

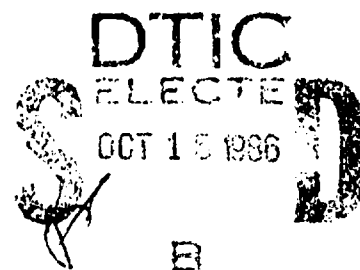
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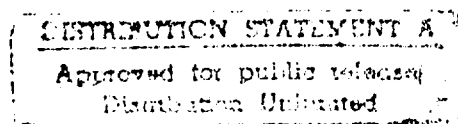
SLEEP MANAGEMENT IN SUSTAINED OPERATIONS USER'S GUIDE

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Sleep Management User's Guide

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SUMMARY

Sleep management (sleep logistics) consists of knowledge about sleep and how to satisfy the sleep needs of people who work in demanding environments of shift and continuous work schedules. Sleep logistics is an application of sleep management to military operations establishing and requiring compliance to a work/rest-sleep schedule. The objective of sleep logistics is to assure that fighting men and women, at all levels, have sufficient sleep for maintaining their combat effectiveness. In the past, major battles were often limited to daytime due to poor night visibility and unreliable equipment. With improved technology, these problems are being resolved. This means that sleep logistics has become ever more critical because combat troops are required to fight both night and day, losing sleep. This User's Guide explains management of sleep in sustained operations without using drugs. Its purpose is to give basic information about human sleep need and the behavioral and mood consequences of not satisfying that need. It provides the best available techniques to determine the severity of sleep debt and to cope with the ill effects of sleep loss. The User's Guide consists of four major sections with a final section for conclusions/summary. Section 1 introduces challenges which the field commanders are facing in sustained operations: management of men and women under his command so as to keep them combat effective days and nights over the duration of sustained operations without proper rest and sleep. Section 2 offers details of what sustained operations and sleep management consist of, and then explains what work/rest-sleep and sleep loss problems are during the pre-deployment, deployment, pre-combat, combat and postcombat phases. Section 3 reviews three ways by which sleep management copes with performance degradation caused by work/rest-sleep and sleep loss problems: identifying the signs of the problem, preventing performance degradation, and devising ways to overcome it. Section 4 details five psychophysiological techniques by which field commanders manage sleep in field training to assure optimal task performance of men and women under their charge during a future sustained operation. These techniques are: (1) to see if mission requires sleep management, (2) to recognize the signs of degradation, (3) to know tolerance to sleep loss, (4) to develop self-control in order to sleep when you must, and (5), to use aids to measure sleep loss effects. Four aids which are suggested for measuring sleep loss are: (1) sleep/activity diary, (2) mood scale, (3) Plus 7 addition task, and (4) body temperature. In addition, sleep management requires field commanders to learn more facts about human sleep need. It is concluded that the most important steps to be taken in a non-pharmacological approach to sleep management are

to prepare a work/rest-sleep plan to meet sleep needs and to utilize self-diagnosis techniques to detect and compensate for sleep debt effects. Nine key recommendations for sleep management are listed, along with five non-drug measures to avoid deleterious effects of sleep loss.



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SECTION 1 CHALLENGES

This User's Guide explains management of sleep without using drugs. Sleep management for the military (sleep logistics) was developed almost 30 years ago by then LtCol Harold Williams at Walter Reed Army Institute of Research. Sleep logistics, which includes work/rest-sleep planning, will become a matter of serious concern when you are required to work without sleep at about the same level of efficiency throughout a 24-hour or longer period until the enemy is defeated.

During such extended work periods, there are intense continuous work episodes where you are not relieved from performing your assigned job and you have no time for sleep or rest. An extended work period may have one or more continuous work episodes. Continuous work episodes are not limited to the front line. The groups involved in re-supplying the front line will also be involved in episodes of continuous work. In the past, major battles were often limited to daytime due to poor night visibility and unreliable equipment. With improved technology, these problems are being resolved. This means that you may be required to fight both night and day.

This User's Guide discusses undesirable changes in job performance, moods, willingness to work, and fatigue which result from losing sleep. It also discusses how to prevent these degrading effects during an extended work period by sleep management, so that military objectives can be accomplished.

1.0 Background and Problems

Behavioral problems associated with an extended work period with episodes of continuous work in military operations are well documented. George E. Marshall's observation during the Normandy Operation in WWII vividly portrays the problems: disorientation, overwhelming sleepiness, and inability to give and receive orders due to uncontrollable lapses in attention and poor memory. Sleep logistics have been proposed as a means of handling these behavioral problems during an extended work period or military shift work by work/rest-sleep planning. Sleep logistics have been immortalized by Bill Mauldin's cartoons of Willie and Joe.

1.1 Purpose of Sleep Management User's Guide

The purpose of this User's Guide is to provide basic information for field commanders about human sleep need and the behavioral and mood consequences of not satisfying that need. The User's Guide will provide the best available techniques to determine the severity of sleep debt and to cope with the ill effects of sleep loss. The Guide is based upon more than a decade of research on sleep conducted by the Naval Health Research Center, San Diego.

SECTION 2 SUSTAINED OPERATIONS AND SLEEP MANAGEMENT

This Section describes what is meant by Sustained Operations and Sleep Management.

2.0 Sustained Operations: What are they?

Sustained operations (SUSOPS) involve continuous performance of tasks over a period longer than 24 hours. Each sustained operation will contain one or more continuous work episodes (CWES) during which time one works without pause for break/-rest. Three primary factors have limited the duration of CWES in the past: (1) limited vision at night, (2) equipment unreliability, and (3) limited endurance. With improvements in technology, the duration of CWES is determined primarily by endurance, which is limited by the need for sleep. In other words, the duration of SUSOP is determined by the combat unit's ability to endure an extended fight and not by weapon reliability, weather, or darkness.

An extended time period which includes both CWES and relatively quiet periods is referred to as a SUSOP. A battle field environment has varying levels of intensity. There are distinct phases such as movement to contact enemy forces, periods of fighting, consolidation, re-grouping, and re-supply. The periods of intense and continuous fighting with no chance for rest/sleep pauses are CWES. There may be many of these in a single SUSOP. However, even on the front line, there are relatively quiet periods with opportunities for short periods of rest, although one must be ready to resume fighting quickly.

2.1 Sleep Management: What is it?

Sleep management consists of knowledge about sleep and how to satisfy the sleep need of people who work in demanding environments of shift and continuous work schedules. It is concerned with how to prevent and cope with deteriorating performances, poor moods, and lowered willingness-to-work caused by lack of sleep. It deals with discovering new psychological, physiological, pharmacological, nutritional and biochemical methods to remedy and counteract the negative effects of sleep loss.

Sleep logistics is an application of sleep management to military operations establishing and requiring compliance to a work/rest-sleep schedule. Sleep logistics is as much a branch of military science as logistics concerned with how to move, feed, clothe, and house soldiers, or how to supply them with arms and ammunition. Sleep logistics plans the time and place for sleep in a SUSOP. The objective of sleep logistics is straightforward: fighting men and women, at all levels, must have sufficient periods of quality sleep. They must be able to recuperate from the fatigues and stress from CWES and maintain, as an individual and as a fighting unit, combat-effectiveness during a SUSOP.

2.2 Sleep Management: How is it done?

Sleep management provides ways to reduce sleepiness and to reduce the accumulation of fatigue during CWES.

PRE-DEPLOYMENT PHASE: Using mission scenario operation guidelines, you must determine periods available for sleep and the total amount of sleep hours that are possible. Since changes in SUSOP requirements will be inevitable, sleep management recommends that several work/rest-sleep plans be prepared for all phases of a SUSOP so that the best plan for altered SUSOP requirements can be adopted.

You must become familiar with the surroundings where the combat unit will sleep. For example, some may have to sleep in a chemically protective garment (MOPP IV). Sleep in a MOPP IV is unfamiliar and will be poor in quality. If sleep in such unusual environments is anticipated in a forthcoming SUSOP, sleep management requires of your combat unit to practice sleeping in these environments during a pre-deployment phase. Prior experience will reduce the level of stress. Similarly, good sleep managers will

try out anticipated work/rest-sleep schedules before a SUSOP.

DEPLOYMENT PHASE: Sleep management realizes that, under time-pressure during the deployment phase, sleep will be reduced. Sleep quality will also suffer from traveling in uncomfortable vehicles and from changes in time zone and climate. During the deployment phase, pre-planned work/rest-sleep schedules should be adopted and followed as closely as possible. Otherwise, members of the combat unit may be too tired to be fully combat effective, even before the pre-combat phase.

PRE-COMBAT PHASE: The body has a circadian rhythm associated with the time zone to which it is adapted. People are most effective during the period of circadian peak, in the afternoon. We are least effective at the circadian trough, in the early morning hours. When there is a delay of a week or more between arrival in a combat zone and actual combat, the best sleep schedule is the work/rest-sleep pattern of the destination time zone. However, if there is no time to adjust to the local work/rest-sleep pattern, it is best to stay with the work/rest-sleep pattern of the home base, similar to the U.S. astronauts in the space craft who stayed with Houston time. In that case you and your combat unit members will not follow the circadian rhythm of those who have adjusted to local time. You may be sleeping during the day and working at night.

Body and performance efficiency are influenced by how well one is adjusted to a new day/night cycle. For example, combat unit members may be engaged with a job in the afternoon of the local time which may correspond to 0200-0500 hours of home base time. Without prior adjustment to the local time, your daytime performance would be poorer because 0200-0500 hours is a circadian low point in performance efficiency. Leaders should be aware of this inefficiency and plan the workload accordingly.

COMBAT PHASE: By means of a work/rest-sleep plan and counter-degradation measures, the sleep manager attempts to avoid a situation where all personnel are physically and mentally exhausted at the same time. However, operational demands may prevent adoption of optimal work/rest-sleep and shiftwork plans, resulting in significant loss of sleep in all personnel.

One remedy is making the most of any lull during the combat phase by briefly sleeping. Remember that only sleep can satisfy the need for sleep; the detrimental effects of sleep loss on performance can only be overcome by sleep. Merely resting flat

(on a bed) does not help.

Uninterrupted short sleep of 10 minutes or longer is beneficial in partially recovering alertness and maintaining a baseline level of job performance. However, taking sleep may be risky, especially in the combat phase. You may wake up from sleep confused, sluggish, uncoordinated. This post-sleep state, usually lasting 5 minutes, is known as sleep inertia. The sleep manager must balance between negative effects of sleep (lost man-hours and sleep inertia) and positive effects of improved ability to perform a job after sleep.

POST-COMBAT PHASE: Immediately following the completion of a SUSOP, combat unit members should be allowed to sleep for up to ten hours. Longer periods of sleep are not desirable as they tend to cause sleep drunkenness and a delay in getting back to the pace of normal schedules. Hours of lost sleep during SUSOP need not be replaced by an equivalent increase in hours of sleep. After a long first recovery sleep, the sleep duration should be kept within a normal range for subsequent sleep periods. The sleep manager should be aware that longer than five minutes sleep inertia and increased susceptibility to naps may occur for a week following a SUSOP.

SECTION 3 HOW DOES SLEEP MANAGEMENT WORK?

Sleep Management will (1) prevent degradation in performance, moods and work motivation by devising the best work/rest-sleep plan for any SUSOP; (2) identify the symptoms of poorly managed or no sleep and increase combat unit awareness of these symptoms; and (3) overcome degradation by re-allocation of jobs and utilization of performance aids.

3.0 Identifying Signs of Performance Degradation

Symptoms of sleep loss are variable. They are not always present in all individuals and may be intermittent. However, as sleep debt accumulates, symptoms will be more prevalent and last longer. When these symptoms appear in each individual depend not only on hours of wakefulness but also on tolerance to sleep loss, kinds of tasks to be done, severity of physical workload, and time of day.

A. Mood and Motivational Changes Early symptoms of insufficient sleep include

changes in mood and decreased willingness to work. Combat unit members may feel less energetic, less alert, less cheerful, more irritable, and increasingly negative and sleepy. Individuals who regard sleepiness and mood changes as signs of weakness often deny negative moods and tiredness but may admit to decreased positive mood. After a prolonged sleep loss, combat unit members will pass from increased irritability and negativism to a sense of dullness and weariness.

- Less positive and more negative mood.
- Less willing to work due to lack of energy.
- Decreased initiative (decreased willingness to report events and interact with others).

B. Impaired Attention Attention span becomes shortened. Sleep deprived individuals cannot concentrate on the job for long. Intermittent dream-like, irrelevant thoughts cause lapses of attention.

- Decreased vigilance (decreased sustained alertness).
- Decreased ability to concentrate (decreased focused attention).
- Intrusion of irrelevant thoughts.
- Increased lapses (an increased number and duration of intermittent loss of focused attention).

C. Memory Loss for Recent Events A common sign of sleep loss is the inability to recall what you were just told, saw, heard or read. Memory loss is limited to recent events or to short term memory. A sleep deprived individual often remains confident about retaining messages, events, and data only to find later that these have been forgotten.

D. Variable and Slowed Responses Under high work demands, the best response time the members of a combat unit can manage is only slightly affected by sleep loss. The effect of sleep loss on response time appears, not as slowing down of all responses, but more as unevenness in response time. Some responses remain fast; others become very slow. The danger of sleep loss is the unpredictable failure or slowing down of appropriate responses.

E. Vision Illusion/Hallucination After more than 24 hours without sleep, some members of the combat unit may see incorrectly or even see what is not really there. The prevalence of visual illusions and hallucinations is variable. Some may never develop these symptoms. Auditory illusion or hallucination is rarely experienced.

F. Failure to Complete Routines Sleep loss interferes with completion of routines, such as drying feet or changing socks or filling up canteens whenever water becomes available. Confirmation of verbal orders by repeating the orders aloud, the standard operation procedure, becomes perfunctory and eventually is omitted altogether.

G. Impaired Task Performance Effectiveness in performing assigned tasks is significantly lowered when a CWE lasts longer than 24 hours. For example, after a CWE of 36 hours duration, the combat unit may be able to perform only 50% of the average message coding/decoding work output expected in a normal workday. Similarly, members of the combat unit may be able to detect only 70% of incoming signals in a usual workday. Task performance is degraded due to impaired short-term memory, decreased ability to concentrate, and intrusive, irrelevant, dream-like thoughts. Performance errors most frequently result from failure to respond to task demands (errors of omission) and less frequently result from responding to task demands indiscriminately or inaccurately (errors of commission). Speed of reading written documents slows down but comprehension accuracy is good after sleep loss. However, members of the combat unit may experience difficulty in remembering the directives in the documents. Impaired Performance follows a circadian rhythm. The worst performances occur during early morning hours.

H. Exaggerated Feeling of Physical Exertion Physical work is performed with a subjective feeling of physical exertion ranging from very light to very hard. This follows a circadian pattern. In the early morning hours members of the combat unit may feel that more effort is required to do the same physical workload than if this workload were performed later in the day. Sleep loss exaggerates this early morning change so that combat unit members may feel like stopping work due to exaggerated feelings of physical exertion. However, one can continue working without causing physical harm.

I. Lack of Insight on Impaired Behaviors You observe behaviors in members of your combat unit, especially during a CWE, and correct their inadequate responses. Normally, your observations of combat unit members corresponds well with their self-

observations. For example, when you observe that a person has been inattentive to incoming signals, the impaired behavior is quickly corrected when you command them to be more attentive. The rapid correction results from the fact that the person's self-observation agrees with your outside observation. With sleep loss, however, the power of self-observation or insight deteriorates to such an extent that the combat unit members become unaware of impaired behavior and angrily deny such impairments pointed out by you and any others.

J. Failed Verbal Communication This is caused by attentional lapses combined with impaired short term memory. It is most serious when it happens to field commanders.

Since sleep deprived individuals fail to remain continuously attentive to ongoing conversations, and fail to remember what is being discussed, their conversation may become fragmented, wander, and contain repetitive phrases and ideas. Impatience and/or weariness due to sleep loss makes verbal communication very difficult and tends to result in misinterpretation. Members of the combat unit are less likely to have misunderstandings if you ask questions and cross-check given answers. Ignoring orders can result from a combination of the effects of sleep loss. This is mainly caused by failed verbal communication, but a sense of numbness, omitting routines, and impaired short term memory also contribute.

Bickering is a form of irritability caused by sleep loss. However, bickering has one positive aspect. It shows that the sleep deprived individuals are still talking to each other, exchanging orders and messages. The frequency of bickering increases with increased sleep loss, up to a point. It decreases when sleep deprived individuals begin to have difficulty continuing to talk. As long as bickering goes on, sleep loss effects are not severe. In a SUSOP, a decline in overall message exchanges and the amount of bickering is a serious symptom of sleep loss. When bickering decreases, especially after a period of increased bickering, individuals may be in a state of mental exhaustion.

- Difficulty in giving/receiving orders
- Incoherence and/or fragmented speech
- Difficulty in maintaining effective verbal communications

K. Signs of Jet Lag Jet lag is a common experience which occurs after crossing many time zones while traveling in a jet plane. It involves general malaise and performance inefficiency. Jet lag symptoms include poor moods, increased irritability, seriously disturbed sleep, headache, and acute intestinal upset. Jet lag occurs because internal biological functions are organized by the circadian rhythm which is in harmony with the local time clock. The orderly sequence of waking and sleeping is set by the daily rhythms around a local clock.

When you and your combat unit members fly east or west from a home base across many time zones and try to resume working, local time is different from the home base time. For example, if you fly east from Los Angeles to West Germany, your body clock time (the home base time) will be nine hours out of synchronization with West Germany time. Working between 1100 and 1500 West German time means that your body and mind are working at 0200 to 0600 Los Angeles time (the period of circadian low). Under these circumstances, the best performances and moods cannot be expected.

L. Signs of Shift-work Fatigue Some work/rest-sleep schedules cause performance degradations similar to those caused by sleep loss and jet lag.

A typical work/rest-sleep schedule calls for an 8-hr On/16-hr Off, i.e., 8 hours on duty (e.g., from 0900 to 1700), and 16 hours off duty, with about 8 hour of continuous sleep.

Planning for shiftwork in a SUSOP is desirable as the available manpower pool is relatively fixed. Usually the simplest way to plan for shiftwork in a SUSOP is to divide available manpower into two or three teams where each team includes the supervision, skill-mix and number of people necessary to accomplish the task. These teams rotate, providing workers around the clock. With three teams, you can establish a basic 8-hour On/16-hour Off schedule. If only two teams can be formed, the workload per team will go up, (i.e., 12-hour On/12-hour Off schedule), and the length of rest periods will be shortened correspondingly. The work/rest-sleep plan must balance the demands of the job to be done against the fatigues expected to build up.

M. Physical Signs of Serious Sleep Loss

- Vacant stare - "glazed" eyes
- Blood-shot eyes
- Pale skin
- Body sways on standing; sudden dropping of chin on sitting
- Intermittent loss of hand grip strength
- Walking into obstacles and ditches
- Poor personal hygiene
- Very low body temperature
- Very slow heart rate
- Loss of interest in surroundings
- Slurred speech

3.1 Preventing Performance Degradation

Performance degradation in SUSOP can be prevented by reducing sleep debt. This requires using a properly established work/rest-sleep schedule. If possible, there should be at least 4 to 5 hours of sleep per 24 hours, in a single unbroken period. This is enough sleep to prevent performance impairment over an indefinitely long period of time for the average person.

There are large stable individual differences in tolerance to sleep loss. If one ranks a group of individuals in terms of tolerance to sleep loss (or capacity to work without sleep) from the highest to the lowest, this ranking will remain stable across various sleepless operations.

Tiring easily is not a personality weakness or a learned trick but something we are born with. Some individuals are born long-sleepers and others are short-sleepers. Similarly some individuals tolerate sleep-loss well, whereas some others will not.

It is important for you and your combat unit members to know how well you can tolerate working without sleep. You may be overwhelmed by loss of one night's sleep or you may be able to take sleep loss in stride. The work/rest-sleep schedules will set an optimal pattern for the average person. If you are sensitive to loss of sleep, you should sleep more frequently or longer than the others to lower the rate of sleep-debt

accumulation. If you are tolerant of sleep loss, you can remain awake a bit longer than the average person. However, you should not be overconfident in your ability to tolerate sleep loss. You will succumb quite suddenly to sleepiness when sleep loss continues over 72 hours. You may feel peppy and clear-headed, and then suddenly be hit by irresistibly strong sleepiness, fatigue and other effects of sleep loss. Being aware of this prevents the catastrophic failure in job performance which is often seen among those who are tolerant of sleep loss.

As a leader, one has the responsibility of examining the operation scenario and determining when opportunities for sleep will arise for the combatants under your charge and how long they will be able to sleep. As a leader, you must make sure that some of the rest period is efficiently used for sleep because only sleep can prevent sleep debt from increasing. However, you must know your own tolerance to sleep loss and that of all the others in your command. Combat unit members will suffer from imposed inaction and situational insomnia when told to sleep when they are not sleepy. Their restlessness may disturb the sleep of others in the unit.

Usually, in an extended combat, involuntarily falling asleep is a more serious problem than situational insomnia or inability to sleep. However, as a field commander, you should be prepared to deal with some individuals who are unable to sleep during the predeployment and deployment phases. For those who cannot sleep, suggest a breath counting method. Instruct them to breathe shallowly and slowly, counting each breath.

3.2 Overcoming Performance Degradation

When signs of performance degradation begin to appear among the members of your combat unit during a SUSOP operation, there are several things to do. Find time for them to nap, change routines, or rotate jobs, if they are cross-trained.

Let the most sleep-loss affected member do a task which can be accomplished at a pace set by the worker, not by the job. Sleep loss has less impact on self-paced jobs. Encourage everyone to write down work to be done or messages received and have others check what has been written for clarity and legibility.

It is unlikely that two members of a combat unit will become sleepy at exactly the

same time. Teaming up to do a job, or creating the buddy-system, is as valid a concept in SUSOP as in SCUBA diving.

SECTION 4 SLEEP MANAGEMENT IN SUSOP FIELD TRAININGS

Sleep management is one of many problems a field commander faces in a SUSOP. As you go through pre-deployment, deployment and combat phases, you may feel that sleep management has low priority compared with other tasks. However, it is the responsibility of the field commander to see that combat unit members comply with recommendations of sleep management. If the field commander is noncompliant with sleep discipline, sleepiness and sluggishness may result in hazards to the combat unit under command. The best way to remain alert and responsive to changing tactical environments is to plan for sleep. Taking naps during a SUSOP is not a sign of low fighting spirit and weakness; rather, it is a sign of foresight.

The following text contains six sections:

- 4.0 The Work/Rest-Sleep Plan
- 4.1 Recognize Signs of Degradation
- 4.2 Know Tolerance to Sleep Loss
- 4.3 Develop Self-Control to Sleep When You Must
- 4.4 Use Aids to Measure Sleep Loss Effects
- 4.5 Learn the Facts About Sleep

These six sections (4.0-4.5) reiterate previously examined topics of sleep management and discuss new topics. They show how you can successfully play the role of sleep manager in SUSOP field training exercises and combat mobilization.

4.0 The Work/Rest-Sleep Plan

The work/rest-sleep plan should assure that sufficient hours of sleep are available to everyone during all phases of a mission (see Section 2.1). Sleep management is particularly important during the pre-deployment phase which tends to involve heavy workload lasting over many days and weeks. If a total sleep time per a 24-hour period is being reduced from a normal 7 to 8 hours to less than 4 to 5 hours, careful sleep management is needed. Anybody who sleeps less than 4 to 5 hours per day over an

extended period of time becomes vulnerable to circadian rhythms and post-prandial tiredness. Irritability, mood changes, and communication with others may deteriorate. Jobs involving hard physical work will amplify the undesirable effects of sleep loss. However, the reduction of sleep to 4 to 5 hours per 24 hours does not cause serious degradation in cognitive task performances. Thus, a minimum of 4-5 hours per day is recommended during a SUSOP.

During a deployment phase, it is important to provide environments which facilitate sleep of at least 4-5 hours per day. Sleep is facilitated by quiet environments. Social interactions should be restricted, but reading with a small lamp is acceptable. If personnel are able to sleep only 2 or less hours one day, then this should be made up by sleeping for more than 5 hours the next day. A key factor in sleep management is to avoid accumulation of daily sleep deficit.

In pre-combat and combat phases of SUSOP, apply the basic rule of sleeping at least 4-5 hours per a 24-hour period. In these phases, it is unrealistic to expect that a single unbroken period of 4-5 hours will be available for sleep. If necessary, sleep can be taken in short periods of 10-30 minutes. This method is, however, less recuperative than long blocks of sleep, so the longest periods feasible should be allotted.

Sleep management is usually not considered necessary for the post-combat phase but plays a significant part in regaining combat effectiveness. This is especially important when another combat phase is expected to follow shortly. The first post-combat sleep period should be allowed to extend either to spontaneous awakening or for 10 hours (whichever comes first). This first recovery sleep should be arranged so that there will be an awake period of 12 hours or longer before the next sleep period. Inadequate sleep management results in delay in adjusting back to a routine work/rest-sleep schedule.

4.1 Recognize Signs of Degradation

See Section 3.0

4.2 Know Tolerance to Sleep Loss

See Section 3.1

4.3 Develop Self-Control to Sleep When You Must

There are many factors in the field which maintain excitement. Sometimes members of the combat unit may not want to sleep so as to not miss exciting events. However, distractions must not cause sleep to be shortened to less than 4 hours per 24-hour period. You must discipline combat unit members to napping. Napping is not a time wasting luxury but is mandatory for maintaining performance in a SUSOP.

4.4 Use Aids to Measure Sleep Loss Effects

Four aids are discussed here, all of which will help a field commander to learn sleep management in a field exercise. These aids are (1) to keep a sleep/activity diary, (2) to examine moods, (3) to do a "Plus 7 Task," and (4) to measure oral temperature.

Sleep/Activity Diary

The best way to manage sleep in the field is to keep a sleep/activity diary. From the pre-deployment phase to the post-deployment phase, record all of the sleep and nap periods of the combat unit members. Include a record of the total hours of sleep accumulated in the SUSOP. Such a diary will assist in assuring that members of the combat unit are sleeping at least 4-5 hours per 24-hour period.

If a diary shows that total hours of sleep (including nap periods) of combat unit members has been less than 4 hours per 24-hour period, the first chance for a long rest period must be used for sleep.

If combat unit members have not slept for 48 or more hours, sleep less than 2 hours should be avoided. This is especially important if this sleep period should fall between 0400-0600, a trough of circadian rhythm. The combined effects of a deeper circadian low (caused by sleep loss) and sleep being too short may cause a long period of sleep inertia.

A sleep/activity diary can be very simple. You can write down the length of time the combat unit members have slept, or to be a bit more complex, write

down the time sleep begins and the time of awakening.

Be sure to indicate in the diary whether or not the combat unit members did moderate or heavy physical work.

Mood Scale

A field commander must watch the moods of members of the combat unit for early warnings of accumulating sleep debt. Since you know these men and women, you will be able to detect mood changes from positive and energetic to negative, jittery and defiant.

However, if you wish to know objectively how rapidly their moods are changing during a SUSOP field exercise, you can use a mood scale. One example is the NHRC Mood Scale. NHRC Mood Scale consists of 19 positive and 10 negative adjectives to describe moods. When they feel alert, they check off positive adjectives to describe their mood. When they are tired, they check off negative adjectives.

Once you become familiar with completing the NHRC Mood Scale, it will take less than a minute to score positive and negative changes in mood. You must administer the NHRC Mood Scale to combat unit members before the beginning of a SUSOP field exercise as well as during it. This enables evaluation of subsequent increased negative and decreased positive moods against the baseline phase.

Plus 7 Task

The effects of inadequate sleep are sometimes masked by extra efforts put forth by men and women in doing their assigned tasks. This is evidence of the professionalism of these men and women. However, this masking of the effects of sleep loss may be misleading. You may believe that sleep loss is not affecting anyone. A short time later, you may suddenly discover the combat unit members are showing serious performance degradation.

Moderate physical work and excitement may also mask performance degradation.

However, during the post-physical work period, combat unit members will show greater deterioration of performance. The combined effects of physical work and sleep loss cause increased fatigue and sleepiness once the physical activation and excitement wear off.

The best way to detect early degradation in mental task performance, despite the effects of extra effort and excitement, is to have combat unit members do an over-learned task of rather boring nature, such as the Plus 7 Task. The Plus 7 Task tests short-term memory which is affected by sleep loss, and it reliably detects mental degradation.

The Plus 7 Task consists of continuous additions. Pick a random starting number between 5 and 9, (for example 9). Add 7 to it and get the sum of 16. Add 7 to the sum to get the new sum of 23. Continue to add 7 to the sum. These additions are all done in the head, remembering the sum and calculating the new sum by adding 7. When combat unit members can continue to do the Plus 7 Task for one minute or longer without long pauses, they do not have severe sleep loss effects. If you wish to test a particular individual, you can ask the individual to speak the sum aloud as it is calculated and note how steady and correct this individual is in adding. You can check the accuracy with a table listing a sequence of the correct sums. However, the most important thing to look for is an ability to do repeated additions without long pauses. A few minutes of the Plus 7 Task, preferably with eyes closed, will reveal any mental degradation due to sleep loss.

Similar to using Mood Scale in sleep logistics, the Plus 7 Task must be administered first on the pre-SUSOP baseline day. Subsequently give it at least once each 24-hour period, preferably several times a day. A substantial decrease in the total number of additions completed as well as increased number of long pauses indicates deterioration.

Check Your Body Temperature

Body temperature shows regular daily fluctuations. It is high in late afternoon and low in early morning hours, ranging from about 97.5° to 98.5° F (oral temperature). This fluctuation of body temperature represents one of many

circadian rhythms which follow approximate 24-hour cycles. Although body temperature does not directly determine how efficient you are in performing a job or how positive you feel, the body temperature trough between 0200-0600 corresponds to a period of relatively low mental performance efficiency. The circadian peak of body temperature is associated with an overall high performance efficiency and a positive mood.

The effects of living under an irregular and/or reduced sleep schedule for a prolonged period of time, as in any SUSOP, are reflected by shifts in the time and degree of the body temperature's circadian low and high. With sleep deprivation, the circadian low temperature may be 96.5 instead of 97.5. When you travel across several time zones, the circadian peaks and troughs of body temperature and other rhythms do not match with the work/rest-sleep cycle of the new time zone. You may be forced to work during the circadian trough of body time when you are inefficient. However, the body will gradually adapt to the work/rest-sleep rhythm of the destination over a few days after arrival. After you have adapted, body temperature will be in synchrony with the local work/rest-sleep time; a circadian high during the local work period and circadian low in the local rest-sleep time period (see Section 3.0, part K).

Measurement of oral temperature can tell you whether your combat unit members' oral temperature readings of the circadian high or low match with a local activity. If the readings do not, your combat unit is experiencing jet-lag. If the circadian low reading of the combat unit members is very low, it indicates sleep loss. Use of a special solid-state temperature measurement device instead of an ordinary glass thermometer will make temperature readings in the field safe and rapid. Do not take cold or hot beverages for five minutes before an oral temperature measurement.

If you observe a low temperature reading, have the affected combat members move around to avoid falling asleep, have others assist them with the job, and/or switch them to a self-paced task.

4.5 Learn the Facts About Sleep

As a field commander and the sleep manager of your combat unit, you need to understand sleep. The following are some basic facts about sleep.

- Resting on a bed is not the same as sleep. During the deployment phase, many soldiers may be resting but not sleeping due to the excitement of the novel experience. You need to make certain that the men and women under your charge are asleep, not merely resting.
- People become sleepy at least twice a day; once in the afternoon and once just before habitual sleep time.
- Sleep cannot be stored in our bodies for emergency use. A sleep of much greater duration than the normal 7-8 hours, taken before deployment, does not store-up excess sleep. Subsequent sleep loss is no better tolerated than after 8 hours of sleep. Although it is important not to start on a SUSOP already sleep-deprived, long sleep will not result in a greater tolerance to sleep loss during a SUSOP.
- To aid uninterrupted sleep, you must insist that everyone empty their bladder before they attempt to sleep. Waking up to urinate interrupts sleep, and getting in and out of bed can disturb others trying to sleep.
- During the daytime or early morning nap, many people experience vivid dreams as they fall asleep, often waking up frightened. To some soldiers, the dreams may have a component of situational anxiety. You should assure members of the combat unit that vivid dreams are quite common in daytime sleep.
- There are several types or stages of sleep: Stage 1, 2, 3, 4 and Rapid Eye Movement (REM). You may have read that one type is more beneficial than another. However, many studies have shown that the total amount of sleep, not the amount in a specific stage, is most important. The body will take care of the type of sleep obtained if there is time for sleep.

SECTION 5 CONCLUSIONS/SUMMARY

The most important steps to be taken in a non-pharmacologic approach in sleep management are the following:

(a) First, and most important, prepare a work/rest-sleep plan to meet sleep need. Sleep need is satisfied only by sleeping.

(b) Second, utilize appropriate self-diagnosis techniques and performance aids to detect and compensate for sleep loss (sleep debt).

A SUSOP causes a varying degree of sleep debt, leading to decreased combat effectiveness and hidden cost in manpower resources. The process of removing sleep debt is quite similar to that for hunger. Hunger is eliminated by eating food. Logistics for food will scientifically work to reduce hunger. Similarly, sleep logistics (management) will work to reduce sleep debt in SUSOP. Sleep management is a collection of guidelines to evaluate and prevent the degrading effects of sleep loss on performance, moods, and willingness to work.

Sleep researches at the Naval Health Research Center and many other research centers have found:

(1) A total sleep duration of 4-5 hours per 24-hour period is the minimum amount required to maintain an acceptable level of performances (but with poor mood, fatigue, lowered motivation, and general malaise).

(2) All sleep stages contribute equally to recovery from sleep loss. That is, one sleep stage is as good as another in removing the undesirable effects of sleep loss.

(3) How quickly one falls asleep, how long one can remain asleep before spontaneous awakening, and how quickly one regains his/her ability to work after awakening from sleep (sleep inertia) are influenced by circadian rhythm.

(4) It is preferable to sleep in one uninterrupted duration of 4-5 hours rather than many short sleep episodes.

Nine major statements are listed to summarize some key facts and recommendations of sleep management:

(1) Degrading effects of sleep loss on performance, moods, and willingness to work are felt most strongly during the daily circadian trough, as defined by body temperature. The circadian trough occurs between 0200 and 0600 of the time zone to which the body is adapted.

(2) There is a significant loss of performance efficiency when a SUSOP demands a longer than 24-hour continuous work episode (CWE). After a CWE of 36-hour duration, target detection is 70% and decoding is 50% of baseline.

(3) Uninteresting and complex tasks are more seriously affected by sleep loss than interesting and/or simple tasks.

(4) Critical but routinized tasks are often skipped because sleep loss reduces overall willingness to respond.

(5) Physical work feels much heavier than it did before sleep loss because of exaggerated perception of physical exertion.

(6) Short-term memory is seriously affected. Poor short-term memory and lapses in attention work against effective communication. Sleep loss causes a listener to forget what was recently said in a conversation. A listener may fill the information gap by inaccurately restructuring the conversation.

(7) The ability to initiate action decreases with increasing sleep debt. This decrease in initiative includes all interactions among team members.

(8) Sleep-deprived individuals tend to overestimate their ability to do tasks. That is, they lose insight as to how well they are performing their assigned tasks.

(9) Sleep loss causes deterioration of personal hygiene, such as keeping the feet clean and dry.

Sleep management suggests some non-pharmacologic measures to avoid the deleterious effects of lack of sleep:

(1) Know the effects of sleep loss.

(2) Get as much sleep as possible before a SUSOP. Although you cannot store sleep, avoid having a sleep debt before the start of a SUSOP.

(3) Try to sleep at least 4-5 hours in a single unbroken period each 24 hours. This amount of sleep will be adequate to keep going indefinitely on a SUSOP.

(4) Use every opportunity to have short sleep. Napping is usually beneficial in maintaining task performances. However, be aware that awakening from naps may be accompanied by a state of confusion and sluggishness due to sleep inertia. Allow enough time to overcome this before getting started.

(5) Use diagnostic aids, such as a sleep/activity diary, examining moods, doing a Plus 7 Task, and taking body temperature measurements to get a realistic idea of the severity of sleep debt.

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20. ABSTRACT (continued)

sustained operations and sleep management, and then explains what kinds of work/rest-sleep and sleep loss problems occur during the pre-deployment, deployment, pre-combat, combat and post-combat phases. Section 3 reviews three ways by which sleep management copes with performance degradation caused by work/rest-sleep and sleep loss problems: identifying the signs of, preventing, and overcoming performance degradation. Section 4 details five psychophysiological techniques by which field commanders manage sleep in field training to assure optimal task performance of men and women under their charge during a future sustained operation. These techniques are: (1) to see if mission requires sleep management, (2) to recognize signs of degradation, (3) to know tolerance to sleep loss, (4) to develop self-control to sleep when they must, and (5) to use aids to measure sleep loss effects. In addition, sleep management requires field commanders to learn more facts about the human need for sleep.

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