training/injury prevention subject matter experts organic to military personnel system. 3. The main proponent for physical readiness training (U.S. Army Physical Fitness School) is not resourced adequately; particularly with personnel. 4. Poor synchronization, integration and communication of human performance optimization/injury prevention efforts across a) Army Commands and b) across operators, health practitioners, researchers, and leaders. 5. Implementation of physical training doctrine is unevenly applied across Army. 6. Validated and agreed upon performance metrics do not exist with regard to human performance optimization/injury prevention. 7. HPO/IP initiatives have not been systematically applied or researched across the Warfighter's entire Life cycle.
Opportunities
1. Soldier Medical Readiness Campaign (SMRC). 2. Current and future science and technology advances hold great promise with regard to human performance optimization and injury prevention research. 3. Increasing senior leader awareness with regard to the impact of musculoskeletal injuries on military readiness and national security. 4. Military health and fitness outreach to society's youth 5. Revise manner in which HPO/IP is assessed. Establish metrics of performance and effectiveness.
Threats
1. Extreme conditioning programs (i.e., CrossFit) are becoming increasingly popular among Soldiers and have not been supported by evidence-based research 2. Shrinking budgets can negatively impact a) research and development budgets and b) HPO/IP resource allocation. 3. Excessive and increasing external loads (i.e., load carriage). 4. Increasing societal trends for declining fitness. 5. Lack of Unified Joint Medical/Research Command.

Table 3. Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis for Current Army HPO/IP initiatives.

Endnotes

[1] Jim Garamone and Karen Parrish, “Military Strategy Drives Budget Decisions, Dempsey Says,” *American Forces Press Service*, December 9, 2011.

[2] Jim Garmone, “Panetta Announces Fiscal 2012 Budget Priorities,” *American Forces Press Service,* January 26, 2012.

[3] Keith G. Hauret, Bonnie J. Taylor, Nakia S. Clemmons, Suzanne R. Block, and Bruce H. Jones. “Frequency and Causes of Nonbattle Injuries Air Evacuated from Operations Iraqi Freedom and Enduring Freedom, U.S. Army, 2001-2006,” *American Journal of Preventive Medicine* 38, no. 1 (January 2010): S94-S107.

[4] Eric B. Schoomaker, “The U.S. Army Medical Department Commitment to Injury Reduction”, *American Journal of Preventive Medicine* 38, no. 1 (January 2010): S217.

[5] Robert M. Gates, *Quadrennial Defense Review*, (Washington, DC: Department of Defense, February 2010), 1-105.

[6] Office of the Assistant Secretary of Defense (Health Affairs), Force Health Protection and Readiness, Joint Staff/J4 Health Serviced Support Division, Office of the Command Surgeon for the United States Joint Forces Command, and Service and Combatant Command Surgeon Representatives on the Joint Force Health Protection Integrated Process Teams, *Joint Force Health Protection Concept of Operations* (Washington, DC: Department of Defense, July 2007).

[7] Ibid., ES-2.

[8] Doug Sample, “Army wants more Soldiers back on deployable status”, *Army News Service,* October 11, 2011.

[9] Ibid.

[10] U.S. Army Medical Surveillance Activity. Estimates of absolute and relative health care burdens attributable to various illnesses and injuries. U.S. Armed Forces, 2005. *Medical Surveillance Monthly Report* 12, no. 3 (2006): 2-23.

[11] Ibid.

[12] Headquarters, Department of the Army, *Prevention and Control of Musculoskeletal Injuries Associated with Physical Training,* TB Med-592 (Washington, DC: U.S. Department of the Army, May 2011), 6-7.

[13] Ibid.

[14] Ibid.

[15] Ibid.

[16] Ibid., 9.

[17] Ibid., 11.

[18] Doug Sample, “Army wants more Soldiers back on deployable status”, *Army News Service,* October 11, 2011.

[19] Headquarters, Department of the Army, *Prevention and Control of Musculoskeletal Injuries Associated with Physical Training,* TB Med-592 (Washington, DC: U.S. Department of the Army, May 2011), 6-7.

[20] Ibid., 10.

[21] Ibid., 6-7.

[22] Keith G. Hauret, Bruce H. Jones, Steven H. Bullock, Michelle Canham-Chervak, and Sara Canada, “Musculoskeletal injuries: description of an under-recognized injury problem among military personnel,” *American Journal of Preventive Medicine* 38, no. 1 (January 2010): S61-S70.

[23] Headquarters, Department of the Army, *Prevention and Control of Musculoskeletal Injuries Associated with Physical Training,* TB Med-592 (Washington, DC: U.S. Department of the Army, May 2011), 16.

[24] Ibid., 6-7.

[25] Keith G. Hauret, Bonnie J. Taylor, Nakia S. Clemmons, Suzanne R. Block, and Bruce H. Jones, “Frequency and causes on nonbattle injuries air evacuated from operations Iraqi Freedom and Enduring Freedom, U.S. Army, 2001-2006,” *American Journal of Preventive Medicine* 38, no. 1 (January 2010): S94-S107.

[26] Steven P. Cohen, Charlie Brown, Connie Kurihara, Anthony Plunkett, Connor Nguyen, and Scott A. Strassels, “Diagnoses and factors associated with medical evacuation and return to duty for service members participating in Operation Iraqi Freedom or Operating Enduring Freedom: a prospective cohort study,” *Lancet* 375, (January 23 2010): 301-309.

[27] Headquarters, Department of the Army, *Prevention and Control of Musculoskeletal Injuries Associated with Physical Training*, TB Med-592 (Washington, DC: U.S. Department of the Army, May 2011), 18.

[28] Ibid., 23.

[29] Army Physical Fitness School, *Army Training Circular-TC 3-22.2.0: Army Physical Readiness Training*, August 2010.

[30] Joseph J. Knapik, William Rieger, Frank Palkoska, Steven Van Camp, and Salima Darakjy, “United States Army Physical Readiness Training: Rationale and Evaluation of the Physical Training Doctrine,” *Journal of Strength and Conditioning Research* 23, no. 4 (July 2009): 1353-1362.

[31] Joseph J. Knapik, Keith G. Hauret, S. Arnold, Michelle Canham-Chervak, A.J. Mansfield, A.J. Hoedebecke, and D. McMillan, “Injury and fitness outcomes during implementation of Physical Readiness Training,” *International Journal of Sports Medicine* 24 (2003): 372-381.

[32] Joseph J. Knapik, Steven H. Bullock, S. Canada, E. Toney, J.D. Wells, E. Hoedebecke, and Bruce H. Jones, "Influence of an injury reduction program in injury and fitness outcomes among Soldiers," *Injury Prevention* 10 (2004): 37-42.

[33] Joseph J. Knapik, S. Darakjy, S.J. Scott, Keith G. Hauret, S. Canada, R. Marin, William Reiger, and Bruce H. Jones, "Evaluation of a standardized physical training program for basic combat training," *Journal of Strength and Conditioning Research* 19 (2005): 246-253.

[34] Joseph J. Knapik, William Rieger, Frank Palkoska, Steven Van Camp, and Salima Darakjy, "United States Army Physical Readiness Training: Rationale and Evaluation of the Physical Training Doctrine," *Journal of Strength and Conditioning Research* 23, no. 4 (July 2009): 1353-1362.

[35] Everett A. Harman, Peter N. Frykman, David Gutekunst, Bradley C. Nindl, Joseph A. Alemany, Robert P. Mello, and Marilyn A. Sharp, "Effects of two different eight-week training programs on military physical performance," *Journal of Strength and Conditioning Research* 22 (2008): 524-534.

[36] William J. Kraemer, Scott A. Mazzetti, Bradley C. Nindl, Lincoln A. Gotshalk, Jeff S. Volek, Jill A. Bush, James O. Marx, K. Dohi, Ana L. Gomez, Mary P. Miles, Steven J. Fleck, Robert U. Newton, and Keijo Hakkinen, "Effect of resistance training on women's strength/power and occupational performances" *Medicine and Science in Sports and Exercise* 33, no. 6 (June 2001): 1011-1025.

[37] National Strength and Conditioning Association Blue Ribbon Panel on Military Physical Readiness, 13-14 January, 2011, Key West, Florida.

[38] Donald Rumsfeld, Memorandum. Office of the Secretary of Defense. Reducing Preventable Accidents. 19 May 2003.

[39] Steven H. Bullock, Bruce H. Jones, Julie Gilchrist, and Steven W. Marshall, "Prevention of physical training-related injuries: Recommendations for the Military and other Populations Based on Expedited Systematic Reviews," *American Journal of Preventive Medicine* 38, no. 1 (January 2010), S156-S157.

[40] Ibid, S157.

[41] Ibid.

[42] Ibid., S164.

[43] Ibid.

[44] Bruce H. Jones, Michelle Canham-Chervak, and David A. Sleet, "An Evidence-Based Public Health Approach to Injury Priorities and Prevention: Recommendations for the U.S. Military," *American Journal of Preventive Medicine* 38, no. 1 (January 2010), S2.

[45] Ibid., S8-S9.

[46] Headquarters, Department of the Army, *Prevention and Control of Musculoskeletal Injuries Associated with Physical Training*, TB Med-592 (Washington, DC: U.S. Department of the Army, May 2011), 1-81.

[47] Michael F. Bergeron, Bradley C. Nindl, Patricia A. Deuster, Neal Baumgartner, Shawn F. Kane, William J. Kraemer, Lisa R. Sexauer, Walter R. Thompson, and Francis G. O'Connor, "Consortium for Health and Military Performance and American College of Sports Medicine Consensus Paper on Extreme Conditioning Programs in Military Personnel," *Current Sports Medicine Reports* 10, no. 6 (November/December 2011): 383-389.

[48] Ibid.

[49] U.S. Army Medical Command, "Soldier Medical Readiness Campaign Plan 2011-2016," Version 1.2, May 2011,http://www.armymedicine.army.mil/news/docs/SMR_CP_Version_1.2.pdf (accessed 18 Dec 2011), 1-37.

[50] Ibid., 5.

[51] PowerPoint briefing, 2007 Military Health Services Conference, subject: "Human Performance Optimization (HPO) within DoD," slide 6, http://tricare.mil/conferecnes/2007/Mon/M107.ppt (accessed 18 Dec 2011).

[52] Ibid.

[53] Office of the Assistant Secretary of Defense (Health Affairs), Force Health Protection and Readiness, Joint Staff/J4 Health Serviced Support Division, Office of the Command Surgeon for the United States Joint Forces Command, and Service and Combatant Command Surgeon Representatives on the Joint Force Health Protection Integrated Process Teams, *Joint Force Health Protection Concept of Operations* (Washington, DC: Department of Defense, July 2007), 21-22.

[54] A. Russell, B. Bulkley, and C. Grafton, *Human Performance Optimization and Military Missions: Final Report*, GS-10F-0297K (Washington, DC: Office of Net Assessment, May 2005).

[55] Patricia A. Deuster, Francis G. O'Connor, Kurt A. Henry, Valerie E. Martindale, Laura Talbot, Wayne Jonas, and Karl Friedl, "Human Performance Optimization: An Evolving Charge to the Department of Defense'" *Military Medicine* 172, no. 11 (November 2007), 1133-1137.

[56] ADM Michael Mullen, "On Total Force Fitness in War and Peace," *Military Medicine* 175, no. 8 (August 2010): 1-2.

[57] Wayne Jonas, Patricia Deuster, Francis O'Connor, and Christain Macedonia (guest editors), Total Force Fitness for the 21st Century: A New Paradigm, *Military Medicine* 175, no. 8 (August 2010): 1-126.

[58] Tom Philpott, "Rejected Medical Command," December 16, 2006 http://www.military.com/features/0,15240,120543,00.html (accessed 18 Dec 2011).

[59] Darwin D. Kumpula, *Joint Medical Command – Do it now*, Strategy Research Project (Carlisle Barracks, PA: U.S. Army War College, 18 March 2005, 1-26.

[60] Arthur M. Smith, David A. Lane, and James A. Zimble, “Purple Medicine: The Case for a Joint Medical Command,” *Naval War College Review* 60. no. 1 (Winter 2007): 129-138.

[61] Patricia A. Deuster, Francis G. O’Connor, Kurt A. Henry, Valerie E. Martindale, Laura Talbot, Wayne Jonas, and Karl Friedl, “*Human Performance Optimization: An Evolving Charge to the Department of Defense*” *Military Medicine* 172, no. 11 (November 2007), 1134.

[62] Ibid.

[63] Ibid.

[64] Ibid.

[65] Ibid.

[66] Ibid.

[67] Ibid., 1135.

[68] Patricia A. Deuster, Francis G. O’Connor, Kurt A. Henry, Valerie E. Martindale, Laura Talbot, Wayne Jonas, and Karl Friedl, “*Human Performance Optimization: An Evolving Charge to the Department of Defense” Military Medicine* 172, no. 11 (November 2007), 1135.

[69] Ibid.

[70] Ibid.

[71] Ibid.

[72] Ibid., slide 16.

[73] Ibid., slide 23.

[74] Patricia A. Deuster, Francis G. O’Connor, Kurt A. Henry, Valerie E. Martindale, Laura Talbot, Wayne Jonas, and Karl Friedl, “*Human Performance Optimization: An Evolving Charge to the Department of Defense” Military Medicine* 172, no. 11 (November 2007), 1137.

[75] U.S. Army Medical Command, “Soldier Medical Readiness Campaign Plan 2011-2016,” Version 1.2, May 2011,http://www.armymedicine.army.mil/news/docs/SMR_CP_Version_1.2.pdf (accessed 18 Dec 2011), 1-37.

[76] Timothy C. Sell, John P. Abt, Kim Crawford, Mita Lovalekar, Takashi Nagai, Jennifer B. Deluzio, Brian W. Smalley, Mark A. McGrail, Russel S. Rowe, Sylvain Cardin, and Scott Lephart, “Warrior model for human performance and injury prevention: Eagle Tactical Athlete Program (ETAP) Part I,” *Journal of Special Operations Medicine* 10, no. 4 (Fall 2010): 2-20.

[77] LTC Pendergrass, “Injury Prevention and Human Performance Optimization Initiatives,” Information Paper, July 12, 2011.