# 2

# The Strategy

The four reports completed from the work of the first 2 years of this study (IOM, 1999; NRC 2000a,c,d) provide detailed discussions and recommendations about areas in which actions are needed to protect the health of deployed forces. The Committee on Strategies to Protect the Health of Deployed U.S. Forces has been informed by those reports and endorses the recommendations within them. In the present report the committee describes six major strategies that address areas identified from the earlier reports that demand further emphasis and require greater effort by the U.S. Department of Defense (DoD). The committee selected these strategies on the basis of the contents of the four reports, briefings by the principal investigators of those reports, and input from members of the military and other experts in response to the four reports.

- Strategy 1. Use a systematic process to prospectively evaluate non-battle-related risks associated with the activities and settings of deployments.
- Strategy 2. Collect and manage environmental data and personnel location, biological samples, and activity data to facilitate analysis of deployment exposures and to support clinical care and public health activities.
- Strategy 3. Develop the risk assessment, risk management, and risk communication skills of military leaders at all levels.
- Strategy 4. Accelerate implementation of a health surveillance system that spans the service life cycle and that continues after separation from service.
- Strategy 5. Implement strategies to address medically unexplained symptoms in populations that have deployed.

- Strategy 6. Implement a joint computerized patient record and other automated record keeping that meets the information needs of those involved with individual care and military public health.

In the report that follows, the committee outlines recommendations relating to each of these important strategies.

## STRATEGY 1

*Use a systematic process to prospectively evaluate non-battle-related risks associated with the activities and settings of deployments.*[1]

Managing risk is a complex task that requires a strong partnership between the parties involved. Health risk assessment is a tool that can aid decision making and strengthen the military enterprise[2]. The process of risk evaluation performs optimally when it provides a comprehensive profile of the primary agents and activities that may affect the health of deployed troops, promotes reasoned choices by commanders and military planners, and is responsive to the legitimate questions of service members and their families. DoD and the military services have made progress in the programs and processes that they use to assess deployment-related health risks to service members. However, significant work is needed for better integration of the information gathered and for more effective conveyance of that information to decision makers. Particular challenges exist in assessing and integrating the risks from environmental chemicals, chemical and biological warfare agents, and the array of disease and non-battle injury risks to deployed forces. In this section, the committee describes additional initiatives required from DoD to assess deployment-related health risks and provide integrated information about these risks to commanders and medical personnel.

A systematic process is needed for evaluation of deployment-related health risks. This process should take into account not only potentially hazardous agents but also the likely steps and actions within a deployment that could expose service members to health risks. The methods could be similar to those used in pollution prevention efforts in both civilian and military settings, which involve review of the life cycle of hypothetical deployments to consider the ac-

[1]In the first 2 years of the National Research Council-Institute of Medicine Strategies to Protect the Health of Deployed U.S. Forces project, Lorenz Rhomberg carried out a study charged with developing an analytical framework for assessing the risks to the health of deployed forces, particularly from disease and non-battle-related injuries or from chemical or biological warfare agents. The National Research Council report *Strategies to Protect the Health of Deployed U.S. Forces: Analytical Framework for Assessing Risks* (NRC, 2000a,b) describes the framework and is the starting point for this section. The executive summary of that report is found in Appendix B.

[2]Health risk assessment includes consideration of both health endpoints and exposure assessment.

tivities that occur, the exposures entailed, the materials consumed, the wastes produced, and the accidents and failures that might occur. The reviews would take into account the range of different missions and settings to which service members may be deployed. Although the committee understands that implementation of the full range of prevention measures or controls may not be possible in settings with high levels of combat-related risks to life and limb, a thorough inventory of possible risks that might be encountered in the course of deployment activities can help in planning and prioritization. The practice of reviewing activities in their entirety and likely settings should prompt consideration of what might be hazardous and what further investigation is needed to understand their safety and risks. Information on all non-battle-related risks should be provided to commanders in an integrated form so that they are readily considered together in the context of all risks to service members.

Part of the challenge for the integrated analysis of deployment activities needed is the fragmentation of health and safety expertise found in both civilian and military settings. Different organizations and groups of people within them are responsible for assessing the risks from infectious diseases, industrial chemicals, equipment, and the array of battle injury threats, including chemical and biological warfare agents. Yet, any given activity within a deployment could contain risks from bullets, climate, chemicals, noise, lasers, infectious diseases, psychological stress, and so forth, in many possible combinations. A systematic evaluation of deployment activities to identify deployment hazards will therefore require overcoming institutional barriers to provide interdisciplinary consideration of these hazards**. As deployment circumstances become increasingly varied**, **the multidisciplinary perspective is even more essential for accurate assessment of the different elements of risk that may arise.**

When deployments are considered in their entirety, assessing risks from combinations of agents and activities poses an additional challenge. Different exposures can interact additively, synergistically, or antagonistically, raising many questions about potential health risks. Unfortunately, little guidance is available in the civilian sector on how to assess potential synergism among mixtures of risks that include biological agents, chemical agents, physical and other environmental processes (e.g., climate conditions), and psychological stress. Continued research is needed to begin to sort out a hierarchy of potential hazards from such combinations. In the meantime the military should continue to pursue strategies of minimization of exposure to agents that might cause significant short-term effects as well as those that might cause long-term or delayed health effects. Such an exposure minimization orientation is one in which, in the absence of complete information about the health risks posed by particular compounds, efforts are made to use them with caution and limit exposure to them.

Uncertainty is an inevitable component of health risk assessment. It can be reduced with careful efforts to consider activities in their entirety, but uncertainty will remain because of the still-limited knowledge of all aspects of exposures and health effects, and this uncertainty must be conveyed to decision makers.

Although for decades organizations within the military have been dedicated to assessing risks from chemical warfare agents and infectious diseases, consideration of the array of other potentially hazardous chemicals that might be encountered is more recent. Because of the enormous array of industrial chemicals in use around the world, it is a tremendous challenge to evaluate the risks they pose, particularly at low levels. It is also difficult to measure human exposure at low levels. Despite its difficulty, however, this challenge should not be ignored. Efforts have begun to include assessment of the risks from toxic industrial chemicals in military planning and risk assessment activities, but **continued effort is needed to integrate consideration of both the acute effects of exposure to these chemicals and the risks posed by long-term, low-level exposures.**[3] The assessment results must be integrated into the spectrum of potential hazards accounted for before and during deployments. The potential long-term effects of other exposures during deployments must also be part of the assessment of risks from deployment activities. This integrated health risk assessment will therefore be complex and detailed in its entirety, but should be summarized in a chart or matrix to be provided to the commander for decision making. The additional resources required for this challenging task must be identified and developed. Furthermore, the risk management concepts derived from these efforts should be included in scenarios used for military exercises and war games, with the lessons learned used to further refine the assessment and planning process.

Contemporary models of health risk management and assessment suggest that effective responses to risk situations require a broad understanding of the values of importance to the affected populations (Fisher, 1991; International Life Sciences Institute, 1993; Kasperson and Kasperson, 1996; Kuehn, 1996; Kunreuther and Slovic, 1996; NRC, 1996). Without accommodation of these concerns by the assessment process, analyses may not adequately address the right questions, may increase the perceived uncertainty about an exposure situation, and may undermine the partnerships required to implement plans and policies. **Therefore, a primary objective of the decision-making process is to integrate the values and concerns of affected and interested parties into scientific procedures.** Health risk assessments should thus be the outcome of an analytic and deliberative process—a process that should include early consideration of the problem from several perspectives. Incorporating the concerns of service members will necessitate a review of the questions posed for analysis (e.g., most likely scenario versus worst-case scenario), the data required, and the risk consequences considered (e.g., the long-term health consequences as well as the acute effects of exposure). In risk management situations anticipated to be

[3]In the National Research Council report S*trategies to Protect the Health of Deployed U.S. Forces: Detecting, Characterizing, and Documenting Exposures* (NRC, 2000c), principal investigator Thomas McKone describes the need for dose-response information to evaluate the effects of "low-level" exposures. This information is crucial to establishing criteria for detecting and monitoring low-level exposures to chemicals. The executive summary of that report is found in Appendix C.

controversial, it is particularly important that the analytic-deliberative process be inclusive and iterative (NRC, 1996).

In practice, the groups responsible for assessing deployment health risks should involve focus groups to gain some service member input regarding the concerns raised by various aspects of deployment activities. Future assessments should also be informed by past conflicts in which interested parties explicitly detailed key risk and health issues that were perceived to have been ignored in formal assessments and previous decisions. Records of past congressional and expert panel hearings on risk and the health of deployed troops (e.g., Agent Orange in Vietnam and illnesses in Gulf War veterans), as well as other discussions in the public sector regarding community exposures, represent a rich source of information for pending health risk assessments. The organization appointed to carry on the work of the DoD Office of the Special Assistant for Gulf War Illnesses should provide another source of information from lessons that have already been learned. The formal analysis of such material could offer DoD guidance about which dimensions of exposure situations frequently emerge as principal considerations for service members, their families, and diverse lay populations. A substantial body of work also exists in the scientific literature regarding lay populations' evaluations of and perspectives on risk situations (Slovic, 1987; Fischhoff et al., 1993; NRC, 1996). DoD might also consider soliciting experts from academia and other non-military settings for advice about integrating service members' perspectives into the process of risk estimation and assessment.

Review of deployment activities and settings to anticipate threats and health risks requires accurate information from the intelligence community. In addition to intelligence about the military threat, information about the climate, the epidemiology of endemic infectious diseases, the safety of the local blood supply, and the locations, raw materials, and products of nearby industries must be considered to identify potential hazards to deploying service members. This information is considered medical intelligence. Significant improvements in the collection and communication of this information to commanders and the medical community are needed. Improvements in the communication of information from the medical community to the medical intelligence organization are also needed.

As mentioned earlier, toxic industrial chemicals are fairly new to the mix of hazards included in risk assessment and are recent additions to medical intelligence gathering. The Armed Forces Medical Intelligence Center (AFMIC) has evolved from a group in the U.S. Army responsible for gathering information on endemic infectious diseases and health care infrastructures in other countries into a joint, cross-service organization. Recently, it has established an environmental branch that assesses the presence of toxic industrial chemicals in other countries. AFMIC is small, however, a total of only about 40 analysts, and requires additional resources to be effective. The health risk assessment effort should include increased cooperation between AFMIC and the environmental health risk assessment groups at the U.S. Army Center for Health Promotion and Preventive Medicine, the Naval Environmental Health Center, and the Air Force Institute for Environment, Safety, and Occupational Health Risk Analysis.

Communication and coordination between the medical intelligence community and the deployed medical community need to be improved. The preventive medicine officers are those best able to interpret and act on the intelligence gathered, so they need access to this information. Currently, however, medical intelligence information is not available to most deployed preventive medicine professionals because of their lack of access to classified databases and communications, particularly in deployed and remote locations.

Medical intelligence must make its way to the commanders as well as to the medical community. One way to ensure this is to include it in the intelligence annex to the operations plan. The operations plan is written by commanders to anticipate the actions and requirements of a particular deployment, and the intelligence annex is a particularly important aspect of this plan. In the past, medical intelligence information has been included in the medical annex to the operations plan, which tends to come near the end of the document, where it runs the risk of being ignored. Placing it in the intelligence annex will better convey the importance of the information to commanders as well as to medical personnel.

Improvement is also needed in the medical annex and preventive medicine requirements written to provide direction for medical preparations and care during the deployment. The annex should incorporate up-to-date medical and preventive medicine information both from external sources and from resources across DoD.

It is also vital that there be a flow of information from medical personnel and others with access to information at the unit level back to the medical intelligence community to better inform members of the community of future needs. The preventive medicine and other health care personnel (e.g., medical corps personnel) involved with deployments on the ground have access to valuable information about the risks that service members are encountering daily, including unanticipated hazards that are manifested during the operation. Their experiences and observations would enrich the understanding of the operation and its setting to provide valuable lessons for the future. A barrier to this transfer of information has been the fact that the medical and intelligence communities work in very separate spheres. However, mechanisms are already in place to collect and review the lessons learned from deployments within the medical community, and these should also be shared with the medical intelligence group and all services.

### Strategy 1 Recommendations

**1.1 DoD should designate clear responsibility and accountability for a health risk assessment process encompassing non-battle-related risks and risks from chemical and biological warfare agents as well as traditional battle risks.**

- **The multidisciplinary process should include inventorying exposures associated with all aspects of the anticipated activities and settings of deployments.**

- **Commanders should be provided with distillations of integrated health risk assessments that have included consideration of toxic industrial chemicals and long-term effects from low-level exposures.**
- **Service member perceptions and concerns should be factored into the process of risk assessment. This will require assessing common concerns of the affected populations and evaluating whether the contents of risk assessments address those issues critical to cultivating effective risk management and trust in the process.**

**1.2 Incidents involving toxic industrial chemicals should be among the scenarios used for military training exercises and war games to raise awareness of these threats and refine the responses to them.**

**1.3 DoD should provide additional resources to improve medical and environmental intelligence gathering, analysis, and dissemination to risk assessors and to preventive medicine practitioners. DoD should provide a mechanism for information feedback from the medical community to the medical intelligence system.**

**1.4 DoD should ensure that medical intelligence is incorporated into the intelligence annex to the operations plan and is considered in shaping the operational plan.**

**1.5 DoD should devise mechanisms to ensure that state-of-the-art medical knowledge is brought to bear in developing medical annexes to the operational plans and preventive medicine requirements, drawing on expertise both inside and outside DoD.**

**1.6 DoD should adopt an exposure minimization orientation in which predeployment intelligence about industrial and other environmental hazards is factored into operational plans.**

## STRATEGY 2

*Collect and manage environmental data and personnel location, biological samples, and activity data to facilitate analysis of deployment exposures and to support clinical care and public health activities.*

Service members must be confident that the military is doing its best to protect their health to the greatest extent possible for each mission. In recent years both military populations and society at large have demonstrated increased

concern about delayed or long-term effects from environmental exposures as well as from vaccines and other medical prophylactics. DoD and the services must have in place systems that can be used to collect and manage the information necessary to make sound health protection decisions and modify them over time as needed.

Collecting information about the environmental, infectious disease, psychological, and other non-battle-related risks of deployment should be an operational requirement. How much information is it necessary to gather? As discussed for Strategy 1, health risk assessment before deployment can help to identify risks most likely to be associated with the activities of a deployment. On the basis of that health risk assessment, decisions must be made about what environmental data and biological samples might be most useful to collect in the field. The sampling plan may change as additional needs for environmental or biological samples become apparent during the deployment.

Preventive medicine planners should prioritize the collection and analysis of environmental samples on the basis of both the mission, including the planned activities of the troops, and the site of deployment and assessment of threats in the area. Statistical sampling and sample stratification strategies should be developed to the extent possible to help meet needs for data collection[4] (NRC, 2000c). Not every sample collected can or should be analyzed; some (particularly biological materials) could be stored for testing of specific hypotheses as they arise (e.g., Gulf War illnesses and environmental exposures).

There is a danger of collecting so many samples (to carefully characterize a given setting) that the system is bogged down. A minimal data set could be determined on the basis of a decision analysis approach referred to in the previous National Research Council (NRC) report (2000c). This approach views information as a means to improve decision making under uncertainty; information is valuable only if it can affect current or future decision making. The challenge is to determine the minimum amount of information needed to inform decisions related to both immediate and long-term health risks, given that uncertainty is inevitable. For this, a tiered approach to prioritizing data collection based on a dimensions of harm scale could be used (Figure 2-1). The dimensions of harm are measured along three scales: the time to effect, the number of individuals at risk, and the severity of the consequences. Larger numbers of individuals at risk and more severe consequences are of higher priority, as are, often, harms with shorter times to their effects. The most crucial data to be gathered are those about imminent hazards with potentially catastrophic effects, when the data can have an influence on the decisions to be made (GEO-CENTERS, Inc., and Life Systems, Inc., for the U.S. Army Center for Environmental Health Research 1997; NRC, 2000c). Data relating to delayed or chronic effects in large numbers would also be important. However, different deployment scenarios will dictate different

[4]This section draws on the work in *Strategies to Protect the Health of Deployed U.S. Forces: Detecting, Characterizing, and Documenting Exposures* (NRC, 2000c).

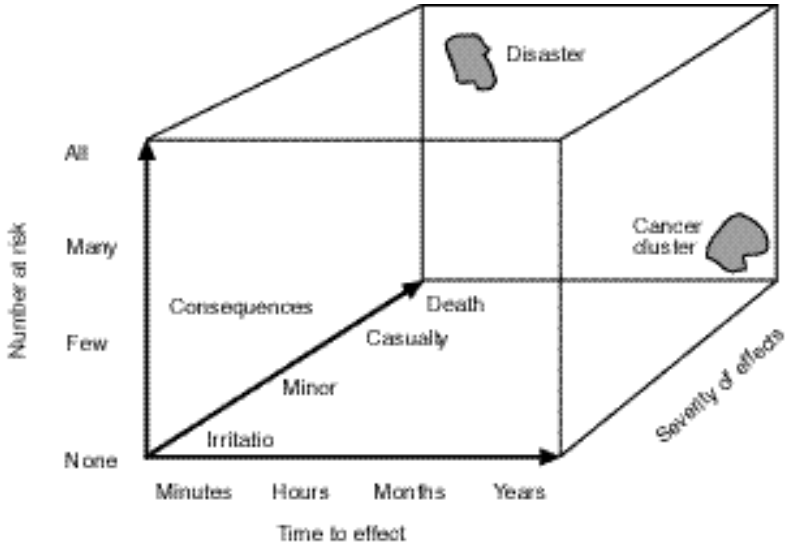


**FIGURE 2-1** Dimensions-of-harm scale. SOURCE: GEO-CENTERS, Inc., and Life Systems, Inc., for the U.S. Army Center for Environmental Health Research, 1997.

evaluations of priorities. To the extent possible, the exposure minimization approach applied at garrison in peacetime should carry over to the deployment.

Different information will need to be made available to different parties at different time scales before, during, and after a deployment. The commander will need information in advance about the spectrum of disease and non-battle-related risks facing the troops in a deployment setting so that, together with staff (who will provide integrated engineering, safety, preventive medicine, nuclear, biological, and chemical information), he or she can plan protective and control measures and determine the potential impact of risks and countermeasures on accomplishment of the mission. During the deployment, the commander will need real-time information, with a priority on those risks that affect many people, have a short time to consequences, and that have consequences of death or casualties, that is, that affect accomplishment of the mission. Different deployment scenarios will prompt different evaluations of priorities, and long-term consequences will take on greater import when risks of immediate effects (from bullets, for example) are lower. Health care providers for service members after deployments have other information needs. Health care providers, as well as commanders, service members, and their families, need timely information not just about events with short-term consequences but also about known exposures that may pose future risks to service members and exposures that may pose risks to fewer individuals. Military acquisition personnel will also need information, but they will need this information far in advance of deployments, when they are striving to anticipate the uses and attendant risks of equipment.

Priority setting for collection and archiving of biological samples for potential analysis is also needed, particularly during deployments.[5] Increasingly, the biomedical community has developed the capability to detect chemical or toxic agents and metabolites in biological samples, such as blood, serum, and urine.[6] Markers in other biological samples such as saliva and hair may become increasingly useful for monitoring exposures to a large number of harmful chemicals (NRC, 2000c) as the technology advances. For substances for which such a biomarker has been developed and validated and when a putative exposure has occurred, analysis of biological samples collected from deployed forces may help to assess past exposures. Environmental monitoring is important to allow avoidance or minimization of an exposure before it has occurred. If an exposure may have occurred, biological sampling may be far more efficient than environmental area sampling for the documentation of human exposure. The use of biological samples can be more efficient than the use of environmental area samples in that biological samples can indicate and help to document that human exposure has actually occurred. This permits intervention to prevent further exposures and to give appropriate medical care where needed.

Currently, DoD stores sera collected from all deployed forces within a year before deployment[7] and immediately following certain designated deployments. This practice should continue. Biomonitoring, which currently requires urine or serum for most testing, is not a trivial exercise, especially during a deployment. Sampling may be difficult and interfere with the mission, and the logistics and cost may be quite high for each specimen. Yet, biological samples may also be of great value should unanticipated questions arise later. Thus, during major deployments or deployments with a threat from chemical or industrial agents, biological specimens should be collected from a small subset of individuals, and these samples should be archived for analysis should the need arise. Ideally, these would be drawn as part of a sampling strategy with statistical validity; however, this is frequently not feasible. In such situations a statistical sample should not be required, but samples should be sought in a purposeful manner to maximize useful information about individual exposures. In addition, if the po-

[5]This section primarily addresses monitoring for environmental and toxic exposures. However, the committee expects that specimen collection and laboratory testing for infectious diseases for both individual patient needs and detection of epidemics should continue, with adequate infectious disease laboratory capacity assured.

[6]The laboratory of the National Center for Environmental Health of the Centers for Disease Control and Prevention can rapidly screen blood and urine for 90 chemical agents and is anticipated to be able to screen blood and urine for more than 150 chemical agents by September 2001 (National Center for Environmental Health, 2000; James Pirkle, Medical Director, Environmental Health Laboratories, National Center for Environmental Health, personal communication to Ruth Berkelman, May 3, 2000, and June 26, 2000).

[7]Sera are collected for human immunodeficiency virus screens, which are mandatory every 2 years, or within 1 year before a deployment.

tential for an exposure in the field is known to be high or troops develop symptoms potentially indicative of a chemical or infectious exposure, biological samples from potentially exposed troops may be collected in a targeted fashion and tested immediately.

Collection of biological samples from service members that might be stored indefinitely and used for as-yet-undeveloped analyses raises reasonable questions about protections of the confidentiality of such information. Some protections are already in place for the tissue samples collected for remains identification and the serum samples from human immunodeficiency virus testing.[8] It is crucial that safeguards be in place for other types of biological samples to protect the privacy of individuals. Clear statements of the intended uses of data from biological samples should be provided, and guidelines and policies for consideration of subsequent modifications to the intended uses should be developed and made available (IOM, 1999).

Even with the development of biomonitoring, environmental monitoring should continue to be used before and during deployment, as this can permit avoidance of hazardous exposures during deployments. Expertise in both environmental monitoring and biomonitoring is needed so that the fields are integrated noncompetitively and the advances in each field are used most effectively and efficiently to protect the health of the individuals deployed.

It is vital that the locations of units and individuals during deployments be documented, together with activity information. This information is important not only for real-time command decision making on the battlefield but also for enabling the reconstruction of deployment exposures for epidemiological studies and the provision of appropriate medical care after the deployment.[9] However, despite painful lessons learned from both the Vietnam War and Operations Desert Shield and Desert Storm, adequate systems for recording and archiving the locations of deployed forces are still not in place. At present, the tracking of service member locations varies with the deployment. In the current deployment to Kosovo, troops are tracked at the unit level. Each week, the unit provides the task force commander a unit situation report that describes where the unit was located over the previous week. If necessary, these data could be linked with rosters of the individuals in units (collected by the Defense Manpower Data Center) to arrive at an approximation of the locations of individuals for that

[8]A series of special rules and procedures protects the privacy interests in the tissue samples collected for identification of remains and any analysis of the DNA from these samples (IOM, 1999). Guidelines on the use of samples from the DoD Serum Repository exist (http://amsa.army.mil), and the repository is subject to "rules and procedures to protect privacy interest of members and ensure exclusive use of specimens for the identification, prevention and control of injuries and diseases associated with military operations" (DoD, 1997, p. 3).

[9]Detailed discussion of tracking the locations and time-activity budgets of deployed military personnel is found in NRC, 2000b, pp. 110–124.

time. Such weekly tracking is not being done for current deployments to Bosnia, Saudi Arabia, and Kuwait.

Information about which units are deployed to a theater of operations and who is present in the units is gathered separately by each service and is transmitted to the DoD Deputy Chief of Staff for Personnel. These data are frequently inaccurate and out of date because no system has been designated for the collection, maintenance, and forwarding of the information from the units. The data also are not available to the preventive medicine community in real time or even within a short period of time after a deployment. Those trying to carry out surveillance must thus work without good denominators.

Miniaturized Global Positioning Satellite technology is now available and is integrated with consumer and military devices, such as cellular telephones. Troops can thus be tracked in real time. However, systems have not been built to capture these location data, catalogue and archive them, or, when security concerns permit the provision of these data, make them available for retrospective analyses and in real time to preventive medicine officers. The committee urges rapid progress toward this goal.

The collection of detailed information about the locations and activities of service members could have costs in terms of privacy and could result in potential misuse of the technology. Careful thought about how such technology could be applied must take into consideration the potential for thwarting the systems (willfully deceiving the system), unnecessarily intruding in private activities, or revealing information to the enemy. Clear explanation of the justification for real-time tracking must be provided during service member training.

Careful coordination is lacking for the planning and execution of data collection activities related to environmental monitoring, biomonitoring, and personnel activity and location information. Data systems must be planned so that these data can be linked as needed with one another and with an individual's medical data. Responsibility for these activities currently falls across research, operational, and personnel organizations and preventive medicine and nuclear, biological, and chemical organizations. DoD should clarify these responsibilities to permit the most effective integration and use of environmental exposure information.

### Strategy 2 Recommendations

**2.1 DoD should assign single responsibility for collecting, managing, and integrating information on non-battle-related hazards.**

**2.2 DoD should integrate expertise in the nuclear, biological, chemical, and environmental sciences for efficient environmental monitoring of chemical warfare agents and toxic industrial chemicals for both short- and long-term risks.**

**2.3 For major deployments and deployments in which there is an anticipated threat of chemical exposures, during deployments DoD**

**should collect biological samples such as blood and urine from a sample of deployed forces. Samples can be stored until needed to test for validated biomarkers for possible deployment exposures or analyzed in near real time as needed for high-risk groups.**

**2.4 DoD should clearly define the individuals permitted access to and the uses of biological samples and the information derived from them. DoD should communicate these policies to the service members and establish a process to review ethical issues related to operational data collection and use.**

**2.5 DoD should ensure that adequate preventive medicine assets including laboratory capability are available to analyze deployment exposure data in near real time and respond appropriately.**

**2.6 DoD should ensure that the deployed medical contingent from command surgeons to unit medics has mission-essential information on the likely non-battle-related hazards of the deployments and access to timely updates.**

**2.7 DoD should implement a joint system for recording, archiving, and retrieving information on the locations of service member units during operations.**

**2.8 Environmental monitoring, biomarker, and troop location and activity databases should all be designed to permit linkages with one another and with individual medical records. It is crucial that means be developed to link environmental data to individual records.**

## STRATEGY 3

*Develop the risk assessment, risk management, and risk communication skills of military leaders at all levels.*

Military leaders are crucial to the successful preparation and execution of any military mission. Successful leaders are masters of military science, which at its core entails the assessment, management, and communication of battle risk. Although military leaders are well schooled in military science developed for the traditional battlefield, they should be better equipped to address the full range of risks to the health of deployed forces in today's missions. The failure to adequately prepare the leadership for this new milieu may result in reduced mission-readiness and force effectiveness and at times unnecessary exposures to avoidable risks (see Box 2-1). Thus, the training of the leadership in the assessment, management, and communication of health and other non-battle-related

**BOX 2-1**
**Exposures to Avoidable Risks**

- Service member concerns about personal protective measures for insects and application of the insect repellent DEET (N,N-diethyl-meta-toluamide) to their skin contributed to several cases of malaria following a deployment to Somalia in 1993 (Newton et al., 1994; Ledbetter, 1995).
- Also in Somalia, problems arose when family members of injured soldiers learned about firefights and injuries from the news media instead of from more reliable sources of information through the chain of command. Distraught family members in the United States called their relatives who were deployed service members, upsetting the service members and causing decreases in force effectiveness. Commanders developed a system of phone trees to notify family members in near-real time of the status of their family members after a conflict event (LaBoa, 2000).

risks is a mission-essential task. The committee believes that such training will, in time, redress the credibility problems that result as the military attempts to move through this unfamiliar territory on a case-by-case basis.

All levels, but particularly commanders and medical personnel, need training in how health risk assessments are generated and how risk is communicated and managed, taking into account evolving societal concerns. The current guidance provided to commanders and military medical personnel is inadequate because it can result in incomplete and inaccurate descriptions of risk, and thus mismanagement of the risk and insufficient communication about the risk of concern. It does not reflect the most contemporary scientific principles of risk assessment, risk management, and risk communication (Fischhoff, 1995; Leiss, 1996; NRC, 1996).

In recent years, all three services have developed doctrine for operational risk management. The Army's Field Manual FM 100-14, the Navy's OPNAVINST 3500.39 (MCO 3500.27), and the Air Force's Instruction 91-213 and Pamphlet 91-215 all reflect similar approaches to risk assessment. The approach follows the classic risk assessment paradigm established by the NRC "Red Book" in 1983 (NRC, 1983). The book describes a risk assessment process in which the assessment and characterization of a risk are separated from broader social concerns, and the level of participation of the affected communities is low at the initial stages of risk estimation. More recent perspectives have evolved from this traditional paradigm.

In practice, health risk assessment cannot be easily separated from risk management (including risk communication) (NRC, 1996). Moreover, the circumstances and perspectives of those likely to experience the consequences of decisions to be made must influence the process of risk characterization. Characterizations of risk should include consideration of fairness, the context and

necessity of exposures, and other factors crucial to human perceptions of risk (NRC, 1996).

To be effective leaders today, commanders must understand these contemporary principles of risk assessment and risk management. They also need to be able to communicate effectively about these topics with the service members they lead and with their families. For example, a traditional model of risk assessment may lead military medical personnel to emphasize the low probability of a negative reaction to a vaccine when attempting to persuade service members to comply with orders to be inoculated. These arguments, however, can actually exacerbate concern if communications leave unanswered the questions most important to individuals. Service members may question the certainty of risk estimates, the effectiveness of inoculation under different deployment scenarios, or the acceptability of any level of risk when the rationale for a vaccine has not been effectively communicated. Furthermore, questions may arise about the fairness of a policy that is perceived to have ignored fears about the long-term consequences of a vaccine.

Effective risk communication is not a simple algorithm, nor is it conducive to checklists.[10] It sometimes requires dialogue instead of the "top-down" information flow common in military settings. Commanders will need to be trained in discussing and hearing the concerns of the individuals in their units about potential health risks. They will also need to turn to their medical staffs and unit medics for additional information about the concerns of their units. This training in risk communication is not a one-shot event but must be ongoing, with continuing reevaluation and effort. DoD trainers in risk communication should continue to draw upon outside experts to ensure the currency of their materials and approaches. Training should be supplemented or updated if a need arises over time or if circumstances change and the risk communication process targets new questions or audiences. Commanders and other risk communicators within DoD should see health risk assessment, risk communication, and risk management as interrelated components of a decision-making process.

The most effective risk communication process must include evaluation of its effectiveness. Box 2-2 provides some considerations that may be useful in evaluating the effectiveness of risk communication.

All of these criteria will not (and cannot) be satisfied in some cases. For example, in the theater of operations, time constraints regarding decision making may exist, making it unproductive, unwise, or undesirable to engage in an extended and explicit consideration of the uncertainties of the risk estimates associated with impending activities. Acceptance, however, of the unavoidable uncertainties of risk management in particular deployment circumstances is more likely with a high level of trust and a belief that troop protection receives top priority. Service members must feel confident that commanders and the military establish-

[10]Further discussion of risk communication in the military is found in *Strategies to Protect the Health of Deployed U.S. Forces: Medical Surveillance, Record Keeping, and Risk Reduction* (IOM, 1999, pp. 92–98).

**BOX 2-2**
**Considerations Useful in Evaluating Risk Communication Effectiveness**

An evaluation of the effectiveness of a risk communication process might include the following considerations:

- Are the prioritized concerns of service members and their families reflected in the decision making process and the products of risk assessments?
- Does risk communication promote and foster trust among service members and their families ?
- Do service members and their families believe that their perspectives have been considered in decision making?
- Have parties addressed concerns about fairness and equity in the distribution of risk across service members and their families?
- Have communicators engaged in an open and inclusive process of risk communication?
- Are service members and their families satisfied that uncertainties associated with scientific estimates of risk have been identified and given serious consideration in the decision making process?
- Have communications effectively presented the rationale for choices and made clear what dimensions were weighed in formulating decisions related to risks?
- Has the risk communication process improved the effectiveness of the mission?

ment, as a rule, incorporate service members' perspectives and concerns into risk assessments and decisions. Risk communication training should include some education about the varied contexts in which communication occurs and training in how to identify when a more involved, deliberative process is required.

Physicians and other health care providers also need training in health risk communication so that they can better listen and respond to concerns raised by service members. For many health-related topics, it is helpful for the health care provider to acknowledge both the incompleteness of medical and scientific understanding and the areas where evidence is more complete. **The acknowledgment of uncertainty does not erode trust and confidence in leaders; instead, it fosters confidence in the reliability of information deemed to be more certain and valid.** In addition to training in risk communication for commanders and health care providers, DoD itself must demonstrate greater openness. It should develop an overall plan for risk communication generally that involves stakeholders (the service members and their families) and outside experts and that includes a response plan for new risks to or health concerns of deployed forces (IOM, 1999). This requires an inclusive, iterative process in which as-

sessments and communication approaches are reevaluated in response to input from affected and interested parties (NRC, 1996).

This dynamic approach to risk communication emphasizes ongoing participatory strategies. It suggests that DoD must provide more information to service members and their families than it has in the past, including some of the complexities of risk–benefit trade-offs. It must also immediately admit to mistakes and fully air all the facts related to mistakes as quickly and as transparently as possible. **DoD must be candid with and trusted by service members, their families, and the American people.**

### Strategy 3 Recommendations

**3.1 DoD should provide training in the contemporary principles of health risk assessment and health risk management to leaders at all levels to convey understanding of the capabilities and uncertainties in these processes.**

**3.2 DoD should institutionalize training in risk communication for commanders and health care providers. Periodic formal evaluation and monitoring of the quality of training programs should be standard procedure. Risk communication should be framed as a dynamic process that is responsive to input from several sources, changing concerns of affected populations, modifications in scientific risk evidence, and newly identified needs for communication.**

**3.3 DoD should jump start training in risk communication by delivering it at appropriate settings for various levels of service, including at the time of initial entry into service and at the service schools. DoD should give particular attention to the training of medical officers on initial entry into service. Opportunities for supplemental training and support of ongoing education in risk communication should be formally identified.**

**3.4 DoD should include the stakeholders (service members, their families, and community representatives) in the development of a plan for DoD risk communication to include when and how risk communications should take place when new concerns arise.**

## STRATEGY 4

*Accelerate implementation of a health surveillance system that spans the service life cycle and that continues after separation from service.*

An earlier report (IOM, 1999) dealt at some length with many of the different factors and needs for improvement in the military's health surveillance system. Here, the committee highlights some of the most urgent needs: health history and health status information on recruits, periodic updates of health status information that continue to be obtained after deployments, improved laboratory-based surveillance, and clarified leadership for preventive medicine and health surveillance.

Baseline health information on service members that begins upon their entrance in the military and that is periodically updated is crucial. The Recruit Assessment Program (RAP) (IOM, 1999) is a promising program now in the pilot phase to gather demographic, medical, psychological, occupational, and risk factor data on recruits soon after they begin training. Periodic standardized updates to the medical record[11] are also needed to maintain current and accurate data about service members' health status. The data from all the various health assessments and physical examinations administered throughout the service career must be collected and stored such that they are available to health care providers and epidemiologists as needed, and the survey instruments must be periodically evaluated to ensure that reliable and relevant data are collected. To the extent possible, consistent health domains or dimensions should be measured over the life of the service member.

Reports of health problems in veterans after their deployment to the Gulf War made clear another challenge for military health surveillance: the need to continue to collect health information after the service member has returned from a deployment. An annual health status questionnaire should continue to be administered to those who remain in the military. In the years after a major deployment, the same questionnaire should also be given to a representative sample of those who separate from the military for a period of 2 to 5 years after the deployment. Data collected from those who use health care for the 2 years after a major deployment as part of the Veterans Benefits Improvement Act of 1998 should be captured and used to provide information on the symptoms experienced by this population and the diagnoses made. Extensive and effective cooperation is required between DoD and the U.S. Department of Veterans Affairs (VA) to permit long-term surveillance of the health of deployed forces.[12] The Military and Veterans Health Coordinating Board could facilitate this cooperation.

A crucial aspect to medical surveillance is the timely central reporting of laboratory results. The information systems in current use are insufficient to this task; in particular, the International Classification of Diseases, version 9 (ICD-9)-based reporting is inadequate for infectious disease surveillance (IOM, 1999). Central reporting of laboratory findings as well as provider reporting of clinical

[11]Such as through the Health Evaluation and Assessment Review discussed previously (IOM, 1999, pp. 47–48).

[12]The Millenium Cohort Study, now in the planning phase, could help to provide insights on service member health status after deployments.

diagnoses should be required for reportable conditions. It is imperative that DoD be able to provide reliable automated laboratory-based surveillance, with capabilities both to discern and to investigate disease outbreaks. Thus, integration of laboratory and epidemiological expertise is needed.

Many of the topics addressed in this report concern actions and operations that are the responsibility of the preventive and occupational medicine components of the services. For the recommendations in this strategy to be effectively implemented, it is crucial that their efforts be adequately supported with personnel and resources. More physicians are needed who are trained and experienced in preventive medicine (Lane, 2000). Expansion of preventive medicine residencies or other programs such as M.D.-Ph.D. programs is needed to provide the personnel base for military needs. Furthermore, improved coordination of many of their efforts is needed. For example, environmental, infectious disease, psychological-behavioral, and injury-safety considerations all have a bearing on preventive medicine during a deployment and members of these disciplines should not carry out their efforts in isolation. Similarly, laboratory analysis, training, and epidemiological investigations need to be integrated for an effective preventive medicine effort. Strong leadership is needed to better clarify and support the role of preventive medicine within and across the individual services and DoD. Without it, competing systems and a lack of coordinated planning are likely to continue to hamper effective surveillance of the health of the forces and the provision of effective medical support for commanders and the mission.

### Strategy 4 Recommendations

**4.1 DoD should establish clear leadership authority and accountability to coordinate preventive medicine—including environmental and health surveillance, training, and investigation—within and across the individual services and DoD. DoD should ensure that adequate preventive medicine personnel and resources are available early on deployments.**

**4.2 DoD should collect health status and risk factor data on recruits as they enter the military, as planned through the Recruit Assessment Program, now in the pilot stage. DoD should maintain health status data for both active-duty and reserve service members with annual health surveys.**

**4.3 DoD should continue to collect self-reported health information from service members after their deployments to permit comparisons with their predeployment health and with the health of other service members. For a representative sample of those who leave the military health system, DoD should continue to administer the annual health status survey for 2 to 5 years after a major deployment to learn about health changes after deployments.**

**4.4 DoD should mandate central reporting of notifiable conditions including laboratory findings across the services. DoD should strengthen public health laboratory capabilities and integrate laboratory and epidemiological resources to facilitate appropriate analysis and investigation.**

## STRATEGY 5

*Implement strategies to address medically unexplained symptoms in populations that have been deployed.*

Medically unexplained symptoms are symptoms not explained by a known medical etiology that lead to use of the health care system (e.g., chronic fatigue syndrome). The report *Strategies to Protect the Health of Deployed U.S. Forces: Medical Surveillance, Record Keeping, and Risk Reduction* describes how such symptoms are increasingly recognized as prevalent and persistent problems in civilian populations, in which they are associated with high levels of subjective distress and functional impairment with extensive use of health care services (IOM, 1999). Similar conditions have been observed in military populations after military conflicts dating back to the Civil War, and in the absence of increased understanding such conditions are anticipated after future deployments (Hyams et al., 1996; Presidential Advisory Committee on Gulf War Veterans' Illnesses, 1996). The medically unexplained symptoms reported by veterans of the Gulf War have been the driving force behind many expert studies as well as several new programs and initiatives in DoD and VA.

The committee believes that, in addition to the improvements in health surveillance and preventive measures described earlier, DoD's approach to medically unexplained symptoms is another means to address an issue of importance to service members, their families, and the public. It is therefore important that several steps be taken or continued in this area.

First, the ability of military health care providers to identify, communicate with, and manage patients with medically unexplained symptoms must be improved. Although a specific program of primary prevention is not feasible given the current state of knowledge, enough is known to implement a secondary prevention strategy. For example, there is increasing evidence of the effectiveness of cognitive behavioral therapy (CBT) for addressing such symptoms (Buckelew, 1989; Martin et al., 1989; Peck et al., 1989; Salkovskis, 1989; Blanchard et al., 1990; Hellman et al., 1990; Skinner et al., 1990; DeGuire et al., 1992; Keefe et al., 1992; Sharpe et al., 1992, 1996; Payne and Blanchard, 1995; Sharpe, 1995; Speckens et al., 1995; Van Dulmen et al., 1996; Deale et al., 1997; Fulcher and White, 1997; Clark et al., 1998). Studies also indicate that medically unexplained symptoms are more difficult to treat once they have become chronic (Kellner, 1986, 1991; Kroenke and Mangelsdorff, 1989; Craig et al., 1993; Barsky, 1998), providing an additional incentive to identify and treat sufferers early.

Work is under way within DoD to develop a set of clinical practice guidelines for postdeployment health care, including guidelines for the management of chronic fatigue syndrome, which shares many characteristics with other types of medically unexplained symptoms. Once developed, the guidelines will need to be implemented along with research to evaluate their effects on patient outcomes.

DoD has an important opportunity to build on this information base with additional research. Not only can the military health care system explore the effectiveness of management and treatment options by evaluating health outcomes,[13] but it can also expand understanding of some of the predisposing, precipitating, and perpetuating factors for medically unexplained symptoms. This will require the collection of information relevant to medically unexplained symptoms in both the RAP currently being piloted and a periodic health status questionnaire such as the Health Evaluation Assessment Review (HEAR) (IOM, 1999). Beyond simply collecting the information, a research plan for medically unexplained symptoms must be designed and implemented. Since there is no evidence to suggest that medically unexplained symptoms differ between civilian and military populations, research into this topic should be of general benefit. This research should be done with the involvement of both DoD and VA to gain insights into both short- and long-term outcomes. As hypotheses about treatment options and predisposing, precipitating, and perpetuating factors are tested and refined, the information can be used to better protect and promote the health of service members and can be helpful for the general population. If properly designed, the large prospective study of deployed forces (Millenium Cohort Study) now in the planning phases might provide insights into these and other illnesses that may be associated with deployment. Plans should be made for the RAP, HEAR, and Millenium Cohort Study to evaluate similar multidimensional factors relevant to health so that these factors can be assessed over the lifetime of the service member.

New treatment or management guidelines will need to be accompanied by training of the military health care providers. The best setting for the identification and management or treatment of patients with medically unexplained symptoms is in the primary health care setting. Thus, a program of continuing education about medically unexplained symptoms should be undertaken for military primary care providers, as should a program that educates those starting their military medical service in the military graduate medical education programs and the service schools. Care providers must learn to establish working relationships with patients with medically unexplained symptoms so that they understand the current limits of medical knowledge and do not feel dismissed or stigmatized by the lack of an identified medical etiology. At the same time,

[13]VA and DoD have under way a large clinical trial that is assessing the benefit of multimodal therapy including CBT and aerobic exercise on the physical functioning of veterans with Gulf War illnesses (VA and DoD, 1999). Completion of the trial is planned for late 2001.

health care providers and the entire system must remain open to new data that might provide insights into medical etiologies for these patients.

Education and discussions about medically unexplained symptoms should not be confined to medical professionals. Misconceptions and ignorance about medically unexplained symptoms exist throughout society, and the military is a microcosm of that society. DoD must squarely face the problem of medically unexplained symptoms. Efforts at the communication of risk to the wider military should include the provision of information about medically unexplained symptoms to remove some of the mystery and fear surrounding them. Like the rest of the general public, service members from commanders on down need to be aware that medically unexplained symptoms are not uncommon in the general population, that they may be more prevalent in service members after military deployments, and that treatments that can prevent or mitigate disability from them are available.

### Strategy 5 Recommendations

**5.1 DoD should include information about medically unexplained symptoms in the training and risk communication information for service members at all levels.**

**5.2 DoD should complete and implement guidelines for the management of patients with medically unexplained symptoms in the military health system. DoD should provide primary health care and other health care providers with training about medically unexplained symptoms and in the use of the guidelines. DoD should carry out clinical trials to accompany the implementation of the guidelines and evaluate their impact.**

**5.3 DoD should establish a treatment outcomes and health services research program within DoD to further provide an empirical basis for improvement of treatment programs to address medically unexplained symptoms. This program should be carried out in collaboration and cooperation with the U.S. Department of Veterans Affairs health system and the U.S. Department of Health and Human Services.**

**5.4 DoD should design and implement a research plan to better understand predisposing, precipitating, and perpetuating factors for medically unexplained symptoms in military populations.**

**STRATEGY 6**

*Implement a joint computerized patient record and other automated record keeping that meets the information needs of those involved with individual care and military public health.*

In the 10 years since the Gulf War, insufficient improvements to military medical record-keeping systems have been made. Medical records for service members are contained in a mixture of distinct automated and paper-based systems (National Science and Technology Council, 1998) at multiple and remote locations. There is still no consistent means for documenting in individual medical records ambulatory care that service members receive during deployments (Office of the Special Assistant for Gulf War Illnesses, 1999; COL Mark Rubertone, Director, Army Medical Surveillance Activity, personal communication, March 10, 2000). Progress has been unacceptably slow toward development of the computer-based patient record (CPR) (IOM, 1999) and automated reporting of laboratory results.

A well-functioning medical information system is crucial for the military and crucial for successfully implementing many of the recommendations in this report. Outside experts as well as those within DoD have described the need for an automated system that would fulfill the varied needs of the large DoD health care system (IOM, 1996a, 1999; National Science and Technology Council, 1998; Staggers and Leaderman, 2000), but progress toward the goals has been slow (IOM, 1999).[14] A major challenge is the existence of many separate information systems developed independently to address different needs over the years. Often each branch of the military has its own processes and programs for data collection. The net effect is one of disjointed systems (that often cannot be linked) that are difficult to access and that do not yet successfully fulfill the needs for the entire force. Fewer systems that simultaneously address multiple functions are required. To accomplish this will require strong centralized leadership, careful planning, and coordination.

**The committee believes that the design and implementation of a cross-service CPR and related automated systems to support patient care and public health needs are among the most important challenges to protecting the health of deployed forces today.** The system must fulfill many needs for many people. The data collected must comply with preestablished standards so that they can be integrated as needed from different systems. A single authority with accountability is mandatory to make this possible in an organization with a strong tendency to create distinct and specialized applications.

[14]The Institute of Medicine report by principal investigators Philip Russell and Samuel Guze, *Strategies to Protect the Health of Deployed U.S. Forces: Medical Surveillance, Record Keeping, and Risk Reduction* (IOM, 1999), treats the topic of the military health information systems in more detail and serves as the starting point for this section.

The committee has a particular interest in the medical record systems under development for use during deployments. Some improvements have occurred in this area since the Gulf War, but significant challenges remain, including the use of different systems by different services and the lack of means for the recording of ambulatory medical events in an individual's medical record. Although simple solutions for the most basic medical surveillance needs might be possible fairly quickly, progress on the whole effort is slowed by trying to build a system that can accommodate both current and anticipated future information needs—from simple text to multimedia data and from simple querying facilities to expert systems and decision support systems. The committee urges accelerated implementation of a system for mission critical needs that is consistent with the architecture and data standards planned for the final system instead of waiting for a system that provides total capabilities. The mission critical needs must be defined by preventive medicine and casualty care experts within the military.

Finally, plans for how information on personnel locations, environmental exposure databases, and other databases will be able to interface with the CPR are not yet in evidence. These are crucial aspects of the development of the comprehensive, life-long medical record described as a goal for protection of the health of deployed forces (National Science and Technology Council, 1998). Work is progressing slowly on a means to share medical record information between DoD and VA so that medical records for service members are available to VA health care providers for patients who have separated from the military.

As limited as the progress in medical record keeping has been for the active duty forces, less progress has taken place for reserve forces (Reserve and National Guard). Medical record keeping for reserve forces is the same as that for active-duty forces when they are on deployments, but the real challenge is in maintaining medical information for the reserve forces after or between deployments. Since they receive their medical care from civilian systems, the military has no accessible health status or medical data on these individuals before deployments, beyond the predeployment questionnaire.[15] As a result, individuals among reservist units may needlessly be receiving an additional immunization when reserve units are sometimes immunized en masse (LaBoa, 2000; Lynch, 2000). At a minimum, records of the immunizations provided to service members including members of the reserves need to be stored in individual medical records. Automation of immunization records for all service members should be a priority for the development of the CPR.

[15]A more complete description of some of the particular challenges for health surveillance and medical record keeping for reserve forces is found in IOM, 1999, pp. 141–145.

**Strategy 6 Recommendations**

**6.1 DoD should treat the development of a lifetime computer-based patient record for service members as a major acquisition, with commensurate high-level responsibility, accountability, and coordination. Clear goals, strategies, implementation plans, milestones, and costs must be defined and approved with input from the end users.**

**6.2 DoD should accelerate development and implementation of automated systems to gather mission-critical data elements. DoD should deploy a system that fills the basic needs of the military mission first but is consistent with the architecture and data standards planned for the overall system.**

**6.3 DoD should implement the electronic data system to allow the transfer of data between DoD and the U.S. Department of Veterans Affairs.**

**6.4 DoD should establish an external advisory board that reports to the Secretary of Defense to provide ongoing review and advice regarding the military health information system's strategy and implementation.**

**6.5 DoD should include immunization data, ambulatory care data, and data from deployment exposures with immediate medical implications in the individual medical records and should develop a mechanism for linking individual records to other databases with information about deployment exposures.**

**6.6 DoD should develop methods to gather and analyze retrievable, electronically stored health data on reservists. At a minimum, DoD should establish records of military immunizations for all reservists. DoD should work toward a computerized patient record that contains information from the Recruit Assessment Program and periodic health assessments and develop such records first for those most likely to deploy early.**