4

Medical Surveillance

Even within a public health or medical context, the term *surveillance* can have different meanings to different people. The Centers for Disease Control (CDC; now called the Centers for Disease Control and Prevention) defines *epidemiologic surveillance* as:

> the ongoing and systematic collection, analysis, and interpretation of health data in the process of describing and monitoring a health event. This information is used for planning, implementing, and evaluating public health interventions and programs. Surveillance data are used both to determine the need for public health action and to assess the effectiveness of programs. (Centers for Disease Control, 1988, p. 1)

Similarly, Benenson, writing in the context of communicable diseases, defines *disease surveillance* as:

> the continuing scrutiny of all aspects of occurrence and spread of a disease that are pertinent to effective control. Included are the systematic collection and evaluation of 1) morbidity and mortality reports; 2) special reports of field investigations of epidemics and of individual cases; 3) isolation and identification of infectious agents by laboratories; 4) data concerning the availability, use and untoward effects of vaccines and toxoids, immune globulins, insecticides and other substances used in control; information regarding immunity levels in segments of the population; and other relevant epidemiologic data. A report summarizing the above data should be prepared and distributed to all cooperating persons and others with a need to know the results of the surveillance activities. The procedure applies to all jurisdictional levels of public health from local to international. (Benenson, 1995, p. 543)

Crucial components in these definitions are the continuing and systematic nature of surveillance activities and the fact that they are related in some way to facilitating the control of disease or certain health events in a population. Reporting of selected conditions and laboratory-based surveillance are both part of disease surveillance. The routine collection of medical data does not constitute disease surveillance per se, but when that information is assembled and used for disease prevention or control, it can play an important role in a health surveillance system. Epidemiologic investigations to determine etiology are not surveillance but are part of the appropriate and necessary response to surveillance information (Halperin, 1992). Overseas laboratories have a critical role in carrying out relevant disease surveillance in areas where troops are likely to deploy.

Carrying out an effective medical surveillance program in the military is challenging, as it is in the civilian sector. It is important that it be carried out not as an end in itself but considered in the context of a larger plan for public health within the military. During its investigation, the study team has learned of a variety of different health surveillance initiatives and efforts that are planned or under way. Although each has its own justifiable goals, the disjointedness of the efforts makes it less likely that the goal of keeping the force healthy during a deployment will be reached efficiently. As articulated in the three pillars of the Department of Defense's (DoD) current effort of Force Health Protection, reaching this goal entails (1) promoting wellness and sustaining health to deliver a healthy and fit force; (2) preventing acute and chronic casualties during training, deployment, and war, and (3) providing high-quality health care in peacetime and on the battlefield (Bailey, 1999a).

Professional personnel are needed to evaluate data needs over time as well as to analyze the information and respond to emerging trends and events. A reliable record keeping system will be crucial (this is addressed in Chapter 5). The push to develop and implement a policy and system for medical surveillance has been strong since the Gulf War. There might be some tendency to think or hope that such a system, when fully functional, would preclude or prevent health problems such as those that have been reported in many Gulf War veterans. This is unlikely. What such a system should be able to do, however, is to help identify high- and low-risk populations to permit the implementation of appropriate preventive measures for the array of known and well-understood hazards to deployed forces, as well as provide early alerts about new or emerging health problems in the population. It will also provide data to permit retrospective analysis when future problems arise.

The following sections describe aspects of the medical surveillance system under development by DoD and the military services, and evaluate them on the basis of their apparent objectives and the needs and definitions discussed above.

DoD POLICIES ON MEDICAL SURVEILLANCE

Since the Gulf War, and particularly from 1996 to 1999, DoD and the military services have placed new emphasis on the importance of medical or health surveillance. This emphasis has been encouraged by outside organizations such as the Presidential Advisory Committee on Gulf War Veterans' Illnesses (1996a,b) and the Institute of Medicine (1996a). A DoD joint directive and instruction have been published on the topic, as has a more recent DoD joint memorandum. Coinciding with these has been the development of the concept of Force Health Protection.

Force Health Protection

Force Health Protection is a campaign to place greater emphasis on protecting the health of service members. Its goal is "a unified strategy that protects service members from all health and environmental hazards associated with military service" (Clines, 1998). In November 1997, President Clinton directed DoD and the U.S. Department of Veterans Affairs (VA) to create a new "Force Health Protection Program" to help provide a military force fully protected from preventable and avoidable health threats throughout military operations and deployments (White House, Office of the Press Secretary, 1997). The four critical elements of the Force Health Protection Strategy are threat analysis, countermeasures, medical surveillance in the area of operations, and analysis (National Science and Technology Council, 1998).

DoD Joint Directive

In August 1997, DoD released the directive Joint Medical Surveillance (U.S. Department of Defense, 1997b) (Appendix H) as well as an instruction on its implementation and application (U.S. Department of Defense, 1997a) (Appendix I). The directive establishes policy and assigns responsibility for "routine joint medical surveillance of all Military Service members during active Federal service, especially military deployments" (U.S. Department of Defense, 1997b, p. 1).

The directive notes the CDC definition of medical surveillance as "the regular or repeated collection, analysis, and dissemination of uniform health information for monitoring the health of a population, and intervening in a timely manner when necessary" (U.S. Department of Defense, 1997b, p. 2). It emphasizes the application of health information data to military activities to prepare and implement early intervention and control strategies. It states that "a surveillance system includes a functional capacity for data collection, analysis and dissemination of information linked to military preventive medicine support of operational commanders" (U.S. Department of Defense, 1997b, p. 2).

The directive states as policies that: medical and personnel information systems be designed, integrated, and used in a manner compatible with military medical surveillance; such systems be continuously in effect throughout military service and be *specifically configured to assess the effects of deployment on the health of service members*; and service members be made aware of significant health threats and corresponding protection before and during deployment. Medical surveillance will encompass the periods before, during, and after deployment to monitor threats and stressors, assess disease and non-battle injuries of all kinds, and reinforce the use of preventive countermeasures and the provision of optimal medical care during and after deployment. There shall be a serum repository to be used exclusively for the identification, prevention, and control of diseases associated with operational deployments of military personnel.

The directive designates the Secretary of the Army as the DoD Executive Agent for medical surveillance for deployment and for maintenance of the related Armed Forces Serum Repository. However, medical surveillance is the continuous responsibility of the DoD components (Army, Navy, and Air Force). During a deployment, this responsibility becomes shared with the joint task force (JTF) commander and the commander in chief of the appropriate combatant command (U.S. Department of Defense, 1997a). Policies for health surveillance of the Ready Reserve are to be consistent with the policies established for the active component.

DoD Joint Instruction

The instruction (U.S. Department of Defense, 1997a) (Appendix I) accompanying the directive details the specific actions necessary for medical surveillance before, during, and after deployments and outlines roles and responsibilities at these three stages. It anticipates that new systems will be developed to facilitate medical surveillance, such as automated medical record devices, and that a geographical information system will be used to conduct spatial analyses of the environmental and disease exposures of company-sized and larger units. The environmental exposure data will be capable of being linked to service members' individual medical records. It specifies that pre- and postdeployment health screening assessments be carried out, to include a mental health assessment. It also states that during a deployment, the Defense Manpower Data Center shall provide collective data such as daily strength by unit and grid coordinates for each unit, and inclusive dates of each individual service member's deployment. These data shall be linkable to collective medical surveillance data and to service members' individual medical records.

DoD Joint Memorandum on Deployment Health Surveillance and Readiness

In December 1998, the Chairman of the Joint Chiefs of Staff published a memorandum entitled Deployment Health Surveillance and Readiness to provide routine, standardized procedures for assessing readiness from a health perspective and conducting health surveillance in support of deployments (Joint Chiefs of Staff, 1998) (Appendix J). It states that health surveillance during a deployment includes identification of the population at risk, recognition of and assessment of hazardous exposures, use of specific countermeasures, and monitoring health outcomes. It details surveillance requirements before, during, and after deployments. It also includes, in its Enclosure D, a useful Tri-Service Reportable Medical Event List that should be updated on a regular basis.

Joint Publication 4-02 Doctrine for Joint Health Service Support

The policies described above still await incorporation into doctrine. Joint Publication 4-02 is under revision to reflect these policies.

National Science and Technology Council, Presidential Review Directive 5

In response to a recommendation from the Presidential Advisory Committee on Gulf War Veterans' Illnesses, a National Science and Technology Council Interagency Working Group developed an interagency plan to address health preparedness for and readjustment of veterans and families after future conflicts and peacekeeping missions. The resulting plan, released in November 1998, is called, *A National Obligation: Planning for Health Preparedness for and Readjustment of the Military, Veterans, and Their Families after Future Deployments* (National Science and Technology Council, 1998).

The plan addresses broad topics of deployment health, record keeping, research, and health risk communications. In the chapter on deployment health, the supporting narrative describes the Force Health Protection Strategy, including threat analysis, countermeasures, medical surveillance in the area of operations, and data analysis. Medical surveillance in the area of operations is explained as follows: "During the operation, monitoring the health status of the force and the health threats to determine short- and long-term risks to health and to take appropriate countermeasures" (National Science and Technology Council, 1998, p. 11).

Many of the policies and recommended strategies described in the documents above are evidence that DoD is taking the need for improvements in medical surveillance seriously. In sections that follow, a variety of tools are de-

scribed that can contribute information to a medical surveillance system. Rather than being developed as part of a systematic plan for improved surveillance, however, each has been developed or planned to address other specific needs. Some coordination and examination of the "big picture" of health surveillance is needed to consider the tools available to make the process more effective and efficient for medical surveillance. The Joint Preventive Medicine Policy Group (or JPMPG) is a group of preventive medicine officers representing all of the services that has provided input to policy making. However, they do this work in addition to their full-time work, and have not been involved as early in the process as needed. Earlier involvement of such a group, providing them with adequate time and resources, could facilitate such coordination.

CURRENT SERVICE PRACTICES AND PLANS

Although the military's stated goal is for medical surveillance that is seamless over the career of the service member, present surveillance practices must necessarily differ in some aspects between garrison and deployed settings. This section reviews the current practices and plans for military surveillance in both settings in light of the policies noted above. For the purposes of this report, *deployment* is defined as it is in the memorandum Deployment Health Surveillance and Readiness, that is, "a troop movement resulting from a JCS [Joint Chiefs of Staff]/unified command deployment order for 30 continuous days or greater to a land-based location outside the United States that does not have a permanent U.S. military medical treatment facility (i.e., funded by the Defense Health Program)" (Joint Chiefs of Staff, 1998, Enclosure A, p. 1).

Garrison

Despite the radically increased operational tempo of U.S. military operations in recent years, at any given time, most military service members are not deployed but are in garrison or ashore. During this time routine medical care and preventive measures will take place, and these activities can also provide information that will serve as a baseline for assessment of changes resulting from or concurrent with deployments.

Recruit Assessment Program

The military is developing a survey instrument proposed to be given to new military recruits immediately upon reporting for basic training. Although baseline health information is already obtained from recruits during Military Entrance Processing, it is limited in scope, is not computerized, and often is not

readily accessible (Hyams and Murphy, 1998). The Navy and Air Force have administered a psychological screening program to recruits since the 1970s; it is now called the Biographical Evaluation and Screening of Troops Program. The proposed new instrument, which is currently undergoing pilot testing, would collect preservice demographic, medical, psychological, occupational, and risk factor data on all U.S. military recruits and establish a computerized database of baseline health information. The Recruit Assessment Program (RAP) questionnaire would be administered to incoming personnel within their first week of training and would be given to active-duty, National Guard, and Reserve troops.

The Institute of Medicine (IOM) study team views the collection of uniform survey data from recruits upon accession into the military as an important contribution both to the individual medical record and to a population database for better understanding the development of disease in military populations generally. The data can help provide the foundation of the medical record maintained for the service member throughout his or her military career and potentially after it. It is thus critical that the instrument be developed in coordination with the continuing development of the Health Evaluation and Assessment Review (HEAR) (see below) and that it be compatible with the VA and DoD joint records system. It can provide baseline information about the health of recruits before their military service, as well as permit the testing of hypotheses about risk factors for disease development in military populations in the future. It is important that the instrument used be carefully developed with validated components and that it be pilot tested. The developers have undertaken or planned both of these. The Armed Forces Epidemiology Board favorably reviewed the RAP proposal in December 1997. Once implemented, the instrument should be periodically reassessed and refined with input from appropriate independent experts.

Periodic Health Assessments

In addition to planning the collection of health information from recruits as they enter the military, DoD is moving to implement an annual collection of health status and risk factor information from all service members. The HEAR was initially developed by the Air Force to "promote prevention and wellness, and evidence-based population health management" (Fonseca, 1998, Overheads, p. 2). Some features are similar to the Health Risk Appraisal used for many years by the Army. Its use has begun across the services, but data are not yet readily available to physicians.

The HEAR began as a scannable paper and pencil questionnaire that addressed topics of demographics, behavioral health risks, mental health, activity limitation and perceived health, medical care utilization, chronic conditions, and family history. It was envisioned to be useful both to the patient and to the health care provider, noting potential health concerns to the patient and to the provider in separate reports (Fonseca, 1998).

Later versions of the HEAR are designed for use as computer-assisted interviews. The later versions cover additional topics, such as nutrition, safety, reproductive health, and dental health, and include expanded sections on mental health and behavioral risk factors. Skip patterns are built into the questionnaire so that the interviewee does not face irrelevant questions. The computerized questionnaire is to be a component of the Preventive Health Care Application (PHCA). PHCA is a computer system for health maintenance to include the HEAR and an immunization tracking system. Through PHCA, HEAR results are provided to health care providers with certain responses flagged to facilitate intervention. Versions of the HEAR now in development will gather information about a service member's children and additional future versions are envisioned to be able to use information from previous surveys or other sources (DoD hospital records, for example) to determine which questions are necessary.

The IOM study team believes that the routine collection of health status and risk factor data through an instrument such as the HEAR can provide a useful component of an ongoing medical surveillance system. However, its goals should be clearly articulated, and the survey instrument should be focused with the use of survey questions validated in other settings or validated by comparison with personal interviews carried out by medical professionals. These longitudinal data may not themselves be useful for answering questions of causation of future clusters of illness, but they may help to provide a better understanding of predeployment factors. The fact that it is entirely self-reported information is a limitation, but routine capture of this information should make it a more reliable source of information about pre- and postdeployment health than data hastily gathered immediately before or after a deployment. Ultimately, the information is expected to be incorporated into the overall medical record which is likely to contain laboratory test results as well as physicians' notes. Incorporation of the baseline data gathered in RAP would help to shorten the questionnaire and eliminate unnecessary redundancy.

The HEAR is envisioned as both a clinical tool to facilitate individual preventive care and a tool to gather population-based data. The study team believes that it can serve a valuable function on both fronts with careful review, refinement, and incorporation of questions designed to note potential warning signs for the manifestations of medically unexplained symptoms, as discussed elsewhere in this report. It can also collect better information about reproductive health to facilitate surveillance for adverse reproductive outcomes addressed later in this chapter. In its current form the questionnaire focuses on diagnosed diseases, uses language that the service members may not understand, and uses categories different from those helpful to epidemiologists. The questionnaire will need modification so that it asks questions about symptoms and will require rigorous field testing and input from experts in survey development. Considerable work in health-tracking instruments has been carried out in the past several decades (Newhouse, 1993), and this information and expertise would be useful to apply to this situation.

Although the HEAR is being planned for use across the active duty services (Institute of Medicine, 1998), it is not yet planned for use with reserve-component troops. Discussions are still under way within the military about how this could take place. Given the increasing reliance on the reserve components, it is appropriate that they too be involved in health surveillance efforts to facilitate the maintenance of a healthy force. However, the fact that members of the reserve components receive most of their health care from civilian providers poses particular challenges. If the HEAR questionnaire flags a health problem in need of attention, the reservist may have to be referred for care to his or her civilian provider. Administration of the HEAR to members of the reserves would allow collection of ongoing baseline data and allow a better understanding of predeployment health than that provided by the hastily administered predeployment questionnaire.

In addition to periodic health assessments that include physical examination and laboratory testing when required, it is also important that both hospitalization and ambulatory visit databases be available and be linked to the remainder of an individual's medical record. Currently this linkage is possible only through the Defense Medical Surveillance System (DMSS), which will be described later, but with the development of a computer-based patient record it should become inherent to the medical record system. This is discussed more fully in Chapter 5.

Periodic Blood Draw

Part of the DoD plan for improved medical surveillance related to deployments incorporates the collection and storage of sera from each member of the military. Samples of sera that remain from the mandatory periodic (at least every 2 years) test for human immunodeficiency virus (HIV) infection are sent for stockpiling in Rockville, Maryland, and are under the care of the Armed Services Serum Repository. Samples from members of the National Guard and Reserves as well as from active-duty forces are collected and stored. The study team believes that collection of a serum sample within the 12 months preceding deployment, as specified in the DoD Joint Instruction on Medical Surveillance (U.S. Department of Defense, 1997a) provides an adequately recent predeployment sample should comparison with sera collected following a specific deployment be needed.

The Armed Services Serum Repository has proved to be useful in addressing questions about exposures to infectious agents by deployed forces. Sera obtained pre- and postdeployment from forces deployed to Bosnia were analyzed for antibodies to tick-borne encephalitis virus and hantavirus to assess the risks of infection with these agents. Similarly, sera from the Gulf War era were analyzed to assess seroconversion due to sandfly fever.

The study team finds the serum bank to be a valuable component of the health surveillance system, with uses beyond assessment of the hazards of spe-

cific deployments. These uses extend to assessment of broader health questions within the military and civilian populations. Recent applications of the serum bank include a large serological survey of military personnel for the prevalence of hepatitis C virus antibodies, and studies have examined potential serologic precursors of Hodgkin's disease and testicular cancer (Kelley, 1999b).

Although only the serum of blood samples is saved and stored, the cellular portion of blood could prove to be a future resource for assessment of exposures. DNA adducts of toxic compounds could be evaluated without intrusion into the privacy of the DNA code. However, at present the use of DNA information for anything but the identification of remains raises large ethical, legal, and social issues that the military must address even as society as a whole strives to evolve widely accepted policies. A series of special rules and procedures ensures the protection of privacy interests in the tissue specimen samples for identification of remains and any analysis of the DNA from these samples (U.S. Department of Defense, 1996c).

Surveillance for Drug- and Vaccine-Associated Adverse Events

Prevention of infectious diseases and protection of deployed forces from chemical and biological threats often require the use of vaccines, antiparasitic drugs, antibiotics, compounds that ameliorate the effects of nerve gas, and insect repellents. It is incumbent on the military to maintain accurate records of drug and vaccine use and to carry out effective surveillance for potential adverse events that may be related to a drug and or vaccine administration. Specific inquiries and definitive studies can be triggered when surveillance detects adverse events that may be linked to the use of drugs and biologicals.

Low-incidence events and possible combination effects are difficult to detect and relate to specific causes. Although difficult, precise evaluation of rates of adverse reactions to vaccines is essential. However, continued use of effective preventive measures will depend in part on how effectively and credibly such surveillance is carried out and how effectively the military responds to suspected adverse events. The first requirement for an effective program to monitor the effects of drugs and vaccines is maintenance of accurate records of vaccinations and drug use. This necessitates both computer-based patient records and a central database. A second requirement is mandatory reporting of medical conditions that may be related to drug and vaccine interventions singly or in combination. The IOM Committee on Interactions of Drugs, Biologics and Chemicals in U.S. Military Forces recommended in 1996 (Institute of Medicine, 1996b) that the services expand the Reportable Disease Surveillance System to include a larger list of conditions including neurological conditions, immune suppression and autoimmune conditions, and conditions related to liver and kidney toxicity. DoD has not acted on this recommendation.

Laboratory-Based Surveillance

Laboratory-based surveillance is the collection of diagnostic information on health events from central laboratories rather than from hospital discharge code databases or from clinicians. Implementation of a managed health care system within DoD over the last several years (with many fewer and shorter hospital stays and more outpatient treatment) has made the latter information sources insufficiently specific to be useful for epidemiology (Kelley, 1999a). The low sensitivity of provider-based reporting (Vogt et al., 1983; Hinds et al., 1985; Thacker et al., 1986; Standaert et al., 1995) and the low sensitivity and specificity of reporting based on the ninth revision of the *International Classification of Diseases* (ICD-9) for some conditions (Wenger et al., 1988; Guevara et al., 1996) are important reasons for the emphasis on laboratory-based surveillance (Harrison and Pinner, 1998).

At the same time, the managed health care system has taken a toll on the laboratory capability for public health surveillance. The new capitation systems reward the collection of information useful for treatment of individual patients but do not reward the collection of information useful for evaluation of the larger population. For example, a clinician does not need to know the precise strain of influenza virus with which a patient is infected to provide appropriate care for that patient. However, for public health reasons it is important to know the influenza virus strains causing current infections so that future vaccines will provide coverage against the prevalent strains and better protect the larger population (Harrison and Pinner, 1998).

Another relevant factor is the specificity level of diagnostic codes. Even for conditions diagnosed in the laboratory, surveillance in the military is carried out by using ICD-9-based reporting, with the single exception of the reporting of HIV infection. ICD codes are rarely useful for surveillance of infectious disease because the categories are generally too broad. Reliance on ICD-9-based reporting could produce a dichotomy in the quality of surveillance data between the civilian and military sectors (Harrison and Pinner, 1998). In one study, the ICD-9 code for pneumococcal pneumonia detected only 58 percent of cases of bacteremic pneumococcal pneumonia, and the positive predictive value was only 59 percent (Guevara et al., 1996). A study of *Haemophilus influenzae* infection indicated that the sensitivity of discharge diagnosis codes was 52 percent for meningitis and 24 percent for bacteremia (Wenger et al., 1988).

Recently, there has been a renewed effort to strengthen laboratory-based surveillance within DoD; this parallels a similar effort in the civilian community (McDonald et al., 1997; Centers for Disease Control and Prevention, 1997; Harrison and Pinner, 1998). One needed change for the military is in reporting requirements. Although military laboratories are required to report 21 different conditions to local civilian jurisdictions, they are not required to report any of these conditions directly to military health surveillance authorities. Central reporting of reportable conditions as well as information, on, for example, antibiotic resistance patterns within the military could provide information to support

preventive measures for both deployed forces and their dependents. Laboratory-based reporting could also help with the timely recognition of bioterrorism (Kelley, 1999a).

Improvements to laboratory-based surveillance do not require a new infrastructure with new laboratory space and staff. Existing resources could be reinforced and reorganized to better address the public health questions. What is necessary is the ability to carry out unusual tests on unusual infections of public health importance, expertise to develop or implement special procedures, protocols to evaluate unknown agents, and capabilities for molecular epidemiologic studies. One of the critical needs is to better capture and use data that are already being generated but that do not make their way to a central location for analysis and dissemination (Kelley, 1999a).

The information systems in use by laboratories do not efficiently collect and report data (Bolton, 1999). The Composite Health Care System used by DoD medical treatment facilities can generate an infection control report for a particular location, but data cannot be aggregated across different sites. As a result, electronic mail is used to report data to relevant bodies, or sometimes these data are simply logged into notebooks by hand (Bolton, 1999). Tremendous improvements to information systems are possible and are needed for laboratory data collection and reporting.

In 1997 the VA Infectious Disease Program Office implemented a national laboratory-based automated electronic surveillance tool called the Emerging Pathogens Initiative. Software installed at 142 VA facilities nationwide searches Patient Treatment File and laboratory data each night to match criteria for 14 pathogens of interest. Data are transmitted monthly from each site to the VA Austin Automation Center for review and processing and are ultimately provided to VA headquarters for assessment and response. The program has provided number of cases, case rates, and demographic data for several diseases of particular surveillance interest and might be considered a model of interest to the military.

The study team finds that measures are needed to reinforce the laboratory capability for public health surveillance within the military. Adequate people and resources are needed to support an effective laboratory-based surveillance system and to improve the information technology systems for such a system. Diagnoses should be coded with as much specificity as is sought in the civilian sector.

Defense Medical Surveillance System

The Defense Medical Surveillance System (DMSS) is a system of databases managed by the Army's Center for Health Promotion and Preventive Medicine. Data from several military medical databases as well as personnel and deployment rosters are linkable through this passive system. The databases include those for military inpatient data (since 1990), ambulatory care data (since 1996), reportable diseases, acute respiratory diseases, health risk appraisals, and HIV infection status (Table 4-1). Analysts at DMSS are able to link personnel and

medical databases to pose epidemiologic questions for a range of population levels, including the entire military or a particular service or for a range of deployment or demographic category-specific groups. The DMSS provides a valuable resource for military medical surveillance.

TABLE 4-1. Selected Data Tables Integrated Within the Defense Medical Surveillance System

Table	Source	Frequency	No. of Records	Service	Period of Time
Person[a]	DMDC	Monthly	6.4M	All	1990–1999
Demog[a]	DMDC	Monthly	53.9M	All	1990–1999
MEPS	MEPCOM	Monthly	6.4M	All	1985 1999
Deploy_PGW[b]	DMDC	Once	696K	All	1990–1991
Deploy[c]	DMDC	Monthly	282K	All	1993 1999
SIDR	CEIS	Monthly	1.6M	All	1990–1999
OJE_SIDR	PASBA	Weekly	6.5K	All	1996–1999
Deploy_Forms[d]	DST	Monthly	137K	All	1996–1999
SADR	CEIS	Monthly	22.5M	All	1996 1999
HIV_Tests[e]	Testing Labs	Weekly	20M	All	1985–1999
DoDSR	DoDSR	Weekly	23.2M	All	1985 1999
Casualty[f]	DIOR	Yearly	19.3K	All	1985–1998
HRA	CHPPM	Yearly	784K	Army	1990–1998
Reportable Events[g]	MTFs	Daily	48K	Army	1994 1999

[a] Person/Demog contain all persons on active-duty and in the reserve component.
[b] Deployment roster for the Gulf War.
[c] Deployment roster for major deployments since the Gulf War.
[d] Health assessment questionnaires administered before and after major deployments.
[e] Data from mandatory HIV tests performed on DoD personnel and applicants at Military Entrance Processing Stations.
[f] Casualty data on active-duty deaths.
[g] As outlined in the Tri-Service required list of reportable events.

NOTE: DMDC = Defense Manpower Data Center; MEPCOM = Military Entrance Processing Command; MEPS = Military Entrance Processing Stations; SIDR = Standard In-Patient Data Record; CEIS Corporate Executive Information System; PASBA = Patient Administration Systems and Biostatistics Activity; SADR = Standard Ambulatory Data Record; DoDSR U.S. Department of Defense Serum Repository; DIOR = Directorate for Information, Operations and Reports; HRA = Health Risk Appraisals; CHPPM = U.S. Army Center for Health Promotion and Preventive Medicine; MTF = Military Treatment Facility; K = thousand; and M = million.

SOURCE: U.S. Army Medical Surveillance Activity (1999).

A subset of data from DMSS without personal identifiers is available for analysis via remote access through an application called the Defense Medical Epidemiologic Database (DMED). With DMED, users can perform queries regarding disease and injury rates and relative disease burdens in active duty populations. Registration and access to DMED is available through the Army Medical Surveillance Activity web site, http://www.amsa.army.mil.

Global Surveillance for Infectious Disease Threats to Military Operations—Role of Overseas Medical Laboratories

Information on infectious diseases endemic in regions of high military and strategic interest to the United States is an important component of predeployment medical intelligence. It enables the armed services to implement preventive measures tailored to known threats that can severely hamper military operations. Appropriate vaccines, prophylactic drugs, insect repellents, and pesticides can be most effectively used if the disease threats are recognized and fully understood. Epidemiological studies of infectious diseases in local populations are the best sources of such information.

Since the turn of the century, military medical organizations conducting infectious disease research in regions of military interest have been a rich source of information used to guide military preventive medicine doctrine and policy. Seven different overseas medical research laboratories are in operation. Laboratories in Thailand, Brazil, Kenya, Indonesia, Egypt, and Peru focus on infectious diseases, whereas a laboratory in Germany conducts psychosocial research related to military personnel and their families (Gambel and Hibbs, 1996). These laboratories, operated by military medical research personnel augmented by local national scientists, conduct biomedical research and provide insight into regional epidemiological events. They are primarily involved with advanced product development, including efficacy testing in accordance with licensing requirements. They have proved to be a uniquely capable test bed for treatment and preventive medicine measures against a host of militarily important diseases such as malaria, leishmaniasis, hepatitis, bacterial diarrheas, Japanese encephalitis, scrub typhus, leptospirosis, and dengue (Gambel and Hibbs, 1996).

In addition to carrying out testing of diagnostic tests, vaccines, chemoprophylactic agents, and insect repellents to benefit both military and civilian populations, the overseas laboratories have provided sophisticated laboratory support during military deployments such as Operations Desert Shield and Desert Storm (the Gulf War) and Operation Restore Hope (Somalia), and during major field exercises. The laboratories are also an important training resource for the infectious disease and preventive medicine specialists, epidemiologists, microbiologists, entomologists, and research scientists needed by the military during deployments.

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As infectious disease threats continue to change and emerge worldwide, the value of these laboratories to military preventive medicine increases. However, funds and personnel resources for these laboratories have been substantially reduced over the past several years, diminishing the ability of these units to carry out their missions (Institute of Medicine, 1999a).

While it cannot remedy the personnel problems at the overseas laboratories, the new DoD Global Emerging Infectious Disease Surveillance and Response System will provide for some improvements in global surveillance. The program began with a presidential directive in June 1996 to carry out four surveillance goals: systems research, development, and integration; response; training; and capacity building (Walter Reed Army Institute of Research, 1998). The improved funding planned for these laboratories will help to improve their eroded capability. However, the professional personnel issues remain a concern, in that limited personnel slots are budgeted to provide support to these laboratories—qualified personnel can be recruited but not retained. Thus, the service medical departments have insufficient professional personnel quotas to fully staff the overseas laboratories (Institute of Medicine, 1999a).

Deployment

Pre- and Postdeployment Questionnaires

Beginning with the deployment to Bosnia, DoD has instituted an effort to carry out brief health screens on personnel before and immediately after specified deployments. The screens include questions on physical and mental status and are meant to help determine the medical readiness of individuals for the deployment and any change in health status upon their return.

The data collected from these questionnaires are not very useful for providing a thorough baseline measure of health status for personnel or assessment of the health of personnel upon their return. Before deployment, the questionnaires are given at a time when the service member is harried and anxious. After a deployment, the service member is in a tremendous hurry to complete paperwork hurdles to return home. Thus, although these questionnaires might in some cases be useful for pinpointing the start of a service member's concerns about his or her health or documenting some unexpected or unusual exposure, they are not critical for routine medical surveillance. At present there are concerns that the postdeployment questionnaires are not carefully reviewed, so that any red flags that they might raise about exposures during deployments are not being noted (Green, 1999). In addition, predeployment questionnaires are apparently

not being completed for many of the troops deployed to Kosovo (Bailey, 1999b). The study team believes that the information potentially gathered from these pre-and postdeployment questionnaires could be better gathered from a regularly administered survey such as the HEAR, when the information is more likely to be valid and the responses can be more readily addressed.

Capture of Ambulatory Care and Inpatient Data During Deployments

During a deployment, the most important component of medical surveillance is the capture of ambulatory care and inpatient data. These data can provide information to allow implementation of preventive interventions and can also help with the recognition of patterns suggestive of chemical or biological warfare agent use (Institute of Medicine, 1998). They also provide records of reported health problems that could prove useful after a deployment.

Weekly reports of disease and non-battle injury rates (DNBI) within each unit are reported up the medical chain of command. Visits to sick call are logged into one of the DNBI categories, which include combat/operational stress reaction; dermatological; gastrointestinal, infectious; gynecological; several different categories of injuries; ophthalmologic; psychiatric, mental disorders; respiratory; sexually transmitted diseases; unexplained fever; all other medical/ surgical; and dental (Joint Chiefs of Staff, 1998). DNBI reports can provide a useful source of data on these conditions.

No consistent automated means of carrying out this information capture and dissemination is yet available; the different services use different systems. Although these systems are similar and accomplish similar ends, they are all fairly new and could benefit from an exchange of lessons learned for considering a system that could be applicable in a variety of situations with data shared across services. The proposed Theater Medical Information Program (TMIP) is planned to incorporate this capability, but the program it would use to carry out this function has not yet been designated.

There are several challenges to a DoD-wide approach, however. The information management community is responsible for the development of automated medical surveillance systems, and the preventive medicine community is only peripherally involved (Institute of Medicine, 1998). Systems already in use by some services would not be readily applicable across the services because most Army battalion aid stations still do not have computers and are using "stubby pencil" technology (Institute of Medicine, 1998, 1999b).

Another important aspect of the ambulatory and inpatient data collected during deployments is the quality of the data collected. While it is understandable that during the heat of battle attention to record keeping might be decreased, the system should work well in non-battle conditions. The study team learned that the commitment to collecting and reporting ambulatory data at the unit level is variable and frequently low. Furthermore, those assigned to such work are often not adequately trained for the task (Institute of Medicine, 1999b). Further problems

arise when the DNBI tracking systems are perceived as workload reports, leading to the reporting of administrative events or encounters that are not relevant to disease or injury (Institute of Medicine, 1999b). Each time that a new rotation of service members is deployed, training must be repeated. Additional challenges arise in joint-operations settings, in which the three different cultures of data collection and three sets of case definitions come into play. Mental health visits during deployments are not being captured in any electronic system and only infrequently in medical records (Institute of Medicine, 1999b).

The data referred to above are aggregate data. Individual-level data are only beginning to be collected by one of the services (Institute of Medicine, 1999b) and require active entry by providers after hours because of limitations in the numbers of terminals available. The availability of health care data on individuals is clearly critical to understanding the health outcomes of individual service members after a deployment.

Inpatient data are derived from administrative systems not designed for epidemiologic surveillance. The data can therefore be difficult to interpret without understanding, for example, that pregnancies in a theater of operation require medical evacuation. Therefore, for administrative reasons, those who are pregnant require hospitalization. Data from health care provided by host nation facilities and individuals, which are important in the Southwest Asia theater of operations, are not captured (Institute of Medicine, 1999b). As the medical infrastructure deployed ("medical footprint") in future deployments is very likely to decrease, the problem of capturing data from care provided by host nations will continue or grow.

Theater Medical Information Program

TMIP is being planned as a system integration program that will coordinate functioning health information systems. Although it holds promise for the future, when health information systems such as the Composite Health Care System II are further developed, it does not provide additional capability at present. Ultimately, it is planned to be integrated into the line communications, to "organize medical functions into logical, manageable business areas," and to "implement seamless, interoperable systems based on standards based infrastructure" (U.S. Department of Defense, 1998c). Although it is planned to be deployed in 1999, no training, implementation, or infrastructure is yet available to support it (Institute of Medicine, 1999b).

Identifying Deployed Populations

In a system that has not improved since the Gulf War, information about which units are deployed to a theater and who is present in the units is gathered separately by each service and is transmitted to the Deputy Chief of Staff for

Personnel and then to the Defense Manpower Data Center. The information is often inaccurate or out of date with respect to the movement of individuals within and in and out of the theater of deployment. Health concerns raised after the Gulf War highlighted the difficulties of finding out where units had been on given days and at given times and, beyond that, the near impossibility of knowing the locations of individuals. The same problems had been brought out by efforts to estimate exposure to Agent Orange during the Vietnam War.

A series of committees and panels considering the health problems of Gulf War veterans have noted the need for an improved ability to track the movements of deployed individuals, particularly to be able to better know about exposures that they might experience (Institute of Medicine, 1996a; Presidential Advisory Committee on Gulf War Veterans' Illnesses, 1996b).

Despite an apparent consensus that such information is necessary, it is not clear that current deployments involve any improved capabilities. Slowly, plans are being made for a new system called the Defense Integrated Military Human Resources System to provide improved personnel data for all uses, but these plans are still in early stages (St. Claire, 1998) and are thus difficult to evaluate. It is important that representatives of the preventive medicine community such as the Joint Preventive Medicine Policy Group as well as other users of the system be involved as the system requirements for the system are developed.

For the purposes of medical surveillance during a deployment, personnel information including the numbers of service members in a given unit are needed to provide denominators for the calculation of rates of reportable diseases and injuries. An improved system of collection and dissemination of these data will be helpful to the preventive medicine community as well.

Deployment Exposure Data

A clear lesson learned from the Gulf War was the need for the collection of better exposure data during deployments. Exposures of interest include both environmental exposures and exposures to vaccines and other protective agents. The report from a study carried out concurrently (National Research Council, 1999b) addresses exposure assessment from environmental agents, and Chapter 5 in this report discusses DoD efforts to better document immunizations in the individual medical record. Documentation of environmental exposures in individual medical records is a tremendously challenging task, but one that will be necessary to better address questions of long-term health risks from deployment exposures.

Postdeployment Medical Surveillance

Immediate Postdeployment Surveillance

The new surveillance policies described earlier have brought changes in procedures for medical surveillance immediately after a deployment. One com-

ponent is the completion of a postdeployment questionnaire as described earlier. The questionnaire includes questions pertaining to both physical and mental health symptoms and provides service members the opportunity to express concerns that they may have about their health and that could be followed up with further examinations when they return from a deployment. Service members are to complete the screening before departure from the area of operation or, failing that, within 30 days of their return. Postdeployment assessments of reserve component personnel must be completed before release from active duty.

In conjunction with the postdeployment screening, however, is the collection of an additional blood sample from troops who participate in a designated deployment. Serum from 10 milliliters of blood from each redeploying service member is sent to the Armed Forces Serum Repository. The sample is intended to be collected while service members are still in the theater of operation, but failing that, it is to be collected within 30 days of the return home.

As noted earlier, the study team believes that a regularly administered survey, such as an improved version of the HEAR, should obviate any benefit from pre- and postdeployment surveillance questionnaires. The postdeployment serum samples have proved to be useful and should be collected as deemed necessary for pre- and postdeployment comparisons.

Routine Postdeployment Surveillance

Aside from the completion of a brief self-reported health questionnaire and the collection of a blood sample from returning service members, no plans for additional special efforts for medical surveillance of returning troops have been articulated by the DoD or VA. Those who remain on active duty in the military would resume care under their unit's regular garrison or shore provider. This would include an annual HEAR survey and physicals at periodic intervals. Any hospitalizations or visits to the clinic that they experience would ultimately be included in databases linked by DMSS, although with some lag time.

It is far more difficult to monitor the health of the population of service members who separate from the military after a deployment or members of the National Guard and Reserves who return and are then deactivated. No longer eligible for care from the DoD after past deployments, they have been on their own for medical care unless they suffer from health problems that are determined to be service connected, which entitles them to care through the VA medical system. They thus receive care from an array of civilian providers or if they are medically uninsured, may be hindered from seeking medical care at all. Since their medical care is provided by many different sources, there is no way to easily track their health care and be alerted by unusual rates of illnesses or health care use. In fact, without additional information gathering and analysis there is no way to determine the "usual" or expected rates of illnesses or health care for this group.

New legislation improves upon this situation. Language in the Veterans Benefits Improvement Act of 1998 (P.L. 105-368) provides that service members who serve on active duty in a theater of combat operations during a period of war or hostilities be eligible for medical care for a period of 2 years following their return. The care would include hospital care, medical services, and nursing home care.

It is crucial that this medical care be provided by caregivers familiar with features of the deployment and the particular concerns of returning veterans. As a result of the health concerns of veterans after the Gulf War, VA has put a tremendous effort into informing its caregivers about the concerns of veterans, with mixed success. After future major deployments, similar efforts are needed to familiarize caregivers with the experiences and concerns of veterans so that they can provide care appropriate to needs of veterans.

The 2 years following a deployment are a critical time in the development or precipitation of medically unexplained symptoms. It is important that deployed service members (active and reserve components) be monitored so that health care providers can respond to health problems and unexplained physical symptoms that will become apparent over time. One possibility is to administer the HEAR to a sample of all veterans after a deployment. Those still on active duty will complete it periodically as part of their routine care, but it would need to be mailed to those veterans who have separated from the military, requiring expense and concerted effort. A sample of recently separated service members who had not deployed could be included for comparison. The HEAR would be a questionnaire with which service members are familiar, and their predeployment responses to the same questions would be available for comparison. Responses that suggest that the veteran has many physical symptoms could be responded to with care and counseling as needed to try to prevent the further progression of the problem and the development of chronicity (this is described in more detail in Chapter 6).

A survey instrument such as the HEAR must be used with consideration and acknowledgment of the characteristics of self-reported data. Several studies have indicated that health information provided through self-reporting is not necessarily concordant with data from more objective sources such as medical records (Gordon et al., 1993; Kriegsman et al., 1996; Fowles et al., 1997; Bergmann et al., 1998). However, an individual's perception of his or her health status is a critical aspect of health. If people perceive themselves to be in poor health, then they are likely to have some need for care and support, even if the needs and problems are as yet medically unexplained. It is important to address these individuals' health concerns to prevent further progression or disability.

Deployment-Related Registries

Medical care was not readily available for many veterans who were concerned about symptoms that they experienced after deployment to the Gulf War.

In time, both VA and DoD established programs to provide medical evaluations and referrals for these veterans. The VA Persian Gulf Registry Health Examination Program (established in 1992) offers a free, complete physical examination with basic laboratory studies to every Gulf War veteran, whereas DoD's Comprehensive Clinical Evaluation Program (established in 1994) provides similar evaluations to Gulf War veterans still on active duty. Together, these two programs have provided health evaluations to more than 100,000 veterans with health concerns related to their Gulf War service.

Such registries were developed to meet a clear need in the veteran community for health care and for information about the deployment and the illnesses reported by Gulf War veterans. Indeed, the programs have developed to the point where they provide such information far better than civilian caregivers would be able to. The registries do not, however, fill the role of providing medical surveillance in a way that would be desirable after future deployments. Although they do capture health information from veterans who are concerned about their health, they are not based on a case definition of an illness.

After future deployments, the fact that medical care will be covered for 2 years after a designated conflict should permit changes in the way that health information is gathered from veterans who are concerned about their health. Rather than naming a special deployment-specific registry with a protocol unique to the deployment, veterans can simply receive health care as needed from the designated sources. The information should be captured and can be used to the extent to which it is used now to provide data on the symptoms and diagnoses experienced in this population. According to the National Science and Technology Council's Presidential Review Directive 5, DoD and VA plan to institute deployment-specific registries again as needed after future deployments (National Science and Technology Council, 1998). The study team discourages this approach, preferring that quality care be provided to service members after a deployment without a need for attribution to the deployment.

Long-Term Surveillance

Monitoring the health of a cohort of veterans over a long period grows increasingly difficult as, over time, veterans separate from the military and receive their medical care in the civilian sector. Although the ascertainment of mortality for such a group remains relatively straightforward, the collection of any information about morbidity requires far greater resources. DoD and VA plan to work toward the use of a medical record that is seamless between the two organizations (this is discussed in Chapter 5). Such a record would be of help, but it could not address the large numbers of veterans who seek health care outside the VA system. Health data for these veterans would have to be gleaned through surveys or very expensive reviews of medical records where they could be obtained. The available data should be used to try to assess the health of deployed

forces over the long term, with an effort to note the limitations of the data and with research to better understand the biases in the data.

Reproductive Outcomes

A number of adverse reproductive outcomes have been reported by recent veterans, and it remains plausible that current and future military personnel will continue to express such concerns. This is due in part to the increasing percentage of females in the military, greater societal awareness about reproductive health issues in general, and increasing scientific recognition of the reproductive and developmental toxicities of various environmental or occupational exposures (as well as several lifestyle factors).

Increasing concern about adverse reproductive effects may reflect, in part, the clustering of some outcomes in select subpopulations. Clusters of miscarriages, birth defects, and childhood cancers have been reported in civilian populations. Although the cause of most clusters is often not known despite concerted study, there is a growing (albeit limited) literature to support the reproductive and developmental toxicities of many chemicals and other exposures including those that are voluntary (e.g., cigarette smoking).

Surveillance for reproductive outcomes should be considered a part of overall health surveillance. The reason for such an approach is simple. Reproductive processes are broad in scope and have an impact on human health throughout life. For example, nulliparous women are at increased risk of several gynecologic cancers, and men with impaired fecundity may be at increased risk of testicular cancer (Depue et al., 1983; Brinton et al., 1989; Meirow and Schenker, 1996; Moller and Skakkebaek, 1999). Hence, adverse reproductive outcomes have the additional potential to affect morbidity (and, indirectly, mortality) over one's lifetime. Consideration of reproductive health is in keeping with the mission to deploy healthy, fit, and physically and mentally ready military forces.

Surprisingly, much of the attention given to so-called adverse reproductive effects focuses on perinatal outcomes such as birth defects; less attention is given to the spectrum of potential reproductive and developmental outcomes. Surveillance for birth defects alone will not provide the military with a complete picture of reproductive health in deployed forces. To achieve this, information must be collected on a spectrum of endpoints that reflect the processes underlying human reproduction. It should be noted that a complete and updated reproductive and urologic history is critical for assessing adverse effects after deployment-related exposures. It is imperative to have a baseline reproductive history for both men and women, given the tendency for adverse pregnancy outcomes to be repeated in successive pregnancies (Bakketeig et al., 1979; Khoury et al., 1989; Lie et al., 1994; Raine et al., 1994).

There is little surveillance for reproductive outcomes in the general U.S. population, which makes it exceedingly difficult to obtain baseline estimates for military purposes. One notable exception is the live birth registries maintained

by all states. Since 1985, all states submit birth certificate data by tape to the National Center for Health Statistics (NCHS). Although birth certificates may vary across states in terms of the type of data recorded, NCHS offers the U.S. Standard Certificate of Live Birth as a model for use by individual states. Thus, a minimal data set is available for all states.

The literature focusing on the accuracy and reliability of birth certificate data suggests that both vary by type of data item listed on the certificate (Carucci, 1979; Buescher et al., 1993; Piper et al., 1993; Emery et al., 1997; Costakos et al., 1998; Green et al., 1998) as well as by type of hospital reporting information (Parrish, 1993). Typically, agreement is highest for statistical and demographic data (>92 percent) and is lowest for medically relevant data about the pregnancy (Carucci, 1979; Buescher et al., 1993; Schoendorf et al., 1993). For key perinatal outcomes such as preterm delivery, live birth registries may be subject to misclassification bias on gestational age (Emery et al., 1997). The lowest rate of accuracy is found for birth defects (Snell et al., 1992). Tremendous underreporting of birth defects on birth certificates has been reported, stemming in part from delays in diagnosis or clinical variations in the recognition of defects.

Live birth registries can be linked with death registries to assess perinatal and infant mortality outcomes. Live birth registries also can be linked to other state registries such as birth defect or fetal death registries, if such registries are available. However, few states have such registries, and if they do they tend to use passive and not active surveillance mechanisms. Live birth registries may provide useful information on vital status and other outcomes such as multiple births, reductions in birth size and gestational age, and secondary sex ratios. Another important aspect of live birth registries is that they maintain a minimal data set on other potential confounders of adverse pregnancy outcomes (e.g., prior history of adverse outcome or lifestyle factors such as smoking or weight gain). Use of vital registry data for military populations must take into account whether the military component (active-duty or reserve status) or deployment status affects reporting of live births (or fetal deaths) or the accuracy of the recorded information.

It is important to note that surveillance for rates of live births or standardized fertility ratios alone will provide only crude data on the reproductive health of deployed forces. Essentially, live births reflect successful reproduction but do not necessarily provide insight into adverse outcomes that do not manifest in a live birth. Indeed, only 25 percent of all pregnancies result in a live birth (Kline et al., 1989). Accurate and reliable information on live births serves as denominator data when estimating rates of other adverse perinatal outcomes such as the prevalence of birth defects, low birth weight, or pre- or postterm delivery.

Surveillance for birth defects may be of particular concern for ensuring the reproductive health of deployed forces given growing evidence about the developmental toxicities of many chemicals and related environmental exposures, reported clustering of defects in select subpopulations, and the emphasis on birth defects in the media. Ascertainment of birth defects is not a straightforward process and is often hindered by a lack of available data or mechanisms for identi-

fying defects for any given population. In the United States, 31 states have congenital malformation registries, 4 are in the process of implementing registries, and 3 are considering them. States that use passive surveillance mechanisms rely largely on hospital discharge records and may underascertain birth defects. Surveillance for birth defects requires considerable effort if reliable estimates are to be ascertained. Discussion of methodologic issues and a minimal data set are beyond the scope of this report and are provided elsewhere (Eskenazi, 1984; Holtzman and Khoury, 1986; Kallen, 1988).

Further problems associated with monitoring of birth defects include how defects should be defined and counted. For example, should both major and minor defects be counted? Should multiple or single defects be counted? Should genetic defects be counted or excluded? Recognition of birth defects varies across practitioners, and requirements mandated by states also vary (if reporting is required at all). Also, it is important to note that the majority of fetuses with birth defects are spontaneously aborted before birth, hence the need to refer to the prevalence of defects among live births. Recently, upon completion of a feasibility study, the Emerging Illness Division of the Naval Health Research Center concluded that the construction of a DoD-wide birth defects registry is feasible using a hybrid of active and passive surveillance mechanisms (Bush et al., 1999). Although such a registry might prove to be helpful in addressing concerns about birth defects following future deployments, a more sensitive indicator of reproductive health effects might be gathered through the collection and monitoring of reproductive health histories. A modified or refined version of a regularly administered survey such as the HEAR might accommodate this function.

Given that partners can change over time, it is imperative for any surveillance system to use unique identifiers so that individuals (parents and children) can be followed over time and linked with other health databases. As discussed earlier, baseline reproductive histories should be periodically updated, especially before and after deployment, and they should query personnel about subtle outcomes. Prevention of exposure to known and potential reproductive and developmental toxicants by deployed forces will help to ensure the reproductive and overall health of deployed forces (Palmer et al., 1992; Leon et al., 1998), including that of their dependent children. In sum, reproductive processes are broad in scope and have the potential to affect health status throughout life. The military cannot afford to ignore such human health endpoints.

At this time, the evaluation and analysis of data necessary for surveillance take place in a variety of settings in the different services, with special resources involved for specific deployments. While key databases are included in the DMSS and this unit has progressed toward capability for DoD-wide analysis, services also carry out their own surveillance activities. The study team acknowledges that some surveillance resources may necessarily be service-specific or deployment-specific, but urges DoD-wide coordination and oversight from a central authority and encourages the ongoing efforts in this direction through DMSS. Surveillance needs of the reserves must be included. The need for leadership and coordination in data analysis is related to the need described else-

where in this chapter for leadership authority and accountability for coordination for preventive medicine and environmental and health surveillance across the U.S. Department of Defense and the individual services.

Confidentiality of Health Information

Several of the military's current and proposed instruments (both proposed by the military and recommended by this report) collect sensitive health-related data (e.g., mental health status, reproductive health issues, HIV infection status, childhood sexual abuse, and alcohol abuse). As these instruments are developed and used, questions should arise, such as how will the data be used, who will use them, and what protections are available to prevent abuses of the data and to protect the interests of those who complete the questionnaire?

It is anticipated that the data will be used for subsequent clinical decision making and management and for research. Both types of uses may be analogous to some uses of ordinary civilian medical records. For instance, it is unremarkable for a civilian medical record to include information about alcohol abuse or mental illness when that information is of potential utility in managing a variety of maladies. Similarly, health services research makes use of civilian records to study resource utilization, institution and provider performance, and other processes and outcomes.

Challenges arise when personal health information is used for purposes other than the provision of health care. For instance, will such data be used to determine assignments, postings, promotions, or other service-related matters? Given that the record may be maintained throughout a recruit's military career and perhaps after the military career, might the data be used to determine eligibility for future health benefits?

Because DoD is the employer, the issues here parallel those that arise in the context of occupational health. Although it is sometimes argued that employers should be able to use health data to make employment decisions, a noteworthy counterargument is that health records are inferior to on-the-job performance as tools for evaluating an individual's success.

Because reservists get care from civilian providers, and some active-duty service members may also seek private care, questions regarding the confidentiality of civilian records may arise. Military physicians or others currently cannot have access to civilian provider medical records without the consent of the patient. Therefore this consent and information about the intended uses would be needed to establish any links with civilian providers.

Currently, military medical records include a sheet entitled "Privacy Act Statement—Health Care Records" signed by the patient as the record is begun. It notes the following routine uses of the data:

> The primary use of this information is to provide, plan and coordinate health care. As prior to enactment of the Privacy Act, other possible uses are to: Aid

> in preventive health and communicable disease control programs and report medical conditions required by law to federal, state and local agencies; compile statistical data; conduct research, teach; determine suitability of persons for service or assignments; adjudicate claims and determine benefits, other lawful purposes, including law enforcement and litigation; conduct authorized investigations; evaluate care rendered; determine professional certification and hospital accreditation; provide physical qualifications of patients to agencies of federal, state, or local government upon request in the pursuit of their official duties. (DD Form 2005, February 1976)

As described in Chapter 5, the data from these instruments will be stored electronically. This will have the positive effect of making it comparatively easy for appropriate health professionals to access the data. It also means that it might be comparatively easy for inappropriate persons to access the data. As the instruments continue to be developed, it is important that clear statements of the intended uses of the data be provided and that guidelines and policies for considering subsequent modifications to that list be developed and made available. In addition, identification of the kinds of personnel who will have access to the data should be noted. (Note that such an effort will be complicated to the extent that the medical record is planned to be made available to nonmilitary entities, including the VA medical system, after an individual's discharge.) Finally, confidentiality and electronic security policies, referred to in Chapter 5, as well as the extent to which surveillance constitutes human subjects research, should be clarified.

FINDINGS AND RECOMMENDATIONS

Finding 4-1: The collection of uniform survey data from all recruits upon entrance into the military can provide valuable baseline health data from individuals and provide population data useful for understanding the development of disease and injury.

Recommendation 4-1: The Recruit Assessment Program should be implemented to collect baseline health data from all recruits (active-duty, National Guard, and Reserve) and should be periodically reassessed and revised in light of its goals. Its data should be used prospectively to test hypotheses about predisposing factors for the development of disease, injury, and medically unexplained symptoms.

Finding 4-2: Annual collection of health risk information through a survey should facilitate the implementation of preventive measures within the entire military population and provide valuable baseline health information. The instrument should be carefully designed for maximum benefit of health assessments and preventive medicine efforts, including those for medically unexplained physical symptoms and reproductive health.

Recommendation 4-2a: Annually administer an improved Health Evaluation and Assessment Review to reserve as well as to active-duty personnel to obtain baseline health information. When it suggests that an intervention is warranted, alert the individual and encourage him or her to seek care in the civilian sector.

Recommendation 4-2b: Refine the Health Evaluation and Assessment Review by drawing on additional survey instrument and subject matter experts. Make the categories more clinically relevant, and modify or add questions relevant to signs of medically unexplained physical symptoms (sleep disturbances or general symptoms without apparent medical explanation). Modify or add questions relevant to fertility to provide more sensitive indicators of adverse reproductive effects. Validate the questionnaire with comparison of results to those obtained through individual interviews.

Finding 4-3: The potential uses of and protections for sensitive health information are not necessarily known to service members.

Recommendation 4-3:

- **When sensitive information is collected from service members, make clear statements of its intended uses including the types of personnel who will have access to it.**
- **Develop and make available guidelines and policies for the drafting of such statements and the identification of such personnel.**
- **Establish a process to review ethical issues related to data collection and use.**

Finding 4-4: The Armed Forces Serum Repository is important and necessary.

Recommendation 4-4: Continue the Armed Forces Serum Repository by ensuring that the policies regarding timing and frequency of the serum collections in the Joint Medical Surveillance Directive and Instruction are adhered to.

Finding 4-5: The current disease reporting and surveillance system has not been expanded to increase the likelihood of detecting potential adverse effects of drugs and vaccines.

Recommendation 4-5: The U.S. Department of Defense should follow the recommendation of the 1996 Institute of Medicine study, *Interactions of Drugs, Biologics, and Chemicals in U.S. Military Forces* (Institute of Medicine, 1996b) and include potential adverse medical effects of drugs and biologics in the list of reportable conditions.

Finding 4-6: Improved laboratory surveillance is possible through better capture and use of data that are already being generated but that do not make their way to a central location for analysis and dissemination. Current information technology systems for the reporting of laboratory information to central locations are not user-friendly and provide barriers to the effective collection and dissemination of information.

Recommendation 4-6: Reinforce the laboratory capability for public health surveillance within the military. Mandate central reporting of laboratory findings of reportable conditions. Commit adequate personnel and resources to support an effective laboratory-based surveillance system with the information technology systems needed for efficient collection and reporting of data. Code diagnoses with levels of specificity comparable to those used for civilian health surveillance practices. Continue to provide increased resources to overseas laboratories for surveillance in regions of military interest.

Finding 4-7: The pre- and postdeployment health questionnaires do not provide useful baseline or postdeployment health status information because of the circumstances under which they are administered. The predeployment questionnaire is compromised by the mental state of the deploying soldier and the implicit influence from commanders not to flag any problems, and similarly the postdeployment questionnaire is completed in a rushed manner when other interests (getting home or getting compensation) may dominate.

Recommendation 4-7: Discontinue pre- and postdeployment questionnaires unless they are warranted for military reasons other than gathering baseline and postdeployment health status information (as readiness indicators, for example, or to flag topics in areas in which improved risk communication is needed). In their stead, annual administration of an improved Health Evaluation and Assessment Review should provide better information on the health of the service member to provide baseline and postdeployment assessments.

Finding 4-8: Reporting of aggregate disease and non-battle injury (DNBI) data during deployments has improved, although the quality of the data probably has not. Data on the health of *individuals* is still not adequately recorded in a manner that can be used later. Data from host nation and referral care, which are important contributions to care in some deployment theaters, are not captured. The U.S. Department of Defense needs to select a single data collection and reporting system for deployments workable in different settings. This is planned to occur through the Theater Medical Information Plan development process.

Recommendation 4-8: As quickly as possible, implement a deployment disease and non-battle injury (DNBI) surveillance system that is integrated with the patient care information system and that automatically reports information to a central medical command. Continue efforts to capture data at

the individual as well as the aggregate levels during deployments. Provide adequate training to those who report the data at the small-unit level and assign accountability for the quality of the data provided. Provide more preventive medicine support in the field during deployments both to improve the quality of the data reported and to provide sufficient support for disease outbreaks. Develop means of capturing inpatient data from all providers who serve U.S. service members during deployments.

Finding 4-9: It is crucial that exposures that occur during deployments be recorded in individual medical records. Some progress has been made in developing means of recording the receipt of medical prophylactics such as immunizations, but it remains unclear how environmental surveillance data will be documented in individual medical records. A necessary step will be improvement in the collection and documentation of information about the locations of troops on a daily basis, as discussed by a sister NRC report (National Research Council, 1999b).

Recommendation 4-9: Integrate the efforts of environmental surveillance, preventive medicine, clinical, and information technology personnel to ensure the inclusion of medically relevant environmental and other exposures in the individual medical record.

Finding 4-10: Formerly, people who separated from the military following a deployment were eligible for government (U.S. Department of Veterans Affairs) medical care only when they were determined to have a service-connected condition. The Veterans Benefits Improvement Act of 1998 (P.L. 105-368) provides that service members who serve on active duty in a theater of combat operations during a period of war or hostilities be eligible for medical care for a period of 2 years after their return. The provision of this care without need for establishment of a service connection provides a valuable opportunity to ascertain the health needs of this population, including medically unexplained symptoms. It will be important to determine who uses this care and how well data surrounding this care can be captured from the U.S. Department of Defense and U.S. Department of Veterans Affairs providers and their contractors.

Recommendation 4-10: Carry out studies to evaluate the data captured from the 2 years of care provided after a deployment. Try to determine the extent to which the data are representative of the population of service members who deployed and whether they could be used to indicate the health of service members after a deployment.

Finding 4-11: Despite the limitations of self-reported data, the Health Evaluation and Assessment Review is another means by which the health of the forces can be monitored after a deployment. Service members who remain on active

duty will continue to complete it, but special effort would be required for its administration to a sample of service members who separate from the military.

Recommendation 4-11: In addition to continuing to provide the Health Evaluation and Assessment Review (HEAR) to active-duty troops, annually administer the HEAR to a representative sample of service members who have separated from the service for 2 to 5 years after a major deployment to track health status and identify concerns including medically unexplained symptoms. Also administer the HEAR to those separated service members who seek health care during the 2 years after a deployment. Evaluate the validity and usefulness of the information collected.

Finding 4-12: Deployment-specific registries such as those established for Gulf War veterans do not fill the role of providing medical surveillance in a way that would be desirable after future deployments. Although they do capture health information from veterans who are concerned about their health, they are not based on a case definition of an illness. After future deployments, the fact that medical care will be provided for 2 years after a designated conflict would permit changes in the way that health information is gathered from veterans who are concerned about their health.

Recommendation 4-12: Avoid whenever possible the creation of deployment-specific registries. Depend, instead, on the data provided by routine medical care under the Veterans Benefits Improvement Act of 1998 (P.L. 105-368) and the annual Health Evaluation and Assessment Review.

Finding 4-13: Concerns over long-term health effects of deployments have increased. Data are needed to answer questions about the long-term effects of deployments and a variety of deployment-specific exposures.

Recommendation 4-13: Carry out surveillance to look for differences in mortality and morbidity between deployed veterans and comparison populations over the long term after major deployments. Include inpatient and ambulatory care data for service members who remain on active duty; data from the Health Evaluation and Assessment Review administered to active-duty service members, members of the reserves, and a sample of separated veterans; and inpatient and outpatient data from U.S. Department of Veterans Affairs facilities. Follow up with additional studies as indicated.

Finding 4-14: No systematic collection of standardized data on the reproductive histories of service members exists. Basic endpoints (i.e., gynecologic and urologic disorders, menstruation, sexual dysfunction, and impaired fecundity and fertility) are not consistently available as part of the medical record. Although the Health Evaluation and Assessment Review asks for some reproductive information, it is not designed to elicit the breadth of information needed.

Recommendation 4-14: The U.S. Department of Defense should develop, test, and field a questionnaire to capture reproductive endpoints. The questionnaire should be used to obtain reproductive histories upon joining the military and should be updated periodically as part of the Health Evaluation and Assessment Review or some other regularly administered instrument. Reproductive histories should inquire about a spectrum of fecundity- and fertility-related outcomes to ensure that reproductive health (and not just childbearing) has not been compromised.

Finding 4-15: A military birth defects registry would provide an insensitive measure of developmental toxicity stemming from maternal or paternal exposure(s) but would be an improvement over currently available information. This approach would be more complete and timely than record linkage studies with state-based birth defects registries. However, the conceptualization and establishment of such a registry require concerted effort and expertise to ensure the utility of the collected data, including consideration and planning for the methodologic nuances of birth defects and barriers to case ascertainment beyond that carried out in the recent Naval Health Research Center feasibility study.

Recommendation 4-15: The U.S. Department of Defense should proceed to establish a birth defects registry, although it should clearly acknowledge the critical limitations of such a registry. As described earlier in the chapter, birth defects are a very insensitive measure of developmental toxicity. Outside expert input should continue to be used to make decisions about the registry's surveillance strategy, case ascertainment process, classification scheme, inclusion or exclusion of genetic defects, unit of analysis, and choice of denominator.

Finding 4-16: The military health system has evolved and is developing several different tools (such as the Recruit Assessment Program, the Health Evaluation and Assessment Review, the Defense Medical Surveillance System, and deployment surveillance systems) that play or that could play a role in providing health surveillance information for military populations. These tools have not been planned to be part of a coordinated system of health surveillance and preventive medicine, and thus are not maximally efficient. A central authority is needed for environmental and health surveillance analysis and dissemination.

Recommendation 4-16: Clarify the leadership authority and accountability for coordination of preventive medicine and environmental and health surveillance across the U.S. Department of Defense and the individual services.