FIGHTING SOLDIER FATIGUE & ENHANCING COGNITIVE DOMINANCE

SLEEP DISPATCH

WRAIR PROTECTS YOUR SIX

U.S. Army Photo by Staff Sgt. Shawn Morris

Protecting your brain - the most important six inches on the battlefield

CENTER FOR MILITARY PSYCHIATRY AND NEUROSCIENCE

- Blast Induced Neurotrauma and Neuroprotection
- Sleep & Resilience
- Team Performance and Mental Fitness
- Military Psychiatry

Protecting the most important six microns between you and the threat of disease

CENTER FOR INFECTIOUS DISEASE RESEARCH

- Vaccines & Entomology
- Viral & Bacterial Diseases
- Military HIV Research Program
- Experimental Therapeutics & Emerging Infectious Diseases

WHETHER YOU'RE AT HOME STATION OR SIX THOUSAND MILES AWAY

WALTER REED ARMY INSTITUTE OF RESEARCH'S MISSION

Discover, design, and develop solutions for military relevant infectious disease and brain health threats through innovative research protecting and optimizing warfighter lethality.

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PROMOTED HASHTAGS

#BrainHealth #SoldierLethality

#FarForwardBrainHealth

#SleepInTheField #ForgeTheFuture

#SleepSustainsPerformance

WALTER REED ARMY INSTITUTE OF RESEARCH IS A SUBORDINATE COMMAND OF MRDC

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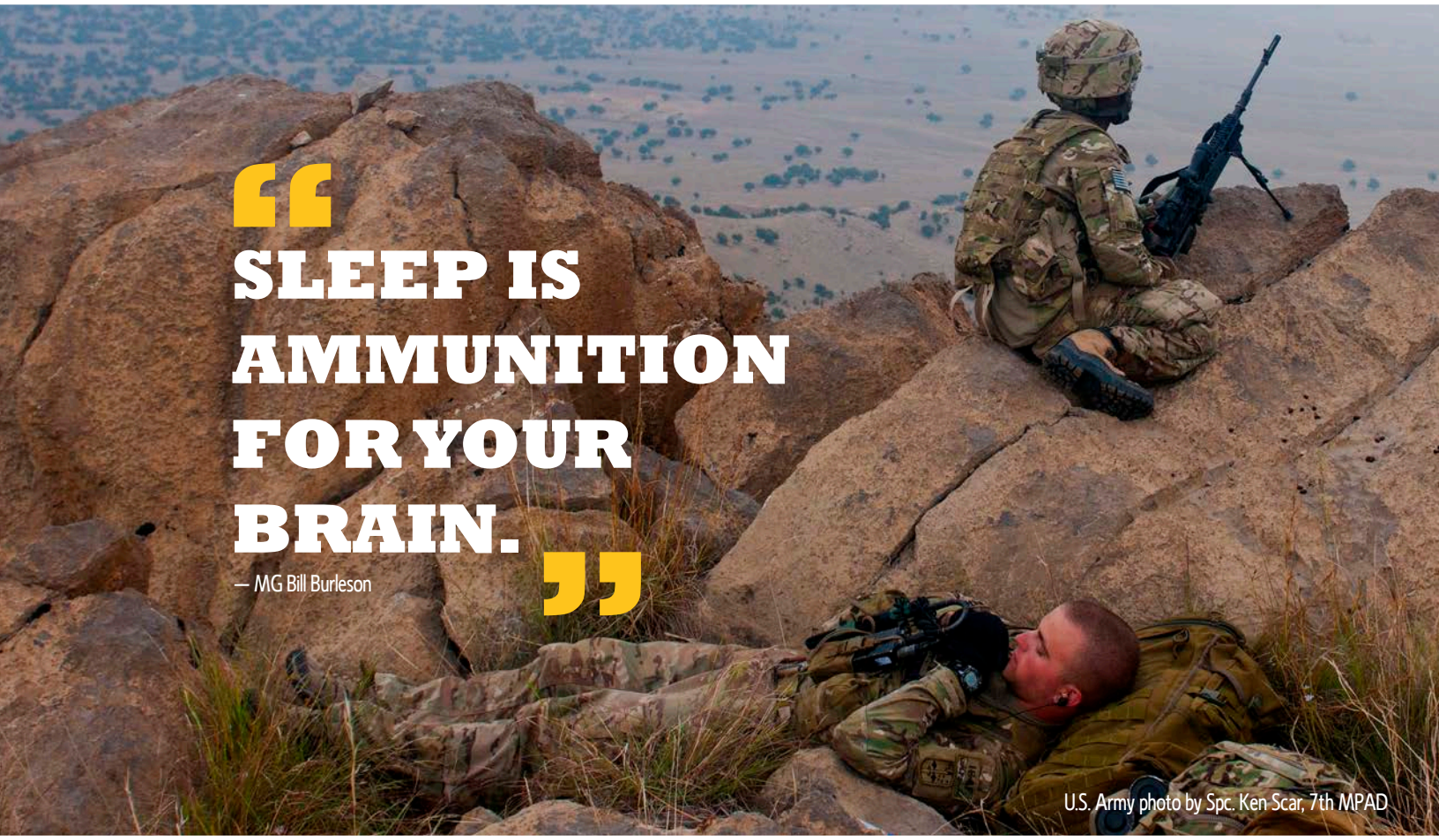

U.S. Army photo by Spc. Ken Scar, 7th MPAD

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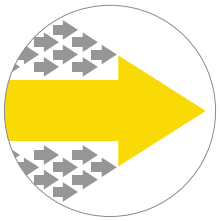

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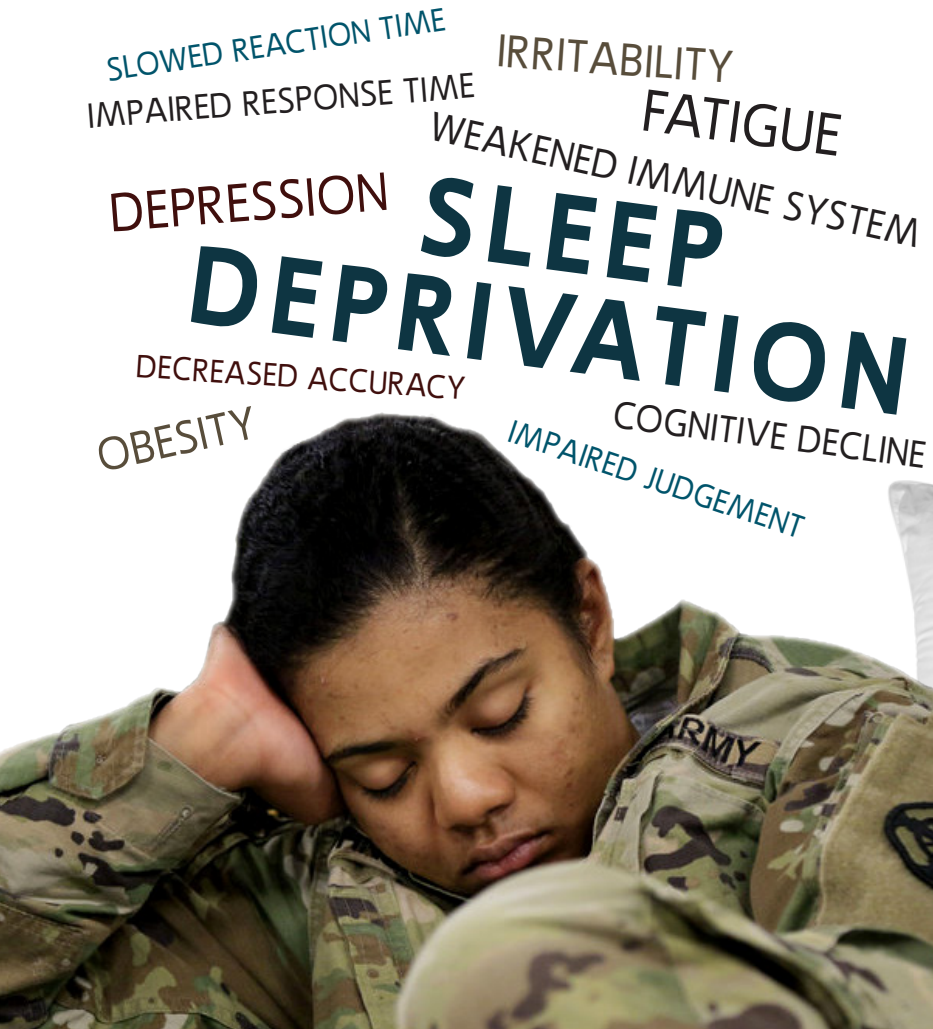
THE SLEEP DEPRIVED SOLDIER

THE CHALLENGE:

Maintaining Cognitive Dominance and the Tactical Advantage in Multi-Domain Operations (MDO)

Cognitive dominance is required for victory in multi-domain operations. Sleep sustains and enhances all capabilities that combine to ensure cognitive dominance on the battlefield: situational awareness, superior judgment and decision-making, faster reaction time, and greater mental flexibility. The key to achieving and sustaining cognitive dominance is to ensure that Soldiers sleep as much as possible — and always sleep more than the enemy.



THE IMPACT:

INCIDENCE AND PREVALENCE
More than **62%** of Soldiers are chronically sleep restricted, averaging less than 6 hours of sleep per night both in garrison and during deployment.

PERFORMANCE
5 nights with less than 5 hours of sleep creates a **20%** cognitive deficiency; the equivalent of a **0.08** blood alcohol level (5 alcoholic drinks in a 180 lb. male).

SAFETY
During deployment, more than **33%** of Soldiers report falling asleep on duty and more than **50%** of accidents are caused by sleepiness. **25%** of all motor vehicle accidents are due to sleep deprivation.

PHYSICAL HEALTH
Chronic sleep restriction (less than 6 hours sleep per night) has been linked to impaired immune function, obesity, hypertension, hyperlipidemia, diabetes, heart disease, stroke, certain cancers, Alzheimer's disease, and generally increased mortality from all causes.

MENTAL HEALTH
Soldiers who average less than 6 hours of sleep every 24 hours are **4.7** times more likely to develop PTSD and **11.4** times more likely to develop depression than Soldiers who average more than 6 hours of sleep.

MORE THAN 62% OF SOLDIERS ARE CHRONICALLY SLEEP RESTRICTED.

SLEEP: THE FORCE MULTIPLIER

> **THE EDGE WILL GO TO WHICHEVER FORCE HAS OBTAINED THE MOST SLEEP.**
>
> — Dr. Thomas Balkin

In conflicts with adversaries who increasingly possess technological capabilities comparable to our own, the difference between victory and defeat will increasingly reflect critical differences between U.S. soldiers and enemy soldiers.

The advantage will go to the military force that is more resourceful, more psychologically resilient, has more physical and mental stamina, has faster reaction times, displays better situational awareness, and possesses the mental flexibility needed to quickly recognize and take advantage of battlefield opportunities as they arise.

Unfortunately, these capabilities deteriorate rapidly on an intense MDO battlefield. After a three-day field exercise with limited sleep, Soldiers' ability to identify and shoot at the enemy decreased by **220%.** They shot at things that did not exist **164%** more after the field exercise. Their errors in decision-making went up **86%** and their reaction time decreased by **22%.** What does a 22% decrease in reaction time mean to Soldier and squad performance? This decrement could mean the difference between life and death in the heat of battle.

All of the decrements found during this study were caused by, or made worse by, the fact that the Soldiers obtained inadequate sleep. Sleep loss increases the effects of all other stressors; however, the other side of the coin is that increased sleep lessens the effects of all other stressors. That is why sleep is a **force multiplier.**

It is also why there is no such thing as "too much" sleep.

SLEEP BANKING

DID YOU KNOW? Obtaining "extra" sleep prior to a mission involving sleep loss greatly enhances your military effectiveness during that mission. Sleep banking is free and the more sleep that you "bank" the greater the benefit.

HOW? Increase the amount of sleep you obtain prior to nighttime, continuous, or sustained operations (when adequate sleep will not be possible) by going to bed earlier and/or waking up later than usual.

HOW MUCH? Every extra hour of sleep obtained during the 2 weeks prior to initiating nighttime, continuous, or sustained operations can have a positive impact!

WHY? Sleep banking results in greater resilience to the negative effects of sleep loss and faster recovery from that sleep loss.

SRC Sleep Research Center

Walter Reed Army Institute of Research

The WRAIR Sleep Research Center (SRC), part of the Behavioral Biology Branch, is the Department of Defense's premier sleep research facility. WRAIR has conducted sleep studies since the 1950s to characterize the acute performance and physiological impacts of sleep loss. The SRC develops strategies (e.g. sleep banking), software (e.g. 2B-Alert), hardware (e.g. wrist actigraphy) and guidance for fatigue management in the operational environment. The sleep research suites offer the infrastructure to conduct sleep deprivation, sleep extension, and intervention studies 24 hours a day.

*Read through pages 6-9 to discover some of the emerging sleep technologies that the SRC is currently working to develop.

The Operational Research Team (ORT) at the Walter Reed Army Institute of Research (WRAIR) is the premier sleep, circadian, and performance field research team within the Department of Defense. The ORT's primary objective is to develop, test, and validate field-capable assessments and interventions to both (1) determine the influence of sleep loss and circadian misalignment on Soldier readiness and lethality in the operational environment (e.g. training missions and deployment) and (2) select optimal strategies (e.g. caffeine, blue light, sleep hygiene, sleep banking and recovery) for enhancing Warfighter readiness and lethality.

*Read through page 11-14 to discover Sleep in Operational Settings topics that the ORT is currently working to address.

Top 5 Findings From Field Studies	Unit
Poor sleep quality before a realistic training exercise predicts higher post-traumatic stress symptoms following the training	1st Armored Division (Ft. Bliss, TX)
Better sleep quality during ROTC Advanced Camp is related to higher leadership ratings from camp leadership	2nd Brigade, 1st Armored Division
Operationally-mandated sleep loss is linked with unstable balance and poorer occupational outcomes (e.g. job burnout)	Elite Infantry Instructors
Operationally-mandated sleep loss leads to poorer vigilance and decreased testosterone	Special Operations Infantry Unit
Operationally-mandated sleep loss leads to poorer physical performance, and decreased subjective readiness	Special Operations Infantry Unit

PerformanceTriad

FM 7-22 ARMY PHYSICAL READINESS TRAINING

5 KEY ACCOMPLISHMENTS OVER THE LAST 10 YEARS

1. Developed the unified model of performance (UMP) which predicts the combined effects of sleep duration, circadian rhythm, and caffeine on performance (with BHSAI).
2. Individualized UMP predictions and created the 2B-Alert app — a fieldable fatigue management tool in collaboration with BHSAI (see next page).
3. Provided and/or vetted all sleep-related recommendations and training materials for Performance Triad (P3).
4. Authored sleep section of ATP 6-22.5.
5. Refined understanding of the "sleep banking" phenomenon — now a recommended strategy for prophylactically mitigating performance deficits during anticipated periods of future sleep loss.

PAST SLEEP RESEARCH ACCOMPLISHMENTS FROM WRAIR

1. Invented wrist actigraphy.
2. Developed the first mathematical performance prediction model (SAFTE). This model has been approved by the FAA and it is currently used as a scheduling tool by all major U.S. airlines, by foreign governments, and by a wide variety of industries throughout the world.
3. In collaboration with Johns Hopkins University, recorded the first functional brain image of human brain during sleep deprivation, which revealed deactivation of prefrontal cortex underlies performance deficits.
4. In partnership with NIH, performed the first functional imaging of the human brain during sleep. This effort revealed a pattern of activation and deactivation exists that is associated with various sleep stages and with re-awakening.
5. Discovered the "sleep banking" phenomenon.

*2B-Alert is currently in beta testing and transitioning to the military, and is now available by our commercial partner as "Peak Alert" on the Apple App and the Google Play Store.

2B-Alert, in collaboration with the Biotechnology High Performance Computing Software Applications Institute (BHSAI), uses machine learning to personalize and predict cognitive function during periods of sleep loss

PRODUCTS

Web Tool

http://sleep.bhsai.org/

Free to the public

1. Input sleep history (caffeine history optional) and receive alertness predictions
2. Obtain optimized caffeine dosing schedule for peak alertness during pre-defined periods in the future

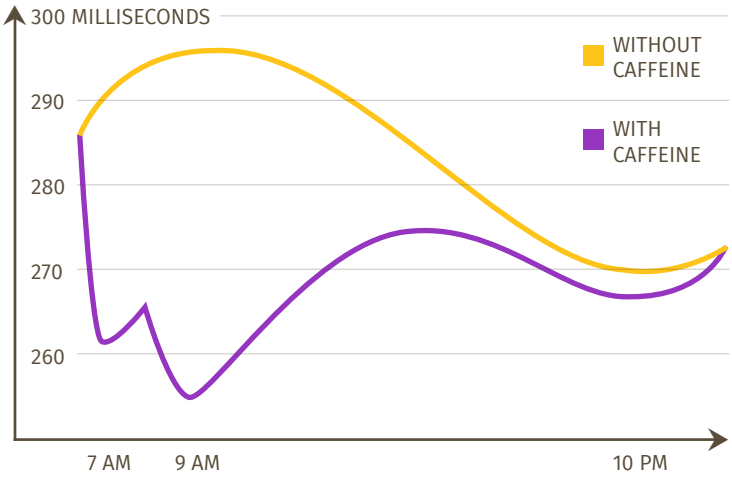
**All 2B-Alert Products are based on many laboratory sleep studies conducted at WRAIR*

1. **Input sleep history (caffeine history optional) manually or automatically with a wearable sleep monitoring device to receive alertness predictions.**
2. **Occasional completion of short reaction time tests on the smartphone allows the program to "learn" how you respond to variations in nightly sleep duration, and thus generate individualized performance predictions.**
3. **If there is an upcoming period of time during which maximum alertness is desired, 2B-Alert can provide a caffeine dosing schedule to maximize and sustain alertness and performance during that period.**

Caffeine Boost

Caffeine is the most widely used psychoactive stimulant, used to combat fatigue and sleepiness. Caffeine not only blocks adenosine receptors to combat fatigue and produce an alerting effect, but is also a cognitive and physical performance enhancer. The WRAIR Sleep Research Center developed Military Energy Gum to provide caffeine in an easy to administer, highly absorbable fashion.

A well-rested person will react to a visual stimulus in about a quarter of a second. This graph shows mean response times after 5 hours of sleep, without caffeine and with 100mg, equivalent to 8 ounces of weak coffee, at 7a.m. and 9a.m., the optimal dose for this scenario according to the 2B-Alert algorithm.



THE CHALLENGE:

Insomnia is prevalent among active duty Service Members, negatively impacting Warfighter performance and readiness.

Psychological stress, suboptimal environmental conditions, and circadian misalignment are a few contributing factors. Both pharmacological and behavioral interventions can be effective for improving sleep.

PHARMACOLOGICAL INTERVENTIONS

CURRENT STATE:

Broad Untargeted Sleep Inducers

Currently prescribed sleep aids in the military act broadly and have limited specificity for the arousal system. Consequently, there are often both physiological and cognitive negative side effects. Soldiers typically do not obtain the recommended minimum 8 hours of sleep necessary to reduce the possibility of negative side effects.

THE SOLUTIONS:

Targeted Sleep Inducers

The WRAIR Sleep Research Center is testing a more targeted intervention, Suvorexant, a dual orexin receptor antagonist with high selectivity that blocks the excitatory effects of orexins on the arousal system. Importantly, this drug may improve Soldier sleep without negatively impacting Soldier readiness.

Targeted Wake Promoters

In addition to our prior work collaborating on the development of caffeine gum, WRAIR Sleep Research Center will be testing other stimulants to promote wakefulness. The ability to both pharmacologically induce sleep as well as rapidly reverse sleep with targeted wake promoters is critical for control over Soldier readiness and lethality.

> **"The American Warfighter owns the night and will continue to do so with cutting edge technology, knowledge products, and pharmacologic interventions developed at WRAIR."**
>
> — Behavioral Biology Researchers

REPURPOSE INITIATIVE

The WRAIR Fast Performance Assessment and Chemical Evaluation (Fast PACE) laboratory is testing a variety of drugs that are currently used in far forward environments and approved by the FDA for other indications. The Repurpose Initiative seeks to rapidly repurpose FDA-approved drugs for use in sustaining Soldier performance in the field by promoting resiliency to sleep loss and other psychological stressors.

PROVIDER'S GUIDE TO
SLEEP MEDICATIONS

	HALF LIFE	BEST USE		SIDE EFFECTS				CONSIDERATIONS					AVOID			
		Dedicate 7-8hrs of Sleep	Promotes Alertness	CNS Depressant	Anterograde Amnesia	Headaches	Higher Risk for Parasomnias	Abuse Potential	Black Box Warnings	Pregnancy Category	Present in Breast Milk	Hormonal Birth Control Less Effective	Alcohol	Muscle Relaxers	Taking With Food	OTC Medicine
ARMODAFINIL Nuvigil, 150mg	~15 h	○	●	○	○	●	○	●	○	C	?	●	●	○	○	●
MODAFINIL Provigil, 200mg	15 h	○	●	○	○	●	○	●	○	C	?	●	●	○	○	●
CAFFEINE *	~5 h	○	●	○	○	○	○	○	○	A	●	○	○	●	○	○
MIRTAZAPINE Remeron, 15- 45mg	20 - 40 h	○	○	●	○	●	○	○	●	C	●	○	●	●	○	●
LORAZEPAM Ativan, 0.5-2mg	~12 h	●	○	●	●	○	○	●	●	D	●	○	●	●	○	●
SUVOREXANT Belsomra, 10-20mg	~12 h	●	○	●	○	●	●	●	○	C	?	○	●	●	●	●
ALPRAZOLAM Xanax, 0.5mg	~11.2 h	●	○	●	●	○	○	●	●	D	●	○	●	●	○	●
TRAZODONE Desyrel, 50-100mg	5 - 9 h	○	○	●	○	●	○	○	●	C	●	○	●	●	●	●
ESZOPICLONE Lunesta, 1-3mg	~6 h	●	○	●	○	●	●	●	○	C	?	○	●	●	●	●
RAMELTEON Rozerem, 8mg	1 - 2.6 h	○	○	○	○	○	○	○	○	C	?	○	●	●	●	●
ZOLPIDEM + Ambien, 5-10mg	~2.5 h	●	○	●	○	●	●	●	○	C	●	○	●	●	●	●
ZALEPLON Sonata, 5-20mg	~1 h	●	○	●	○	●	●	●	○	C	●	○	●	●	●	●
MELATONIN * 0.3-3mg	30 - 50 m	○	○	○	○	○	○	○	○	?	?	○	●	●	●	●

DISCLAIMER: PHYSICIAN RESOURCE, USE DISCRETION WHEN PRESCRIBING.

TABLE LEGEND

- Promotes Sleep
- Promotes Alertness
- A No risk in controlled human studies
- D Evidence of risk
- + Consider 5mg initial dose for females
- C Risk not ruled out
- * Effective in shifting the circadian clock
- ? Unknown

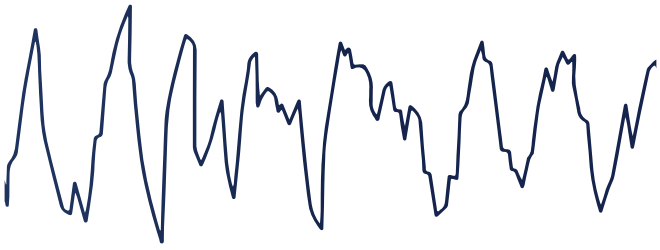
THIS KNOWLEDGE PRODUCT WAS CREATED AS PART OF THE SLEEP RESEARCH CENTER'S EFFORTS IN SUPPORT OF FORCE HEALTH PROTECTION.

TRANSCRANIAL ELECTRICAL STIMULATION

A POSSIBLE NEW TECHNOLOGY FOR FATIGUE MANAGEMENT

Transcranial electrical stimulation (TES) is a non-invasive technology that utilizes a weak current to enhance brain signals. There has been an explosion in TES research over the past 10 years. This technology represents a very fieldable opportunity to enhance sleep and wake in our Soldiers.

Wake EEG: Fast Activity



Slow Wave Sleep EEG: Slow Activity

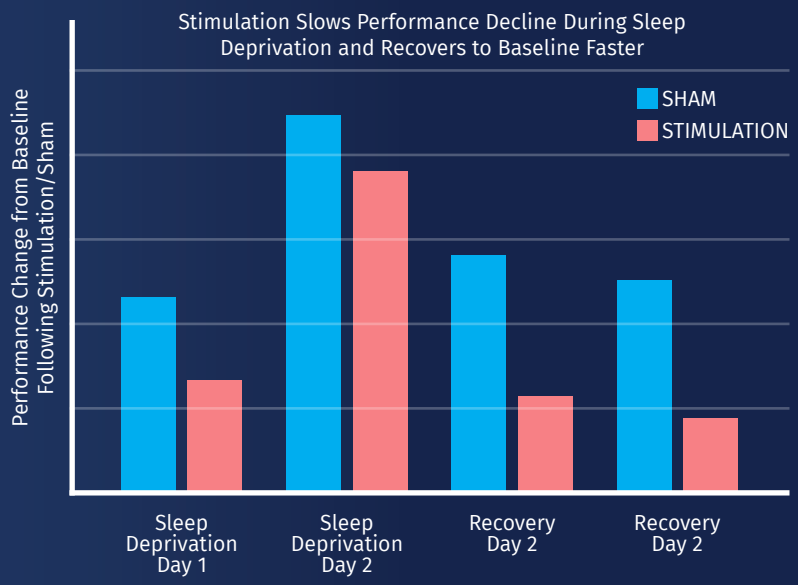
The process of sleep goes from fast activity during wake to progressively slower activity until the brain reaches slow wave sleep. This is the most restorative stage of sleep when the brain has slowed down considerably. We believe TES can help get the brain to this slow and restorative state faster and stay there longer to make short sleep opportunities more restorative.

The Sleep Research Center (SRC) is currently using **TES** during sleep to mimic slow waves that are found during the most restorative part of sleep.

Preliminary evidence suggests this type of TES applied during a short sleep opportunity can slow performance declines and speed recovery from sleep loss.

The SRC has received fieldable TES devices based on technology developed by a DARPA-funded brain stimulation project. The SRC is working in close collaboration with the company that developed the fieldable device, Teledyne Scientific LLC, to continue to develop and refine the technology.

The next step is to test the fieldable device in the laboratory while undergoing simultaneous rapid prototyping of usability in the field.



Preliminary evidence suggests that this type of TES applied during a short sleep opportunity (2 hours), followed by subsequent sleep loss, can slow performance declines and speed recovery. More specifically, stimulation helps participants maintain reaction times that are faster and closer to baseline performance during sleep loss.

SLEEP AND THE IMMUNE SYSTEM

7 OR MORE HOURS OF SLEEP PER NIGHT: 7

- SUSTAINS IMMUNE FUNCTION
- INCREASES RESISTANCE TO INFECTION
- INCREASES THE EFFICACY OF VACCINATION

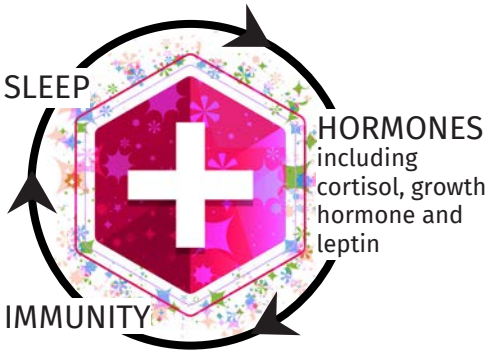
Sleep and the Immune System

Insufficient sleep blunts the immune system's ability to fight infections like COVID-19. Those who average less than 7 hours of sleep per night are **3 times** more susceptible, and those who average less than 5 hours of sleep per night are **4.5 times** more susceptible to infection.

Insufficient sleep can also impair the immune system's response to vaccination, leading to reduced protection from infection. Studies show that the more sleep is associated with a greater level of antibodies.

However, sleeping longer may improve immune function, help the immune system to resist infections, and increase vaccine efficacy.

Sleep and the immune system have a bidirectional relationship. Sleep regulates immune function and the immune system regulates sleep. By influencing hormone activity, sleep allows the immune system to operate. In turn, immune factors increase sleep. Through this relationship, adequate sleep promotes resistance to infections like COVID-19.



FOLLOW THE QR CODE TO ACCESS WRAIR'S BEHAVIORAL HEALTH RESOURCES FOR COVID-19. HTTPS://WWW.WRAIR.ARMY.MIL/NODE/348

Sleep and the fight against COVID-19

Currently, studies at WRAIR are determining how habitual sleep patterns are related to susceptibility to and severity of infections like COVID-19 and how increasing sleep may increase the efficacy of vaccines. This information will be used for decisions like determining shift schedules for Army medical providers and best practices for care of people infected with COVID-19. The results of these studies will also be used in guidelines for COVID-19 vaccine administration once a vaccine is developed.

SLEEP IN OPERATIONAL SETTINGS

How's your sleep *SLANT?*

Environmental factors degrade soldier sleep in the field. Improving these factors can boost the recuperative value of sleep.

SURFACE

S

Soft, yet firm sleeping surfaces (mattresses/cots/pillows)

LIGHT

L

Darkening shades during sleep

Bright light exposure upon awakening (for at least 1 hour)

AIR QUALITY

A

Air filters

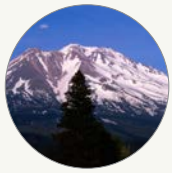
Sleeping quarters away from burning waste

NOISE

N

White noise machines/loud fans/ear plugs

Sleeping quarters away from military operations



TEMPERATURE

T

Air conditioner or heat (65-67 degrees while sleeping is optimal)

Proper blankets/insulation

SLEEP AND CIRCADIAN CHALLENGES CAN BE PRESENT THROUGHOUT ALL PHASES OF A DEPLOYMENT CYCLE

Deployment Travel

Jetlag • Physical adjustment (e.g. altitude) • Improper use of sleep medications • Alcohol withdrawal • Local pathogens (e.g. traveler's diarrhea) • Sleep-disrupting medications (e.g. malaria prophylactics)

Redeployment

Jetlag • Nicotine withdrawal • Family/friend responsibilities • Work responsibilities • Trauma

On the Ground

Mission responsibilities • Environmental factors (SLANT) • Time zone differences from loved ones Excess of nicotine • Excess of caffeine

This knowledge product is based on ORT efforts in support of Force Health Protection, and provides an overview of factors the ORT considers when developing interventions for fatigue management in operational settings.

WARFIGHTER FATIGUE MANAGEMENT DURING
NOCTURNAL OPERATIONS

DAY OF THE FIRST MISSION NIGHT

MAXIMIZE PRE-MISSION SLEEP

- Sleep until you wake up naturally, don't set an alarm
- Avoid stimulants after the late morning
- Nap in the afternoon/early evening
- Exercise later in the day
- Use caffeine closer to mission start time

SLEEP BANKING: Sleep banking, or getting as much extra sleep as possible in the nights leading up to your first mission night, has shown to support mission performance when optimal sleep conditions are not possible.

DURING NOCTURNAL OPERATIONS

ENHANCE PERFORMANCE

- Stay active
- Short tactical naps, when possible, can boost performance
- Caffeine immediately prior to a nap can boost performance
- Eat and hydrate, avoid processed and sugary foods
- Beware of unwanted side effects of stimulants
- Double tap critical duties to avoid error and mitigate risk

CAFFEINE NAP: Drink one 8oz cup of coffee immediately prior to a 10-15 min nap to maximize the alerting effects of the nap.

END OF MISSION NIGHT & WAY HOME

PREPARE FOR SLEEP

- Take only enough stimulants to complete duties
- Limit bright light exposure, change to dark glasses/eye pro when possible
- Use caution when operating a POV or military vehicles/machinery

ONCE HOME

FALL ASLEEP QUICKLY

- Avoid nicotine, caffeine, screen time, exercise and exposure to bright light
- Go to bed as soon as you can

DAYS BETWEEN MISSION NIGHTS

MAXIMIZE POST-MISSION NIGHT SLEEP

- Sleep in a dark, cool, quiet space
- Accumulate as much sleep as possible, even if fragmented
- Encourage house mates to respect daytime sleep schedule
- Upon waking, follow normal daily routine before next mission night. This includes drinking caffeine, eating, and exercising

RESETTING BACK TO DAYTIME OPERATIONS

RE-ESTABLISH NORMAL SLEEP PATTERNS

- Take a 60-90 minute nap following completion of final mission night
- Get bright light exposure during the day
- Avoid naps, caffeine, bright light, screen time, and exercise close to normal bed time
- Go to bed close to normal time

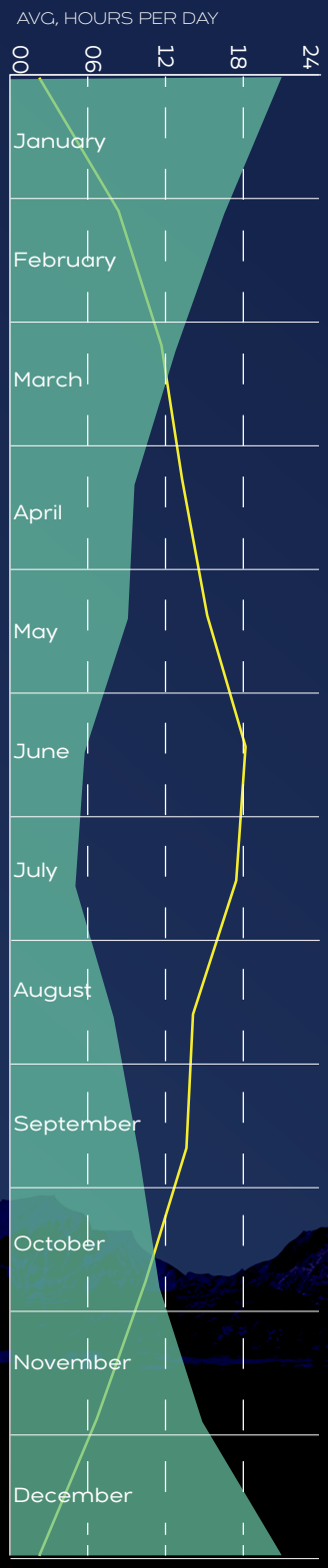
THIS KNOWLEDGE PRODUCT IS BASED ON ORT EFFORTS IN SUPPORT OF FORCE HEALTH PROTECTION, AND WAS DEVELOPED TO PROVIDE ELITE OPERATIONAL UNITS WITH FATIGUE MANAGEMENT STRATEGIES PRIOR TO AND FOLLOWING NOCTURNAL OPERATIONS.

MAXIMIZING SLEEP
AT HIGH LATITUDES

DAYLIGHT VS DARKNESS

HOURS OF DAYLIGHT

HOURS OF DARKNESS



HIGH LATITUDE COUNTRIES

SLEEPING WHEN THE SUN REFUSES TO SET

- Avoid daylight in the evenings close to your bedtime
- Use blackout curtains and/or and eye mask to block light
- Take 3mg melatonin ~1 h prior to bedtime

GETTING UP WHEN IT IS DARK

- Get bright light exposure in the first 1-2 hours of being awake (light boxes and daylight light bulbs are commercially available)
- Maintaining a healthy diet and an exercise routine can help

GENERAL TIPS

Keep your sleep schedule consistent, even on weekends.

Set a daily fixed wake-up time and bedtime, shooting for 7-8 hours of sleep.

Avoid electronics 30-60 min prior to bedtime.

THIS KNOWLEDGE PRODUCT IS BASED ON ORT AND SRC EFFORTS IN SUPPORT OF FORCE HEALTH PROTECTION, AND WAS CREATED TO SUPPORT SOLDIERS ASSIGNED TO UNITS LOCATED AT HIGH LATITUDE LOCATIONS.

WRAIR'S JET LAG MANAGEMENT TIPS

WHILE TRAVELING

1. Time your activities (eating, sleeping, getting light) based on your destination time zone.
2. For short trips (e.g. less than 2 days), avoid adaptating to the new time zone. Keep sleep, activity, eating schedule to your "home" time zone.

Below are a few tips you can do at your local time zone on the day of travel based on the example itineraries.

Westward Travel

Example itinerary for a morning flight:
Home or Local time: Washington DC (EST)
Destination: Honolulu (HAST)

- Avoid bright light in the early morning (close the window shade, wear dark sunglasses)
- Avoid caffeine in the early morning
- Nap in the early morning (eye mask and ear plugs may help during your flight)

Eastward Travel

Example itinerary for a morning flight :
Home or Local time: Washington DC (EST)
Destination: London (GMT)

- Get bright light in the early morning (open the window shade, avoid dark sunglasses)
- Take caffeine in the early morning
- Avoid light in the evening (close the window shade, wear dark sunglasses)

WHEN YOU ARRIVE

1. Go outside, getting daylight at your destination time will ease your shift
2. Take 200 mg of caffeine every 4 hours during daylight hours at your destination as needed for alertness; Stop 6 hours before bed time
3. Short naps (~20 min) may help with alertness

Below are a few tips you can do at your destination time zone on the day you arrive based on the example itinerary. Once adjusted, do 24 activities based on new local time.

Westward Travel

- Try to stay up until your destination bedtime
- Sedative and hypnotic medication may help with staying asleep

Eastward Travel

- Take melatonin prior to bedtime (there is limited data on how melatonin interacts with other medications)
- Sedative and hypnotic medication may help with falling asleep

DAY TO DAY

Example sleep schedule from 2200 to 0600

0600 h

- wake up
- sunlight in A.M. to "reset" alerting signal
- exercise boosts alertness through "feel good" endorphins
- caffeine acts in 20 minutes and lasts for hours

1200 h

- exercise continues to boost alertness through "feel good" endorphins
- caffeine continues to act in 20 minutes and lasts for hours

1600 h

- napping helps reduce sleep drive and boosts day of learning and memory
- refrain from consuming caffeine after 1600 hours

2200 h

- low light helps stimulate release of melatonin, which helps us fall alseep
- low-level relaxing activity at night prepares our body for sleep
- bed time

This knowledge product is based on ORT and SRC efforts in support of Force Health Protection and the White House Medical Unit.

COMPREHENSIVE FATIGUE MANAGEMENT PRODUCT MAP

SOLDIER/SQUAD FATIGUE MANAGEMENT

Currently, WRAIR uses wearable sleep tracking to provide individualized performance prediction through an algorithm, 2B-Alert, developed with collaborators at BHSAI. In the future, the development of real-time individualized biofeedback on sleep behavior and discovery of novel physical biomarkers will allow for targeted individualized interventions for fatigue management.

SLEEP LEADERSHIP

Leadership plays a critical role in unit performance. Tools to help educate leaders on Warfighter fatigue management have been developed and implemented via Army training manuals and the Performance Triad. As methods to monitor and predict fatigue, such as passive digital phenotyping, continue to be developed, these informational tools will be integrated for use during training and MDO to implement decision-making strategies and countermeasures to maximize human potential.

NUTRITIONAL SUPPLEMENTS

Currently, caffeinated gum developed by WRAIR and partners are available in the MORE and First Strike Rations, as well as the knowledge products that teach leaders and Soldiers how to optimize caffeine intake for sustained performance. In the future, a Soldier's unique microbiome and use of trusted and novel supplements can be individualized to maximize efficiency and/or effectiveness to enhance Soldier lethality and performance.

PERFORMANCE ENHANCEMENT

Currently, broad, untargeted sleep inducers are widely prescribed to the Warfighter for sleep dysfunction. WRAIR researchers have created a knowledge product to help guide physicians on the various pharmacological options for sleep aid. Our lab is working on testing targeted sleep inducers that are more easily reversible and less cognitively detrimental as well as targeted wake promotors to increase alertness and maximize human potential.

"SMART" CAP

Current research in our lab using non-invasive brain stimulation demonstrates promise for enhancing the recuperative value of a brief period of sleep and increasing alertness and performance during wakefulness. In the future, we will be developing and testing a ruggedized wearable "smart" cap device capable of stimulation to enhance cognition and performance during MDO.

TOP 5 REFERENCES

BEHAVIORAL BIOLOGY BRANCH BIBLIOMETRICS

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TRAIT-LIKE VULNERABILITY TO TOTAL AND PARTIAL SLEEP LOSS.
RUPP, T.L., WESENSTEN, N.J., & BALKIN, T.J. (2012).
SOURCE:
SLEEP

SLEEP DISRUPTIONS AMONG RETURNING COMBAT VETERANS FROM IRAQ AND AFGHANISTAN.
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MILITARY MEDICINE

THE SLEEP TEAM'S 83 MANUSCRIPTS PUBLISHED IN THE LAST 10 YEAR HAVE GARNERED 1,845 CITATIONS.

SLEEP PROMOTES SOLDIERS' ABILITY TO RECOGNIZE FAILED SOLUTIONS, GENERATE NOVEL ONES, ANTICIPATE AND OVERCOME OBSTACLES, OPTIMIZE PRIORITIZATION AND FAST AND ACCURATE DECISION MAKING AND RETAIN BETTER PLANNING, GOOD JUDGEMENT, APPROPRIATE RISK TAKING, CREATIVE PROBLEM-SOLVING, VIGILANCE, ATTENTION TO DETAIL, MULTI-TASKING, CONCENTRATION, SHARPENED FOCUS, EMOTIONAL INTELLIGENCE AND PERCEPTIVENESS, EMOTIONAL STABILITY, HIGH MOTIVATION LEVEL AND FAST RESPONSE TIME.

Scan here for a link to resources the Behavioral Biology Branch has contributed to or created to support fatigue management in Soldiers. http://www.wrair.army.mil/node/375

KEY PARTNERSHIPS

Our robust partnerships, in particular our MIL-MIL partnerships, provide a competitive advantage and help build strategic depth during all phases of Multi-Domain Operations. Partnerships with biotech, pharmaceutical companies, and academia aid the development of drugs and devices, allow for cost sharing, speed up timelines and take advantage of robust development platforms in the civilian sector.

ACADEMIA

- BROWN UNIVERSITY
- CLEMSON UNIVERSITY
- CORNELL UNIVERSITY
- INDIANA RIVER STATE COLLEGE
- INSTITUTE FOR BIOMEDICAL RESEARCH (UCA BIOMED)
- JOHN HOPKINS UNIVERSITY/ APPLIED PHYSICS LAB
- LOUISIANA SOUTHERN UNIVERSITY
- SUNNYBROOK RESEARCH INSTITUTE
- TOWSON UNIVERSITY
- UNIVERSITY OF CALIFORNIA, SAN DIEGO
- UNIVERSITY OF COLORADO
- UNIVERSITY OF MARYLAND, BALTIMORE
- UNIVERSITY OF SOUTHERN CALIFORNIA
- UNIVERSITY OF TEXAS, ARLINGTON
- UNIVERSITY OF VIRGINIA
- UNIVERSITY OF WISCONSIN, MADISON

FIELD

- 2/75 RANGER BATTALION, JOINT BASE LEWIS MCCHORD, TACOMA, WA
- 2ND BCT, 1ST ARMORED DIVISION, FORT BLISS, TEXAS
- 44TH MEDICAL BRIGADE
- 75TH RANGER REGIMENT, FT. BENNING, GA
- HUMAN PERFORMANCE TRAINING CENTER, 2ND BATTALION OF THE 75TH (2/75) RANGER REGIMENT
- SCIENCE-BASED OPTIMIZATION OF RANGER ASSESSMENT AND PERFORMANCE

GOVERNMENT

- BIOTECHNOLOGY HIGH PERFORMANCE COMPUTER SOFTWARE APPLICATIONS INSTITUTE
- DEFENSE INNOVATION UNIT
- DEFENSE THREAT REDUCTION AGENCY
- FEDERAL AVIATION ADMINISTRATION
- MILITARY OPERATIONAL MEDICINE PROGRAM AREA DIRECTORATE
- NATICK SOLDIER RESEARCH DEVELOPMENT AND ENGINEERING CENTER
- NATIONAL CAPITOL CONSORTIUM
- NATIONAL INSTITUTE OF DIABETES AND DIGESTIVE KIDNEY DISEASES
- NATIONAL INSTITUTES OF HEALTH
- NATIONAL INSTITUTE OF MENTAL HEALTH
- NATIONAL INSTITUTE OF NURSING RESEARCH
- NAVAL MEDICAL RESEARCH CENTER
- NAVAL MEDICAL RESEARCH UNIT, DAYTON
- OFFICE OF THE SURGEON GENERAL
- SAN ANTONIO MEDICAL CENTER
- TRIPLER ARMY MEDICAL CENTER
- UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
- U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND
- U.S. ARMY MEDICAL MATERIAL DEVELOPMENT ACTIVITY
- U.S. ARMY PUBLIC HEALTH COMMAND
- U.S. ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE
- U.S. ARMY RESEARCH LABORATORY
- U.S. ARMY RESEARCH OFFICE
- U.S. SPECIAL OPERATIONS COMMAND
- WALTER REED NATIONAL MILITARY MEDICAL CENTER

INDUSTRY

- BLACKTHORN THERAPEUTICS, INC
- CIRCADIAN POSITIONS SYSTEMS, INC
- DEEPWAVE TECHNOLOGY, INC
- DESIGN INTERACTIVE, INC
- LIFEAID BEVERAGE COMPANY
- MIT LINCOLN LABORATORIES
- NEUROSCIENCE, INC
- PHILIPS HEALTHCARE
- SAGE THERAPEUTICS, INC
- TELEDYNE SCIENTIFIC
- VANDA PHARMACEUTICALS, INC

THIS IS A SUBSET OF WRAIR'S MORE THAN 400 PARTNERSHIPS