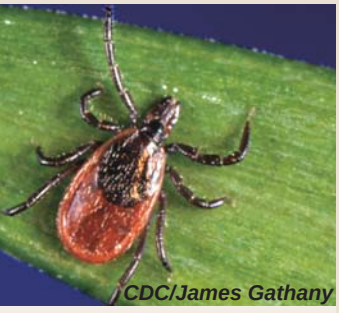
MAY 2012

Volume 19
Number 5

MSMR

MEDICAL SURVEILLANCE MONTHLY REPORT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Deaths While on Active Duty in the U.S. Armed Forces, 1990-2011

Crude mortality rates are lower among U.S. military members than their civilian counterparts; service members must be healthy when they enter service and deaths from illnesses are relatively infrequent. From 1990 through 2011, there were 29,213 deaths of U.S. military members while on active duty (crude overall mortality rate: 71.5 per 100,000 person-years). The most deaths occurred in years when major combat operations were ongoing; from 2004 to 2007, war-related injuries accounted for approximately 40 percent of all deaths. From 2000 to 2011, two-thirds of all deaths unrelated to war were caused by transportation accidents (n=4,761; 37%), other accidents (n=1,358; 10%) and suicides (n=2,634; 20%). From 2005 to 2011, the proportion of deaths due to suicide increased sharply while the proportion due to transportation accidents generally decreased; as a result in 2010 and 2011, suicides accounted for more deaths of service members than transportation accidents. The current focuses of the Services on safety and mental health are clearly indicated to minimize the premature loss of lives of young men and women in military service.

Many military activities are physically and psychologically demanding; some are inherently dangerous. For this and other reasons, applicants for U.S. military service are screened to ensure that they are physically and psychologically healthy before they may enter.

While in active service, military members must be able to perform all duties required by their military occupations, ranks, and assignments. To maintain and enhance the health, fitness, and military occupational capabilities of its members, the Services conduct extensive physical fitness, health promotion, safety, and force health protection programs. In addition, service members receive "free" preventive, curative, and rehabilitation medical services.

Because military members are ostensibly healthy when they enter service and must maintain their health during service, deaths from illnesses (i.e., natural causes) are relatively infrequent. However, deaths from injuries (e.g., combat-related, motor vehicle accidents, self-inflicted) are not uncommon.[1-4] Many deaths of service members are preventable. In order to develop, target, and track the effects of illness and injury prevention policies and practices, it is important to characterize the numbers, natures, risk factors, and causes of "preventable" deaths among active service members. This report is an overview of mortality among U.S. military members since 1990; it updates previous summaries of the numbers, rates, trends, and causes of deaths among members of the U.S. Armed Forces from 1990 through 2011.[5]

METHODS

The surveillance period was 1 January 1990 to 31 December 2011. The surveillance population included all individuals who served on active duty during the surveillance period as a member of the active or reserve component of the U.S. Army, Navy, Air Force, or Marine Corps. Endpoints of interest for this report were deaths of active or reserve component members while serving on active duty. Deaths of active duty service members were ascertained from records produced by service-specific casualty offices and maintained by the Armed Forces Medical Examiner in the DoD Medical Mortality Registry. For surveillance purposes, the records are routinely provided to the Armed Forces Health Surveillance Center for integration in the Defense Medical Surveillance System (DMSS).

The Medical Mortality Registry classifies deaths by "manner" (i.e., natural, accident, homicide, suicide, undetermined) and underlying cause (using a classification system with 457 possible causes). For this report, the 201 underlying causes of service member deaths since 1990 were grouped into 21 categories of cause of death.

Summary measures for this analysis are numbers of deaths in the surveillance population overall (i.e., active and reserve component members on active duty) and mortality rates (calculated as deaths per 100,000 person-years of active military service) among members of the active component. Mortality rates were summarized in relation to person-years at risk (rather than individuals at risk) because the U.S. military is a dynamic cohort – every day, many individuals enter and many others leave service. Thus, in a given calendar year, there are many more individuals with any service than there are total person-years of active service; the latter was considered a more consistent measure of exposure to mortality risk across calendar years. Reserve component members were not included in rate calculations because the start and end dates of their active duty service periods were not available.

RESULTS

During the 22-year surveillance period, there were 29,213 deaths of U.S. military members while on active duty **(Table 1)**. The mean number of deaths per year was 1,328; the range was 795 (in 1997) to 1,941 (in 2007). The numbers of deaths rose in years when major combat operations were ongoing (Operation Desert Storm, 1991; Operations Enduring Freedom, Iraqi Freedom, and New Dawn, 2001-2011) **(Figure 1)**.

In general, the most deaths were among members of military and demographic subgroups with the largest representations in

TABLE 1. Demographic and military characteristics of individuals who died in active service, active and reserve components, U.S. Armed Forces, 1990-2011

	Active/ reserve components	Active component	
	No.	No.	Rate[a]
Total	29,213	24,788	75.1
Service			
Army	14,341	11,269	95.8
Navy	5,775	5,385	60.9
Air Force	4,628	3,972	47.4
Marine Corps	4,469	4,162	103.8
Sex			
Male	27,393	23,308	81.6
Female	1,820	1,480	33.4
Race/ethnicity			
White, non-Hispanic	20,002	16,814	78.4
Black, non-Hispanic	4,907	4,309	70.2
Other	4,304	3,665	67.7
Age			
<20	2,122	1,958	79.4
20-24	10,748	9,900	92.0
25-29	5,688	5,098	70.8
30-34	3,499	3,009	58.0
35-39	3,037	2,450	57.6
40+	4,119	2,373	75.6
Military occupation			
Health	1,459	1,308	54.8
Combat	8,655	7,731	128.5
Other	19,099	15,749	64.0

[a]Death rate per 100,000 person-years of service; for active component only

the military overall. For example, of service members who died while on active duty, most by far (94%) were males, more than two-thirds (68%) were white, non-Hispanic, and more than one-half (56%) were in their twenties. Service members with combat-specific occupations accounted for 30 percent of all deaths but approximately 18 percent of all service members **(Table 1)**.

From 2000 to 2011, three-fourths of all deaths were caused by accidents, war/legal interventions, or suicides **(Figure 2)**. From 2004 to 2007, war-related injuries accounted for approximately 40 percent of all deaths; and from 2000 to 2011, two-thirds of all deaths unrelated to war/legal interventions were caused by transportation accidents (n=4,761; 37%), other accidents (n=1,358; 10%) and suicides (n=2,634; 20%) **(Figure 3)**. From 2008 to 2011, suicides accounted for approximately 26 percent of all non-war-related deaths of U.S. service members. (At the time of this analysis, final determinations of underlying causes were pending for approximately 11 percent of all deaths in 2011; as a result, relatively more deaths in 2011 than in prior years are attributed to "all other" causes).

From 2005 to 2011, the proportion of deaths due to suicide increased sharply while the proportion due to transportation accidents generally decreased; as a result in 2010 and 2011, suicides accounted for more deaths of service members than transportation accidents. The proportions of deaths due to other non-war-related causes were relatively stable during the past 12 years **(Figures 3,4)**.

From 1990 to 2011 among active component members, the crude overall mortality rate was 75.1 per 100,000 person-years (p-yrs). The highest crude overall subgroup-specific mortality rates affected members who were in combat-specific occupations (128.5 per 100,000 p-yrs), in the Marine Corps (103.8 per 100,000 p-yrs) or Army (95.8 per 100,000 p-yrs), 20-24 years old (92.0 per 100,000 p-yrs), and male (81.6 per 100,000 p-yrs). The lowest crude overall subgroup-specific mortality rates affected members who were female (33.4 per 100,000 p-yrs), in the Air Force (47.4 per 100,000 p-yrs), in health-related occupations (54.8 per 100,000 p-yrs), and in their thirties (57.8 per 100,000 p-yrs) **(Table 1)**.

The highest annual subgroup-specific mortality rates (unadjusted) affected service members in the Marine Corps in 2004 (232.7 per 100,000 p-yrs), in the Army in 2007 (212.9 per 100,000 p-yrs) and in combat-specific occupations from 2004 to 2007 (range, annual rates, 2004-2007: 218.1-262.5 per 100,000 p-yrs) **(data not shown)**.

Annual mortality rates from deaths unrelated to war were higher during the first two years (1990-1, mean annual rate: 67.3 per 100,000 p-yrs) and the last seven

FIGURE 1. Deaths per year among individuals on active duty, by service, active and reserve components, U.S. Armed Forces, 1990-2011

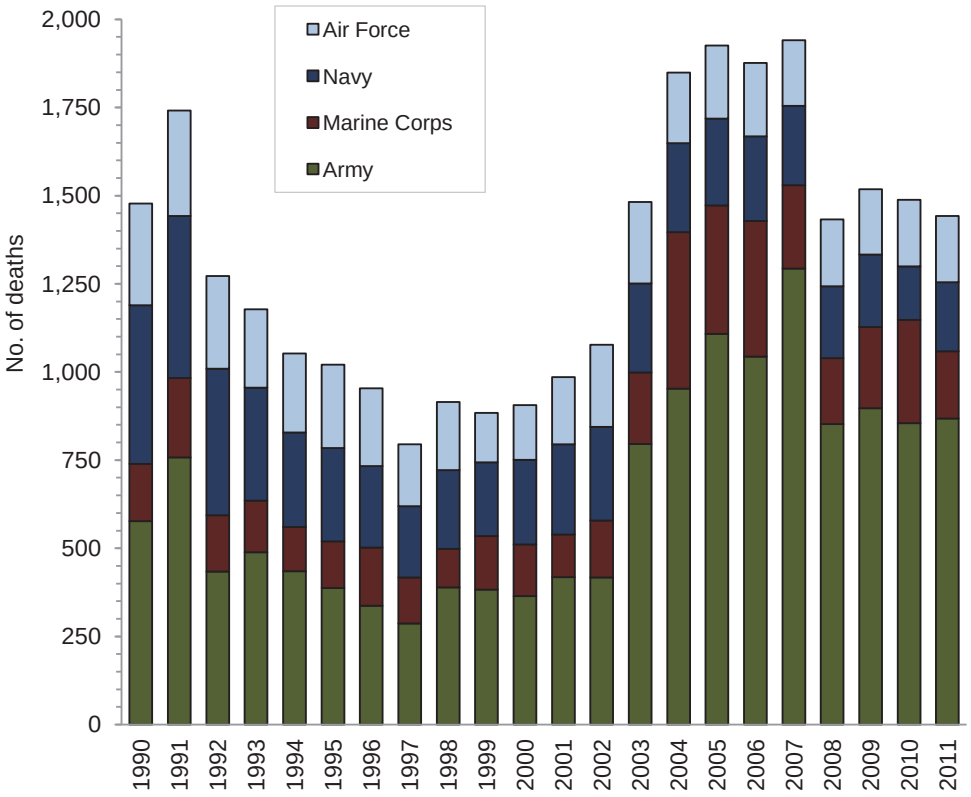


FIGURE 2. Deaths of individuals on active duty, by proportions attributable to various categories of underlying causes, active and reserve components, U.S. Armed Forces, 2000-2011

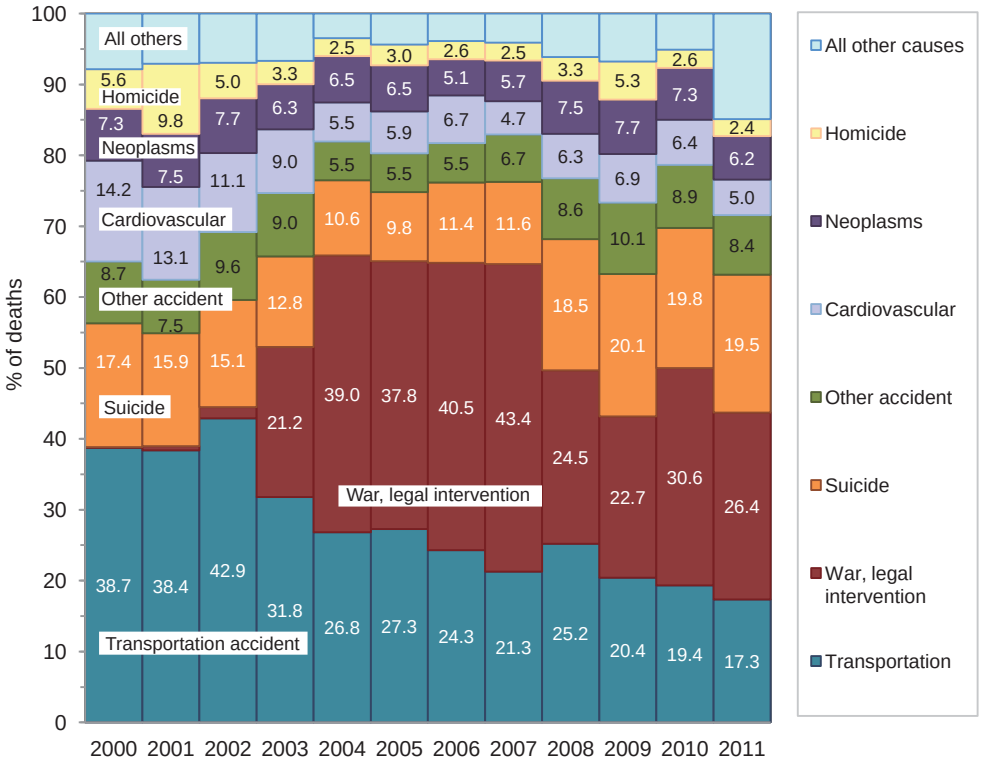
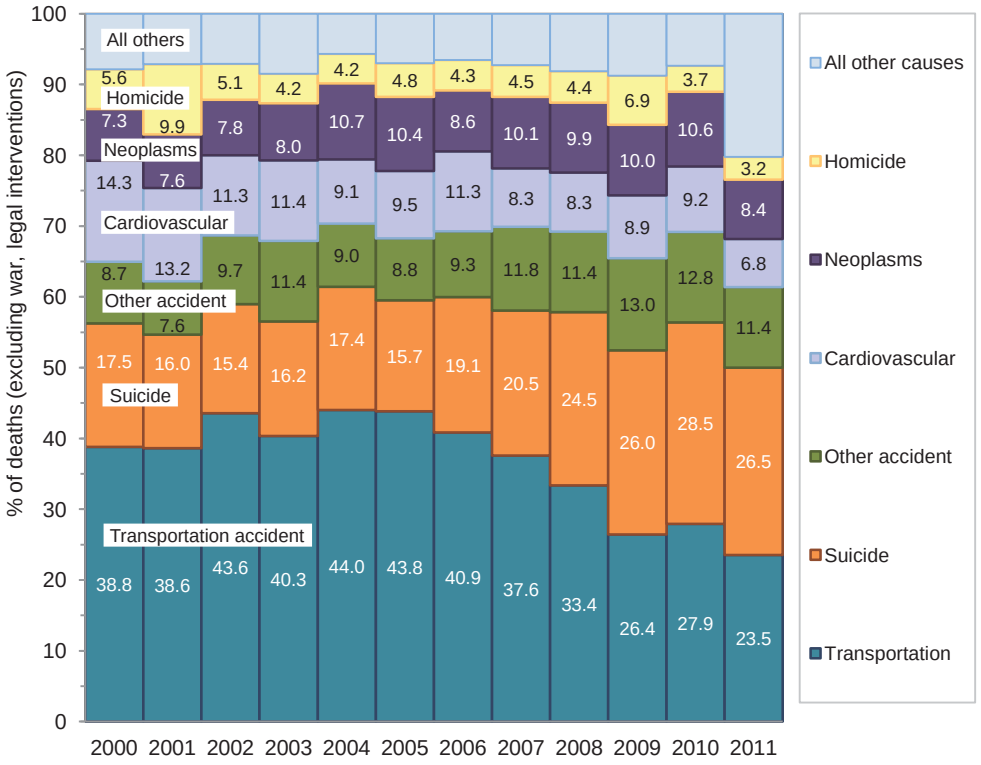


FIGURE 3. Deaths not related to war/legal interventions, among individuals on active duty, by proportions attributable to various categories of underlying causes, active and reserve components, U.S. Armed Forces, 2000-2011



years (2005-11, mean annual rate: 65.5 per 100,000 p-yrs) than the intervening thirteen years (1992-2001, mean annual rate: 58.7 per 100,000 p-yrs) of the overall period. In general, however, there was no clear long-term trend in mortality from deaths unrelated to war **(Figure 4)**.

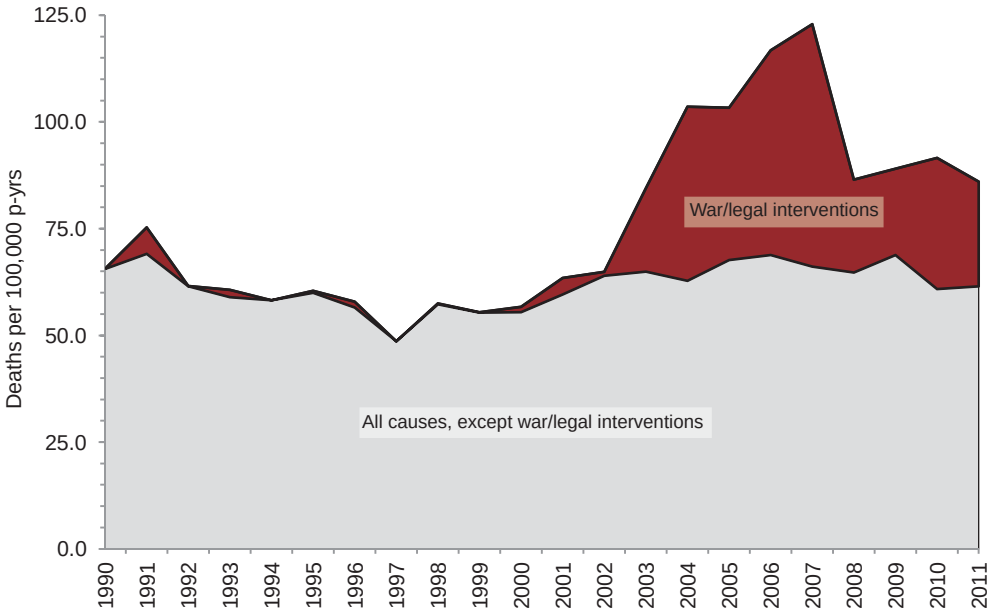
EDITORIAL COMMENT

In the past two decades (which include two periods of intense combat operations), the crude overall mortality rate among U.S. service members was 71.5 per 100,000 p-yrs. In 2005, in the general U.S. population, the crude overall mortality rate among 15-44 year olds was 127.5 per 100,000 p-yrs.[6] If the age-specific mortality rates that affected the U.S. general population in 2005 had affected the respective age-groups of active component military members throughout the period of interest for this report, there would have been approximately 13,198 (53%) more deaths among military members overall **(calculations not shown)**.

Because many military activities are dangerous and some are life threatening (e.g., combat operations), many military members die from military activity-specific causes – particularly during wartime. It is not surprising, therefore, that while crude mortality rates are generally lower among military members overall than similarly aged civilians, in recent years because of war-related injuries, mortality rates have been higher among military members younger than 25 years than among their civilian counterparts. Of note, in both military and civilian populations, accidents and suicides are leading causes of death among individuals in their late teens and early twenties.[5,6] Since 1998 in the military, suicide has been the second leading cause of deaths unrelated to war.

Among U.S. civilians 25 to 44 years old, malignant neoplasms and diseases of the heart are the second and third leading causes of death (after accidents); in contrast, there are relatively few disease-related deaths among military members in active service.[6] The finding is not surprising because young adults with life-threatening

FIGURE 4. Crude annual mortality rate, by relationship to war/legal interventions, active component, U.S. Armed Force, 1990-2011



medical conditions are relatively unlikely to apply for and are medically disqualified from entering military service. Also, active military members who develop life-threatening medical conditions while in service generally leave (e.g., medical disability) prior to the terminal clinical stages of their illnesses. As a result, rates of disease related deaths are much lower among actively serving military members than similarly aged civilians.

In summary, war-related injuries have been the leading cause of deaths of active service members in each year since 2004. Excluding war-related deaths, accidents and suicides account for approximately two-thirds of all deaths of active military members. Since 2005, the proportion of service members' deaths due to suicide has been increasing; and in 2010 and 2011, there were more deaths from suicide than from transportation accidents. The current focuses of the Services on safety and mental health are clearly indicated not only to decrease morbidity, disability, and costs and to enhance individual and unit operational effectiveness but also to minimize the premature loss of lives of young men and women in military service.[7,8]

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Degenerative Disc Disease, Active Component, U.S. Armed Forces, 2001-2011

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Degeneration of intervertebral discs is a common disorder that often leads to pain syndromes and mechanical dysfunction of the spine. Between 2001 and 2010, 131,986 active component service members received diagnoses of degenerative disc disease (DDD) during a hospitalization or at least two ambulatory visits (overall crude incidence rate: 951.4 per 100,000 person-years [p-yrs]). Annual crude incidence rates more than doubled during the surveillance period (2001: 614.9 per 100,000 p-yrs; 2010: 1,347.8 per 100,000 p-yrs). An estimated 68,247 days of lost duty time were attributed to DDD-specific diagnoses. Among service members diagnosed with DDD who subsequently deployed in support of overseas combat operations, more than two-thirds experienced exacerbations of their condition while deployed, although only 1.7 percent were medically evacuated. Deployed service members with DDD were more likely than a deployed comparison group to be medically evacuated for any cause.

Degenerative disc disease (DDD) is a common disorder that is characterized by a progressive degeneration of the intervertebral discs rendering them deformed and mechanically dysfunctional. Resultant loss of structural and functional integrity of the spine can lead to lumbar and/or cervical pain syndromes; consequently, DDD has been reported as a leading cause of low back pain.

DDD results in significant disability, work absenteeism, and healthcare costs.[1] Prevalence estimates of lumbar disc degeneration in the general population range from 3 to 56 percent.[2] This wide range in prevalence estimates likely reflects the absence of a standard definition of DDD and difficulty in diagnosing the disease accurately and reliably.[2] The epidemiology of DDD in military populations has not been extensively examined. Recently, Schoenfeld and colleagues reported an overall crude incidence rate of lumbar DDD (ICD-9-CM code: 722.52) in the U.S. military of 4.18 per 1,000 person-years (p-yrs); female service members and military members older than 40 years had the greatest risk of an incident diagnosis.[3]

Military training and operations are inherently physically demanding. Heavy load bearing, repeated strenuous activities and traumatic injuries may place military service members at increased risk of developing DDD; service members deploying with already diagnosed DDD are likely at increased risk of DDD exacerbations while deployed. Between October 2001 and September 2010, 16.3 percent of medical evacuations of service members from the U.S. Central Command's (CENTCOM) areas of operation were due to musculoskeletal disorders.[4] Intervertebral disc disorders and other (unspecified) disorders of the back accounted for 6.3 percent (n=3,401) of all evacuations of deployed male service members.[4] Another study found that 87 percent of all those evacuated for musculoskeletal disease/injury – and 86 percent of those evacuated for "spinal pain" – did not return to their deployed units.[5] In addition, 11.1 percent of all Medical Evaluation Boards of U.S. Army soldiers completed between January 2006 and January 2010 listed DDD as a primary reason for medical discharge from service.[6] Taken together, these data indicate that DDD is a substantial threat to service member health and military operational effectiveness.

This analysis examines the incidence, trends, and occupational and demographic characteristics of service members with DDD. It quantifies the health care burden and lost duty time associated with DDD as well as exacerbations in theater among individuals who deploy after being diagnosed with DDD. The analysis also assesses the risk of medical evacuation of deployed service members with a history of the condition.

METHODS

The surveillance period was from January 2001 to June 2011. The surveillance population included all individuals who served in an active component of the U.S. Army, Navy, Air Force, or Marine Corps at any time during the surveillance period.

Events of interest for this analysis were ambulatory encounters and hospitalizations with diagnoses suggestive of DDD. These events were derived from two sources: the Defense Medical Surveillance System (DMSS) documents medical encounters in fixed military and civilian (if reimbursed through the Military Health System) treatment facilities, and the Theater Medical Data Store (TMDS) contains records of medical care provided in the CENTCOM theater of operations. Additionally, the records of medical evacuations from the CENTCOM area of responsibility to medical treatment facilities outside CENTCOM were analyzed using data from the Transportation Command Regulating and Command & Control Evacuation System (TRAC2ES).

For surveillance purposes, an incident case of DDD was defined by any hospitalization with a DDD-specific diagnosis code in any diagnostic position; or by two or more ambulatory visits occurring within 183 days of each other with a DDD-specific diagnostic code in any position **(Table 1)**. Two measures were calculated to estimate the burden of DDD on the active component military population: total medical encounters and lost duty days. The total number of medical encounters is the sum

TABLE 1. ICD-9-CM diagnostic codes for degenerative disc disorders

ICD-9-CM Code	Description
DDD-specific ICD-9-CM codes	
722.xx (excluding 722.8x, post laminectomy syndrome)	Intervertebral disc disorders
DDD-related ICD-9-CM codes	
723.0	Spinal stenosis, cervical
724.00, 724.01, 724.02, 724.09	Spinal stenosis,other
723.1	Cervicalgia
724.2	Lumbago
724.3	Sciatica
724.4	Thoracic or lumbosacral neuritis or radiculitis, unspecified
724.5	Backache, unspecified
738.4	Acquired spondylolisthesis

of all hospitalizations and ambulatory visits associated with an ICD-9 code of interest in the primary (first-listed) diagnostic position with a limit of one encounter per person per day. Lost duty days were calculated as the sum of hospital bed days plus one day for each ambulatory visit in which the discharge code indicated a disposition of sick at home or confined to quarters. Two estimates of each measure were calculated: one in which the primary diagnostic code was a DDD-specific code and one in which the primary diagnostic code was either a DDD-specific or a DDD-related code **(Table 1)**.

DDD exacerbations during deployment were assessed among service members diagnosed with DDD who subsequently deployed to CENTCOM in support of combat operations in Iraq or Afghanistan. A DDD exacerbation was defined as a DDD-specific or DDD-related diagnosis in any diagnostic position during any of the following events: a medical evacuation, a hospitalization, or an ambulatory encounter from five days prior to ten days after a medical evacuation; or two medical encounters in the deployed setting occurring within 183 days of each other.

Lastly, a control group for the deployed service members with DDD was randomly selected from all deployed service members without DDD; each deployer with DDD was matched to one control on gender, age, operation, and year of deployment **(Figure 1)**.

RESULTS

Incidence and characteristics of DDD cases

Between 2001 and 2010, 131,986 active component service members met the surveillance case definition of a DDD case. The overall crude incidence rate of DDD was 951.4 per 100,000 person-years (p-yrs) **(Table 2)**; annual crude incidence rates more than doubled during the surveillance period (2001: 614.9 per 100,000 p-yrs; 2010: 1347.8 per 100,000 p-yrs) and nearly tripled in the Army **(Figure 2)**. (Incidence rates and demographic characteristics are not presented for 2011 since data for the entire year were not available at the time of the analysis).

Crude overall rates of DDD were similar among males and females and increased sharply with age; service members 40 and older were 16 times more likely than those younger than 20 to be diagnosed with DDD **(Table 2)**. Among racial-ethnic subgroups, the highest overall crude incidence rate was among white, non-Hispanics (1,023.7 per 100,000 p-yrs). By service branch, the Army had the highest overall rate, followed by the Air Force. In regard to military occupation, the incidence rate was higher (1,190.0 per 100,000 p-yrs, IRR 1.30) among service members in healthcare than any other occupational group; of note, however, incidence rates increased during the surveillance period in all occupational groups **(data not shown)**.

Burden of non-deployed medical care

Between 2001 and 2010, the 131,986 individuals who were classified as incident DDD cases had 816,579 medical encounters for which DDD-specific diagnoses were recorded as primary (first-listed) diagnoses; an estimated 68,247 lost duty days were attributable to these encounters. The second, modified burden estimate, which included either DDD-specific or DDD-related codes in the primary diagnostic position yielded a total of 1,660,702

FIGURE 1. Algorithm for selecting prevalent DDD cases and controls for analyses of medical evacuation experiences during subsequent deployments

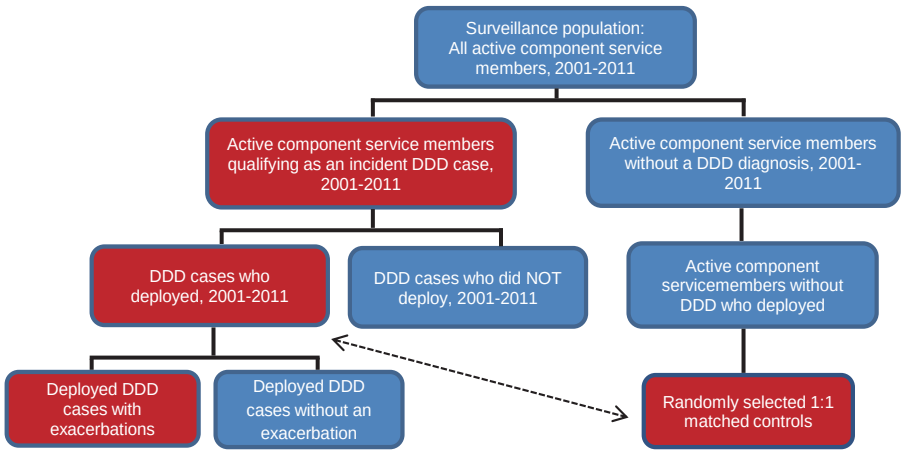


TABLE 2. Demographic and military characteristics of service members with degenerative disc disease, active component, U.S. Armed Forces, 2001-2011

	No.	Rate[a]	IRR[b]
Total	131,986	951.4	
Sex			
Male	111,988	945.3	Ref
Female	19,998	987.2	1.04
Age at diagnosis			
17-19	1,496	145.4	Ref
20-24	19,639	420.8	2.89
25-29	23,835	795.6	5.47
30-34	22,850	1,144.2	7.87
35-39	30,178	1,730.5	11.90
40+	33,988	2,360.2	16.23
Service			
Army	65,111	1,285.7	Ref
Navy	22,764	648.8	0.50
Air Force	33,281	960.7	0.75
Marine Corps	10,830	590.0	0.46
Race/ethnicity			
White, non-Hispanic	89,379	1,023.7	Ref
Black, non-Hispanic	21,720	881.3	0.86
Hispanic	11,100	790.9	0.77
American Indian/ Alaskan Native	4,258	656.0	0.64
Asian/Pacific Islander	1,821	790.5	0.77
Other	3,708	940.0	0.92
Grade			
E1-E4	32,577	534.8	Ref
E5-E9	74,356	1,343.4	2.51
O/W1-O/W3	11,126	814.3	1.52
O/W4+	13,927	1,582.0	2.96
Military occupation			
Repair/eng	17,320	981.7	Ref
Pilot/aircrew	5,505	986.8	1.01
Infantry/artillery/ combat eng	4,868	916.5	0.93
Armor/motor transport	37,221	906.6	0.92
Comm/intel	32,767	1,034.1	1.05
Healthcare	13,734	1,183.3	1.21
Other	20,571	795.8	0.81

[a]Incidence rate per 100,000 p-yrs of service
[b]Incidence Rate Ratio

medical encounters and 90,855 lost duty days attributable to DDD **(Figures 3a,b)**.

DDD exacerbations in the deployed setting

The proportions of deployed service members with DDD increased throughout the period from 1.5 per 1,000 in 2001 to 29.8 per 1,000 in 2011 **(data not shown)**. The increase in prevalence of DDD among deployers correlates with the increase in incident DDD diagnoses among service members overall during the period.

Prior to 2008, there were incomplete records (TMDS) of medical encounters in the deployed setting. As such, estimates of DDD exacerbations in the deployed setting were assessed only between January 2008 and June 2011. During this period, 68 percent of deployers with DDD experienced an exacerbation while deployed. DDD exacerbations in theater were relatively much more frequent among members of the Army than the other services; females were less likely than males to experience DDD exacerbations; and the youngest (17-19 years) and oldest (40+ years) affected deployers were more likely than others to experience exacerbations. Service members in the armor/motor transport occupational group had a higher proportion (approaching 1.0) of DDD exacerbations than those in other occupational groups **(data not shown)**.

Risk of medical evacuation

Of the 33,710 service members who deployed with prevalent DDD, 1,541 (4.6%) were medically evacuated from the CENTCOM theater during their deployments; in contrast, 754 (2.2%) service members with no prior diagnoses of DDD (control group) were evacuated for any cause. Less than 2 percent (n=574) of deployed service members with DDD were medically evacuated for back-related conditions (per primary [first-listed] diagnoses on relevant records); only 9 service members in the control group were evacuated with back-related primary diagnoses. Compared to their counterparts (control group), service members with DDD diagnosed prior to deployment had twice the odds (adjusted OR 1.98, 95% CI 1.78-2.20) of evacuation for any cause during deployment.

EDITORIAL COMMENT

This report documents that, over the past ten years, overall crude incidence rates of DDD diagnoses among active component service members have more than doubled; consequently, there has been a continuous and steep increase in lost duty time and medical care attributable to DDD and DDD-related medical care. Incidence rates of DDD diagnoses were slightly higher among females than males in all age groups, and incidence rates increased steadily with advancing age in both genders. In addition, more than two thirds of service members who were diagnosed with DDD prior to deployment experienced a DDD exacerbation that required medical care in theater.

Throughout the period of interest for this report, the percentage of deployers with DDD increased, mirroring the increase in incident diagnoses of DDD among U.S. military members overall. Although DDD exacerbations have been common in the deployed setting, most have been managed in theater and have not required medical evacuations. Despite this, deployed service members with DDD are almost twice as likely as matched controls to be medically evacuated for any reason; as expected, a greater percentage of those deployed with DDD are evacuated with diagnoses related to DDD although this affects a very small percentage (1.7%) of all those deployed with prevalent DDD. Therefore, while most deployed service members with clinical DDD exacerbations appear to be managed in theater successfully, additional study

FIGURE 2. Incidence rates of degenerative disc disease, by service, active component, U.S. Armed Forces, 2001-2010

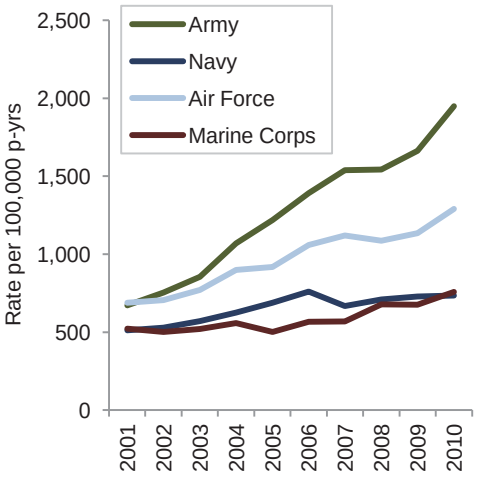
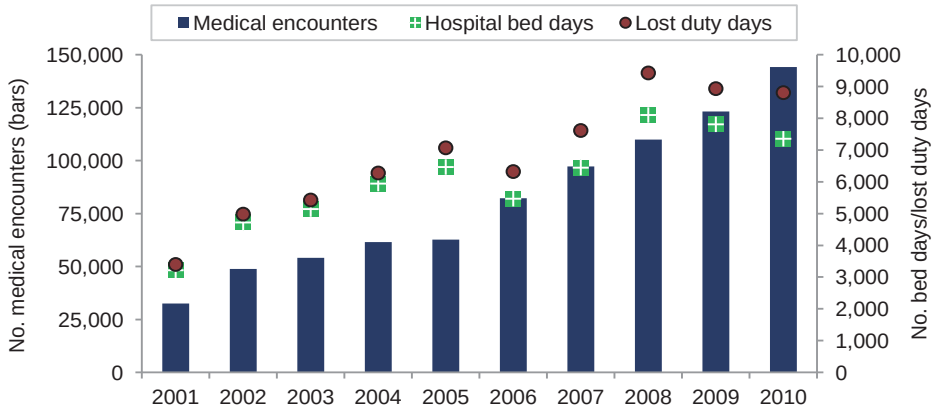
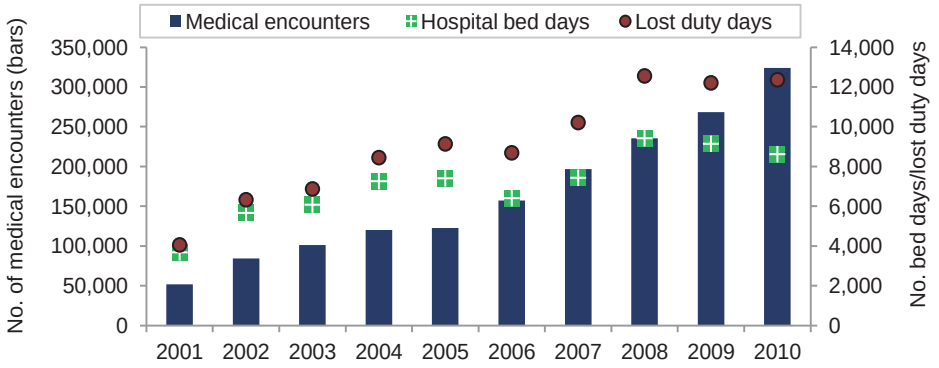


FIGURE 3. Medical encounters, hospital bed days and lost duty days attributable to DDD-specific and DDD-related conditions, active component, U.S. Armed Forces, 2001-2010

a. DDD-specific medical encounters only



b. DDD-specific and DDD-related medical encounters combined



is warranted to identify strategies in the management of DDD that could lessen its deployment-associated health care burden.

Several limitations should be considered when interpreting the results presented here. For example, several variables of potential interest, such as baseline health status, smoking status, and body mass index (BMI) were not addressed because of data limitations. Due to the inability to adjust for these potential confounders in the multivariate regression analysis, caution is necessary when interpreting the results. Future studies, given availability of the aforementioned data, may shed further light on the association between DDD status and the risk of medical evacuation during deployment. In addition, given that the active component of the US military is predominantly male, young, and relatively healthy compared to the general US population, the findings of this report have limited external validity and generalizabilty. Finally, the case definitions of DDD and DDD exacerbation used for these analyses were based exclusively on diagnostic codes (ICD-9-CM) that are recorded on electronic medical records. This method of case ascertainment increases the potential for misclassification; for example, some patients with DDD may not have had encounters documented with DDD-specific ICD-9-CM diagnostic codes. Also, because no ICD-9-CM code is specific for DDD exacerbation, the case definition of DDD exacerbation used here, which utilizes certain DDD-specific and DDD-related diagnoses and a particular temporal diagnostic relationship, is an imperfect surrogate for true clinical DDD exacerbations.

Acknowledgements: The author thanks Dr. Jean Otto, Armed Forces Health Surveillance Center, Silver Spring, MD.

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The Risk of Mental Health Disorders Among U.S. Military Personnel Infected with Human Immunodeficiency Virus, Active Component, U.S. Armed Forces, 2000-2011

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Mental health disorders (MHD) are reportedly more common among soldiers and airmen with HIV than their seronegative counterparts. This report documents the incidence rates of MHD among HIV-positive members of all service branches and compares the rates to those of two HIV-unexposed control groups: an HSV2-infected group and a group without documented HIV or HSV2 infections. Approximately 56 percent of HIV-infected service members received an incident diagnosis of a MHD six months or more after the initial detection of their infections. Cumulative incidence rates in nearly all MHD categories of interest were highest in the HIV group, intermediate in the HSV2 group and lowest in the referent group. The disorders more frequently diagnosed among HIV-infected service members compared to their uninfected counterparts were psychosis/schizophrenia, substance dependence, substance abuse, bipolar disorder, suicide ideation and depression. The findings are consistent with previous studies and reiterate the importance of long-term and comprehensive clinical monitoring of individuals diagnosed with HIV-1 infections.

In the U.S. Armed Forces, periodic screening for HIV infection among all active and reserve component service members began in 1986.[1] By 2004, the Department of Defense had established a policy of HIV antibody testing every two years for all members of the uniformed services.[1] From 1 January 2000 through 30 June 2010, 2,114 incident HIV-1 infections were identified among active component military members.[1] Infection with HIV does not require medical separation from the military; however, HIV-infected service members are ineligible for deployment, appointment as officers and entry into certain career fields.[2]

Individuals with HIV often suffer from mental health disorders (MHD). Several studies have estimated the prevalence of MHD among individuals diagnosed with HIV infection. For example, among patients seeking care at HIV clinics, approximately half of both civilians and military veterans were reported to have symptoms consistent with depression.[3,4] Among HIV-infected patients receiving care at a mixed urban and rural HIV clinic, Pence and colleagues documented that 39 percent were diagnosed with a mood or anxiety disorder and 21 percent were diagnosed with substance abuse.[5]

MHD can affect the prognosis and/or management of HIV infection. In particular, MHDs may impair patients' compliance with antiretroviral treatment regimens and impact associated health care utilization and expenditures.[6-10] Also, mental disorder diagnoses prior to HIV seroconversion are predictive of later MHD among HIV-positive men.[11]

Mental health disorders are relatively common among service members in general. The incidence rate of MHD diagnoses among all active component service members has been steadily increasing over the past several years. Recently, each year approximately one of 19 service members has received at least one incident MHD diagnosis; and in 2011, MHDs were the leading cause of hospitalizations of active component U.S. service members.[12-13]

The incidence and nature of MHDs among HIV-positive U.S. military members have not been recently and comprehensively described. In the early 1990s, HIV-infected soldiers (n=573) were found to have a higher incidence of psychotic, mental and adjustment disorders than seronegative soldiers; also, several psychiatric disorders were reportedly more prevalent among HIV seropositive Air Force members (n=95) than age-matched controls.[14-15] More recently, Hakre and colleagues reported that male HIV seroconverters in the U.S. Army and Air Force (n=274) were more likely than their seronegative counterparts to receive a MHD diagnosis within four years of detection of their HIV infections.[16] It is not known, however, if the finding is consistent across all service branches or if HIV-infected service members are more likely than those with other chronic sexually transmitted infections (e.g., herpes simplex virus [HSV2]) to receive MHD diagnoses after detection of their infections. This report documents incidence rates of MHD among HIV-positive service members and compares the rates to those of two HIV-unexposed control groups: an HSV2-infected group and a group of individuals without documented HIV or HSV2 infections.

METHODS

The surveillance period was 1 January 2000 through 31 December 2011. The surveillance population included individuals who had served at any time in the active component of the Army, Navy, Air Force, Marine Corps, or Coast Guard.

HIV-1 seropositivity was defined as two positive results from serologic testing of two different specimens from the same individual separated by at least one day or

one positive result from the serologic testing of the most recent specimen from an individual. Results of HIV tests are routinely maintained in the Defense Medical Surveillance System (DMSS). An incident case of HSV2 was defined as two or more medical encounters with a diagnosis of "genital herpes" (ICD-9-CM 054.1 with any fifth digit) in any diagnostic position.

Incidence rates of MHD were compared between three groups of active component service members:

HIV-infected cohort: service members who were documented as HIV-1 seropositive during the surveillance but did not receive case-defining diagnoses of HSV2 during or prior to the surveillance period.

HSV2-infected cohort: service members who were documented as incident cases of HSV2 during the surveillance period but who were not HIV-1 seropositive during or prior to the surveillance period.

Referent cohort: service members who were not documented as HIV-1 seropositive or as incident cases of HSV2 at any time. Ten randomly selected controls were matched to each case in the HIV cohort. The date of confirmation of HIV seropositivity for each case in the HIV cohort was used as the reference date for selection of the referent cohort.

The members of each cohort were followed from the time of entry into the HIV, HSV2 or referent groups until leaving active service, the end of the surveillance period, or documentation of an MHD of interest. For most MHDs, cases were defined by at least one inpatient or two ambulatory medical encounters (on separate days) with a MHD diagnosis of interest from six months after the date of HIV or HSV2 diagnosis until the end of follow-up **(Table 1)**. Cases of "suicide attempt" and "suicide ideation" were defined by one inpatient or one ambulatory encounter with the relevant diagnosis.

The six-month "reaction" or lag time after case-defining HIV or HSV2 diagnoses was implemented to exclude undiagnosed mental health disorders whose onsets may have preceded HIV/HSV2 infection and mental disorder "symptoms" that were expressions of acute reactions to receiving a HIV or HSV2 diagnosis. Of note in this regard, many MHD diagnoses require a six-month period of clinical symptoms to meet criteria for diagnosis as determined by the Diagnostic and Statistical Manual of Mental Disorders-IV (DMS-IV) (e.g., anxiety).[17]

Each individual was considered an incident case of MHD only once during the surveillance period. Poisson regression was used for direct calculation of incidence rate ratios (IRR); the regression analysis was adjusted for sex, race/ethnicity, and military branch of service, previous mental health disorder and deployment history.

TABLE 1. Mental health categories and case-defining diagnostic codes (ICD-9-CM)

Category	ICD-9-CM codes
Mental disorder diagnoses (ICD-9-CM: 290-319)	
Alcohol dependence	303.xx, 303.9x
Alcohol abuse	305.xx
Substance dependence	304.xx
Substance abuse	305.2x-305.9x
Post traumatic stress disorder	309.81
Major depression	296.20-296.26, 296.30-296.36, 296.90, 311
Bipolar disorder	296.0x, 296.1x, 296.4x-296.6x, 296.70, 296.80, 296.89
Anxiety disorder	300.00, 300.01, 300.02, 300.09
Personality disorders	301.0x-301.9
Schizophrenia or other psychosis	293.81, 293.82, 295.xx, 297.xx, 298.xx
Mental health problems (selected V-codes & E-codes)	
Suicide ideation	V62.84
Suicide attempt	E950.xx-E958.x

RESULTS

From 1 January 2000 through 31 July 2010, a total of 1,906 active component service members without HSV2 infection were serologically confirmed with HIV-1 infection, and 12,396 service members were diagnosed with HSV2 infection. For analysis purposes, 19,060 service members who were not diagnosed with HIV or HSV2 infections were randomly selected as the uninfected referent group **(Table 2)**.

Compared to the HSV2 and referent groups, the HIV group had higher proportions of service members that were male (97%), of black race/ethnicity (53%), in the Navy (43%) and of lower education and military grade **(data not shown)**. Compared to the referent group, the HSV2 group had relatively more females (52%) and service members of black race/ethnicity (31%).

Nearly 57 percent (n=1,076) of HIV-infected service members received an incident diagnosis of an MHD six months or more after the initial detection of their infections. For nearly all categories of mental disorders, incidence rates of diagnoses were highest in the HIV group, intermediate in the HSV2 group, and lowest in the referent group; for personality disorders, the highest incidence rate of diagnosis affected the HSV2 group. The MHD categories with the highest incidence rates among the HIV cohort were alcohol abuse, depression, anxiety, and alcohol dependence **(Table 2)**.

For 10 of the 12 MHDs of interest for this analysis, service members who were infected with HIV were more likely than uninfected referent cohort members to have received the diagnoses (after adjusting for differences in age, race, service, and other potentially confounding factors) **(Table 3)**. Compared to members of the referent cohort, individuals infected with HIV were approximately four times as likely to have documented diagnoses of substance abuse (IRR 3.9, 95% CI 2.2-6.9) and substance dependence (IRR 4.1, 95% CI 2.1-7.9) and approximately three times as likely to have diagnoses of suicidal ideation (IRR

TABLE 2. Incident diagnoses and incident rates of mental health disorders, among service members with HIV or HSV2 infection and uninfected referents, active component, U.S. Armed Forces, 2000-2011

Mental health disorder	HIV cohort (n=1,906)		HSV2 cohort (n=12,396)		Referent cohort (n=19,060)	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Alcohol abuse	315	58.4	1,666	34.0	2,112	31.0
Alcohol dependence	70	11.6	275	5.2	353	4.8
Anxiety	142	24.4	1,043	20.4	801	11.1
Bipolar	16	2.6	117	2.2	75	1.0
Depression	312	57.5	1,732	35.2	1,115	15.6
Personality disorder	24	3.9	259	4.9	132	1.8
Psychoses, schizophrenia	12	1.9	36	0.7	36	0.5
Post-traumatic stress disorder	58	9.5	473	9.0	562	7.7
Substance abuse	38	6.2	121	2.2	115	1.6
Substance dependence	26	4.2	87	1.6	81	1.1
Suicide attempt	18	2.9	74	1.4	56	0.8
Suicide ideation	45	7.3	171	3.2	144	2.0

[a]Incidence rate per 1,000 p-yrs of service

3.2, 95% CI 1.8-5.5), bipolar disorder (IRR 3.3, 95% CI 1.5-7.1) and depression (IRR 2.9, 95% CI 2.4-3.5).

For 9 of the 12 MHDs of interest, service members who were infected with HIV were more likely than those infected with HSV2 to have received the diagnoses (after adjusting for potentially confounding differences between the groups). For 6 of the 12 MHDs of interest, HSV2-infected service members were more likely than referent group members to have received the diagnoses (after appropriate adjustment). Finally, MHD diagnosis experiences differed more between the HIV infected and the uninfected referent group than between the HIV-infected and the HSV2-infected group **(Table 3)**.

EDITORIAL COMMENT

This report suggests that HIV seroconverters in the active component of the U.S. military are at greater risk than HIV-negative service members of receiving at least one mental health diagnosis six months or more after initial detection of their infections. The MHDs that are the most frequently diagnosed among HIV-infected service members compared to their uninfected counterparts are psychosis/schizophrenia, substance dependence, substance abuse, bipolar disorder, suicide ideation and depression. The findings are consistent with those of studies among HIV-positive civilians and military members.[14-16,18]

The results of this analysis should be interpreted in light of several limitations. For example, the relatively high rates of MHD diagnoses among HIV-infected service members likely reflects at least in part better ascertainment of mental health problems among HIV-positive compared to uninfected service members. In this regard, some service members may have undiagnosed mental health problems that precede the acquisition and clinical detection of their HIV or HSV2 infections. Because HIV-infected service members attend regular follow-up visits for the management of their infections, frequent contact with care

TABLE 3. Incidence rates (per 1,000 person-years) and rate ratios of mental health disorders, among service members with HIV or HSV2 infection and uninfected referents, active component, U.S. Armed Forces, 2000-2011

Mental health disorder	HIV compared to referent	HIV compared to HSV2	HSV2 compared to referent
	Adjusted IRR (95% CI)	Adjusted IRR (95% CI)	Adjusted IRR (95% CI)
Alcohol abuse	1.63 (1.37-1.94)	1.74 (1.44-2.09)	1.12 (1.00-1.26)
Alcohol dependence	1.81 (1.20-2.72)	2.15 (1.39-3.31)	1.09 (0.82-1.45)
Anxiety	2.01 (1.55-2.61)	1.37 (1.05-1.79)	1.43 (1.43-1.69)
Bipolar	3.27 (1.51-7.07)	1.78 (0.85-3.75)	1.96 (1.12-3.44)
Depression	2.91 (2.38-3.55)	1.75 (1.43-2.13)	1.45 (1.26-1.66)
Personality disorder	1.35 (0.60-3.02)	0.86 (0.39-1.90)	1.62 (1.04-2.52)
Post-traumatic stress disorder	1.15 (0.82-1.61)	1.09 (0.77-1.54)	1.17 (0.97-1.41)
Psychoses, schizophrenia	6.22 (2.22-17.43)	3.16 (1.16-8.56)	1.86 (0.76-4.53)
Substance abuse	3.87 (2.17-6.91)	2.68 (1.51-4.76)	2.00 (1.24-3.20)
Substance dependence	4.06 (2.08-7.93)	3.40 (1.71-6.74)	1.76 (0.99-3.15)
Suicide attempt	2.71 (1.15-6.41)	2.65 (1.09-6.47)	0.97 (0.48-1.95)
Suicide ideation	3.19 (1.85-5.51)	1.78 (1.05-3.02)	2.03 (1.36-3.03)

providers may result in increased referrals for and diagnoses of previously undiagnosed MHDs relative to other service members. Of note, service members who received MHD diagnoses prior to their first HIV/HSV2 infection diagnoses were included in this analysis; however, comparisons of rates of MHDs after infection diagnoses were adjusted to account for differences in the mental health histories of the HIV, HSV2, and uninfected referent groups.

Also, some service members may have separated from military service within six months of their HIV or HSV2 diagnoses. If such individuals received MHD diagnoses after leaving service, incidence rates of post-infection MHD diagnoses documented in this report would underestimate the actual rates.

The HIV infection status of all military members is ascertained through routine periodic serological screening; however, military members are not routinely screened for HSV2 infection. As such, some HSV2-infected service members may have been inappropriately included in the HIV infected or uninfected referent cohorts. If so, it is unlikely that the main findings of the report would be significantly affected by the misclassifications.

Finally, the findings of this report have implications for follow-up care of HIV-infected service members. In particular, the findings reiterate the importance of long term and comprehensive clinical monitoring of individuals diagnosed with HIV-1 infections. In particular, each HIV-focused medical encounter should include careful mental health evaluations, with special concern for substance and alcohol misuse, depression, and anxiety. Behavioral, cognitive, and chemotherapeutic interventions should be managed by clinical specialists with expertise in such complex comorbid conditions.

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Images in Health Surveillance: Tickborne Disease Vectors and Lyme Disease Clinical Diagnosis

Military members who live and train in the United States and abroad are at risk for tickborne diseases. Different tick species transmit different infectious agents and have varying geographic distributions. In the U.S. tickborne diseases include Lyme disease, Rocky Mountain spotted fever (RMSF), ehrlichiosis, anaplasmosis, Powassan virus encephalitis, babesiosis, and Colorado tick fever. Tick bites are also a mode of transmission for tularemia and Q fever.

Outbreaks of tickborne diseases follow seasonal patterns (generally April-September). Ticks are commonly found in wooded and brushy areas where they physically contact hosts. Service members are at risk of exposure to ticks while off-duty (e.g., landscaping, camping, hiking) as well as on-duty during training and operations. Prevention of tick bites (e.g., wearing long pants tucked into boots or high socks, repellent usage, bathing after possible exposure), full-body tick checks, and proper identification and removal of ticks are important measures to prevent tickborne disease.

Epidemiologic/clinical features of Lyme disease

In the U.S., Lyme disease is the most commonly known and reported vector-borne disease. Although cases cluster in the north-eastern and north-central U.S., Lyme disease cases have been reported from nearly every state.[1] From 2001 to 2008, counts of Lyme disease among service members increased, particularly from 2006 to 2008; most cases were reported from installations in Lyme disease endemic areas of the U.S. and Europe.[2] In 2010, there were 208 cases of Lyme disease in active and reserve component military service members.[3]

Borrelia burgdorferi, a spirochete bacterium, is the causative agent of Lyme disease in the U.S. **(Figure 1)**. During feeding, ticks infected with the spirochete pass them into the host. Generally, infected ticks must be attached for 36-48 hours to transmit the infection; therefore, prompt removal of embedded ticks is an effective preventive measure against Lyme disease.[4]

FIGURE 1. Dark field microscopy of *Borrelia bugdorferi*

FIGURE 2. Erythema migrans in a Lyme disease patient

The classical clinical presentation of Lyme disease includes a "bulls-eye rash," or erythema migrans (EM) **(Figure 2)**. EM occurs in approximately 70-80 percent of infected persons.[4] Because the identification of EM on darker-skinned individuals can be difficult, infections may remain untreated longer in these individuals. Delays in treatment may contribute to the increased occurrence of Lyme-related arthritis among black, non-Hispanic compared to other racial/ethnic subgroup members.[2,5]

Other common signs and symptoms of Lyme disease are non-specific and include headache, muscle and joint pain, fatigue, nausea, and fever. Without effective antibiotic treatment, acute symptoms can persist and long-term pathologic effects – on joints (e.g., arthritis), the heart (e.g., conduction abnormalities), and the nervous system (e.g., peripheral facial palsy) – can occur.

Tick vectors of Lyme disease

Ixodes scapularis, the blacklegged tick or deer tick, is distributed widely across the eastern half of the U.S. **(Figure 3)**.[4] *Ixodes scapularis* is the primary vector of Lyme disease and can also transmit anaplasmosis, ehrlichiosis, Powassan virus, and babesiosis.[6-8] Most humans are infected through the bites of immature ticks (nymphs) because they are small (less than 2mm) often go undetected; thus, they are less likely to be removed (see inset).[4] In general, nymphs of *Ixodes spp.* are approximately the size of a poppy seed (<2mm), and adult ticks are approximately the size of a sesame seed (2-3mm).[6]

Ixodes pacificus, the western blacklegged tick, is found along the Pacific coast of the U.S. and transmits Lyme disease and anaplasmosis **(Figure 4)**.[4,6,7]

Tick vectors of Rocky Mountain Spotted Fever (RMSF) and other diseases

Dermacentor variabilis, the American dog tick or wood tick, is found in the eastern and central U.S. and in limited areas on the Pacific Coast **(Figure 5)**.[4] It is the major vector of RMSF and can also transmit tularemia.[7,9] Adult *Dermacentor* species, the most common stage found feeding on humans, are approximately 4-5mm (see inset), making them larger and more readily detected than *Ixodes* species.

Dermacentor andersoni, the Rocky Mountain wood tick, is found in the western and northern U.S. and is a vector for RMSF, tularemia, Colorado tick fever, and Q fever **(Figure 6)**.[4,6,9]

FIGURE 3. *Ixodes scapularis*

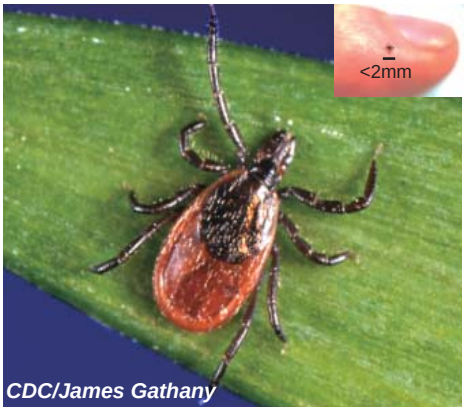

FIGURE 4. *Ixodes pacificus*

FIGURE 5. *Dermacentor variabilis*

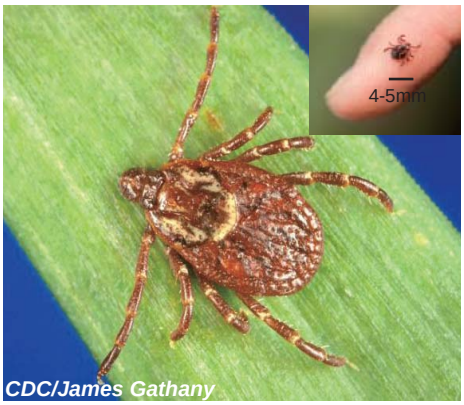

FIGURE 6. *Dermacentor andersoni*

Amblyomma americanum, known as the lone star tick, is found primarily in the southeastern and southcentral U.S.; however, it is also widespread throughout the eastern half of the U.S. **(Figure 7).**[4] Females have a characteristic white star marking located centrally on the dorsal surface. *A.americanum* is a vector for ehrlichiosis and tularemia.[7,9] Similar to *Ixodes* species, the tiny nymph stage is the most common stage found feeding on humans. *Amblyomma* species are slightly larger than *Ixodes* species; adult females are approximately 3mm.

FIGURE 7. *Amblyomma americanum*

CONCLUSION

Reducing exposure to ticks through personal protective measures and prompt removal of attached ticks are the primary preventive measures for tickborne disease. Information regarding Lyme disease, (including instructions for tick removal) is available from the U.S. Army Public Health Command at: http://phc.amedd.army.mil/PHC%20Resource%20Library/18-028-0107-Tick-Borne_Diseases[1].pdf and from the CDC at: http://www.cdc.gov/lyme/.

Acknowledgement: Dr. William K. Reeves, USAFSAM/PHR

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Brief Report

Quadrivalent Human Papillomavirus Vaccine Initiation, Coverage, and Compliance Among U.S. Active Component Service Women, 2006-2011

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Human papillomavirus (HPV) is the most common sexually transmitted pathogen detected among U.S. service members. An estimated 169,682 incident diagnoses of HPV infection occurred between 2004-2009 among active component U.S. service members (rate of 2,306 cases per 100,000 person-years).[1] In 2006, a 3-dose HPV quadrivalent vaccine (HPV4), which protects against common HPV strains (types 6, 11, 16, 18) responsible for about 70 percent of cervical cancers and 80 percent of genital warts, was licensed in the United States.[2] Consistent with the Centers for Disease Control and Prevention's Advisory Committee on Immunization Practices (ACIP) recommendations, the Department of Defense (DoD) has made the HPV4 vaccine available to all eligible service members aged 17–26 years. The ACIP has recommended administration of the second dose of vaccine 2 months after the first dose and the third dose at six months after the first dose.[3]

Despite vaccine availability, utilization of the HPV4 vaccine by active component U.S. service women has been reported to be low. For example, at Womack Army Medical Center in Fort Bragg, North Carolina, 15 percent of eligible service women initiated the series; of these, only 37.4 percent completed the 3-dose series.[4] At the Naval Medical Center San Diego, the 3-dose completion rates were lower among active duty women than other beneficiaries, averaging 16 percent.[5] This brief report quantifies HPV4 vaccine immunization rates in eligible women in U.S. military service. (The results were presented in part at the International Conference on Emerging Infectious Diseases in Atlanta, Georgia in 2012.)

The Defense Medical Surveillance System was used to identify active component service women in the Army, Air Force, Navy, Marine Corps, and Coast Guard eligible for the HPV4 vaccine during the interval 2006-2011. Records of administration of the HPV4 vaccine were obtained from the immunization data base of the Defense Enrollment Eligibility Reporting System (DEERS). From January 2006 to June 2011, of the 270,257 service women who were in the eligible age range for the HPV4 vaccine, 60,807 (22.5%) received at least one HPV4 dose **(Table)**. Of the 51,924 women who remained in the active component for 6 months or more following their first dose, 16,507 (31.8%) received only 1 dose, 11,802 (22.7%) received only 2 doses, and 23,615 (45.5%) completed the recommended three doses. At the six month target date, 15.1 percent of those initiating the series and still on active service completed the series. Of the 44,062 women who did not receive 3 HPV4 doses within the recommended 6 months, 16.1 percent (7,102) completed the series within 1 year; thus, the one year compliance was 32.3 percent. The median times between the first and second, and first and third doses were 3 months and 8 months, respectively.

In theory, proper timing of the complete series of HPV4 vaccinations is necessary to achieve immunologic protection. The low initiation and series completion rates of HPV4 vaccine in service women is concerning. Increased education of service women and providers on vaccine benefits may increase coverage, enhance series completion, and extend protection against HPV infection and its clinical effects.

TABLE. Initiation, coverage, and compliance rates of HPV4 vaccination among female service members, active component, U.S. Armed Forces, 2006-2011

	No. vaccinated	Population[a]	% total
Initiation rates	60,807	270,257	22.5
Coverage rates			
1 dose	16,507	51,924	31.8
2 doses	11,802	51,924	22.7
3 doses	23,615	51,924	45.5
Compliant by 6 months[b]	7,862	51,924	15.1
Compliant by 1 year[c]	14,964	46,373	32.3

[a]Eligible population is time-dependent
[b]Per recommendations of ACIP[3]
[c]Per vaccine prescribing information[2]

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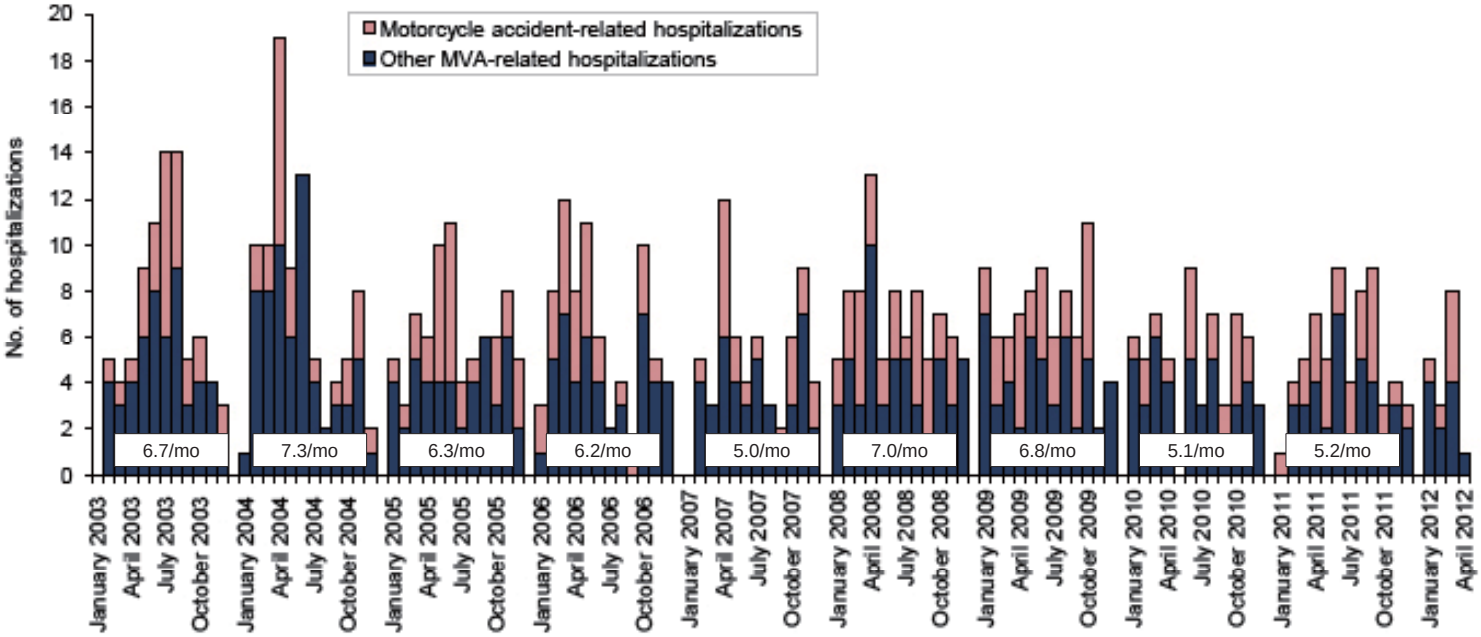
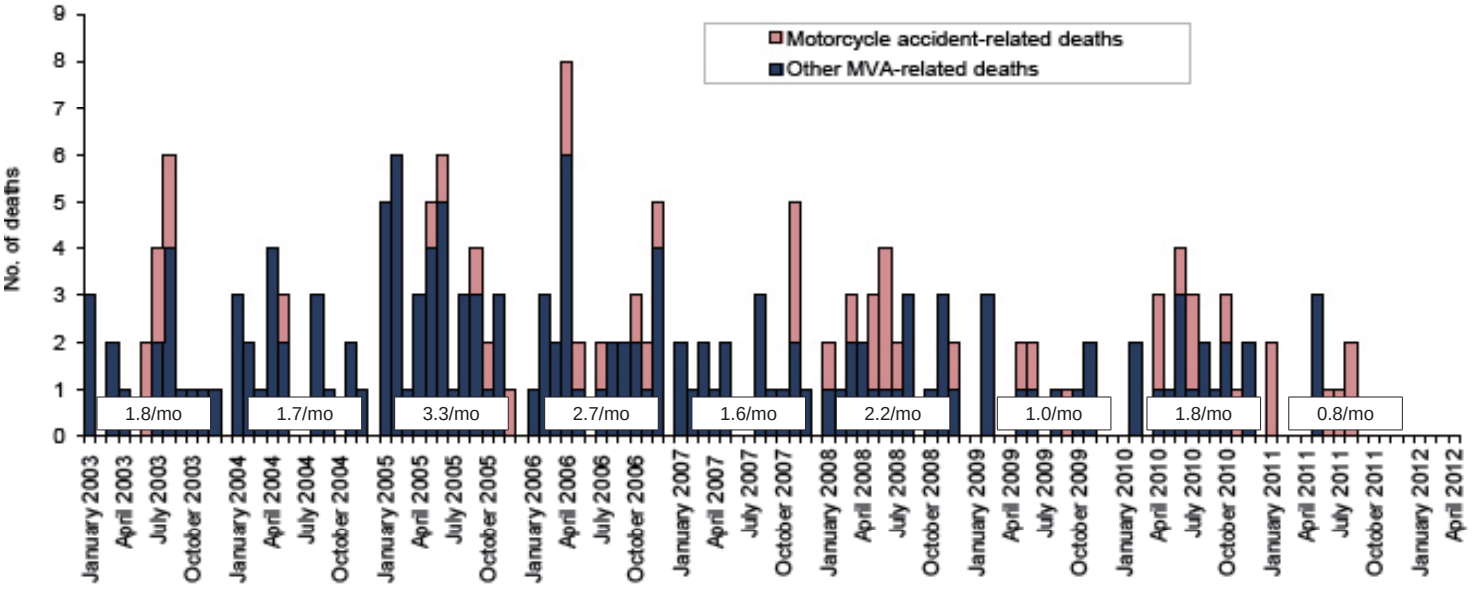
Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003-April 2012 (data as of 25 May 2012)

Hospitalizations outside of the operational theater for motor vehicle accidents occurring in non-military vehicles (ICD-9-CM: E810-E825; NATO Standard Agreement 2050 (STANAG): 100-106, 107-109, 120-126, 127-129)



Note: Hospitalization (one per individual) while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany within 10 days of another motor vehicle accident-related hospitalization.

Deaths following motor vehicle accidents occurring in non-military vehicles and outside of the operational theater (per the DoD Medical Mortality Registry)



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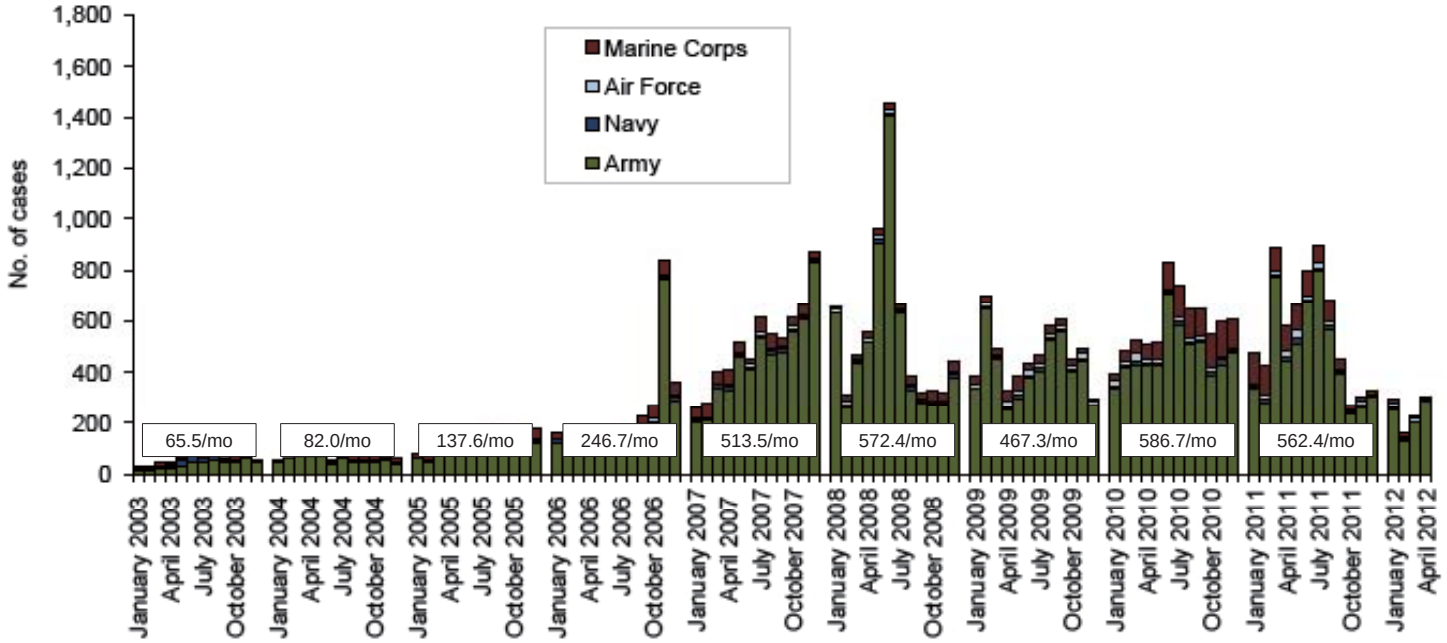
Note: Death while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany within 10 days prior to death.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003-April 2012 (data as of 25 May 2012)

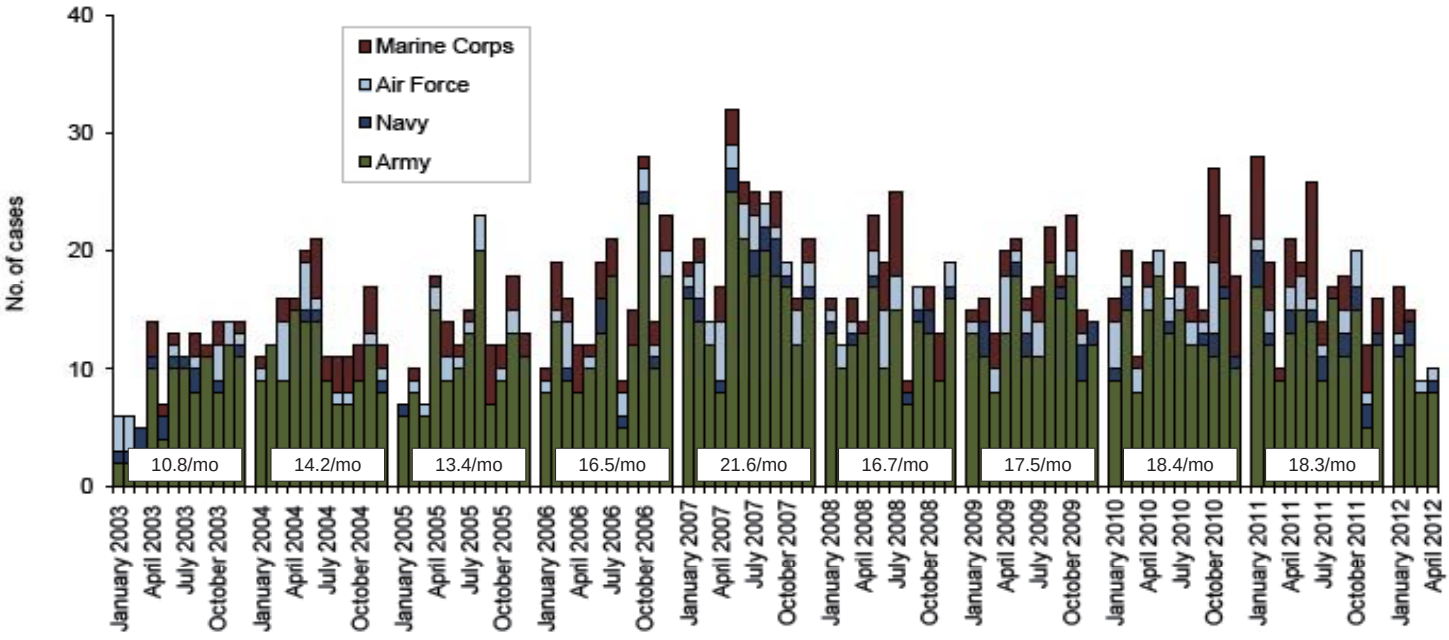
Traumatic brain injury (ICD-9: 310.2, 800-801, 803-804, 850-854, 907.0, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F, V15.52_0-9, V15.52_A-F, V15.59_1-9, V15.59_A-F)[a]



Reference: Armed Forces Health Surveillance Center. Deriving case counts from medical encounter data: considerations when interpreting health surveillance reports. *MSMR*. Dec 2009; 16(12):2-8.

[a]Indicator diagnosis (one per individual) during a hospitalization or ambulatory visit while deployed to/within 30 days of returning from OEF/OIF/OND. (Includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 3,537 deployers who had at least one TBI-related medical encounter any time prior to OEF/OIF/OND).

Deep vein thrombophlebitis/pulmonary embolus (ICD-9: 415.1, 451.1, 451.81, 451.83, 451.89, 453.2, 453.40 - 453.42 and 453.8)[b]

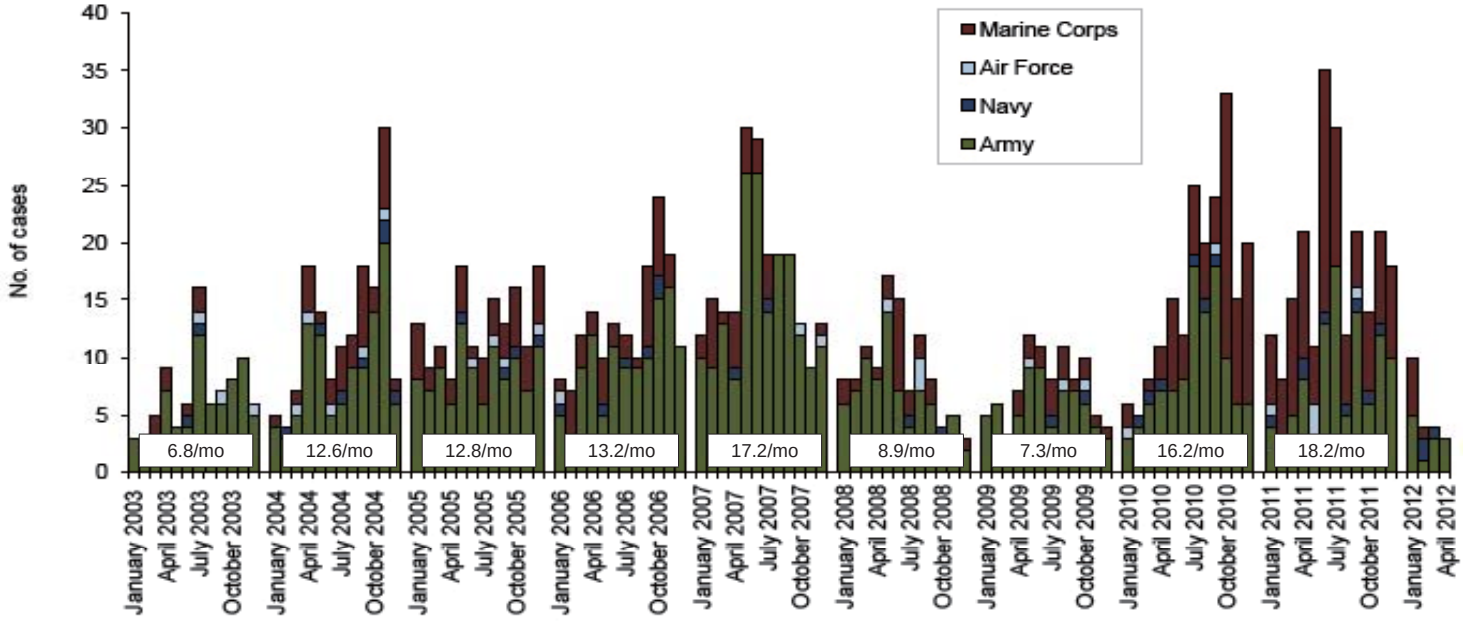


Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379-83.

[b]One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 90 days of returning from OEF/OIF/OND.

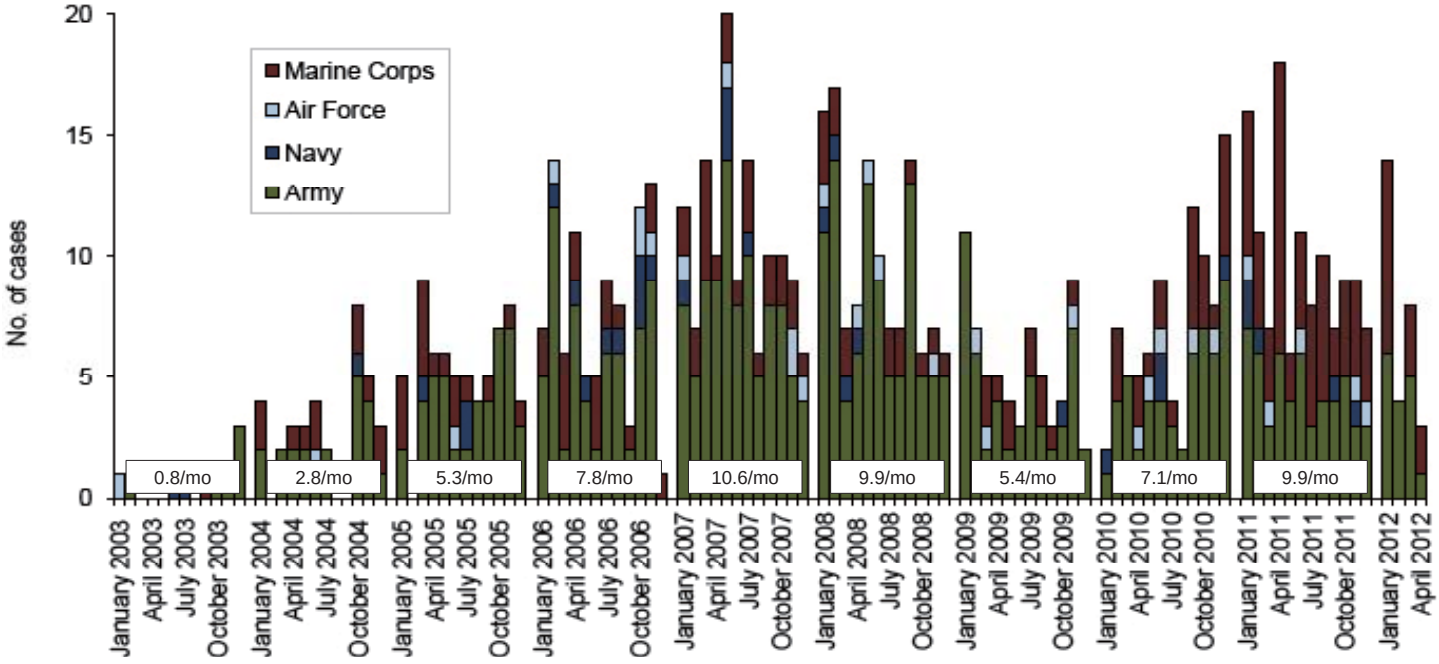
Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003-April 2012 (data as of 25 May 2012)

Amputations (ICD-9-CM: 887, 896, 897, V49.6 except V49.61-V49.62, V49.7 except V49.71-V49.72, PR 84.0-PR 84.1, except PR 84.01-PR 84.02 and PR 84.11)[a]



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: amputations. Amputations of lower and upper extremities, U.S. Armed Forces, 1990-2004. *MSMR*. Jan 2005;11(1):2-6.
[a]Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 365 days of returning from OEF/OIF/OND.

Heterotopic ossification (ICD-9: 728.12, 728.13, 728.19)[b]



Reference: Army Medical Surveillance Activity. Heterotopic ossification, active components, U.S. Armed Forces, 2002-2007. *MSMR*. Aug 2007; 14(5):7-9.
[b]One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 365 days of returning from OEF/OIF/OND.

Medical Surveillance Monthly Report (MSMR)
Armed Forces Health Surveillance Center
11800 Tech Road, Suite 220 (MCAF-CS)
Silver Spring, MD 20904

THE MEDICAL SURVEILLANCE MONTHLY REPORT (MSMR), in continuous publication since 1995, is produced by the Armed Forces Health Surveillance Center (AFHSC). The *MSMR* provides evidence-based estimates of the incidence, distribution, impact and trends of illness and injuries among United States military members and associated populations. Most reports in the *MSMR* are based on summaries of medical administrative data that are routinely provided to the AFHSC and integrated into the Defense Medical Surveillance System for health surveillance purposes.

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ISSN 2158-0111 (print)
ISSN 2152-8217 (online)