

The Department of Defense Medical Mortality Registry

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The Department of Defense Medical Mortality Registry is being implemented at the Office of the Armed Forces Medical Examiner, Armed Forces Institute of Pathology, providing the first comprehensive medical mortality surveillance for the Department of Defense. The Registry attempts to obtain complete medical and circumstantial information on every military active duty death for medical surveillance and prevention research. Medical records, autopsy reports, eyewitness accounts, and investigative reports are reviewed to validate and synthesize medical, circumstantial, and risk factor information on each death. All military active duty deaths since 1980 are currently identified and classified by manner of death (accident, suicide, homicide, illness, hostile, undetermined). Military death rates have decreased during the past two decades by nearly half. About three-quarters of military deaths are attributable to injury (accident, suicide, homicide). The Registry creates new opportunities for prevention-oriented research as it collects detailed information on every military death.

Introduction

The Armed Forces Institute of Pathology (AFIP) is implementing the Department of Defense Medical Mortality Registry (DoD-MMR, or Registry) in its new Division of Medical Mortality Registry at the Office of the Armed Forces Medical Examiner (AFME). This is being accomplished in collaboration with the Center for Military Medical Analysis and Projection at the Uniformed Services University of the Health Sciences and the Department of Repository and Research Services, AFIP. Seed money for development of the Registry was obtained through a grant to the Uniformed Services University of the Health Sciences from the Department of Defense Global Emerging Infections Surveillance and Response System to study exercise-re-

lated and infectious disease deaths, with particular interest in establishing surveillance for unexplained deaths.

Study of the medical and circumstantial aspects of every death allows focused research on prevention efforts. Accurate mortality data are important because (1) death is a clear and objective end point, (2) death represents the worst consequence of illness and injury, (3) deaths are highly visible (by press and society), (4) deaths often result in litigation, (5) even a single death can create immediate policy implications, and (6) deaths usually represent the tip of the iceberg of health events. Death is the most recognizable serious consequence of disease and the worst outcome. As such, it is often the most accurate clinical end point for use in estimating the impact of disease. This makes mortality data important for postdeployment surveillance and surveillance for emerging diseases. The first step of any medical surveillance system is timely and accurate monitoring of disease-specific mortality.

An adequate understanding of the impact of any specific type of illness or injury on mortality requires tabulation of all deaths. There are three levels of medical mortality surveillance. The first level of surveillance is to obtain population-based counts of deaths so that mortality rates can be determined; these can then be compared over time, by population unit, geographic area, etc. The second level of mortality surveillance obtains diagnosis (cause of death) for each case on a relatively superficial basis (e.g., death certificate information); this allows for comparisons of mortality rates by cause. However, more accurate medical diagnosis gives more meaningful information. The third level of surveillance involves validation and review of detailed medical information, including the circumstances surrounding each death, so that medical specifics can be obtained and risk factors evaluated. The DoD-MMR incorporates this third level of detail because it is essential to understand (1) whether the data being collected are accurate, (2) the specific characteristics and circumstances of the diseases/injuries under surveillance, and (3) what preventive interventions might be applicable. Without this level of detailed surveillance, it is not possible to evaluate whether health promotion, safety, and other health programs are successful and cost-effective.

The usual sources of mortality surveillance information (i.e., death certificates) are of limited value in providing accurate medical and circumstantial information. The subtleties of the diseases/injuries under surveillance are not available on the death certificate. For example, emergence of antibiotic resistance might initially present as increased surgical mortality for patients with trauma. Conversely, certain chronic infections can cause mortality by other processes, such as cirrhosis or liver cancer from long-standing viral hepatitis. Or deaths classified as suicide or accident might be related to human immunodeficiency virus seropositivity. In addition, death certificates rarely

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give alcohol or tobacco use as an underlying cause, indicate whether the death was related to exercise, or identify specific risk factors (e.g., seat belt use). Only a thorough review of all related records can provide the type of information necessary to evaluate the preventability of death and allow for development and evaluation of prevention programs.

Preventive intervention is the main objective of medical mortality surveillance. Because active duty military personnel are all younger than 65 years, each death can be considered premature and is a contributor to years of potential life lost. Thus, each death can be viewed as a system failure that warrants thorough evaluation. It is said that "Those who do not learn from their mistakes are destined to repeat them." Prevention requires real-time monitoring of health events to quantify the extent of the problem and identify circumstances resulting in illness or injury. However, preventive intervention must be specific and focus on specific causes and risk factors. Surveillance at the first and second levels does not provide the kind of information necessary to focus a preventive intervention program. This requires more detailed evaluation of the medical events, circumstances, and risk factors (third-level surveillance) so that the appropriate preventive interventions can be designed, implemented, and evaluated. This level of surveillance is also specifically necessary for the evaluation of prevention efforts and for cost analyses.

The current DoD casualty system identifies each military death and provides notification of and casualty assistance for the family, return and disposition of the remains, and provision for military burial honors and payment of benefits. The military casualty offices collect some medical information and provide computerized reports to the Directorate for Information and Operations Reports (DIOR) in a standardized format, where the data are incorporated into its Worldwide Casualty System, providing first-level and partial second-level mortality surveillance. The DoD-MMR expands this information and provides third-level medical mortality surveillance.

Methods

The Registry will collect all readily available medical records, autopsy reports, eyewitness accounts, and investigative reports to establish a file on each military active duty death. These records are reviewed to validate and synthesize medical, circumstantial, and risk factor information from all of these sources, which is entered into a computer database for further surveillance use and research analyses. The information collected includes demographic and identifying information, medical causes of death, circumstances of death, risk factors, and specific medical items of interest (such as relationship to exercise, smoking, alcohol or drug use, sickle cell trait, seat belt use, specific infectious organism, antibiotic resistance, location and circumstances where infection was acquired).

The Registry provides anonymous analyses of military deaths and does not function as an investigative agency for any particular death, nor does it release to the public specific information on any individual death, but refers all queries to the originating sources. These investigations are the role of the Armed Forces Medical Examiner, the service safety centers, legal and police offices, and other designated agencies. The Registry's function is to collect in a central place all of the medical information and

reports of investigations on each death as a repository so that they can be viewed in the context of the entire complex of military deaths and used for prevention and etiologic research. The Registry provides analyses and reports to document trends and risk factors. For analytic and research purposes, deaths may be viewed from several different perspectives (alcohol-related, tobacco-related, exercise-related, etc.) regardless of the official cause of death to better evaluate trends and risk factors. This may be essential to properly understand medical and prevention issues in certain types of deaths. The Registry does not provide the official cause of death; rather, it provides analytical information for research, prevention, and policy application. The objective is prevention of deaths through identification of medical and circumstantial factors relating to each death, synthesis of related information on multiple deaths, and identification of preventive factors.

Data Collection

The military casualty offices and reporting systems provide notification of military deaths. From those sources, the Registry obtains up-to-date computer listings of all active duty deaths (in real time) and copies of the DoD Casualty Report Forms (DD1300). From that beginning point, the Registry requests copies of other related medical and personnel records from the appropriate agencies that house those records. This includes medical records from the individual's base or hospital (both at residence and the place of death), autopsy reports, AFIP consultations and toxicology studies, personnel records, legal investigations, safety center and other special investigations, and other sources of eyewitness accounts. Autopsy reports, toxicology studies, and AFIP consultations provide medical details regarding cause of death and forensic analysis. Other medical records provide medical history and risk factor information. Legal investigative reports provide details of the circumstances, witness interviews, scene evaluation, and other information needed to determine manner of death (e.g., accident vs. suicide vs. homicide in an injury death). Safety center reports detail the circumstances of and factors related to accidents, and psychological autopsies analyze the mental state of suicide victims. Personnel records may provide additional relevant information.

The Registry attempts to obtain a complete file on each death that includes all available records relating to that death and that individual. Records are also requested from appropriate civilian sources as well, working through the AFME and via research channels. Authority for acquisition of these records comes from the Office of the Armed Forces Medical Examiner and is outlined in DoD Directive 5154.24. The newly passed law 10 U.S. Code Section 1471 expands the authority of the AFME to authorize medicolegal investigation (including autopsy) for every military active duty death, whether it occurs in a military or a civilian setting (including those occurring after recent separation from military service).

Review and Analysis

Initial information obtained on the fact and circumstance of death is immediately entered into the DoD-MMR database so that up-to-date counts of deaths are current. Electronic information is transferred, and additional information is entered into the DoD-MMR database as it is received. For each death, the

TABLE I
NUMBERS OF DEATHS AND AGE-ADJUSTED MORTALITY RATES FOR DOD ACTIVE DUTY POPULATION BY YEAR AND GENDER

| Year | Male | | | Female | | |
|------|------------|--------|------|------------|--------|------|
| | Population | Deaths | Rate | Population | Deaths | Rate |
| 1980 | 1,859,757 | 2,291 | 125 | 163,892 | 101 | 67 |
| 1981 | 1,878,062 | 2,292 | 125 | 179,572 | 89 | 52 |
| 1982 | 1,906,754 | 2,203 | 117 | 189,580 | 115 | 69 |
| 1983 | 1,921,545 | 2,354 | 123 | 196,507 | 110 | 56 |
| 1984 | 1,934,131 | 1,909 | 99 | 199,755 | 89 | 44 |
| 1985 | 1,933,981 | 2,153 | 111 | 205,841 | 99 | 48 |
| 1986 | 1,919,159 | 1,889 | 99 | 214,152 | 95 | 45 |
| 1987 | 1,921,404 | 1,874 | 98 | 218,164 | 111 | 51 |
| 1988 | 1,872,931 | 1,721 | 92 | 217,433 | 98 | 45 |
| 1989 | 1,875,666 | 1,558 | 83 | 225,859 | 78 | 38 |
| 1990 | 1,816,291 | 1,428 | 79 | 224,272 | 79 | 35 |
| 1991 | 1,795,535 | 1,690 | 94 | 220,503 | 97 | 42 |
| 1992 | 1,649,656 | 1,224 | 74 | 209,494 | 69 | 33 |
| 1993 | 1,511,588 | 1,146 | 75 | 199,023 | 67 | 34 |
| 1994 | 1,429,648 | 1,006 | 70 | 197,386 | 69 | 34 |
| 1995 | 1,341,484 | 952 | 71 | 193,666 | 88 | 45 |
| 1996 | 1,273,294 | 915 | 72 | 191,166 | 59 | 31 |
| 1997 | 1,227,070 | 750 | 61 | 193,114 | 67 | 34 |
| 1998 | 1,196,596 | 771 | 64 | 193,858 | 59 | 28 |

Rates are age adjusted to the 1989 total U.S. military active duty population age distribution.

available records are reviewed to abstract the medical diagnostic information and itemize risk factors and environmental and operational circumstances. This information is entered into the database, which is updated and amended as additional information is received.

Registry analyses are conducted regarding series of deaths to establish time trends, risk factor analyses, etc., and public reports provide only anonymous information. In addition to information on deaths, the Registry obtains up-to-date military personnel information from the Defense Manpower Data Center, which allows calculation of death rates by subgroup. These active duty personnel data have been obtained for the mid-year population each year since 1980 by service, gender, age, and rank. Data from the DoD-MMR database thus will provide periodic mortality rates by specific cause for active duty military personnel by age, sex, service, rank, and other relevant demographic variables (such as race, unit, occupational specialty, geographic area, etc.) This information will be provided in an understandable and timely manner through periodic reports.

The Registry has incorporated the Worldwide Casualty System data files from DIOR into the DoD-MMR database. These includes all military active duty deaths from 1980 through the present, and they are classified by manner of death (accident, illness, suicide, homicide, hostile, undetermined). Annual mortality rates were calculated by manner of death for each year from 1980 to 1998 within each age group (<20, 20-24, 25-29, 30-34, 35-39, 40+ years). Age adjustment was performed using the 1989 total active duty military population age distribution for weights in standardized summarization of the age-specific rates.

Results

Annual deaths and mortality rates are provided by manner of death for the years 1980 to 1998. Subsequent reports will pro-

vide more detailed cause of death information for military deaths beginning with 1998. Table I shows the total number of deaths and age-adjusted mortality rates by year and gender. Military death rates have decreased during the past two decades by about half for both sexes. These trends are shown by military service and gender in Figure 1. Air Force mortality rates are consistently lower than those of the other services for both sexes.

The time trends by manner of death are shown in Figure 2 for all services combined. A dramatic reduction in mortality attributable to accidents during the past two decades can be seen. In recent years, about half of military deaths have been due to accident, 20% have been due to suicide, and 5% have been due to homicide. Most of the remaining deaths have been due to illness (about 20%), with a few undetermined. The increase in undetermined deaths seen in 1998 reflects the length of time it takes to complete investigations (occasionally more than 1 year) to establish the manner of death.

Military mortality rates attributable to hostile action are pre-

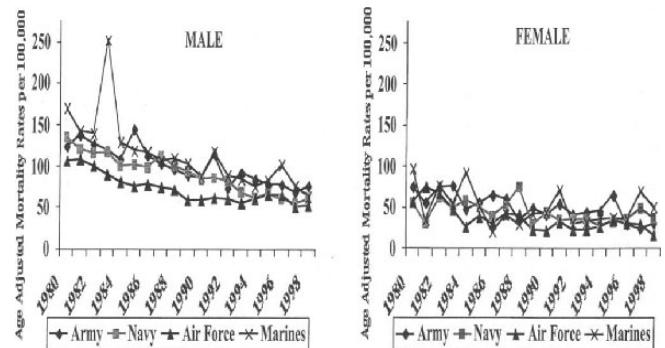


Fig. 1. Annual age-adjusted mortality rates for all causes combined, by military service, for active duty military males and females, 1980 to 1998.

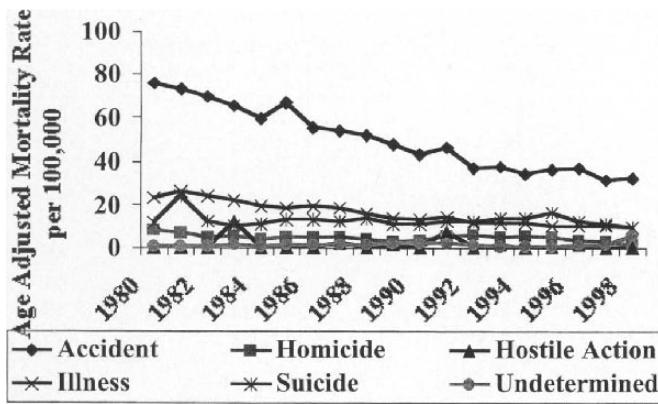


Fig. 2. Annual age-adjusted mortality rates for all active duty military services, by manner of death, 1980 to 1998.

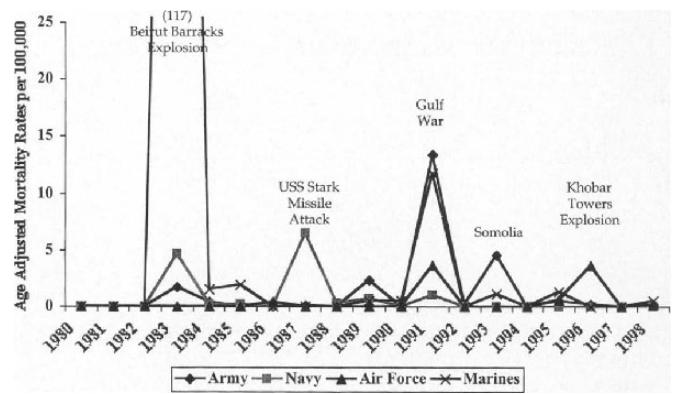


Fig. 3. Annual age-adjusted mortality rates for hostile action, by military service, 1980 to 1998.

sented in Figure 3 by military service and year. The peaks are labeled to reflect U.S. hostile action involvement in the respective years. Comparison of male and female mortality rates for illness, accident, suicide, and homicide are depicted in Figure 4. This figure shows that female mortality rates are well below those of males for accidents, illness, and suicide but not for homicide.

Discussion

About three-quarters of current U.S. military deaths are attributable to injury (accident, suicide, homicide), and hostile deaths have been uncommon in the past two decades. Military mortality rates have declined by about half and are consistently below civilian rates. Female mortality rates are about half of male mortality rates, except as homicide victims.

Although this study has several strengths, including its large size and consistent tabulation of military deaths and populations, it still has some weaknesses. The most important weak-

ness is the lack of specific information on medical and circumstantial causes of death, as well as the absence of risk factor information. This report presents categorizations by manner of death only; future reports will provide medical and circumstantial causes for recent years. Two other weaknesses are important to mention. The first is that the tabulations of deaths include all deaths occurring in military personnel on active duty at the time of death, which may include Reserve and National Guard personnel who may not be included in the active duty denominator populations. The second is that some deaths in active duty personnel have been missed because of the tendency to medically retire individuals with terminal illness to maximize financial benefits for their families. The Registry is currently attempting to document Reserve and National Guard status on each death, and deaths that occur up to 4 months after separation from the military are being collected. Future reports will address these issues.

In 1996, Helmkamp and Kennedy published the first medical epidemiologic analysis of deaths in the entire active duty mili-

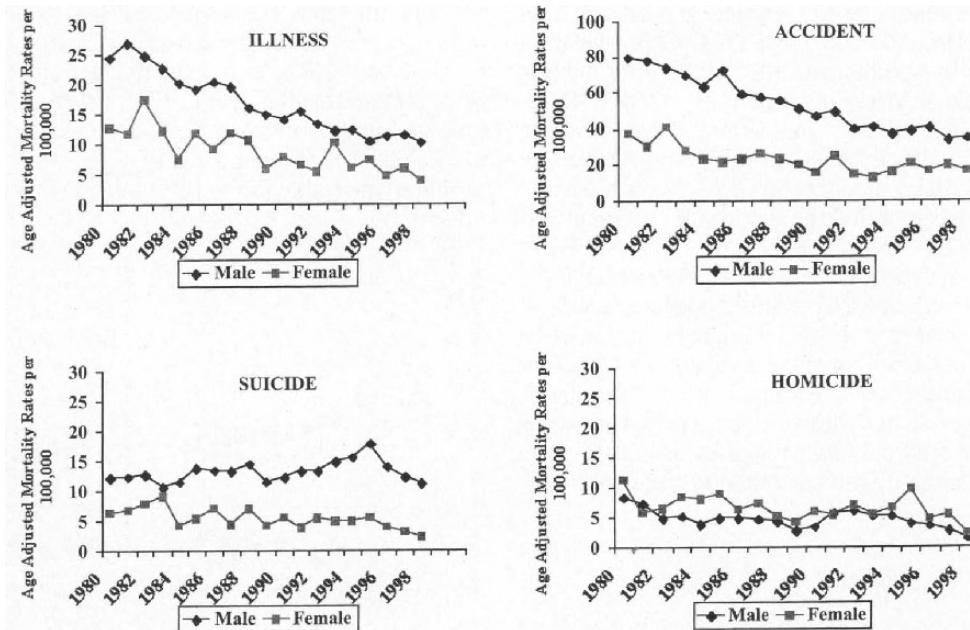


Fig. 4. Annual age-adjusted military mortality rates for illness, accident, suicide, and homicide, by gender, 1980 to 1998.

tary population.¹ The current data expand these analyses through 1998. There have been some other analyses of military deaths, but all have focused either on a specific type of death or on one service or subgroup.²⁻²¹ A general summary of the findings from all of these studies is that military mortality rates are decreasing; the distribution of manner of death is about 60% due to unintentional injury, 18% due to illness, 13% due to suicide, and 5% due to homicide; and military mortality rates are low compared with age- and sex-comparable U.S. civilian mortality rates. The problem with all of these analyses of military mortality, and with the data sources themselves, is that they contain only limited medical information, usually only manner of death.

Although every military death is investigated and the autopsy rate is high, these investigations are conducted and usually maintained at the local level. Until now, there has been no provision for a central repository of these records or of central analysis covering all military deaths. The DoD is now implementing through the DoD-MMR a mortality surveillance system that incorporates adequate cause of death information and third-level mortality surveillance. Establishment of the DoD-MMR provides for medical mortality surveillance of the active duty military population and creates new opportunities for prevention-oriented analyses and research. Trends in military death rates are described by manner of death and will soon be available by specific medical and circumstantial cause of death. The large size of the military population will allow evaluation of specific subgroups, including those defined by geographic area, deployments, specific occupational specialties, etc.

The Registry will supply the first quantitative measures of the impact of known and suspected risk factors for military mortality that are based on specific diagnoses and with sufficient numbers to allow estimation of risk. Quantitative description of effective and ineffective preventive measures and of common causes for mortality will permit the development of recommendations to improve the protection of military personnel in the training and operational environments.

Once complete resourcing is established, the Registry files will provide an accurate, complete, systematic data source available for research on specific mortality-related issues. Links to data and materials outside the DoD-MMR will provide additional opportunities for important research. Research proposals are handled with appropriate institutional review board approval, peer review, and confidentiality protection.

The DoD-MMR addresses military force protection through medical mortality surveillance and research to identify preventable causes of death among active duty U.S. military personnel. It extends and expands ongoing research efforts and establishes a new focus on prevention of unnecessary military mortality from all causes. The first priority of any force protection program

must be to minimize personnel losses. This can be accomplished only through careful monitoring and study of each death and analysis of time trends and risk factors by cause, followed by implementation of procedures and programs to prevent future deaths from preventable causes.

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