Characteristics of the Future Battlefield and Deployment

by Edward D. Martin[1]

ABSTRACT

In an era of unprecedented change, the military planner of today must prepare for contingencies involving operations by forces of a very large size to forces for special operations and operations other than war which may involve just a few soldiers, sailors, or airmen. The entire spectrum of geographic features and weather conditions must be accounted for in the plan. The typical linear battlefield will be replaced by a combat situation with a 360-degree threat, the potential for new high tech weapons, the use of chemicals and biologicals, and the use of non-traditional forces and terrorism.

With the gradual urbanization of the world's population, future battles will inevitably be fought within city limits geometrically compounding the planner's problem and the force commander's options. In addition to the threat from the opposing force, the field commander will face structural damage, local industrial hazards, and loss of mobility and degradation of communication links.

Combined, the future battle field and force deployment scenarios will, in spite of extensive training, provide for extremely high levels of stress. The threats from emerging bacteria and viruses, chemical weapons and industrial compounds and the urban battlefield will additionally inhibit and stress combat forces. Changes in force structure, national demographics, and the greater reliance on women in combat roles, will require minimal changes in force protection.

Natural or weaponized disease, non-battle injury, to include industrial hazard exposure, and stress will continue as the major threat to deployed forces in the future. Military and industrial intelligence of contested areas, modern equipment and extensive training, pre and post deployment health studies will provide the most successful means of force protection.

INTRODUCTION

The purpose of this paper is to briefly discuss the probable characteristics of future battlefields and deployment. In an era of unprecedented change in global economics and politics, military doctrine, and

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the rapid deployment of new and different technologies for use by combat forces and their support personnel, one could easily assume there would be great change in the nature of threats to combat forces when deployed. However, in spite of changes to military roles, missions, and technical capabilities, there will be more threats to deployed forces that will be the same as those threats experienced in the past.

TYPES OF WARFARE

Military planners will be required to continue to plan for the entire spectrum of warfare from two simultaneous major theater wars (MTWs) to the insertion and extraction of a very small tactical unit assigned to do a specific task in support of our National Command Authority. The former is possibly the easiest situation, in general terms, in which to protect deploying forces, due to the extensive planning and substantial deployment of assets involved.

In addition to the objectives and goals of each deployment, there will be specific risks to the deployed forces depending upon the geography and environment of the area in which the deployment is to be accomplished and the relative hostility and capability of the opposite force. Numerous contingency plans exist to cover operating in the varied environmental conditions experienced in most of the world's political hot spots and areas of potential conflict. These environmental conditions include arctic conditions, oppressive desert heat, flatlands and rolling hills, impassable mountain terrain, arid and dusty landscapes, and tropical rain forest and jungles. Due to the varied environmental and climatic conditions, a wide spectrum of military capabilities will be required, ranging from a large standing and well-trained force to special operations units trained to handle terrorist units. Whether any of the current plans will continue to be valid or even useful in 10 to 15 years is certainly debatable. What can be said for sure for the foreseeable future is that contingency planning will require constant updating in response to political, environmental, technical, and fiscal considerations. In general terms, the following will be the most likely major considerations:

A. Weaponry for U.S. Forces will become more accurate, mobile and lethal through the use of technology. The use of these weapons will require very specific and intensive technical and operational training and will require U.S. Force commanders to rely on seamless interoperability of multidisciplinary and multiservice forces.

B. Whenever possible, and particularly in an MTW, the deployment or insertion of ground forces into hostile areas will be preceded by an air campaign. The air campaign composed of United States and Allied Air and Naval Forces will initiate hostilities with appropriate standoff weaponry such as air and sea launched cruise missiles. If and when air superiority or air supremacy are established, and at the appropriate time in the battle plan, there will be maximum use of stealth and conventional aircraft for precision bombing of specific targets. Fighter aircraft and those carrying anti-radiation missiles like the HARM missile used in today's scenarios will provide cover for these attacks, followed by aerial and satellite reconnaissance to assess bomb damage. The risks for environmental contamination and disease for these airmen, seamen, and their support personnel will be, with very few exceptions, precisely the same as those found when flying from their normal garrisons. In fact, it is likely that many of the initial missions will be flown from the continental United States or from air bases that are frequently used by U.S. or Allied Air Forces. In most cases, existing and standard environmental health programs, in compliance with military, U.S. Occupational Safety and Health Administration (OSHA), and U.S. Environmental Protection Agency (EPA) standards, coupled with contingency training and command discipline, should provide the airman and sailor with the necessary environmental or disease protection.

One major exception to the rule would be the risk to the airman if his plane is damaged or shot down and he is forced to eject or land at an alternate field.

A successful air campaign will, by definition, result in the destruction in some or all of the enemy's

- command, control, and communications capabilities;
- industrial base for the production of weapons, power, fuels, and war-fighting materials; and
- infrastructure for the production of power, distribution of water, handling of waste material, and transportation capabilities such as roads, bridges, railheads, and docks.

This will not only put the enemy at risk for industrial hazards, but will also put any future occupying force on the ground at that same risk.

C. In most scenarios, however, ground forces will still be required to occupy specific territories at some time in the deployment. To fully utilize the mobility and technical advantage of weaponry, forces will be deployed in smaller functional units with highly reliable and secure communications and positioning equipment. Although there will be some individual battles directly facing an enemy in a linear fashion, the overall battlefield, or theater of operations, is likely not to be present in a linear fashion. Deployed forces, as such, must be aware of their location relative to friend and foe and must be prepared to move and fight in any direction.

D. Although it is unlikely, due to fiscal constraints, that large forces will be issued highly technical individual equipment by the year 2010, there will be some units issued the equipment available in today's development laboratories because of their special missions or their likelihood to be the first deployed in a variety of scenarios. In the Army's Land Warrior Program, for example, the individual soldier will be provided with lightweight protective material and a myriad of highly sophisticated equipment for physiological sensing, threat presentation, weapons control, and communications. Although each individual piece of equipment will be as light as possible, the amount of equipment that the individual might be required to carry, in addition to his or her weapon, is likely to increase. The resulting weight will require superb physical conditioning to prevent the most common musculoskeletal injuries and strains.

Additionally, through the use of this improved and new personal equipment, the individual soldier will be presented with data akin to that of an air traffic controller at O'Hare International Airport and will be required to assimilate and react to that data. The soldier will also be required to have the situational awareness to protect the lives of unknown airline passengers or airline flight paths, as well as their own lives, the lives of other members of their unit, and their mission objectives. New types of intensive individual training in simulators and in field combat conditions will therefore be an absolute necessity prior to the deployment of forces with this type of equipment, not only for technical purposes, but to minimize the possible stresses inherent in data overload.

E. The nonlinear battlefield, for a variety of sound and proven military reasons, will force commanders into ordering a greater dispersion of forces rather than concentrating their available forces near a specific point for the purposes of supply or support, including medical care. Additionally, again for a variety of reasons, some of which will be political and economic, the use of overwhelming force against an enemy in a linear fashion will often be replaced by the use of expeditionary forces tailored to the specific needs of the force commander and his tactical and strategic objectives. These forces will generally be smaller and more specialized than forces used in the overwhelming-force scenario and might well be less resilient relative to support forces, lines of supply, battlefield reserves, and medical units. In a 360-degree battlefield, a commander might not be able or willing to concentrate forces at a single point of attack. He might use the dispersion of his forces as a means to get greater utilization of

modern weaponry and to disallow the enemy a simple targeting solution. This fact alone will be a source of increased anxiety for the individual soldier. Also, while in the dispersed location, data will be presented to the individual relative to his position on the battlefield, the positions of other elements of the friendly forces, the enemy's location and weapon array, and his order of battle. Because of the constant chatter or rapidly changing data presentations on communications links and his or her reliance on buddy care for injury rather than on an immediately available medical unit, the individual might experience further anxiety, a sense of isolation, and information overload degrading his ability to process the information presented to him.

F. For centuries, military planners have been careful not to bring the battle into the confines of cities when other means of movement, occupation of the area, or defeats of the enemy are possible. History is replete with great campaigns that ended with laying siege to or isolating the enemy's capital or major cities. Although most of these actions brought the final destruction of the enemy's force or government, some did not (Stalingrad). All did have in common great destruction, considerable causalities, and much loss of life. Today 50% of the world's population lives in urban areas. Demographers predict that by the year 2020 about 70% of the world's population will live in cities and at least 70% of these cities will be located within 300 miles of the world's coastlines. Thus, it is highly likely that specific operational capabilities and operations in urban areas will unfortunately be a requirement of ground forces. The U.S. Marine Corps has already begun specific training for that eventuality.

There are many good reasons as to why a military planner would wish to avoid fighting in a city, not the least of which is that urban warfare quickly equalizes the relative abilities of a small defending force opposing a large attacking force. This assumes, of course, that the attacking force does not wish to completely destroy the city with an air campaign or artillery. The ability for the defending force to use the cover of a city for sniper fire and similar operations can quickly demoralize an attacking force. Normal field operations for the attacking force, such as the use of rapid tactical mobility, the use of armored vehicles, logistic resupply, messing, and medical care, are restricted, whereas the defending force is presented with excellent fields of fire. A few of the obstacles, all of which can be experienced in exposures in buildings, streets, and alleyways, include structural damage, falling debris, building fires, the resulting smoke and poor visibility, booby traps, mines, use of nonlethal incapacitants, and civilian refugees. Such conditions will certainly limit the attacking force's progress and might be the cause of considerable injury and stress. Most important, with the attacking force highly dependent upon immediate and effective communications links and technologies, the city, in the best of circumstances, will degrade those communications links and, in some cases, make them ineffective and unusable. Tall structures, although providing the defending force with tactical advantage, will severely hamper locating the enemy force, limit the routes of attack for the occupying force, and severely restrict the location and evacuation of injured and wounded for both combatants. One can imagine trying to find a casualty in a modern tall building and, if found, carrying that casualty down 30 or 40 flights of stairs on a standard litter, all the time under the threat of constant attack from a hidden enemy. In addition to the difficulty of vertical evacuation down from a skyscraper, the tactical evacuation will encounter difficulty in moving over rubble-strewn streets using current vehicular technology.

Because none of these facts will be lost on the individual soldier, once again he or she will have the sense of isolation and separation from his or her combat unit in spite of specific training for this type of warfare. The city will present the attacking force with the additional potential for disease and industrial contamination from the destruction of the city's infrastructure. Fortunately, however, large urban areas more likely have been mapped in detail and surveyed for industrial production, and that information will have been provided to the attacking commander at some point prior to the attack.

OPERATIONS OTHER THAN WAR

It has become increasingly obvious from recent history that U.S. forces will continue to be deployed and used for operations other than war (OOTW), such as peacekeeping, natural disaster recovery, and other humanitarian support. In these roles, very small, and often very technical or specific capabilities, such as medical or engineering units, will be deployed with varying degrees of logistic support and will most likely represent the major role of U.S. forces in the foreseeable future. The lack of major logistic support for this type of deployment might result in the use of local resources for food, water, and supplies. Because of the unpredictability of such deployments relative to their timing and location, OOTW might also represent the most dangerous scenario for deployed forces relative to disease, non-battle-injury, environmental hazards, and even hostile action. Forces might be required to face situations ranging from very hostile and lethal nonuniformed guerrilla forces to exposure to unusual diseases, and often will face massive natural destruction and environmental conditions that will task their ability to perform the mission. Because this type of deployment is "on call" and will most likely be to areas not usually considered likely future deployment areas, there might be little time for commanders to obtain accurate intelligence on disease prevalence and the industrial base or to evaluate the host nation's infrastructure, such as water supplies, sanitation, and insect control. These deployments might well be to parts of the world considered "third world" and to areas of the globe where the emergence of new strains of bacteria or viruses is common. As such, it is imperative that global medical and industrial intelligence continue to be collected and shared by agencies such as the Central Intelligence Agency, the Defense Intelligence Agency, the World Health Organization, and the Centers for Disease Control and Prevention (CDC). These collections must be categorized, analyzed, and packaged for use by deploying force commanders and their medical personnel by the Armed Forces Medical Intelligence Center (AFMIC).

NON-TRADITIONAL WEAPONS

Although research on technologies such as lasers, microwaves, sonics, and microbiological and gene therapies (e.g., the development and use of antisense oligonucleotides) is generally intended to improve the human condition, it can be used to do just the opposite. In general, however, these are not the types of technologies that can be exploited in other than sophisticated laboratories. Additionally, the exploitation of these technologies requires resources, such as special equipment or unusually high amounts of electrical power, all of which will assist intelligence agencies in their discovery and identification. This is not to say that with determination and unlimited fiscal resources countries or political groups could not purchase one or all of these technologies in some type of operative or usable form. That said, the transfer of these advanced technologies into weapons to be used against a large deploying force, other than as a single-use terrorist weapon, will require an industrial base and infrastructure that today is limited to just a handful of potential enemies.

Although U.S. forces, by policy, will not bring nontraditional weapons to the battlefield, the use of nuclear weapons and chemical and biological agents, delivered as weapons or by acts of individual guerrilla or terrorist elements, cannot be ruled out. With the exception of nuclear weapons, the production of this type of threat is not limited to countries or organizations with extremely sophisticated technologies or infrastructures; their delivery to an area as a combat or terrorist weapon depends only upon the determination and will of the offending organization. U.S. forces have been trained to operate in the nuclear, chemical, and biological environment, but they can handle the situation best when the chemical or biological agent has been identified and its source is known. Operating

continually in chemical-biological protective gear, even with fielded and forthcoming improvements, moderately to severely degrades the effectiveness of the deploying force, and this will be especially true in the urban or climatically severe environment. Today, the rapid identification of the presence of an agent of a biological or chemical nature, from a weapon or an industrial source, or in a field of combat, a city, or a specific building, is, at best, modestly successful. To prevent deploying forces in the future from the requirement for passive protection, continued commitment and emphasis on research on detection systems is an absolute requirement to provide that type of information immediately to the force commander.

For the foreseeable future, U.S. forces and their allies will continue to use obscurants to hide tactical movements, smoke to signal locations of friendly forces, and chemicals for pest control and sanitation. All of these, when properly applied, should not pose a major immediate health threat to ground forces, but will inhibit visibility, cause minor eye or respiratory irritation, and might cause long-term effects yet unknown.

Although appalling to most of the world's cultures, the use of nuclear devices as a tactical or political weapon is still possible and, in the view of some planners, even likely. The outcome of the use of this type of weapon is well known and, depending upon the location and timing of the detonation, might well cause massive casualties that would instantly overwhelm existing medical services and be an extremely effective psychological weapon for the remaining fighting or recovery force. Additionally, there will be a political response of some type, either in the United States or the United Nations, that could result in the additional use of nuclear weapons and additional support to deployed forces.

Although the debate continues as to the long-term effects of the military vaccination program in the face of an increasing number of potential new agents, there is little doubt that future deployed U.S. forces will be vaccinated against biological agents known to be endemic to the area of deployment. Vaccination would also be used against those agents known to be available for use as weapons if and when that threat is identified and a safe vaccine exists. However, vaccinating troops against all known and emerging types of biological and viral threats will be practically impossible. Therefore, data, particularly on emerging disease agents, obtained from various intelligence sources and compiled by AFMIC and CDC, must therefore be immediately shared with industry and the academic community to provide for the basic research necessary in epidemiology, vaccine development, and treatment options. Because OOTW are "on call," starting the process of study when the deployment is eminent will be of little value.

Forces deployed and prepared to fight in high-threat chemical environments will require accurate and reliable intelligence of opposing forces and their ability and willingness to use chemicals as a battlefield weapon. Additionally, an in-depth knowledge of the industrial base of the areas to which U.S. forces will be deployed will be an absolute requirement prior to deployment for protection against inadvertent chemical exposure at toxic or subtoxic levels. This will be particularly true for forces deployed in OOTW and for forces required for operating in the urban environment. Force commanders must have the information necessary to select and destroy targets of military importance without putting their own forces at risk for chemical or industrial contamination and, if the risk is unavoidable, to prospectively protect their forces during and after the attack.

PHYSICAL EFFECTS

The physical conditioning of U.S. forces prior to deployment has generally never been better. Active-duty forces are maintained in excellent physical and dental health and this state will be absolutely required, as previously mentioned, as new technologies are brought to the battlespace. The trend

in downsizing the standing forces and relying more on National Guard and Reserve Forces will require continuing emphasis on the physical and dental health of those forces that the Department of Defense (DOD) is addressing. An increasing proportion of deployments now include coalition forces, which require a great deal of medical and support capability from U.S. forces and in which the composition and capabilities of those forces is quite heterogeneous and often different from U.S. forces. Increasing use and dependence upon DOD contractor personnel will require an assessment of the characteristics of these additional personnel deployed, such as age, health status, fitness, past medical treatment and records, training proficiency, and possible stress level associated with separation.

The disease non-battle-injury rate (DNBI) in the Desert Shield and Desert Storm operations was the lowest recorded in history and continued a trend for U.S. forces in major deployments. However, there were major special circumstances (no alcohol use and extremely limited contact with the local population) associated with that deployment, and thus the low DNBI rate is unlikely to be repeated in future deployments. An excellent and extensive report of this experience appears in the Institute of Medicine (IOM 1996) publication on the *Health Consequences of Service in the Persian Gulf War.*

In yet-to-be-published data on the Bosnia-Herzegovina deployment, where surveys and data were collected on 10,000 deployed troops and some 170,000 environmental samples were taken, a low 8.1 medical encounters per 100 soldiers per week was reported. The most frequently cited causes for visits to medical facilities paralleled the Desert Storm experience in spite of considerably different geographical and climatic conditions: injuries and orthopedic conditions (27%), respiratory disease (26%), miscellaneous "other" medical conditions (13%), dermatological disorders (12%), and dental disease (10%). Interestingly, perhaps because of controlled food and water supplies, the incidence of gastrointestinal disease was lower than that found in Desert Storm (2%). With the added emphasis on physical conditioning and the use of mechanized equipment and improved repair procedures, routine industrial injuries continued their downward trend, with sports injuries providing the largest portion of musculoskeletal injury (21.0%). Battle injuries in the future, as in the past, will be directly related to the intensity of the conflict, the geography of the site of deployment, and the capability and size of the opposing force.

In Bosnia-Herzegovina, there were very serious concerns about the environmental hazards for our forward-deployed troops. At this time, more is known about Bosnia-Herzegovina, from a toxicological or an environmental health point of view, than is known about most U.S. military bases. Environmental health specialists, based at a forward-deployed laboratory that was almost as sophisticated as most laboratories in the United States collected over 170,000 specimens of air, water, and soil. A very sophisticated clinical laboratory was also forward-deployed. Enormous apprehension about the environment and very substantial efforts by the command structure to protect U.S. personnel from environmental and other hazards resulted in the net effect of a DNBI rate in Bosnia significantly below that for U.S. garrison troops stationed in the United States.

This level of very considerable attention and effort requires an enormous effort on the part of the command structure and the line commanders, not the medical staff, to maintain the level of awareness and sensitivity. If you had 20 to 30 such deployments under way across the world, it would become very difficult.

PSYCHOLOGICAL EFFECTS

Modern telecommunications technologies have added a new element to the deployed experience, at least at fixed positions and on ships, with the availability of instant access to the news of the day in living color from sources such as CNN. Additionally, readily available telephone service and video teleconferencing with loved ones keeps the deployed force bonded to the home environment. Although

on the surface these technologies are advantageous to troop morale and well being, they can also have the opposite effect and be an additional source of anxiety and depression. Access to these telecommunications technologies will certainly be easier and more common in future deployments.

In general, U.S. forces are psychologically prepared to deploy and fight. They are further prepared by knowing the objective of the deployment and the estimated length of the engagement. Troops react differently, however, when the goals and objectives of the deployment change, they do not engage the enemy upon arrival in the deployed area, and they have an open-ended or changing term of deployment. This was observed in Desert Shield where boredom and separation from family took its toll on morale and the combat edge of the deployed forces during the last few months of Desert Shield.

Smaller dispersed units, increased utilization of technology, information overload, and less reliance on massed forces will all change the psychological environment and stress the psychological state of the deployed force in spite of intense prior operational training. Urban combat, terrorism, sniper activity, 360-degree threats, industrial pollution, and the handling of civilian (noncombatant) populations will further stress the ground force. The perceived and actual limits of medical support and reliance on one's self and buddy care will tend to increase combat stress. As such, in the immediate future there will be unprecedented psychological and physical stresses on deployed troops, particularly in units deployed in OOTW, that might have significant short- and long-term effects on deployed forces. A predeployment study of the Bosnia-Herzegovina activities identified individuals in the survey who had psychological conditions, which prevented their deployment. This in-depth, predeployment psychological screening, initiated for the Bosnia-Herzegovina deployment, will be an important and effective tool in the prevention of long-term psychological diseases.

LONG-TERM AND REPRODUCTIVE EFFECTS

All wars and engagements have resulted in long-term physical and psychological health effects. The most recent major deployment, the Desert Shield and Desert Storm operations, was no exception with reports of unusual and unexplained illnesses documented in the IOM (1996) report. Reproductive difficulties following deployments, however, have had little emphasis until recently when the press reported on numerous problems with birth defects and miscarriages in couples in which one of the pair served in the desert operations. Although these claims were later proven to be within expected limits for the population at risk and, thus, not related to the deployment as such, a lack of baseline data in the deployed forces, and the general population for that matter, makes the conclusion somewhat less than completely satisfactory.

The same is true for studies of unexplained physical and psychiatric illness. What has not been documented, until recently, is the mental and physical health of the deployed force prior to deployment. DOD has aggressively initiated programs to correct this deficiency, not only as a basis for further study, but to have the data to use as a baseline for follow-on care and compensation when necessary. Specifically and significantly missing in the predeployment survey required in the December 4, 1998, Joint Chiefs of Staff *Memorandum on Deployment Health Surveillance and Readiness*, however, are any questions relative to the reproductive history of the deploying member or his or her spouse. To be of any value in post-deployment studies to identify injury or degree of compensation for injury, these questions must be asked in great depth and the data preserved to protect privacy. In a predeployment survey of the type required, the military procedure of only having the deploying member fill out a form will not be satisfactory.

Overseas Clearance Forms, used for years in the military system, have been notorious for their inaccuracy and lack of data. Depending upon the individual's motivation for the assignment, the forms

were filled out to provide the best situation for the individual's deployment agenda. (Even the term "normal" was not well defined. An example is an individual who arrives overseas with a Down's Syndrome child and asks for special schooling and medical care. When reviewing the Overseas Clearance Form, the health of the child was checked as normal—normal in the view of the deploying member for a child with Down's Syndrome.) Therefore, every deploying member should have to have an in-depth interview with a skilled health professional to get reliable reproductive history for a baseline. Only then can comparative pre- and post-deployment studies be of any value. However, until further data prove otherwise, there is no indication that the risks for reproductive health in future deployments will be any greater than those found today.

Post-deployment health studies for forces known to be at risk from a known specific agent, such as that of the Ranch Hand group that studied the effect of dioxin and related compounds on troops in Vietnam, will continue to be utilized in specialized and routinely deployed forces.

CHARACTER OF DEPLOYED FORCES

Although the current armed forces do not represent the ethnic, racial, and gender mix of the general population (approximately 32% minorities and 14% women), a condition exacerbated by the end of the military draft and the institution of the all-volunteer force, it is debatable whether there will be much movement to bring forces closer to the racial and ethnic mix of the nation in future deployments. Major players in this situation will be the nation's economy and employment opportunities as well as the associated training and educational benefits resulting from military service. The recently announced considerations by Congress to markedly improve veterans' benefits, including a college education and stipend after 4 years of service, will play an important role in the mix of future deployed forces.

There is general agreement on one trend. As the relative supply of young men decreases in society, women will increasingly be brought in to the battlespace and play increasingly more important roles in combat and OOTW. With the exception of additional supply requirements for female deployed forces (birth control, female specific medications, and feminine hygiene supplies) and their different reactions to deployment stresses, women have proven that they are effective personnel and easily integrated into a well-commanded unit. The use of women in deployed forces will, nonetheless, continue to require major special considerations in future operations relative to their unique health risks, not the least of which is the potential for, or actual, pregnancy. Again the predeployment health assessment must play a significant role. Women in deployed forces must have easy access to the supplies mentioned above, as well as the means by which to detect pregnancy while deployed. Depending upon the type of deployment, its location, and the potential for operations in hazardous chemical or industrial environments, policies for the evacuation or movement of pregnant personnel out of the risk area must be developed, clearly enunciated, and strictly enforced.

CONCLUSIONS

The future battlespace will most likely be characterized by considerable structural and industrial damage, force dispersion, smaller tailored force structures, new personal equipment, data links to the individual soldier, an urban environment, a 360-degree threat, and a nontraditional enemy force structure. Nontraditional weapons, particularly chemical and biological agents, and weapons developed from future technological advances are likely, and the location of the deployment will not have been planned for in any detail. In spite of rapid and significant changes in technology, equipment, operational tempo, operations, and force size, disease non-battle injury and psychological stresses will remain as the

most important threats to future deployed forces in all scenarios. The long-term effects of: toxic and subtoxic levels of chemicals; unknown or evolving bacteria and viruses; the potential for misuse of evolving biologicals and therapies; new weapon technologies; training symposia and techniques; and, the psychological effects of stresses in the deployment and in combat will need continued emphasis and research to provide for prophylaxis prior to deployment, study following the deployment, and treatment, when needed, upon return to garrison or civilian employment. It will be only through this type of research that deployed forces might be protected from all the potential dangers of the future battlespace.

REFERENCES

IOM (Institute of Medicine). 1996. Health Consequences of Service During the Persian Gulf War: Recommendations for Research and Information Systems. Washington, DC: National Academy Press.

JSC (Joint Chiefs of Staff). 1998. Deployment Health Surveillance and Readiness. MCM-251-98. Office of the Chairman, Washington, D.C. (Dec. 4).

ADDITIONAL REFERENCES (NOT CITED)

Antisense 98. 1998. Work in progress. Nature Biotechnology. 16:1319-1321.

Beiting, J. 1993. Defending against an unseen enemy. Mil. Med. Technol. 3:8-11.

Binder, S., and A. Levitt. 1998. Preventing Emerging Infectious Diseases: Strategy for the 21st Century. Report prepared for the Centers for Disease Control and Prevention.

Blanck, R.R., and W.H. Bell. 1991. Special reports: Medical aspects of the Persian Gulf War. N. Engl. J. Med. 324:857-859.

Broad, W.J., and J. Miller. 1998. The threat of germ weapons is rising. Fear, too. The New York Times. (Dec. 27).

Centobene, S. 1998. The future is now. Airman. (Dec.)

Chrousos, G. 1992. The concepts of stress and stress system disorders: Overview of physical and behavioral homeostasis. JAMA. 267:1244-1252.

Cigrang, J., E. Carbone, S. Todd, and E. Fiedler. 1998. Mental health attrition from air force basic military training. Mil. Med. 163:834-838.

Clauw D.J., and G.P. Chrousos. 1997. Chronic pain and fatigue syndromes: Overlapping clinical and neuroendocrine features and potential pathogenic mechanisms. Neuroimmunododulation. 4:143-153.

Correll, J. 1999. On course for global engagement. Airforce Magazine. 82:22-33.

Cowan, D.N., R.F. DeFraites, G.C. Gray, M.B. Goldenbaum, and S.M. Wishik. 1997. The risk of birth defects among children of Persian Gulf War veterans. N. Engl. J. Med. 336:1650-1656.

Directorate of Office of the Special Assistant for Gulf War Illnesses. 1998. Depleted Uranium in the Gulf. Draft. Investigation and analysis. Directorate of the Office of the Special Assistant for Gulf War Illnesses.

Dohrenwend, B. 1997. A psychological perspective on the past and future of psychiatric epidemiology. Am. J. Epidemiol. 147:222-231.

Dohrenwend, B. 1983. Psychological implication of nuclear accidents: the case of Three Mile Island. Bull. N. Y. Acad. Med. 59(10):1060-1076.

Ember, L. 1998. Surviving stress. C&EN. (May 25):12-24.

Engle, C, M. Roy, D. Kayanan, et al. 1998. Multidisciplinary treatment of persistent symptoms after Gulf War service. Mil. Med. 163:202-208.

EPA (Environmental Protection Agency). 1992. Guidelines for Exposure Assessment. (Feb. 7).

Fortune. 1998. Wired Warrior. 21:184-185.

Garland, F.C., C.D. Garland, and E.D. Gorham. 1998. The Association of Unplanned Pregnancy, Marital Status and Age with Adverse Reproductive Outcomes and Elective Abortions in U.S. Navy Women. NHRC Publication 98-7.

Headquarters United States Air Force. 1999. Global Engagement: A Vision for the 2st Century Air Force. Online. Available: http://www.xp.hq.af.mil/xpx/21/nuvis.htm.

Hobfoll, S.E., C.D. Spielberger, S. Breznitz, C. Figley, S. Folkman, B. Lepper-Green, D. Meichenbaum, N.A. Milgram, I. Sandler, I. Sarason, et al. 1991. War-Related Stress. Addressing the stress of war and other traumatic events. Am. Psychol. 46(8):848-855.

Hyams, K., S. Wignall, and R. Roswell. 1996. War syndromes and their evaluation: from the U.S. Civil War to the Persian Gulf War. Ann. Int. Med. 125:398-405.

Hybridon, Inc. 1999. What Is Antisense? Online. Available: http://hybridon.com/graphic_version/antisense/antisense.html.

IOM (Institute of Medicine). 1996. Interactions of Drugs, Biologics and Chemicals in U.S. Military Forces. Washington, DC: National Academy Press.

IOM (Institute of Medicine). 1999. Chemical and Biological Terrorism: Research and Development to Improve Civilian Medical Response. Washington, DC: National Academy Press.

Joseph, S. 1995. DOD News Briefing. (Aug. 1).

Knoke, J.D., G.C. Gray, and F.C. Garland. 1997. Lack of Association of Testicular Cancer With Persian Gulf War Service. NHRC Publication 97-7.

Lombardi, W., and S. Wilson. 1999. Wellness intervention with pregnant soldiers. Mil. Med. 164:22-29.

Marlowe, D., K. Wright and R. Gifford. 1991. Key Desirable Leader Actions and Behaviors in Final Preparation of Small Units and Small Groups for Combat. Report prepared for Chief of Staff of the Army and Vice Chief of Staff of the Army. (Jan.14).

Marlowe, D., K. Wright, and R. Gifford. 1991. Some Considerations On the Human Issues in Troop Return after Operation Desert Storm. Report prepared for: Chief of Staff of the Army and Vice Chief of Staff of the Army. (Feb. 8).

Martin, S., J. Gambel, J. Jackson, et al. 1998. Leishmaniasis in the United States Military. Mil. Med. 163:801-807.

McEwen, B. 1998. Protective and damaging effects of stress mediators. N. Engl. J. Med. 338:171-179.

McKee, K., M. Kortepeter, and S. Ljaamo. 1999. Disease and Non-Disease Battle Injury Among United States Soldiers Deployed in Bosnia-Herzegovina During 1997: Summary Primary Care Statistics for Operation Joint Guard.

Nelson, D. 1999. Core competencies. Airman. XLIII:2-56.

Nice, D.S., R.L. Calderson, and S.M. Hilton. 1997. Reproductive Outcome in the U.S. Navy: Experience of 33,130 Hospitalized Pregnancies During 1982-1992. NHRC Pub. 97-16.

Parker, J. 1998. Maximizing Human Performance in the Military Environment. 2nd SAF Military Medicine Conference.

Pincus, S. 1998. Operational stress control in the former Yugoslavia: A joint endeavor. Mil. Med. 163:358-362.

Sternberg, E. 1997. Neural-immune interactions in health and disease. J. Clin. Invest. 100(11):2641-2647.

Stretch, R.H., and K.H. Knudson. 1998. Psychological health and trauma in male and female soldiers. Mil. Med. 163:363-367.

The Associated Press. 1999. Study Confirms Gulf Illness Claims. (Jan. 15).

Stuempfle, A.K., S.J. Howells, and C.A. Boulet. 1996. Final Report of International Task Force 25 Hazard From Industrial Chemicals.

USACHPPM (U.S.Army Center for Health Promotion and Preventive Medicine). 1999. The Medical NBC Battlebook. Department of Defense. Online. Available: http://chppm-www.argea.army.mil

USACHPPM (U.S.Army Center for Health Promotion and Preventive Medicine). 1999. Short-Term Chemical Exposure Guidelines for Deployed Military Personnel. TG230A. Draft. Aberdeen Proving Ground, Edgewood, MD. (March).

U.S. Army. 1998. Risk Management. Field Manual No. 100-14. Department of the Army, Washington, D.C. (April 23).

U.S. Medicine. 1991. U.S. Medicine in Gulf War. 27:1-113.

U.S. Navy. 1998 Department of the Navy Posture Statement.

Verton, D. 1998. Marines take it to town. Federal Computer Week 7:18.

Wolfe, J., S. Proctor, J. Davis, et.al. 1998. Health symptoms reported by Persian Gulf War veterans two years after return. Am. J. Ind. Med. 33:104-113.