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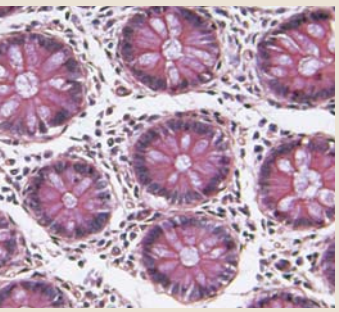
MEDICAL SURVEILLANCE MONTHLY REPORT



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A publication of the Armed Forces Health Surveillance Center

Amputations of Upper and Lower Extremities, Active and Reserve Components, U.S. Armed Forces, 2000-2011

Traumatic amputations of limbs profoundly alter the lives of affected service members. Service members are at risk for traumatic amputations of limbs during combat deployments as well as from other hazards such as motor vehicle accidents. From 2000 to 2011, there were 6,144 incident cases of traumatic amputations among 5,694 service members. Over one-third of these service members (n=2,037) had major amputations (i.e., loss of a hand or foot or more). Male, junior enlisted members of the Army and Marine Corps in combat-specific military occupations have been most affected by major amputations. Nearly two-thirds of major amputations occurred during a deployment or were deployment-related. Recent increases in numbers of major amputations generally reflect the extent and intensity of ground combat operations in Iraq and Afghanistan.

Traumatic amputations of limbs profoundly alter the lives of those affected and their families. In addition, combat-related amputations are often complicated by other life-threatening or life-changing conditions such as: traumatic brain injury (TBI); spinal cord and internal organ injuries; loss of hearing and visual acuity; heterotopic ossification; deep vein thrombosis/pulmonary embolus; chronic pain syndromes; post-traumatic stress disorder (PTSD) and many others.[1] The treatment and rehabilitation of amputations can be long and complicated; as such, care of traumatic amputees places significant burdens on the military and veterans' health systems.

Military members are at risk for minor (i.e., fingers, toes) and major (i.e., hands, arms, feet, legs) traumatic amputations during combat deployments and in many other settings. During the period of interest for this report, service members were frequently exposed to severe injury risk during combat operations in Iraq and Afghanistan. Because of improvements in protective equipment and innovations in medical evacuation procedures and battlefield trauma care (e.g., mobile trauma teams, triage procedures, forward deployment of multidisciplinary specialists) many severely injured service members, who might have died in earlier wars/conflicts, survived their injuries with significant disabilities, including amputations.[2-4] Service members are also at risk of non-combat related amputations resulting from motor vehicle, occupational, and recreational accidents (e.g., collisions, lacerations, falls, burns).

This report summarizes the numbers, types, and anatomic locations of minor and major traumatic amputations, and the demographic and military characteristics of active and reserve component members affected by them, from 2000 to 2011. The report also describes temporal trends and demographic and military characteristics of deployment-related amputations.

METHODS

The surveillance period was 1 January 2000 through 31 December 2011. The surveillance population consisted of all individuals who served in an active and/or reserve component of the U.S. Armed Forces at any time during the surveillance period. Diagnosis and procedure codes of the International Classification of Diseases, Ninth Revision, Clinical Modifications (ICD-9-CM) that specify injuries or treatments specific for amputations were used to identify traumatic amputations that occurred among service members during the surveillance period; the ICD-9-CM codes considered case-defining for this analysis are listed in Table 1.

The Defense Medical Surveillance System (DMSS) maintains electronic records of all hospitalizations and ambulatory visits of actively serving U.S. military members in U.S. military and civilian (contracted/purchased care through the Military Health System) medical facilities worldwide; the Theater Medical Data Store (TMDS) maintains records of medical encounters of service members deployed to southwest Asia/Middle East. For this analysis, the DMSS and the TMDS were searched to identify all medical encounter records that included one or more traumatic amputation-specific diagnostic and/or procedure codes. TMDS records were available only for calendar years 2005 through 2011.

For surveillance purposes, a case of traumatic amputation was defined as an individual with: 1) a hospitalization record with a case-defining ICD-9-CM diagnosis or procedure code in any diagnostic position; 2) an outpatient encounter record with a case-defining ICD-9-CM code in any diagnostic position, if the outpatient encounter occurred during a hospitalization; 3) two outpatient encounter records that included case-defining ICD-9-CM codes as their primary (first-listed) diagnoses – and at least one of the case-defining ICD-9-CM codes was an injury diagnosis (not a procedure or V-coded diagnosis). For all cases of major amputations identified through outpatient encounters alone (per definition 3), all relevant electronic medical encounter data were reviewed to confirm the presence of amputations (e.g., amputation-specific CPT codes and other non-case-defining but amputation-related codes). Finally, using TMDS data, a case was defined by any encounter with a non-V-coded case-defining amputation code in any diagnostic position **(Table 1)**.

For the purpose of summarizing the numbers and anatomical sites of amputations, each affected individual could be counted as both an incident upper

TABLE 1. ICD-9-CM diagnostic and procedure codes for traumatic amputation

	ICD-9-CM		
	Diagnosis codes	Health status codes (V-codes)	Procedure code
Upper extremity			
Traumatic amputation of thumb (complete) (partial)[a]	885.x	V49.61	84.02
Traumatic amputation of other finger(s) (complete) (partial)[a]	886.x	V49.62	84.01
Amputation of hand/wrist[b]		V49.63, V49.64	84.03, 84.04
Traumatic amputation of arm and hand (complete) (partial)[b]			
Unilateral, below elbow	887.0, 887.1	V49.65	84.05
Unilateral, at or above elbow	887.2, 887.3	V49.66, V49.67	84.06-84.09
Bilateral (any level)	887.6, 887.7		
Lower extremity			
Traumatic amputation of toe(s) (complete) (partial)[a]	895.x	V49.71, V49.72	84.11
Traumatic amputation of foot - unilateral (complete) (partial)[b]			
Unilateral (complete) (partial)	896.0, 896.1	V49.73, V49.74	84.12-84.14
Bilateral	896.2, 896.3		
Traumatic amputation of leg(s) (complete) (partial)[b]			
Unilateral, below knee	897.0, 897.1	V49.75	84.15
Unilateral, at or above knee	897.2, 897.3	V49.76, V49.77	84.16- 84.19
Bilateral (any level)	897.6, 897.7		
Unspecified[a]			
Upper limb, unilateral, unspecified	887.4-887.5	V49.6, V49.60	84.0, 84.00
Lower limb, unilateral, unspecified	897, 897.4, 897.5	V49.7, V49.70	84.1, 84.10

[a]Minor amputation
[b]Major amputation

extremity case and/or an incident lower extremity case once during the surveillance period. Summaries of anatomic locations were based on the most proximal site per extremity per individual and the most severe injury (i.e., bilateral prioritized over unilateral) that was reported during the surveillance period. Furthermore, inpatient encounters were prioritized over outpatient encounters, and diagnoses reported from deployed settings (TMDS data) were prioritized over those reported from nondeployed settings (DMSS data).

For purposes of summarizing demographic and military characteristics, an individual could be considered a case only once during the surveillance period regardless of the number of encounters for amputations per individual. Individuals were excluded if they had a case-defining amputation code prior to the surveillance period in either inpatient or outpatient encounters.

Causes of amputations were assessed based on E-codes (ICD-9-CM-based supplemental external cause of injury codes) reported during inpatient and outpatient encounters and STANAG codes (per NATO Standard Agreement No. 2050) reported on the record of each case-defining hospitalization in a U.S. military medical facility.

Deployment-related amputations: For the purposes of this analysis, a service member with a deployment-related amputation was defined as an individual with a major amputation that occurred during a deployment period or had a war- or battle-related cause of injury code listed on the record of an amputation-specific encounter. Service members with other or unknown causes of amputations were combined into an "other" group and used for comparison purposes.

RESULTS

During the surveillance period, there were 6,144 incident cases of traumatic amputation among 5,694 service members **(Table 2)**. A majority of all amputation-related injuries were considered minor amputations (i.e., toes, fingers, thumbs, upper/lower unspecified) (n=3,849; 63%). There were 2,295 major amputations (i.e., hands, feet, arms, legs) among 2,037 affected individuals; of these, 29 were bilateral upper extremity amputations and 360 were bilateral lower extremity amputations **(Table 2, Figures 1, 2)**.

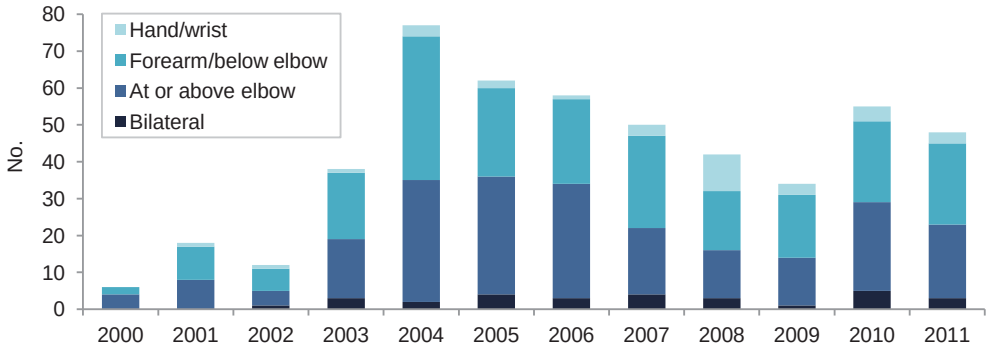
Of the upper extremity amputations (n= 3,839), a majority were minor amputations (n= 3,339; 87%). Of the major upper extremity amputations (n=500), there were 32 amputations that occurred at the hand/wrist, 223 of the forearm or below the elbow, 216 at or above the elbow, and 29 bilateral **(Figure 1)**. During the surveillance period the number of major upper extremity amputations increased from six in 2000 to a high of 77 in 2004. From 2005 to 2009, the number slightly decreased each year, then increased again in 2010 and 2011. Each year the greatest proportion of major upper extremity amputations occurred at a level more proximal than at the hand/wrist. Annual numbers of bilateral upper extremity amputations were relatively low and stable throughout the period (range, per year: 0 [2000, 2001] to 5 [2010]) **(Figure 1)**.

Of the lower extremity amputations (n=2,305), 22 percent were minor amputations (n=510) **(Table 2)**. A majority of lower extremity amputations were major amputations (n=1,795, 78%); of these, 135 were at the foot/ankle, 818 were below the knee, 482 were at/above the knee to the hip, 21 were bilateral foot/ankle, and 339 were bilateral leg amputations **(Table 2, Figure 2)**. During the surveillance period, the number of major lower extremity amputations increased from 22 in 2000 to 226 in 2007, decreased in 2008 and 2009, and then increased to 313 in 2011, the highest yearly

TABLE 2. Distribution of upper and lower extremity amputations by anatomical location, active and reserve component, U.S. Armed Forces, 2000-2011

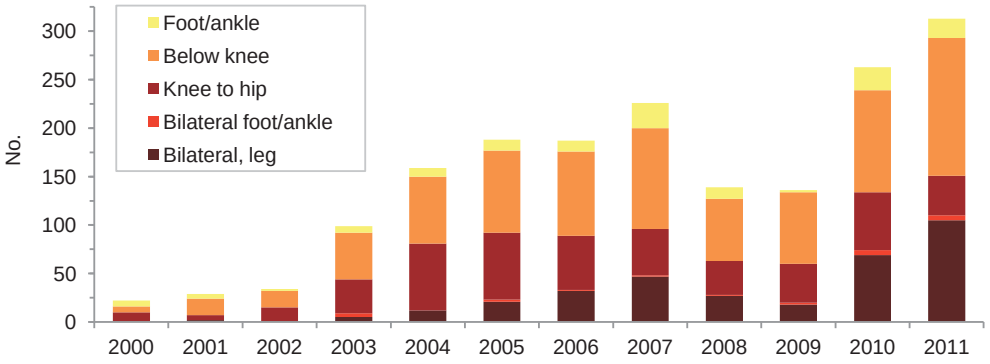
	Minor lower	Major lower	No lower	Total
Minor upper	29	148	3,162	3,339
Major upper	15	258	227	500
No upper	466	1,389	.	1,855
Total	510	1,795	3,389	5,694

FIGURE 1. Number of major upper body amputations by anatomical location, active and reserve components, U.S. Armed Forces, 2000-2011



[a]Excludes fingers, thumbs, and unspecified amputations

FIGURE 2. Number of major lower body amputations by anatomical location, active and reserve components, U.S. Armed Forces, 2000-2011



[a]Excludes toes and unspecified amputations

count during the period **(Figure 2)**. The number of bilateral lower extremity amputations increased from 2002 to 2007, then increased again in 2010 and 2011. In 2011, there were 110 bilateral lower extremity amputations, the most in any year of the surveillance period.

Of the 5,694 service members with an amputation, 450 (7.9%) had both upper and lower extremity amputations; 258 had two major extremity amputations (4.5%); 163 had one major and one minor amputation (2.9%); and 29 had two minor amputations (0.50%) **(Table 2)**. Twelve service members had both bilateral upper and bilateral lower amputations **(data not shown)**.

Overall, there were 2,037 service members with at least one major amputation. These individuals were more likely to be active component members (n=1,728; 84.8%), males (n=1,977; 97.1%), aged 20-24 (n=938;46.0%), white, non-Hispanic (n=1,516; 74.4%), in the Army (n=1,245; 61.1%), in the junior enlisted grades (E1-E4) (n=1,101; 54.1%), and in the infantry/artillery/combat engineering occupational category (n=1,089; 53.5%) than in the respective other military/demographic subgroups **(Table 3)**.

From 2005 to 2010, the proportion of service members affected by amputations who were in the active component increased from 75.8 percent to 90.1 percent **(data not shown)**. Consistently during the same period, there were many more major amputations among members of the Army and Marine Corps than the other services **(Figure 3)**. Of note, from 2009 to 2011, numbers and proportions of major amputations sharply increased among Marine Corps members; as a result, in contrast to recent prior experience, in 2011 there were more major amputations among members of the Marine Corps (n=157, 47.4% of the total) than the Army (n=146, 44.0% of the total) **(Figure 3)**.

Between 2009 and 2011, numbers and proportions of major amputations among junior enlisted (E1-E4) service members also markedly increased (2009: n=75 [48.1% of total]; 2011: n=203 [61.1% of total]) **(Figure 4)**.

Over the entire 12-year surveillance period, there were more amputations among service members in the "infantry, general" (n=728; 35.7%) than any other specific military occupational group **(data not shown)**. From 2005 to 2011, more than 40 percent of all amputations occurred among service members in combat-specific (infantry/artillery/combat engineering) occupations; in 2010 and 2011, nearly 70 percent of amputations affected service members in combat-specific occupations **(Figure 5)**.

Of the 2,037 service members with a major amputation, 52.8 percent (n=1,075) had an external cause of injury code associated with the amputation encounter. Over one-third of all service members with a major amputation had an external cause of injury indicating "battle injury" (n=694; 34.1%); 11.1 percent (n=227) had a code indicating "guns and explosives" (accident or undetermined intent); and 5.9 percent (n=120) had a code indicating "motor vehicle accident" **(data not shown)**.

Deployment-related amputations

Nearly two-thirds (66.1%; n=1,347) of all service members with major extremity amputations were likely injured during deployments, i.e., the traumatic amputation occurred during a deployment or had a cause of injury code indicative of a deployment-related injury **(Table 3)**. During the surveillance period, the number of deployment-related amputations increased from 2001 (n=1) to 2007 (n=178), decreased in 2008 and 2009, then increased again in 2010 (n=202) and 2011 (n=248) **(Figure 6)**.

EDITORIAL COMMENT

This report summarizes annual numbers and types of minor and major traumatic amputations in active and reserve component service members from 2000 through 2011. The report also compares experiences regarding upper and lower major extremity amputations, overall and in relation to various demographic and military characteristics. Notably, the report documents

TABLE 3. Demographic and military characteristics of service members with major extremity amputations, active and reserve component, U.S. Armed Forces, 2000-2011

	Deployment-related		Other		Total	
	No	% total	No	% total	No	% total
Total	1,347	.	690	.	2,037	.
Active	1,176	87.3	552	80.0	1,728	84.8
Reserve/Guard	171	12.7	138	20.0	309	15.2
Sex						
Female	24	1.8	36	5.2	60	2.9
Male	1,323	98.2	654	94.8	1,977	97.1
Age Group						
<20	63	4.7	35	5.1	98	4.8
20-24	685	50.9	253	36.7	938	46.0
25-29	340	25.2	151	21.9	491	24.1
30-34	139	10.3	75	10.9	214	10.5
35-39	87	6.5	73	10.6	160	7.9
>39	33	2.4	103	14.9	136	6.7
Race-ethnicity						
White, non-Hispanic	1,035	76.8	481	69.7	1,516	74.4
Black, non-Hispanic	95	7.1	109	15.8	204	10.0
Hispanic	141	10.5	47	6.8	188	9.2
Asian/Pacific Islander	37	2.7	22	3.2	59	2.9
Other	39	2.9	31	4.5	70	3.4
Service						
Army	893	66.3	352	51.0	1,245	61.1
Navy	32	2.4	137	19.9	169	8.3
Air Force	25	1.9	89	12.9	114	5.6
Marine Corps	397	29.5	106	15.4	503	24.7
Coast Guard	0	0.0	6	0.9	6	0.3
Grade						
E1-E4	774	57.5	327	47.4	1,101	54.1
E5-E9	481	35.7	284	41.2	765	37.6
O1-O3&WO1-WO3	84	6.2	46	6.7	130	6.4
O4-O10&WO3-WO5	8	0.6	33	4.8	41	2.0
Occupation						
Armor/motortransport	93	6.9	37	5.4	130	6.4
Infantry/artillery/combateng	912	67.7	177	25.7	1,089	53.5
Comm/intel	129	9.6	124	18.0	253	12.4
Repair/engineer	75	5.6	169	24.5	244	12.0
Healthcare	44	3.3	54	7.8	98	4.8
Pilot/aircrew	9	0.7	13	1.9	22	1.1
Other	85	6.3	116	16.8	201	9.9

trends over the past 12 years with particular emphasis on the last two years.

Not surprisingly, the report documents relatively large numbers of major extremity amputations during periods of more widespread and intense ground combat operational activities – initially in Iraq and more recently in Afghanistan. For example, there were relatively large numbers of major upper extremity amputations in 2004 through 2006 and again in 2010 and 2011 and of major lower extremity amputations from 2003 to 2007 and again in 2010 and 2011. Of particular note, in 2010 and 2011, there were sharp increases in lower extremity amputations – particularly among junior enlisted members of the Marine Corps and Army serving in combat-specific military occupations (i.e., infantry, artillery, combat engineering). The experience generally reflects the recent surges in the extent and intensity of ground combat operations in Afghanistan.

There are several limitations to the report that should be considered when interpreting the results. For example, the ICD-9-CM diagnosis and procedure codes used to identify traumatic amputation do not specify limb laterality (i.e., right or left side of the body) or surgical revisions of prior amputations. Thus, it is often difficult to determine if a new encounter with a code for amputation represents re-documentation of a known injury, a surgical revision of a previous amputation (at the same level or more proximal), or a new amputation on the opposite side of the body from the previously recorded injury.

FIGURE 3. Number and proportion of service members with major extremity amputation by service, active and reserve components, U.S. Armed Forces, 2005-2011

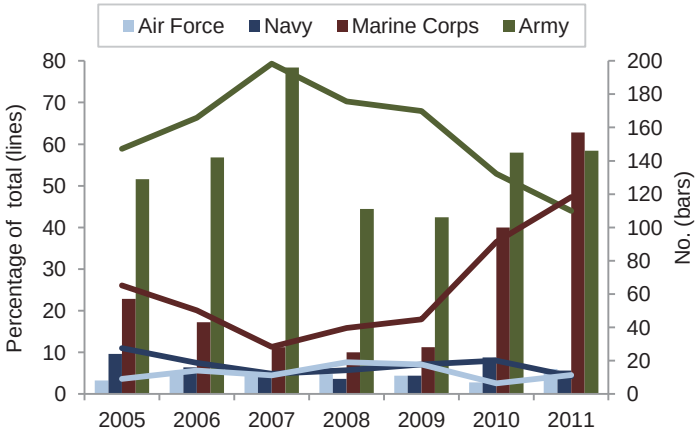


FIGURE 4. Number and proportion of service members with major extremity amputation by grade, active and reserve components, U.S. Armed Forces, 2005-2011

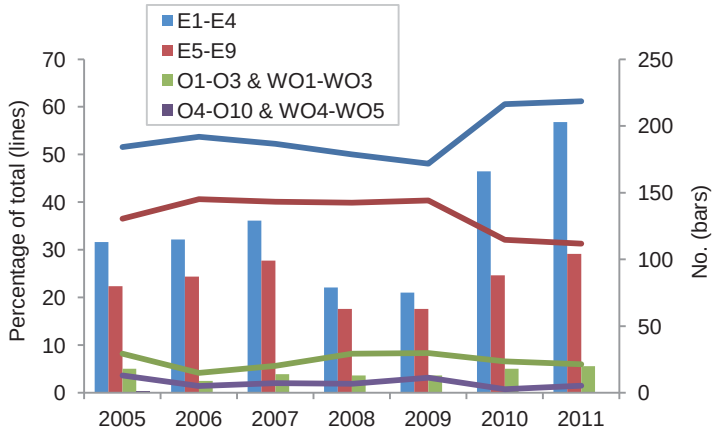
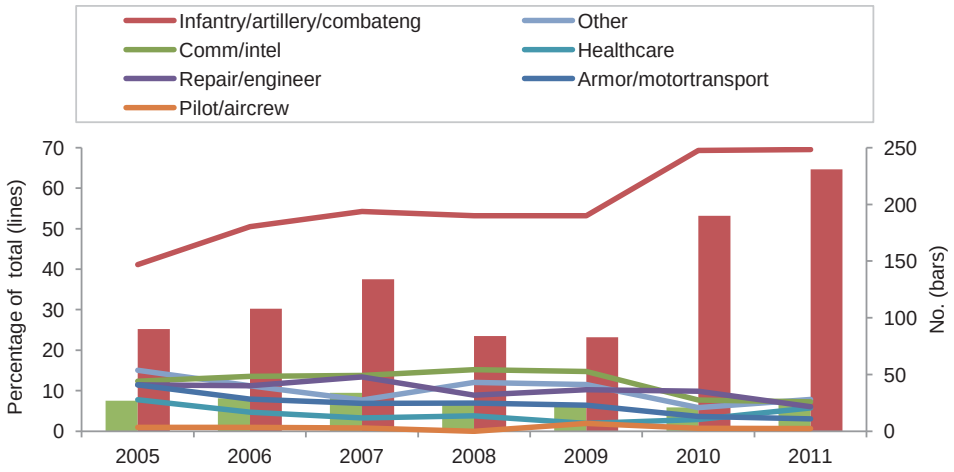


FIGURE 5. Number[a] and proportion of service members with major extremity amputation by military occupation, active and reserve components, U.S. Armed Forces, 2005-2011

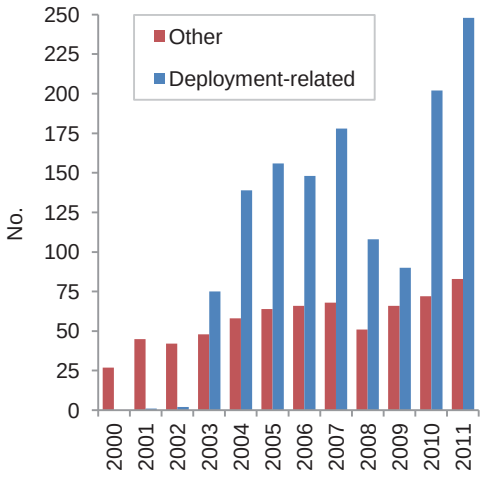


[a]Number shown for infantry/artillery/combateng and comm/intel only (for comparison purposes)

Furthermore, the assignment of anatomical location and severity (i.e., minor, major) were estimated based on ICD-9 codes which can be imprecise and ambiguous. For example, the codes that specify "bilateral amputations" do not indicate the anatomic locations of the amputations. Thus, the anatomical locations and severity (e.g., toe vs. leg, finger vs. arm) of the bilateral amputations reported here remain unclear.

The current case definition was repeatedly refined to optimize the sensitivity of the case finding algorithm while preserving the specificity of the surveillance case definition. To this end, the electronic medical records of a sample of potential cases were reviewed in detail to assess the numbers, timing, and natures of follow-up encounters, outpatient procedures (per common procedure codes [CPT]), and other amputation-related experiences.

FIGURE 6. Number of major amputations by deployment-related and "other," active and reserve components, U.S. Armed Forces, 2005-2011



Traumatic amputations – especially when combat-related – are often associated with life-threatening comorbid conditions. In such cases, the life-threatening conditions may take precedence in reporting of diagnoses, and/or amputations may be inaccurately or not specifically reported, on standardized medical encounter records. For example, if a service member was gravely injured, and an amputation was not reported in one of the available diagnostic positions on the standardized record of the related hospitalization, the encounter would not be identified as a case-defining event (unless amputation-specific procedure codes or contemporaneous outpatient diagnoses were recorded). Also, some severely injured service members may receive care outside of the Military Health System (e.g., civilian trauma centers, Veterans Health Administration hospitals); in such cases, amputations may not be documented on records used for this analysis. In summary, some amputations may not have been identified by the automated screening of administrative medical encounter records using the surveillance case definition developed for this report.

Finally, assessments of the causes of amputations and their relationships to deployment were based on cause of injury codes and routinely collected deployment-related information. Because such data sources are incomplete and potentially inaccurate (e.g., exact start and end dates of deployments), there are undoubtedly misclassifications of relationships between amputations and deployment statuses. In addition, deployment-related amputations are not necessarily "combat-related"; for example, severe injuries unrelated to combat can occur during periods of deployment (e.g., motor vehicle accidents in theater or while on leave outside of theater).

In summary, since 2003, many traumatic amputations among U.S. service members have occurred during combat-related activities in Iraq and Afghanistan. Male, junior enlisted members of the Army and Marine Corps in combat-specific military occupations have been most affected. Numbers and types of amputations generally reflect the extent and intensity of ground combat operations in Iraq and Afghanistan. Improvements in protective equipment, medical evacuation procedures, and in theater trauma care improve the survivability of previously lethal combat-related injuries. In turn, there are increasing demands for multidisciplinary treatment and rehabilitative care for wounded warriors with upper and/or lower extremity amputations and other complex medical, surgical, and psychological conditions.

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Deaths by Suicide While on Active Duty, Active and Reserve Components, U.S. Armed Forces, 1998-2011

Since 2010, suicide has been the second leading cause of death among U.S service members, exceeded only by war injury. Suicide mortality rates in the Army and Marine Corps have increased during the conflicts in Iraq and Afghanistan; however, most active duty service members who die by suicide have never deployed. During 1998-2011, 2,990 service members died by suicide while on active duty. Numbers and rates of suicide were highest among service members who were male, in the Army, in their 20s and of white race/ethnicity. Suicide death rates were 24 percent higher among divorced/separated than single, never-married service members. Firearms were the most frequently used method of suicide among both males and females. Numbers and rates of suicide among military members have increased sharply since 2005 and an increasing proportion of suicides were by firearms. When adjusted for age, rates of suicide are somewhat lower among active military members than civilians. There are not well established and clearly effective interventions to prevent suicides – in general or specifically in a military population during wartime.

Since 2010, suicide has been the second leading cause of death among U.S. service members, exceeded only by war injury.[1] Increases in suicide mortality during the past several years have affected the Army more than the other Services; in 2010, 39 percent of active component U.S. military personnel but 53 percent of suicide deaths were Army members. The Services and the Department of Defense (DoD) have focused considerable resources to prevent suicide.[2] The U.S. Air Force has reported success in reducing suicide rates; however the effectiveness of prevention programs has been difficult to measure objectively.[3,4] Ongoing studies continue to seek strategies for preventing suicide and improving mental health among service members.[5]

Suicide among military members is thought to be an impulsive act triggered by one or multiple stressors such as relationship breakups, legal/disciplinary problems, financial difficulties or physical health problems.[6,7] Since 2008, the DoD Suicide Event Report (DoDSER) has summarized numbers, rates and risk factors of fatal and non-fatal suicide events among active duty service members, including detailed information collected for each event.[8] Service members who die by suicide are more likely than the military population overall to be male, in their 20s and of white, non-Hispanic race/ethnicity. As compared to their respective counterparts, service members who are divorced, of lower military rank and who did not complete high school have higher suicide mortality rates. Approximately 45 percent of suicide decedents have histories of mental health problems; an investigation of suicide deaths during 2003-2009 found that soldiers with behavioral health disorders (e.g., anxiety, depression, substance abuse) had higher suicide rates than soldiers without such disorders.[8,9]

During 2008-2010, of suicide deaths of military members on active duty, 80 percent occurred in the U.S. and 13 percent in Iraq or Afghanistan. Nearly two-thirds of suicides were inflicted by firearms. Of those who died by firearm, nearly three-quarters used personal weapons; however, nearly all of those who died by suicide while deployed to Iraq or Afghanistan used military weapons.[8]

Suicide mortality rates in the Army and Marine Corps have increased since the beginning of Operations Enduring Freedom and Iraqi Freedom. U.S. Army researchers have suggested that deployment to these conflicts increases a soldier's risk of suicide and have estimated a proportion of suicides that may be related to deployment.[6,10] Such relationships are plausible but difficult to characterize precisely because many correlates of risk for suicide are closely associated with wartime deployments (e.g., access to weapons, high operational tempos, mental health problems). Of note in this regard, the majority (55%) of service members who died by suicide during 2008-2010 had never deployed and 84 percent had no documented combat experiences.[8]

This report summarizes numbers, rates, trends and correlates of risk of deaths by suicide among active duty military members during a 14-year period. It focuses on trends in methods of suicide and includes data through calendar year 2011.

METHODS

The surveillance period was January 1998-December 2011. The surveillance population included all individuals who served on active duty as a member of the U.S. Army, Navy, Air Force or Marine Corps anytime during the surveillance period. Deaths by suicide of active and reserve component members while serving on active duty were ascertained from records produced by service-specific casualty offices and maintained by the Office of The Armed Forces Medical Examiner (OAFME). These records are routinely provided to the Armed Forces Health Surveillance Center for integration into the Defense Medical Surveillance System. OAFME-assigned "underlying cause of death" codes were used to determine the methods of suicide. Because this report summarized all suicides documented by the OAFME as of 3 April 2012, the numbers of suicides reported here may differ from those reported at other times and by other DoD sources.

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, i.e., 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. Members of the reserve component (i.e., reserve and National Guard) were excluded from rate calculations because the start and end dates of their active duty periods were not available.

RESULTS

Rates, trends and demographic characteristics

During January 1998-December 2011, 2,990 service members died by suicide while on active duty **(Table 1)**; the average number per year during the period was 214. Annual numbers of suicides of military members on active duty ranged from 151 (in 1999) to 296 (in 2009) among males and from 4 (in 2001) to 16 (in 2011) among females **(data not shown)**.

Most service members who died by suicide were males (95%), active component members (89%), of white, non-Hispanic race/ethnicity (70%) and in their 20s (58%) **(Table 1)**. The same subgroups of service members experienced the highest suicide mortality rates (calculated for the active component only). Suicide death rates were 24 percent higher among divorced/separated than single, never married active component members. The Army and Marine Corps had much higher crude (unadjusted) suicide rates than the other Service branches; these differences persisted when directly adjusted for age **(Table 2)**.

Among active component members, suicide death rates were fairly stable from 1998 to 2005, increased sharply from 2005 to 2009, and then declined slightly through 2011 **(Figure 1)**. Overall crude rates ranged from 10.1 (in 2002) to 19.7 (in 2009) per 100,000 p-yrs **(Figure 1)**.

Suicide method

During the period, firearms were the most frequently used method of suicide by military members on active duty; firearms accounted for 62 and 46 percent of suicides among males and females, respectively **(Figure 2)**. Among various military/demographic subgroups, the proportion of suicides due to firearms was highest among males in the reserve component (291/312; 70%) **(data not shown)**. Firearms were the most frequently used suicide method among males of all age groups and females 20 and older; among teenaged females, hanging/suffocation was the most frequently used method **(Figure 2)**. Poisonings accounted for fewer than 9 percent and 23 percent of all suicides among male and female service members, respectively.

From 2005 through 2010, rates of suicide by firearms increased sharply among

TABLE 1. Demographic characteristics of active duty military members who died by suicide, active and reserve components, U.S. Armed Forces,1998-2011

	Active and reserve components	Active component		
	No.	No.	Rate[a]	Rate ratio
Total	2,990	2,652	13.7	-
Sex				
Male	2,848	2,536	15.3	ref
Female	142	116	4.1	0.27
Race/ethnicity				
White, non-Hispanic	2,098	1,861	15.3	ref
Black, non-Hispanic	364	328	9.5	0.62
Other	528	463	12.5	0.82
Age				
<20	234	222	12.0	0.77
20-24	1,070	1,012	15.7	ref
25-29	660	610	15.1	0.96
30-34	355	313	11.1	0.70
35-39	369	294	12.1	0.77
40+	302	201	11.5	0.73
Marital status				
Single, never married	1,347	1,219	15.2	ref
Married	1,472	1,288	12.2	0.80
Divorced/separated/widowed	171	145	18.9	1.24

[a]Rate per 100,000 p-yrs; rate for active component only

FIGURE 1. Numbers and crude rates of death by suicide among active component service members (n=2,652), by gender, 1998-2011

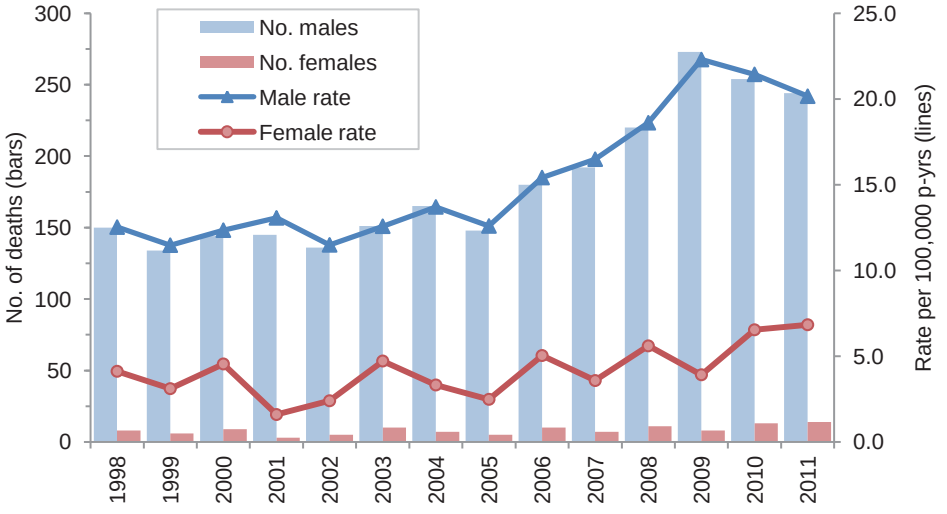


TABLE 2. Suicide rates by service, crude and directly adjusted to the 2000 standard U.S. population, active component, U.S. Armed Forces, 1998-2011

	No.	Crude rate	Age-adjusted rate
Total	2,652	13.7	12.9
Army	1,188	16.9	15.4
Navy	549	11.1	11.2
Air Force	517	10.8	10.4
Marine Corps	398	15.6	13.5

[a]Rate per 100,000 p-yrs

both male and female members of the active component **(Figures 3a,b)**. Among active component males, the proportion of suicides by firearms was 66 percent in 2010 and 61 percent overall. Relative to the respective prior years, rates of suicide by hanging/suffocation were moderately higher after 2005 among males and after 2006-7 among females. Rates of suicide by poisoning and unknown or "other" methods (e.g., jumping) were relatively stable throughout the period.

EDITORIAL COMMENT

This report reiterates and extends the findings of numerous other studies and reports regarding suicides among U.S. military members. Most notably, the report reiterates the sharp increases in numbers and rates of suicide deaths among military members – particularly among males since 2005. The findings should be and are deeply concerning to military, medical, and political leaders at the highest levels of the U.S. government.

It is useful and informative to interpret the findings of this report in relation to the contemporaneous experience of the U.S. general population. For example, from 1998 through 2011, the overall suicide rate (unadjusted) among male members of the active component of the U.S. military was 15.3 per 100,000 person-years. However, because young males comprise a much larger proportion of the military than the general U.S.

FIGURE 3a. Suicide death rates by method of suicide in males (n=2,536), active component, U.S. Armed Forces, 1998-2011

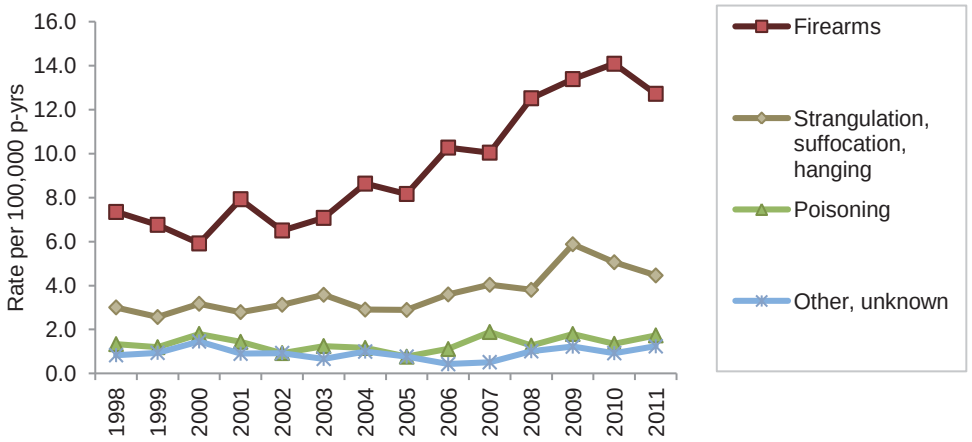


FIGURE 3b. Suicide death rates by method of suicide in females (n=116), active component, U.S. Armed Forces, 1998-2011

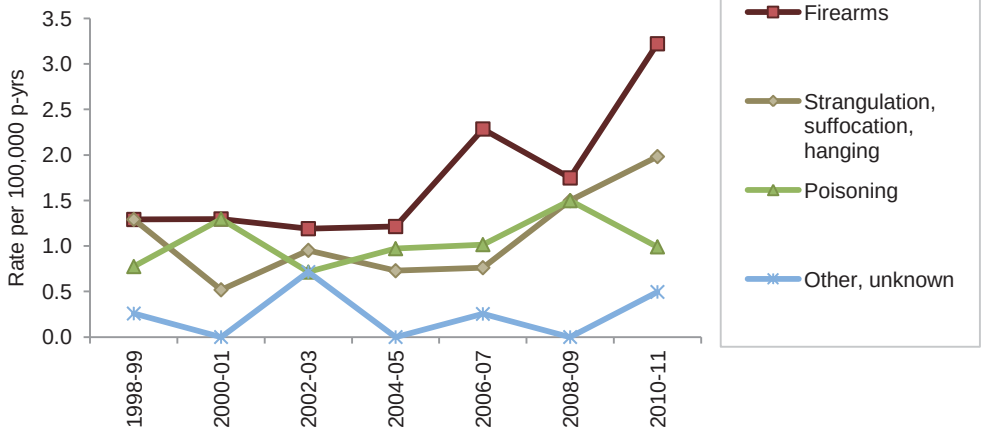
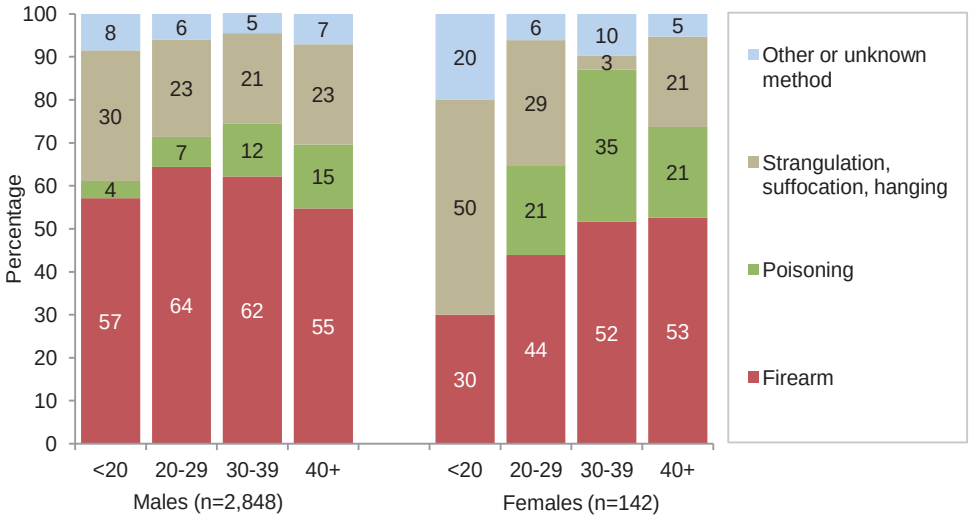


FIGURE 2. Proportions of suicides attributable to selected methods, by age group and gender, active and reserve components, 1998-2011



population, suicide rates in military and civilian populations are not directly comparable.[11] If the suicide rates that affected males in various age groups of the U.S. general population in 2010 had affected the respective age-groups of males in the active component of the U.S. military throughout the period of interest for this report, there would have been approximately 598 (23%) more suicide deaths among male military members than were observed **(calculations not shown)**. The observation does not diminish the tragic impact or military public health importance of suicides among military members; rather, it highlights the extraordinary impact and public health importance of suicides among young adults – both military and civilian – in the United States in general.

Unfortunately, there are not well established and clearly effective interventions to prevent suicides – in general or specifically in a military population during wartime.

The relationship between military service and suicide is complex. For example, while many service members have mental disorders (see page 11) that place them at risk for suicide, they also have access to treatment and counseling for mental health problems, which is potentially protective.[12] Also, the cohesion of a military unit provides service members with "belongingness," which may protect against suicide; however, separation from the unit (e.g., following active duty periods of Reservists) may increase feelings of isolation.[13]

This report confirms previous findings regarding demographic subgroups at highest risk of suicide. However, it did not find suicide rates to be comparable across service branches after adjustment for age and gender.[11] Of particular note in this regard, young males in the Army and Marine Corps had much higher suicide rates than similarly aged males in the Navy and Air Force **(data not shown)**.

In addition, this report documents that, in recent years, increasing numbers and rates of suicides of military members have been by firearms. Suicides among female service members are relatively uncommon, and suicide methods likely vary by service. Still, it is noteworthy that, in contrast to the experience of civilian females, firearms – not poisoning – was the leading method of suicide among female military members during the period of interest for this report.

More than half of military suicide decedents have a firearm in the home or immediate living environment.[8] Service members who live on a military installation are required to register personally-owned weapons. However, the 2011 National Defense Authorization Act does not allow military personnel to restrict or "collect or record any information relating to the otherwise lawful acquisition, possession, ownership, carrying, or other use of a privately-owned firearm or ammunition by a member of the Armed Forces" if that firearm is kept off base.[14] One report suggests that this law may be an obstacle to suicide prevention among military members because it prevents commanders from discussing privately owned weapons with at-risk service members and their families.[15]

The results of this report should be interpreted with consideration of its limitations. For example, the analyses were based on mortality data provided by the OAFME, which includes only those deaths that occurred during active duty military service. As such, the summaries reported here do not include the deaths of inactivated members of the Reserve and National Guard or of individuals who die by suicide after their military service has ended. In addition, service members who died from suicides – but were hospitalized before their deaths (e.g., lethal brain injury) may undergo expedited retirement processing prior to being removed from life support (e.g., for the benefit of survivors); such cases would not be included in official suicide counts.[16] Also, suicide rates due to various methods are subject to ascertainment bias. For example, deaths from self-inflicted gunshots may be more clearly identifiable as suicides than those by drug overdose or automobile crash, which may be misclassified as accidents.[16]

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Mental Disorders and Mental Health Problems, Active Component, U.S. Armed Forces, 2000-2011

Mental disorders account for significant morbidity, health care utilization, disability, and attrition from military service; the health care burden associated with mental disorders has increased over the last several years. During the years 2000 through 2011, 936,283 active component service members were diagnosed with at least one mental disorder. Annual counts and rates of incident diagnoses of mental disorders have increased by approximately 65 percent over the last twelve years; this overall increase is largely attributable to diagnoses of adjustment disorders, depressive and anxiety disorders, and post-traumatic stress disorder. Rates of incident mental disorder diagnoses were higher in females than males and in service members under 30 years of age. These findings reinforce previous reports that have documented a rise in demand for mental health services in the active component force and suggest that continued focus on detection and treatment for mental health issues is warranted.

Among U.S. military members, mental disorders account for significant morbidity, disability, health care utilization, and attrition from military service.[1] In recent years, there have been continuous and steep increases in lost duty time and health care burden due to mental disorders. In 2011, mental disorders accounted for more hospitalizations of U.S. service members than any other diagnostic category and more ambulatory visits than any other category except musculoskeletal and connective tissue disorders and routine medical care (e.g., routine medical examinations, immunizations).[2-4]

In studies of mental disorders in military populations, "cases" are often identified by medical encounters documented with diagnosis codes 290 to 319 of the International Classification of Diseases, Clinical Modification (ICD-9-CM); these diagnoses generally correspond to psychiatric disorders documented in the Diagnostic and Statistical Manual, 4th edition (DSM-IV).[5] However, some military mental health experts suggest that comprehensive assessments of the natures, burdens, and impacts of mental disorders in military populations should account for mental health problems that are not documented with mental disorder-specific diagnosis codes. Such conditions include psychosocial and behavioral problems related to difficult life circumstances (e.g., marital, family, other interpersonal relationships; occupational, and other military-related stresses); they are often documented with V-codes of the ICD-9-CM. In some studies, service members who received mental health care (documented with V-coded diagnoses) were at greater risk of attrition from military service than those treated for only physical health conditions but at less risk of attrition than those who received mental disorder-specific ICD-9-CM diagnoses.[6] In addition, Skopp et al. recently reported that service members with V-coded diagnoses indicating partner or family problems were at increased risk of suicide.[7]

This report summarizes numbers, natures, and rates of incident mental disorder-specific diagnoses (ICD-9-CM: 290-319) among active component U.S. service members over a twelve-year surveillance period. It also summarizes numbers, natures, and rates of incident "mental health problems" (documented with mental health-related V-codes) among active component members during the same period.

METHODS

The surveillance period was 1 January 2000 to 31 December 2011. The surveillance population included all individuals who served in the active component of the U.S. Armed Forces at any time during the surveillance period. All data used to determine incident mental disorder-specific diagnoses and mental health problems were derived from records routinely maintained in the Defense Medical Surveillance System. These records document both ambulatory encounters and hospitalizations of active component members of the U.S. Armed Forces in fixed military and civilian (if reimbursed through the Military Health System) treatment facilities.

For surveillance purposes, "mental disorders" were ascertained from records of medical encounters that included mental disorder-specific diagnoses (ICD-9-CM: 290-319, the entire "mental disorders" section of the ICD-9-CM coding guide **[Table 1]**) in the first or second diagnostic position; diagnoses of pervasive developmental disorder (ICD-9-CM: 299.xx), specific delays in development (ICD-9-CM: 315.xx), and mental retardation (ICD-9-CM: 317-319) were excluded from the analysis. Diagnoses of "mental health problems" were ascertained from records of health care encounters that included V-coded diagnoses indicative of psychosocial or behavioral health issues in the first or second diagnostic position **(Table 1)**.

For summary purposes, mental disorder-specific diagnoses indicative of adjustment reaction, substance abuse, anxiety disorder, post-traumatic stress disorder (PTSD), or depressive disorder were grouped into categories defined by Seal et al. and previously reported in the *MSMR* with two modifications as follows: "depressive disorder, not elsewhere classified" (ICD-9-CM: 311) was included in the depression category instead of the "other mental diagnoses" category.[8-9] Also, alcohol abuse and dependence diagnoses and substance abuse

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

Diagnostic category	ICD-9 codes
ICD-9 mental disorders	
Adjustment disorders	309.0x-309.9x (excluding 309.81)
Alcohol abuse/dependence disorders	303.xx, 305.0x
Substance abuse/dependence disorders	304.xx, 305.2x-305.9x
Anxiety disorders	300.00-300.09, 300.20-300.29,300.3
Post-traumatic stress disorder	309.81
Depressive disorders	296.20-296.35, 296.50-296.55, 296.9x, 300.4, 311
Personality disorders	301.0, 301.10, 301.11, 301.12, 301.13, 301.20, 301.21, 301.22, 301.3, 301.4, 301.50, 301.51, 301.59, 301.6, 301.7, 301.81, 301.82, 301.83, 301.84, 301.89, 301.9
Schizophrenia	295.xx
Other psychoses	293.81, 293.82, 297.0x-297.3x, 297.8, 297.9, 298.0. 298.1, 298.2, 298.3, 298.4, 298.8, 298.9
Other mental health disorder	Any other code between 290-319 (excluding 305.1, 299.xx, 315.xx, 317.xx-319.xx)
V-coded behavioral health disorder	
Partner relationship problems	V61.0x, V61.1, V61.10 (excluding V61.11, V61.12)
Family circumstance problems	V61.2, V61.23, V61.24, V61.25, V61.29, V61.8, V61.9
Maltreatment related	V61.11, V61.12, V61.21, V61.22, V62.83, 995.80-995.85
Life circumstance problems	V62.xx (excluding V62.6, V62.83)
Mental, behavioral problems, substance abuse counseling	V40.xx (excluding V40.0, V40.1), V65.42

and dependence diagnoses were separated into two discrete categories. Diagnoses indicative of personality disorder or "other psychotic disorders" were grouped using the categories developed by the Agency for Healthcare Research and Quality (AHRQ). A case of schizophrenia was defined as an active component service member with at least one hospitalization or four outpatient encounters that were documented with schizophrenia-specific diagnoses (ICD-9-CM: 295). V-coded diagnoses indicative of mental health problems were grouped into five categories using previously published criteria **(Table 1)**.[6]

Each "incident diagnosis" of a mental disorder (ICD-9-CM: 290-319) or a mental health problem (selected V-codes) was defined by a hospitalization with an indicator diagnosis in the first or second diagnostic position; two outpatient visits within 180 days documented with indicator diagnoses (from the same mental disorder or mental health problem-specific category) in the first or second diagnostic positions; or a single outpatient visit in a psychiatric or mental health care specialty setting (defined by Medical Expense and Performance Reporting System [MEPRS] code: BF) with an indicator diagnosis in the first or second diagnostic position. As described above, the case definition for schizophrenia required four outpatient encounters.

Service members who were diagnosed with one or more mental disorders prior to the surveillance period (i.e., prevalent cases) were not considered at risk of incident diagnoses of the same conditions during the period. Service members who were diagnosed with more than one mental disorder during the surveillance period were considered incident cases in each category in which they fulfilled the case-defining criteria. Service members could be incident cases only once in each mental disorder-specific category. Only service members with no incident mental disorder-specific diagnoses (ICD-9-CM: 290-319) during the surveillance period were eligible for inclusion as cases of incident mental health problems (selected V-codes).

RESULTS

During the 12-year surveillance period, 936,283 active component members were diagnosed with at least one mental disorder; of these individuals, 459,430 (49.1%) were diagnosed with mental disorders in more than one diagnostic category. Overall, there were 1,793,506 incident diagnoses of mental disorders in all diagnostic categories **(Table 2a)**.

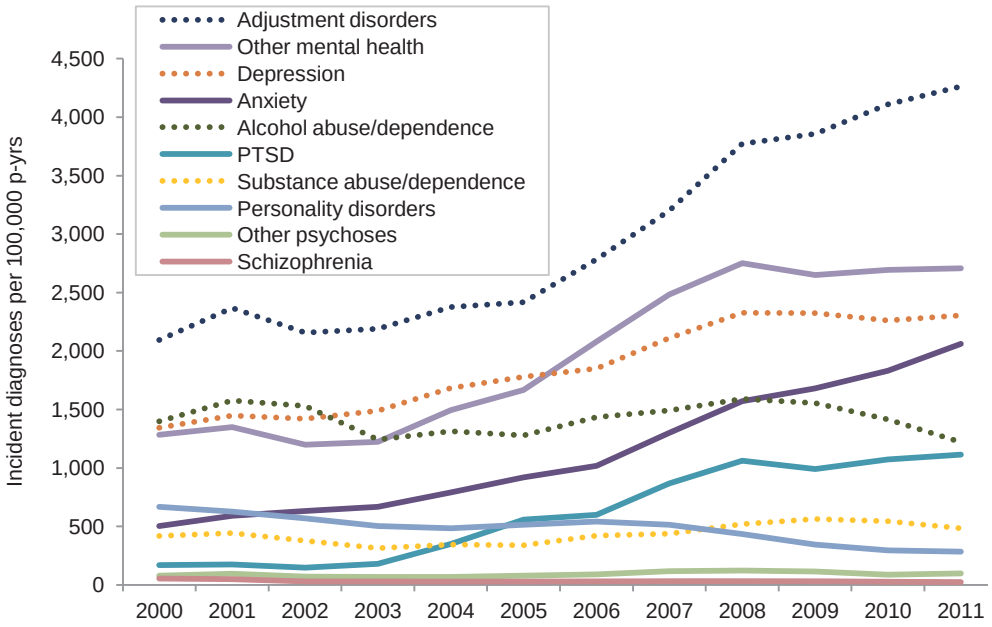
Among active component members, annual numbers and rates of incident diagnoses of at least one mental disorder increased by approximately 65 percent during the period (incident diagnoses of at least one mental disorder, by year: 2000: n=75,353, rate=5,387.1 cases per 100,000 person-years [p-yrs]; 2011: n=129,678, rate=8,900.5 per 100,000 p-yrs) **(Table 2a)**.

Over the entire period, approximately 85 percent of all incident mental disorder diagnoses were attributable to adjustment disorders (n=471,833; 26.3%), "other" mental disorders (n=318,827; 17.8%), depressive disorders (n=303,880; 16.9%), alcohol abuse and dependence related disorders (n=232,625; 13.0%), and anxiety disorders (n=187,918; 10.5%); relatively few incident diagnoses were attributable to personality disorders (n=81,223; 4.5%), PTSD (n=102,549; 5.7%), and substance abuse and dependence related disorders (n=73,623; 4.1%) **(Table 2a)**.

Crude rates of incident diagnoses of PTSD, anxiety disorders, depressive disorders, adjustment disorders, and other mental disorders generally increased during the period – particularly after 2003. In contrast, crude incidence rates of diagnoses of personality disorders, schizophrenia/other psychoses, and alcohol and substance related disorders were relatively stable or declined during the period **(Figure 1)**.

The relative percentage of all incident mental disorder diagnoses that occurred during the first six months of military service generally declined throughout the period. For example, during the entire 12-year surveillance period, approximately 1.5 percent of all incident PTSD diagnoses occurred within the first six months of service; notably, the proportion of PTSD diagnoses received within the first six months

FIGURE 1. Incidence rates of mental disorder diagnoses, by category, active component, U.S. Armed Forces, 2000-2011



of service declined from 8.9 percent in 2000 to 0.6 percent in 2011. The mental disorders that were relatively most frequently diagnosed in the first six months of service were personality disorders (7.5%), schizophrenia and other psychoses (7.5 and 7.1%, respectively), and adjustment disorders (6.1%) **(data not shown)**.

In general, rates of incident mental disorder diagnoses were higher among females than males and declined with increasing age. For example, crude incidence rates of adjustment and personality disorders were more than twice as high among females than males; and crude incidence rates of anxiety and depressive disorders were between 1.4 and 1.9 times as high among females than males **(Figure 2)**. Also, crude incidence rates of adjustment, PTSD, personality, "other" mental disorders and schizophrenia and other psychoses were higher among the youngest (<20 years old) compared to any older age group of service members; rates of alcohol/substance abuse were highest among those 20-24 years of age, and rates of anxiety disorders and depression were highest among those 25-29 years of age **(Figure 3)**.

Overall incidence rates of mental disorders were higher in the Army than in any of the other Services **(Figure 4)**. The Army also had the highest crude incidence rates for each category of mental disorders except schizophrenia **(data not shown)**. Crude incidence rates for adjustment disorders, anxiety, and personality disorders were higher among those in health care than any other military occupational group. Of note, rates of PTSD, depression, and alcohol and substance abuse disorders were higher among those in combat-specific than any other category of occupations **(Figure 5)**.

During the surveillance period, there were 425,489 incident reports of mental health problems (documented with V-codes) among 361,489 active component members who were not diagnosed with a mental disorder (ICD-9-CM 290-319). During the period, nearly 70 percent of all incident reports of mental health problems were related to life circumstances (e.g., pending, current, or recent return from military deployment; bereavement; acculturation difficulties) (n=194,869; 45.8%) or partner relationships (n=98,492; 23.1%) **(Table 2b)**.

Rates of mental health problems related to life circumstances were fairly stable from 2000 to 2003, increased to a sharp peak in 2005 (1,837.48 per 100,000 p-yrs), and then declined through 2008. This category increased again in 2009 (1,008.15 per 100,000 p-yrs) then declined slightly **(Figure 6)**. The crude incidence rate of life circumstance-related problems was more than 30 percent lower in the last (2011: 940.32 per 100,000 p-yrs) compared to the first year of the period (2000: 1,366.86 per 100,000 p-yrs).

A significant proportion of mental health problems related to life circumstances occur in the first six months of a service member's military service. In 2011, almost 10 percent of life circumstance related problems were diagnosed within the first six months of service; of note, in 2007 compared to 2011, the proportion was more than twice as high (21.2%). Rates of mental health problems related to mental, behavioral, and substance abuse difficulties steadily increased from 2002 through 2009 but declined slightly in the last two years **(data not shown)**.

Rates of any mental health problem (as reported with V-codes) were relatively stable during the period compared to rates of any mental disorder diagnosis, which increased sharply after 2003 **(Figure 7)**. In general, gender, age, service, and military occupation had similar relationships with rates of mental health problems as with mental disorder diagnoses **(data not shown)**.

EDITORIAL COMMENT

This report provides a comprehensive overview of incident diagnoses of mental disorders and reports of mental health problems among active component members of the U.S. Armed Forces during the last 12 years. The report reiterates and reemphasizes previously reported increases in the numbers and rates of diagnoses of most categories of mental disorders in military members and documents a growing demand for mental health services among U.S. military members.

However, the nature and magnitude of mental health disorders and related problems in the military should be interpreted in a broader context. For example, a recently conducted, nationally representative survey of adults in the U.S. estimated that approximately one-half of all Americans will meet criteria for a mental disorder sometime in their lifetime; clearly, the large

TABLE 2a. Numbers and rates of incident diagnoses of mental disorders (ICD-9-CM: 290-319), by diagnostic category, active component, U.S. Armed Forces, 2000-2011

	Total (2000-2011)		2001		2003		2005		2007		2009		2011	
Category[a]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]
Adjustment disorders	471,833	2,952.4	30,451	2,366.9	30,343	2,190.1	32,379	2,418.0	41,783	3,200.2	51,593	3,857.4	55,409	4,263.8
Alcohol abuse/ dependence	232,625	1,419.2	20,381	1,575.9	17,408	1,243.4	17,431	1,279.5	20,003	1,490.7	21,746	1,554.9	16,920	1,220.0
Substance abuse/ dependence	73,623	434.2	5,860	441.9	4,539	314.3	4,773	338.8	6,086	437.1	8,212	563.0	7,003	484.8
Anxiety	187,918	1,129.2	7,802	591.2	9,549	667.9	12,771	920.1	17,721	1,299.5	23,763	1,680.0	28,565	2,061.1
PTSD	102,549	607.5	2,318	174.4	2,599	179.7	7,863	558.9	12,023	868.2	14,285	991.2	15,805	1,112.7
Depression	303,880	1,860.4	18,820	1,447.2	20,924	1,489.7	24,188	1,778.8	28,179	2,110.8	32,162	2,325.0	31,407	2,305.6
Personality disorders	81,223	479.8	8,281	626.0	7,264	504.6	7,222	514.1	7,130	513.2	5,014	343.7	4,110	284.2
Schizophrenia	5,572	32.7	650	48.8	429	29.6	412	29.1	453	32.4	440	29.9	351	24.1
Other psychoses	15,456	90.7	1,255	94.3	1,005	69.3	1,119	79.1	1,637	117.0	1,689	115.0	1,416	97.4
Other MH	318,827	1,958.4	17,555	1,350.8	17,198	1,222.2	22,720	1,667.5	33,007	2,481.8	36,320	2,650.9	36,394	2,707.5
No. of individuals	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]
>1 category of mental health disorder	459,430	2,693.2	24,068	1,806.4	23,144	1,595.2	28,622	2,021.5	38,176	2,725.9	45,144	3,068.5	44,483	3,053.1
Any mental disorder diagnosis[c]	936,283	5,488.6	78,429	5,886.3	77,822	5,364.0	87,683	6,192.9	109,011	7,783.8	124,503	8,462.6	129,678	8,900.5

[a]Each individual may be a case within a category only once per lifetime
[b]Incident diagnoses per 100,000 p-yrs
[c]At least one reported mental disorder diagnoses

TABLE 2b. Numbers and rates of incident diagnoses of mental health problems (V-coded mental health visits) among those WITHOUT a mental disorder diagnosis (ICD-9-CM: 290-319), active component, U.S. Armed Forces, 2000-2011

	Total (2000-2011)		2001		2003		2005		2007		2009		2011	
Category[a]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]
Partner relationship	98,492	595.7	8,920	684.3	8,150	577.1	8,361	609.5	8,018	593.5	7,193	507.7	6,972	497.6
Family circumstance	38,495	227.9	3,393	256.3	3,684	256.2	2,358	168.2	2,634	190.1	3,217	221.4	3,726	259.4
Maltreatment related	21,690	128.2	2,887	218.4	2,197	152.8	1,816	129.4	1,300	93.7	709	48.6	797	55.1
Life circumstance problem	194,869	1,189.0	18,937	1,459.1	16,360	1,166.0	24,887	1,837.5	13,397	1,003.4	14,134	1,008.2	13,050	940.3
Mental, behavioral & substance abuse	71,943	426.8	4,088	308.2	3,834	266.0	5,397	384.9	6,674	483.2	9,487	657.4	7,432	521.9
No. of individuals	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]	No.	Rate[b]
>1 type of V-code	52,456	307.5	3,478	261.0	2,822	194.5	2,933	207.2	2,721	194.3	2,524	171.6	2,631	180.6
Any V-code	361,489	2,119.1	34,143	2,562.5	30,972	2,134.8	39,440	2,785.6	29,048	2,074.1	31,948	2,171.6	28,997	1,990.2

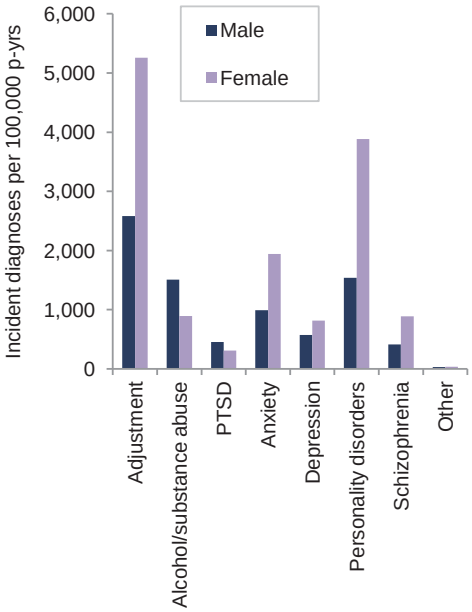
[a]Each individual may be a case within a category only once per lifetime
[b]Incident diagnoses per 100,000 p-yrs
[c]At least one reported mental health problem (V-coded diagnosis)

and growing problem of mental disorders among military members reflects to some extent the similar experience of the general U.S. population.[10]

The increases in rates of most categories of mental disorders after 2003 may reflect an increasing psychological toll among participants in Operations Iraqi Freedom (OIF) and Enduring Freedom (OEF). Most notably in this regard, the rate of incident diagnoses of post-traumatic stress disorder (PTSD) increased nearly sixfold from 2003 to 2008. This report did not specifically examine mental disorder diagnoses in relation to repeated deployments. However, other analyses have documented that greater percentages of deployed personnel have been diagnosed with PTSD and anxiety related disorders after second and third deployments than first deployments, but that the percentages of deployers diagnosed with PTSD were lower after fourth and fifth deployments than third deployments.[11] More detailed investigation into the relationship between deployment and mental health outcomes is warranted.

The results of this report should also be interpreted in light of the significant changes in Department of Defense (DoD) mental health-related policies, enhancements of mental health education, outreach, and screening efforts, and increases in mental health care resources. For example, the DoD has made significant efforts to reduce stigmas associated with care seeking for and treatment of mental illnesses and to remove barriers to receiving timely and appropriate diagnostic and treatment services. Undoubtedly, such changes have

FIGURE 2. Incidence rates of mental disorder diagnoses, by category and gender, active component, U.S. Armed Forces, 2000-2011



resulted in increases in the detection and treatment of previously undiagnosed mental disorders and more complete documentation of mental disorders in electronic medical records. Such records are routinely used for health surveillance activities such as the analyses reported here and elsewhere in this issue.

The findings of this report in regard to age-related risk are consistent with the findings of other studies in veteran and active military populations. Most notably, for most categories of mental disorders, rates of incident diagnoses were highest among the youngest (and thus likely most junior) service members. Several factors likely contribute to the finding. For example, recruit training and first time experiences in active combat are among the most psychologically stressful of all military activities. Recruits are the youngest and most junior of all military members; and among all deployed service members, the most junior are most likely to be experiencing their first lifetime exposures to combat. Also, the endpoints of analyses in this report were incident (i.e., first ever during military service) diagnoses of mental disorders; thus, even if the prevalences of a disorder were similar across age groups, rates of incident diagnoses of the disorder would likely decrease with age (because in younger versus older age groups, relatively more of the diagnoses would be considered incident diagnoses, i.e., documented for the first time in their military service careers). Also, because of real or perceived stigmas and/or fears of negative impacts on their military careers, older (and higher ranking) service members may be more reluctant to seek mental health care than those who are younger. In addition, studies of U.S. and United Kingdom military members have documented that mental disorders and mental health problems are associated with higher rates of attrition from military service; thus, compared to their counterparts, individuals with mental health problems likely leave military service sooner and at younger ages. [1,12,13]

Of interest, service members in health care occupations had relatively high rates of incident diagnoses of most types of mental disorders. In particular, rates of incident diagnoses of PTSD were similar among those in health care and combat-specific occupations. The finding likely reflects, at least in part, increased access to and utilization of health care services by medical personnel in general. It likely also reflects the effects of the psychological stresses inherent to many health care roles, particularly in wartime. Studies of deployed military medical personnel in the Armed Forces of the United Kingdom have demonstrated higher rates of psychological distress in medical personnel.[14]

This analysis did not consider the effects of deployment-related experiences on the incidence of mental disorders. Many researchers have examined the effects of deployment in general and combat exposure specifically on rates of diagnosed mental disorders. For example, in 2008, Larson and colleagues documented mental disorder diagnoses among U.S. Marines who had recently served in OEF/OIF; among those with no predeployment mental disorder diagnoses, rates of all types of mental disorders except PTSD were lower among combat-deployed than non-combat deployed Marines.[15] *MSMR* analyses have documented that deployers who were diagnosed with mental disorders before deploying were more than twice as likely as their counterparts to receive mental disorder diagnoses after deploying.[9] Among veterans of OEF/OIF service in general, combat exposure is a strong predictor of post-deployment anxiety diagnoses, including among those with no predeployment histories of mental disorders.[16] Hoge and colleagues documented that mental health outcomes are correlated with combat experiences; in particular, combat veterans had more post-deployment psychiatric problems than their counterparts who served in non-combat locations.[17]

There are significant limitations to this report that should be considered when

FIGURE 3. Incidence rates of mental disorder diagnoses, by category and age group, active component, U.S. Armed Forces, 2000-2011

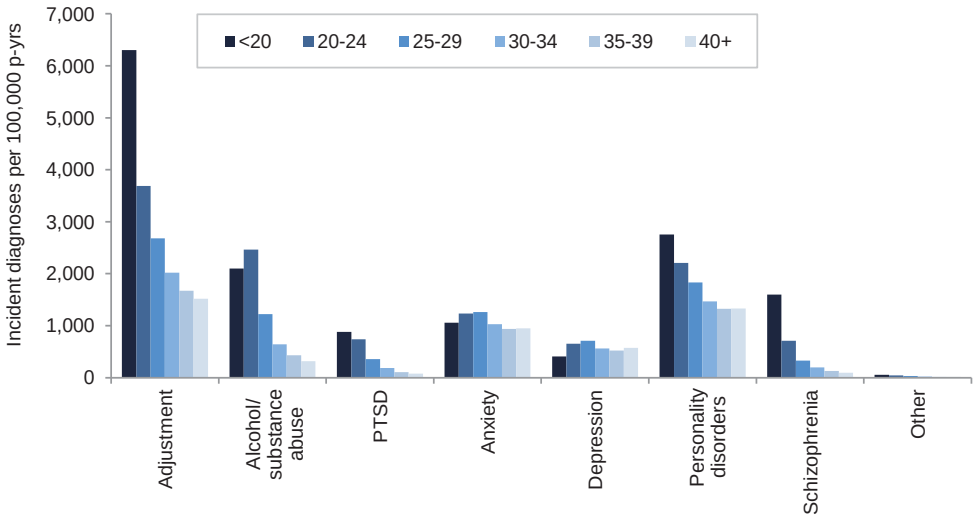
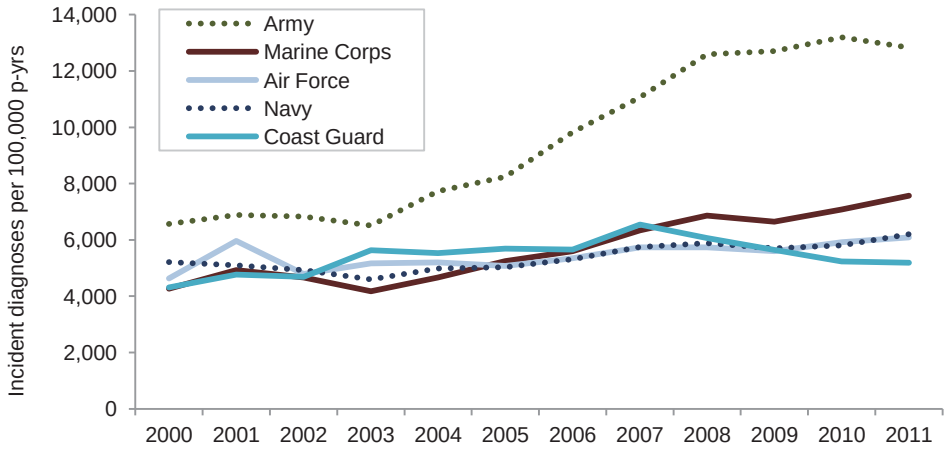


FIGURE 4. Incidence rates of mental disorder diagnoses, by service and year, active component, U.S. Armed Forces, 2000-2011



interpreting the results. For example, incident cases of mental disorders and mental health problems were ascertained from ICD-9-CM coded diagnoses that were reported on standardized administrative records of outpatient clinic visits and hospitalizations. Such records are not completely reliable indicators of the numbers and types of mental disorders and mental health problems that actually affect military members. For example, the numbers reported here are underestimates to the extent that affected service members did not seek care or received care that is not routinely documented in records that were used for this analysis (e.g., private practitioner, deployed troop clinic); that mental disorders and mental health problems were not diagnosed or reported on standardized records of care; and/or that some indicator diagnoses were miscoded or incorrectly transcribed on the centrally transmitted records. On the other hand, some conditions may have been erroneously diagnosed or miscoded as mental disorders or mental health problems (e.g., screening visits). Finally, the analyses reported here summarize the experiences of individuals while they were serving in an active component of the U.S. military; as such, the results do not include mental disorders and mental health problems that affect members of reserve components or veterans of recent military service.

Finally, as with most health surveillance-related analyses among U.S. military members, this report relies on data in the Defense Medical Surveillance System (DMSS). The DMSS integrates records of nearly all medical encounters of active component members in fixed (i.e., not deployed or at sea) military medical facilities. Administrative medical record systems, like DMSS, enable comprehensive surveillance of medical conditions of interest through identification of likely cases; such cases are identified by using surveillance case definitions that are based entirely or in part on indicator ICD-9-CM codes. Other considerations in the construction of surveillance case definitions include the clinical setting in which diagnoses of interest are made (e.g., hospitalization, relevant specialty clinic), frequency and timing of indicator diagnoses, and the priority with which diagnoses of interest were reported (e.g., first-listed versus subsequent reported diagnoses). The accuracy of estimates of the numbers, natures, and rates of illnesses and injuries of surveillance interest depend to a great extent on specifications of the surveillance case definitions that are used to identify cases. For this analysis, the medical literature and subject matter experts were consulted prior to creating the surveillance case definitions that were used to identify the mental health conditions of interest for this report. If case definitions with different specifications were used to identify cases of nominally the same conditions, estimates of numbers, rates, and trends would vary from those reported here.[18,19]

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FIGURE 5. Incidence rates of mental disorder diagnoses, by category and military occupation, active component, U.S. Armed Forces, 2000-2011

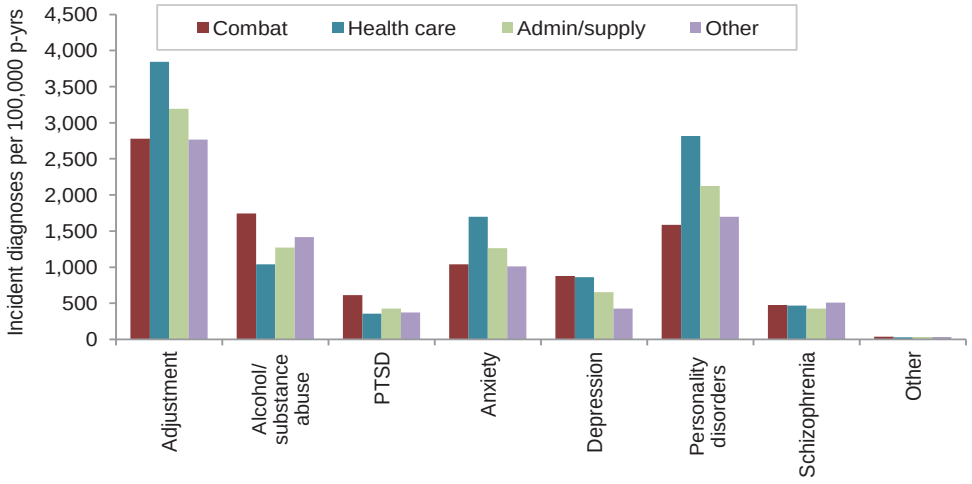


FIGURE 6. Incidence rates of mental health problems (V-coded mental health visits) among those WITHOUT a mental disorder, by category and year, active component, U.S. Armed Forces, 2000-2011

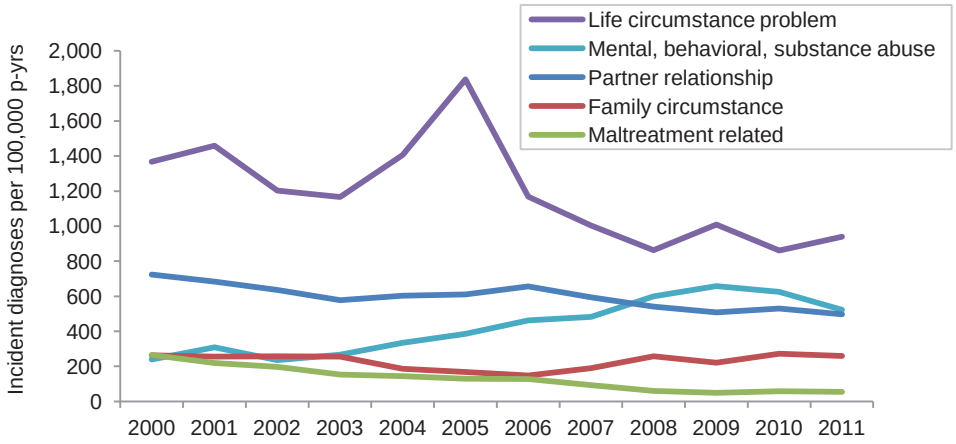
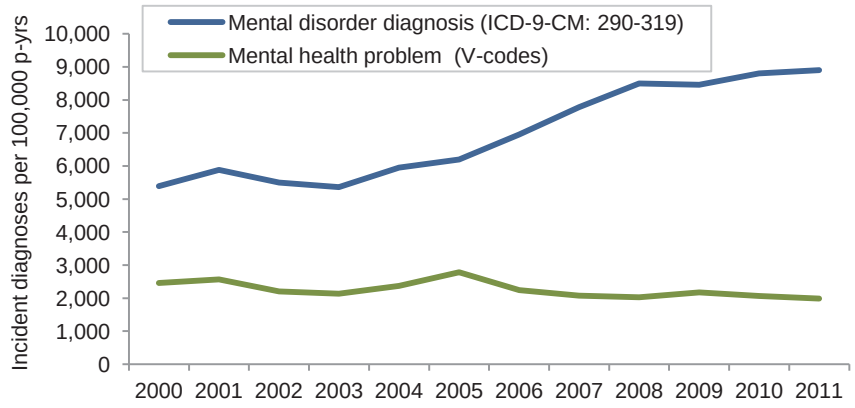


FIGURE 7. Incidence rates of any mental disorder diagnosis or any mental health problem, by year, active component, U.S. Armed Forces, 2000-2011



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Incident Diagnoses of Cancers and Cancer-related Deaths, Active Component, U.S. Armed Forces, 2000-2011

In the United States, cancer is one of the five leading causes of death in all age groups among both men and women; overall, approximately one in four deaths is attributable to cancer. Compared to the general U.S. population, military members have been estimated to have lower incidence rates of several cancers including colorectal, lung, and cervical cancers and higher rates of prostate, breast, and thyroid cancer. Between 2000 and 2011 in active component members of the U.S. military, crude incidence rates of most cancer diagnoses have remained stable. 9,368 active component service members were diagnosed with one of the cancers of interest and no specific increasing or decreasing trends were observed. Cancer is an uncommon cause of death among service members on active duty and accounted for a total of 1,185 deaths during the 12-year surveillance period.

Since 1998, in the United States, statistics regarding cancer incidence and cancer-related mortality among U.S. civilians have been published each year in the Annual Report to the Nation; the most recent report documents declining death rates due to all cancers in the period from 1999 to 2008 and decreasing incidence of prostate and colorectal cancers over the same period. Similar declining trends are evident for lung and breast cancers in general.[1] However, cancer remains a significant public health concern; cancer is one of the five leading causes of death in all age groups among both men and women, and approximately one in four deaths in the U.S. is attributable to cancer.[2]

Most studies of cancer incidence in military members have focused on specific cancers or a single service; the risk of developing cancer in a specific military occupational group (e.g., aviators) has also been examined. For example, Yamane investigated overall cancer incidence in the U.S. Air Force from 1989-2002. The findings indicated that the incidence of invasive cancers overall had significantly decreased during the 12-year period. Compared to the general U.S. population, standardized incidence ratios for all cancers were lower than expected among male Air Force members (0.50; 95% CI:0.48-0.53) and as expected among females (0.96; 95% CI:0.89-1.03). Standardized incidence ratios of cervical (3.19; 95% CI:2.74-3.70), prostate (1.44; 95% CI:1.21-1.69) and vulvar (3.54; 95% CI:1.77-6.28) cancers were significantly higher.[3] Zhu and colleagues compared incidence rates of six cancers (lung, colorectal, prostate, breast, testicular and cervical cancer) in active military and civilian populations. As in the Yamane study, cancer incidence among military members was determined using the Department of Defense Automated Central Tumor Registry (ACTUR); cancer incidence among U.S. civilians was estimated using data from the SEER (Surveillance, Epidemiology, and End Results) study of the National Cancer Institute. Compared to the general U.S. population, military members were estimated to have lower incidence rates of colorectal, lung, and cervical cancers and higher rates of prostate and breast cancers.[4] Most recently, Enewold and colleagues reported significantly higher incidence rates of thyroid cancer in white women and black men and women serving in the military as compared to the general U.S. population.[5]

In 2010, the *MSMR* reported on incidence rates of malignant melanoma and selected cancer diagnoses and cancer-related deaths from 2000-2009 in active component military members; in general, rates of diagnoses of the cancers of interest were relatively stable during that time period.[6] This report extends that analysis by summarizing numbers, rates and trends of incident diagnoses of melanoma and other selected cancers and by enumerating cancer-related deaths among active component military members through 2011.

METHODS

The surveillance period was 1 January 2000-31 December 2011. The surveillance population included all individuals who served in the active component of the U.S. Armed Forces at any time during the surveillance period. For deaths attributed to cancer, the surveillance population included all individuals who served in the active or reserve components of the U.S. Army, Navy, Air Force, Marine Corps, or Coast Guard during the surveillance period. All data used to determine incident cancer cases were derived from records routinely maintained in the Defense Medical Surveillance System (DMSS). Deaths of active duty service members were ascertained from records produced by Service-specific casualty offices and the Armed Forces Medical Examiner System, maintained in the DoD Medical Mortality Registry, and routinely provided for health surveillance purposes to the Armed Forces Health Surveillance Center (AFHSC).

For surveillance purposes, an incident case of malignant melanoma was defined as (a) two or more medical encounters with diagnoses of "malignant melanoma" in the first diagnostic position (ICD-9-CM codes: 172.0-172.9) following at least one medical encounter with a diagnostic procedure commonly used to evaluate clinically suspicious lesions; or (b) five or more medical encounters with diagnoses of "malignant melanoma" in the first diagnostic position (if there are no reported relevant diagnostic procedures).

Diagnostic procedure codes indicative of malignant melanoma are listed in a previous *MSMR* report.[7] For other cancer diagnoses, incident cases were defined as either one inpatient encounter with a defining diagnosis in the first diagnostic position (or in the second diagnostic position if the first code was a V-code indicating radiotherapy or chemotherapy treatment [ICD-9-CM:V58.0-V58.12]) or three or more outpatient encounters within a 90-day period with the defining diagnosis in the first or second diagnostic position.

The following ICD-9-CM codes were used to define cases of selected cancers by the affected anatomic site or cell type: malignant neoplasm of the colon and rectum: 153.0-154.1, 159.0; malignant neoplasm of the lung and bronchus: 162.2-162.9; malignant neoplasm of the female breast: 174.0-174.9; cervical cancer: 180.0-180.9; prostate cancer: 185; malignant neoplasm of testis: 186.0-186.9; malignant neoplasm of the brain: 191.0-191.9; non-Hodgkin lymphoma: 200.0-200.8, 202.0-202.2, 202.8-202.9; leukemia: 204.0-208.9. Summaries of cancer-related deaths include a category of "other." The "other" category included all sites of cancers that accounted for fewer than 60 deaths each during the 12-year period: gastrointestinal (n=59), head and neck (n=52), urinary (n=45), bone and joint (n=31), Hodgkin lymphoma (n=21), testicle (n=17), mesothelium (n=26), prostate (n=9), and cervical and other gynecologic (n=7) **(data not shown)**.

For surveillance purposes, incident dates of cancer diagnoses were the dates of the first medical encounters of affected individuals that included case-defining diagnoses. Individuals could be counted as incident cancer cases only once during the surveillance period (even if cases had diagnoses of more than one cancer type, recurrences of previously treated cancers, or metastatic lesions of primary cancers). Military members with case-defining cancer diagnoses prior to the start of the surveillance period were excluded from the analysis (because they were not considered at risk of incident [first-ever] cancer diagnoses during the period). However, any death attributed to cancer that occurred during the surveillance period was counted, although in some cases, the initial diagnosis of cancer for those individuals may have occurred before the beginning of the surveillance period.

RESULTS

During the 12-year surveillance period, 9,368 active component members were diagnosed with at least one of the cancers of interest for this report. Over the 12-year period, the crude rate of incident diagnoses of the subject cancers was 55.2 per 100,000 person-years (p-yrs); the lowest annual incidence rate was 50.3 per 100,000 p-yrs in 2003, and the highest annual incidence rate was 60.1 per 100,000 p-yrs in 2009 **(Figure 1)**.

From January 2000 through December 2011, the numbers of incident diagnoses of non-gender-specific cancers were malignant melanoma (n=1,788), non-Hodgkin lymphoma (n=1,197), colorectal cancer (n=762), brain cancer (n=748), leukemia (n=530), and cancer of the lung/bronchus (n=274). Among males, the most frequent cancer diagnoses were testicular cancer (n=1,832), malignant melanoma (n=1,499), and prostate cancer (n=1,263); among females, the most frequent cancer diagnoses were breast cancer (n=874), malignant melanoma (n=289), and non-Hodgkin lymphoma (n=148) **(Table 1, Figure 1)**. There were no clear trends of increasing or decreasing cancer diagnosis incidence – of specific sites or overall **(Figures 1, 2a, 2b)**.

In general, the strongest demographic correlate of increased risk of a cancer diagnosis was older age. For example, for all cancer sites except the cervix and testicle, the highest rates of diagnoses were among those older than 40 years **(Table 1)**. For most cancers examined, crude incidence rates were lower among members of the Marine Corps than the other Services. Military members in health care occupations had relatively high rates of several cancers; the relatively highest cancer-specific incidence rates (unadjusted) among health care workers (compared to those in combat-specific occupations) were for prostate (RR: 2.86), female breast (RR: 1.95), and lung (RR: 1.49) cancers **(Table 1)**.

Consistent with published literature, the incidence rate for prostate cancer in black males was about twice that observed in white males; however, black males had much lower crude incidence rates

FIGURE 1. Incident diagnoses of selected cancers and total incidence rate, by year and affected anatomic site/cell type, active component, U.S. Armed Forces, 2000-2011

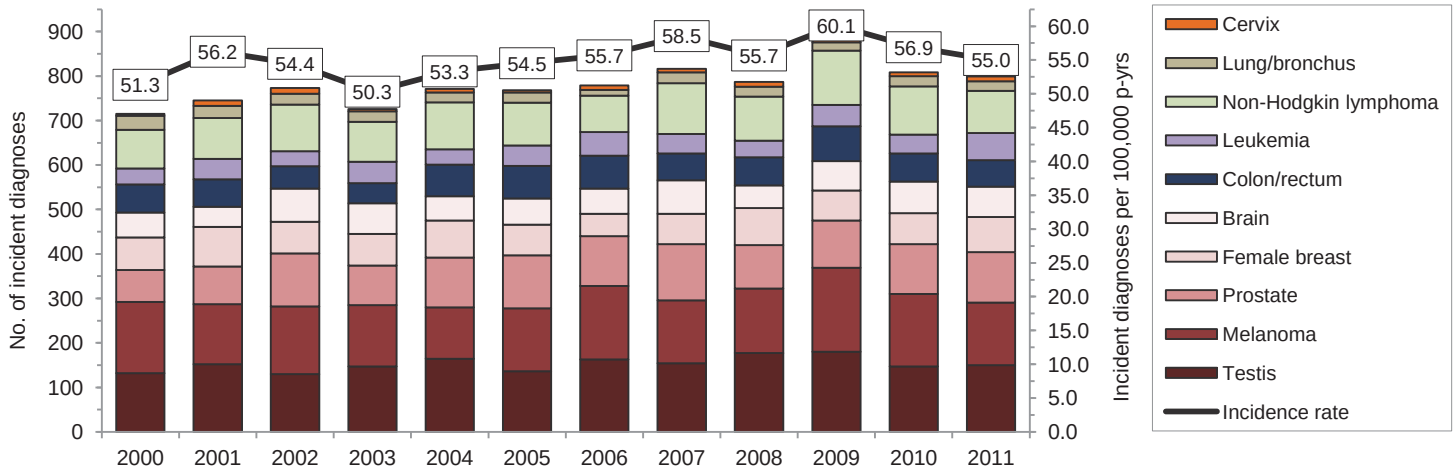


TABLE 1. Numbers and rates of incident diagnoses of selected cancers, by demographic and military characteristics, active component, U.S. Armed Forces, 2000-2011

	Malignant melanoma			Colorectal			Lung/bronchus			Brain/other central nervous system			Non-Hodgkin lymphoma		
	No.	Rate[a]	RR	No.	Rate[a]	RR	No.	Rate[a]	RR	No.	Rate[a]	RR	No.	Rate[a]	RR
Total	1,788	10.5		762	4.5		274	1.6		748	4.4		1,197	7.0	
Service															
Army	523	8.6	ref	266	4.4	ref	95	1.6	ref	266	4.4	ref	416	6.8	ref
Navy	470	11.2	1.31	201	4.8	1.10	85	2.0	1.30	169	4.0	0.92	299	7.1	1.04
Air Force	633	15.5	1.81	206	5.1	1.16	60	1.5	0.94	205	5.0	1.15	334	8.2	1.20
Marine Corps	162	7.3	0.85	54	2.4	0.56	27	1.2	0.78	89	4.0	0.92	117	5.3	0.78
Coast Guard	0	0.0	0.00	35	7.4	1.71	7	1.5	0.96	19	4.0	0.93	31	6.6	0.97
Sex															
Male	1,499	10.3	ref	660	4.5	ref	236	1.6	ref	648	4.4	ref	1,051	7.2	ref
Female	289	11.7	1.14	102	4.1	0.91	38	1.5	0.95	100	4.1	0.91	146	5.9	0.82
Race/ethnicity															
White, non-Hispanic	1,659	15.5	ref	490	4.6	ref	179	1.7	ref	561	5.2	ref	774	7.2	ref
Black, non-Hispanic	9	0.3	0.02	164	5.5	1.22	54	1.8	1.10	86	2.9	0.56	223	7.5	1.05
Other	120	3.6	0.23	108	3.2	0.71	41	1.2	0.73	101	3.0	0.58	200	6.0	0.83
Age															
<20	13	1.0	ref	2	0.2	ref	5	0.4	ref	28	2.2	ref	43	3.4	ref
20-24	192	3.4	3.27	47	0.8	5.20	28	0.5	1.24	170	3.0	1.34	281	5.0	1.45
25-29	287	7.7	7.44	78	2.1	13.14	21	0.6	1.41	154	4.1	1.85	220	5.9	1.72
30-34	288	11.6	11.18	110	4.4	27.73	26	1.0	2.62	121	4.9	2.18	164	6.6	1.92
35-39	374	17.4	16.76	161	7.5	46.85	47	2.2	5.47	139	6.5	2.89	203	9.4	2.75
40+	634	35.6	34.27	364	20.4	127.70	147	8.2	20.61	136	7.6	3.41	286	16.0	4.67
Military grade															
Enlisted	987	6.9	ref	516	3.6	ref	210	1.5	ref	580	4.1	ref	901	6.3	ref
Officer/other	801	28.9	4.18	246	8.9	2.45	64	2.3	1.57	168	6.0	1.49	296	10.7	1.69
Military occupation															
Combat	419	11.9	ref	152	4.3	ref	55	1.6	ref	168	4.8	ref	246	7.0	ref
Health care	217	15.7	1.32	76	5.5	1.28	32	2.3	1.49	71	5.1	1.08	135	9.8	1.40
Other	1,152	9.5	0.80	534	4.4	1.02	187	1.5	0.99	509	4.2	0.88	816	6.7	0.97

	Leukemia			Female breast[b]			Cervix[b]			Prostate[b]			Testicle[b]		
	No.	Rate[a]	RR	No.	Rate[a]	RR	No.	Rate[a]	RR	No.	Rate[a]	RR	No.	Rate[a]	RR
Total	530	3.1		874	35.6		100	4.1		1,263	8.7		1,832	12.6	
Service															
Army	207	3.4	ref	321	37.0	ref	42	4.8	ref	532	10.2	ref	586	11.3	ref
Navy	118	2.8	0.83	187	30.5	0.82	20	3.3	0.67	283	7.9	0.78	468	13.1	1.16
Air Force	137	3.4	0.99	325	41.4	1.12	30	3.8	0.79	338	10.3	1.01	458	14.0	1.24
Marine Corps	54	2.4	0.72	24	17.5	0.47	4	2.9	0.60	64	3.1	0.30	249	12.1	1.07
Coast Guard	14	3.0	0.88	17	31.0	0.84	4	7.3	1.50	46	11.1	1.09	71	17.2	1.53
Sex															
Male	466	3.2	ref	na	na	na	na	na	na	1,263	8.7	na	1,832	12.6	na
Female	64	2.6	0.81	874	35.6	na	100	4.1	na	na	na	na	na	na	na
Race/ethnicity															
White, non-Hispanic	350	3.3	ref	437	35.8	ref	63	5.2	ref	748	7.9	ref	1,423	15.0	ref
Black, non-Hispanic	71	2.4	0.74	300	43.2	1.21	15	2.2	0.42	382	17.0	2.15	64	2.8	0.19
Other	109	3.3	1.00	137	25.4	0.71	22	4.1	0.79	133	4.8	0.60	345	12.3	0.82
Age															
<20	33	2.6	ref	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	66	6.4	ref
20-24	128	2.3	0.86	21	2.4	ref	9	1.0	ref	3	0.1	ref	502	10.5	1.65
25-29	83	2.2	0.85	46	8.1	3.39	18	3.2	3.10	6	0.2	3.04	515	16.4	2.58
30-34	91	3.7	1.39	112	33.8	14.17	26	7.9	7.68	11	0.5	8.17	356	16.6	2.61
35-39	78	3.6	1.38	197	78.7	32.97	32	12.8	12.50	50	2.6	42.12	238	12.6	1.98
40+	117	6.6	2.49	498	233.8	97.95	15	7.0	6.88	1,193	77.0	1,224.66	155	10.0	1.57
Military grade															
Enlisted	417	2.9	ref	533	26.1	ref	74	3.6	ref	548	4.5	ref	1,477	12.1	ref
Officer/other	113	4.1	1.39	341	82.0	3.14	26	6.3	1.72	715	30.6	6.80	355	15.2	1.25
Military occupation															
Combat	104	2.9	ref	43	26.4	ref	5	3.1	ref	246	7.3	ref	452	13.5	ref
Health care	52	3.8	1.28	241	51.6	1.95	17	3.6	1.18	190	20.9	2.86	126	13.9	1.03
Other	374	3.1	1.05	590	32.3	1.22	78	4.3	1.39	827	8.1	1.10	1,254	12.2	0.91

[a]Incident diagnoses per 100,000 p-yrs of military service
[b]For gender-specific cancers, rates as based on p-yrs of service of the respective gender only

of testicular cancer than other race/ethnic groups. As found in previous analyses, the crude rate of malignant melanoma was higher among white, non-Hispanic than other racial/ethnic groups **(Table 1)**.[4]

During the period, cancers accounted for 1,185 deaths of service members on active duty; this included service members in the active and reserve components **(Figure 3a, 3b)**. The number of cancer-related deaths per year markedly varied during the period; the fewest and most deaths per year for members of the active component were in 2000 (n=44) and 2009 (n=81). The cancers (by affected organ system or cell) that caused the most deaths during the period were lung/bronchus (n=129), brain/other central nervous system (n=130), and colon/rectum (n=124); however, the category with the most cancer deaths overall was that classified as "other" (n=132) **(Figure 3a).**

FIGURE 2a. Incidence rates of of selected cancers in males, active component, U.S. Armed Forces, 2000-2011

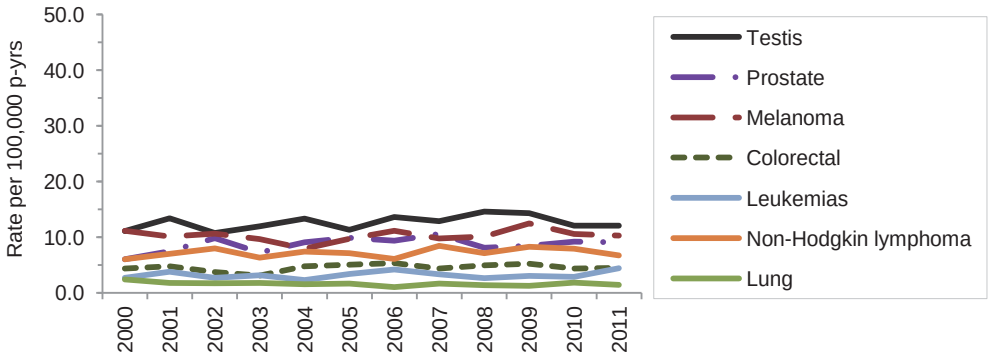
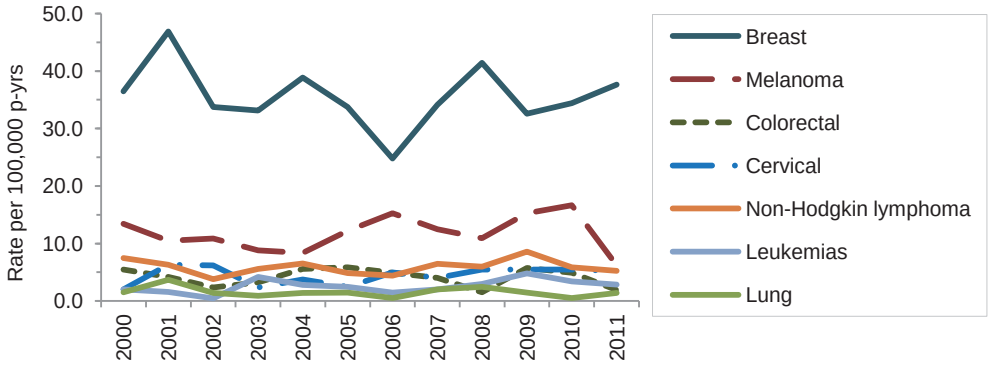


FIGURE 2b. Incidence rates of of selected cancers in females, active component, U.S. Armed Forces, 2000-2011



EDITORIAL COMMENT

Over the past twelve years, rates of diagnoses of the cancers of interest for this report have been stable among active component members of the U.S. military.

There are limitations to the analyses that should be considered when interpreting the results. For example, for this surveillance report, cancer cases were ascertained from ICD-9-CM coded diagnoses reported on standardized records of hospitalizations and outpatient medical encounters. As such, cancer diagnoses were not independently confirmed as with pathology reports or records in cancer registries (as was done to ascertain cases for some previous studies in military populations). As a result, some cancer-specific diagnoses considered case-defining for this report may reflect erroneous or miscoded diagnoses (e.g., some "rule out" or suspected cases may have been reported with cancer-specific codes). Because of the potential lack of specificity of cancer diagnoses on administrative medical encounter records, cancer cases reported herein may overestimate the actual numbers of cancers definitively diagnosed among active component military members during the surveillance period. On the other hand, while ACTUR (the DoD tumor registry) and SEER (a U.S. population based cancer registry managed by the National Cancer Institute) are considered gold standards for cancer case identification in the United States, cases that are registered likely underestimate the total of all cancers that affect the populations of interest. Interpretations of the findings of various population-based cancer studies should consider the likely completeness and accuracy of case ascertainment.

In this regard, the Defense Medical Surveillance System (DMSS) contains records of nearly all medical encounters of active component military members in "fixed" (i.e., not deployable or at sea) military and non-military medical treatment facilities. The use of administrative medical records to conduct and enhance cancer surveillance has been extensively studied. In general, the ability of administrative medical records to identify incident cases of cancers has been good, depending on the types of cancers examined and definitions used for case ascertainment. For example, estimates of incidence rates of lung, breast, and colon cancers using administrative data were found to be within six percent of the respective incidence rates that were estimated using SEER data.[8-11]

An important determinant of the quality of health surveillance in general is the completeness and accuracy of case finding. In turn, the criteria used to detect and categorize cases for surveillance purposes (e.g., as possible, likely, or confirmed cases) significantly impact counts of cases of specific conditions and surveillance findings and their implications in general. To inform our selection of cancer case definitions, we reviewed several case finding algorithms before deciding on the case definitions used for this report.

Active military populations differ from the U.S. civilian population in many ways. Several factors that differ in the populations affect both the incidence of and mortality from cancers. For example, the incidence rates of many cancers increase with age, and many behavioral factors are associated with cancer risk including tobacco use, food and alcohol consumption, physical activity, medication use, history of infectious disease and sun exposure,

FIGURE 3a. Cancer-related deaths by year and affected anatomic site/cell type, active component, U.S. Armed Forces, 2000-2011

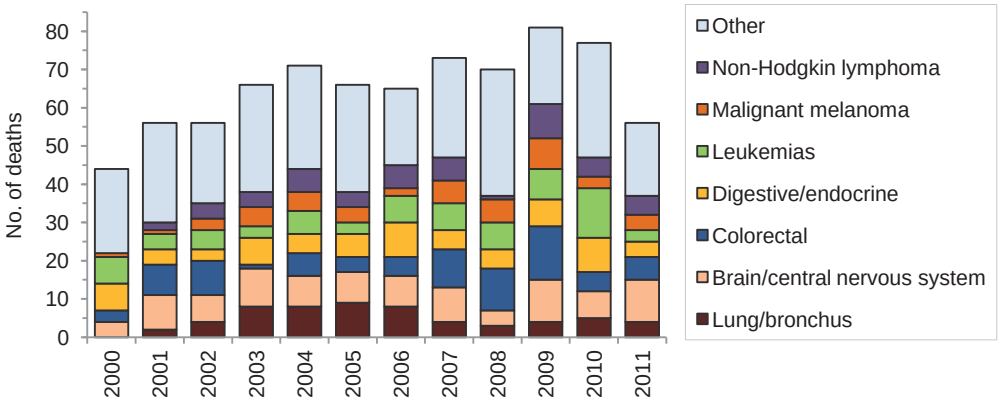
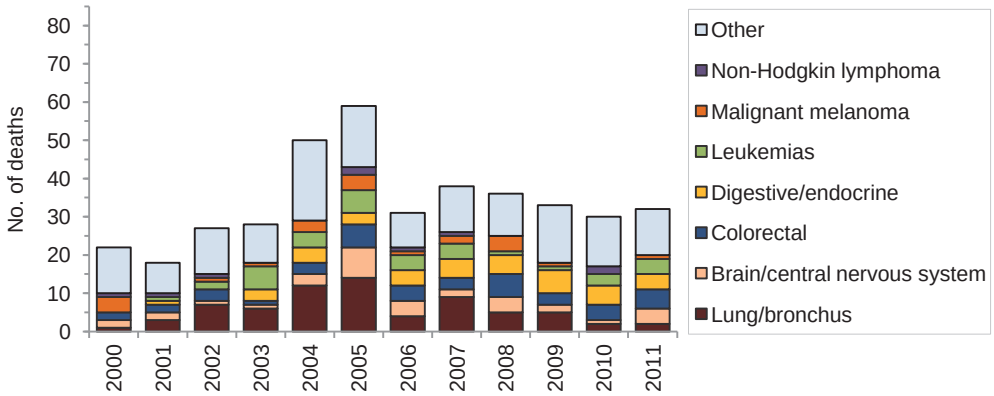


FIGURE 3b. Cancer-related deaths by year and affected anatomic site/cell type, reserve component, U.S. Armed Forces, 2000-2011



and so on. In general, U.S. service members are younger and healthier than their civilian counterparts. All applicants for military service are medically examined before induction, and those with specified medical conditions (e.g., prevalent cancers, HIV-1 infections) are disqualified. In addition, all military services have height, weight, and physical fitness standards; as a result, obesity and sedentary lifestyles (which are correlates of risk for some cancers) are not common among active military members. Military members have unlimited access to health care at no cost to themselves; in addition, they are required to undergo special and periodic medical examinations that may include cancer screening examinations such as mammography, prostate specific antigen (PSA) testing, cytological examination of the cervix (Papanicolaou smear), and so on.

Because military members may seek care for signs or symptoms of cancers at early clinical stages and are subject to relatively intensive medical screening, cancers may be detected earlier in their clinical courses in active military than in civilian populations. If so, rates of cancer diagnoses may be higher among active military members than similarly aged civilians (because they are detected earlier); however, the detection and treatment of cancers at earlier stages may decrease cancer-related mortality among military members compared to civilians.

Interpretations of temporal trends of rates of cancer diagnoses should consider not only changes in screening practices but also changes in behavioral risk factors in relation to the clinical latencies of cancers of interest. For example, cigarette smoking is a significant risk factor for several cancers. While the U.S. military discourages cigarette smoking by its members and prohibits smoking in some settings, smoking prevalence remains higher among active military members (31%) than in the general U.S. population (20%).[12-13] This report documented a low incidence of lung cancers among military members; however, the finding may reflect the long latency of smoking-related lung cancer; lung cancer cases related to current tobacco smoking may not be clinically apparent until after affected members leave active service. Unquestionably, smoking cessation should be a high priority for all military health care and public health practitioners.

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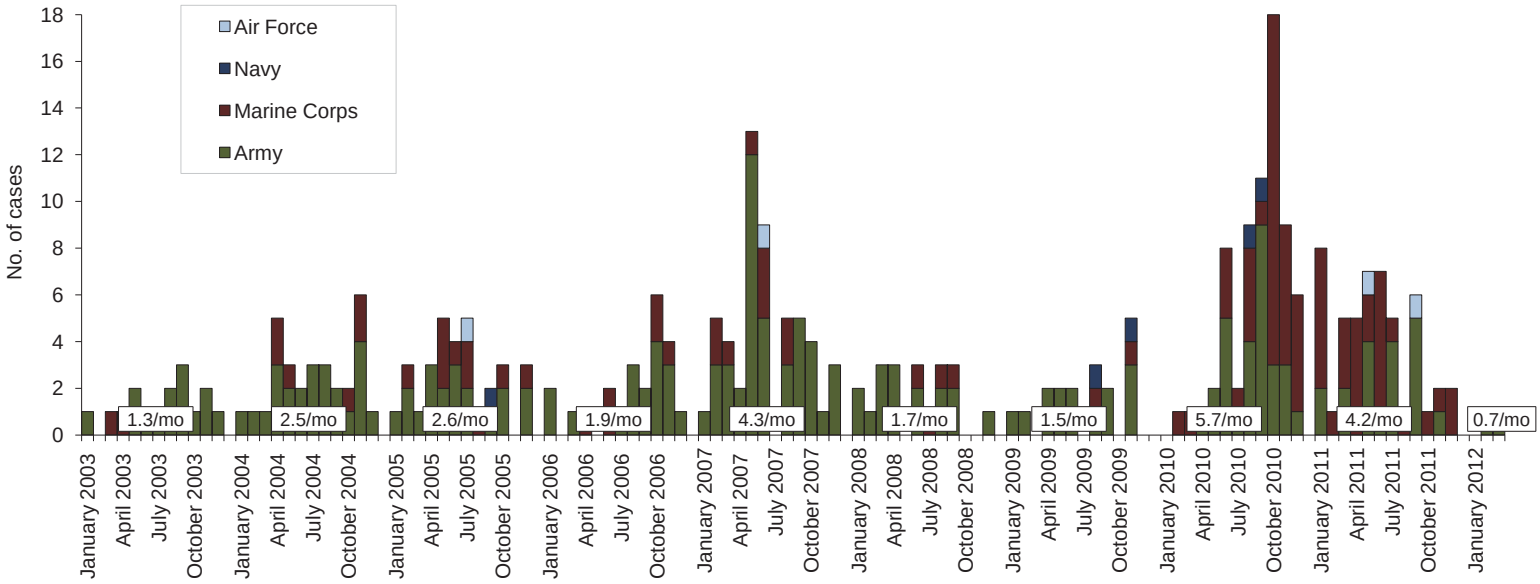
Surveillance Snapshot: Deployment-related Injuries to External Genital Organs by Month and Service, Active and Reserve Components, U.S. Armed Forces, January 2003- April 2012

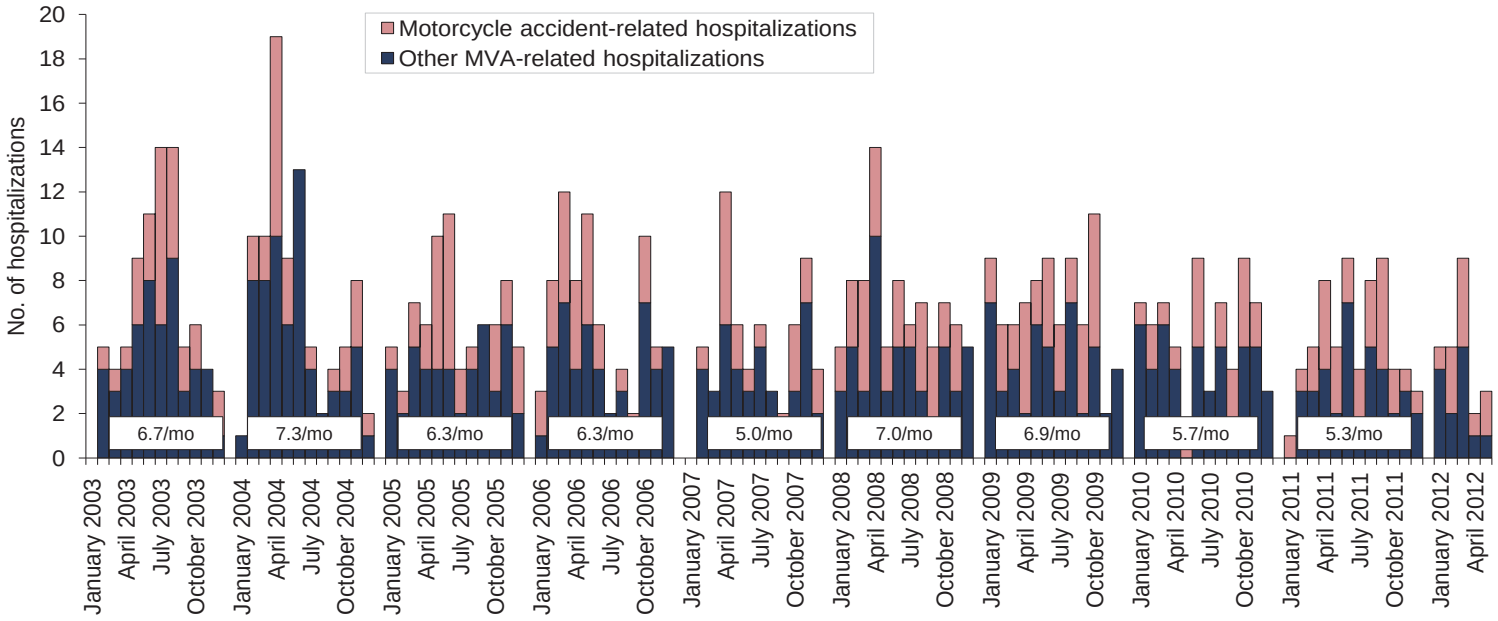
Open wounds of genital organs (external) (ICD-9-CM: 878.x)



Note: One hospitalization per individual or one outpatient encounter that occurred during a hospitalization while deployed to/within 365 days of returning from OEF/OIF/OND.

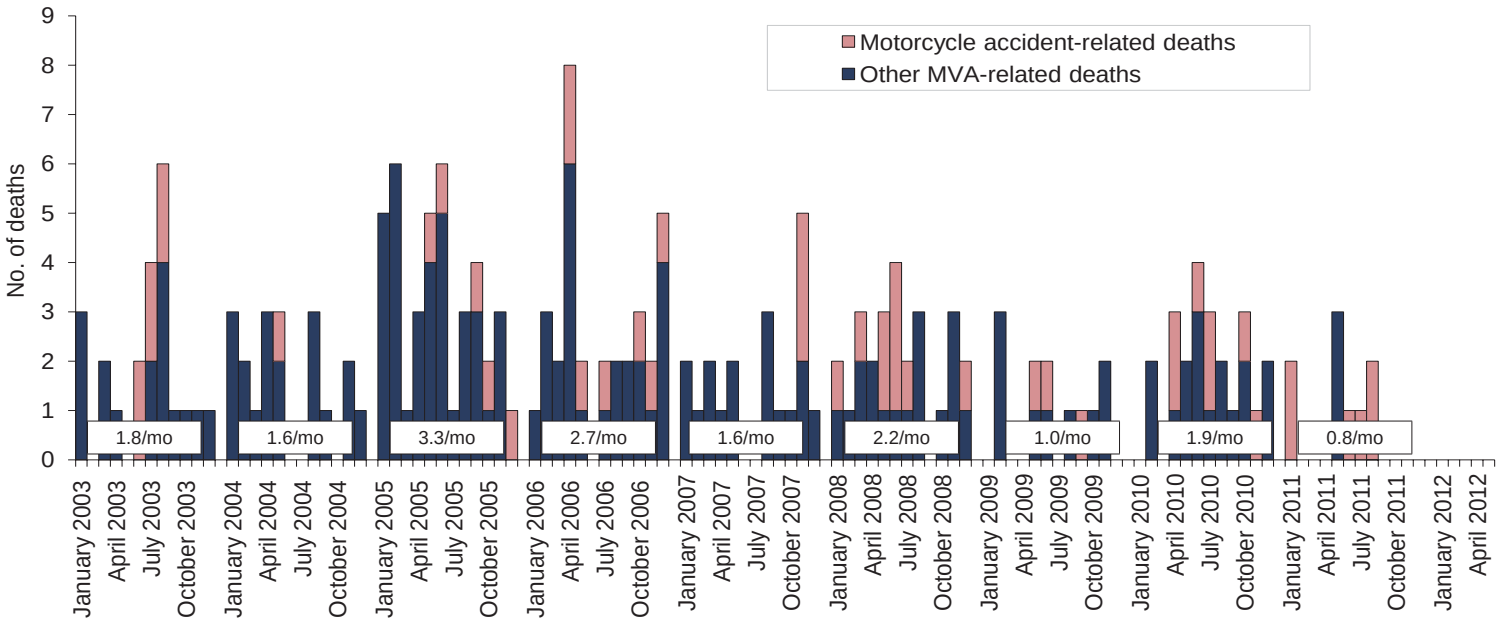
Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003-May 2012 (data as of 25 June 2012)

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.

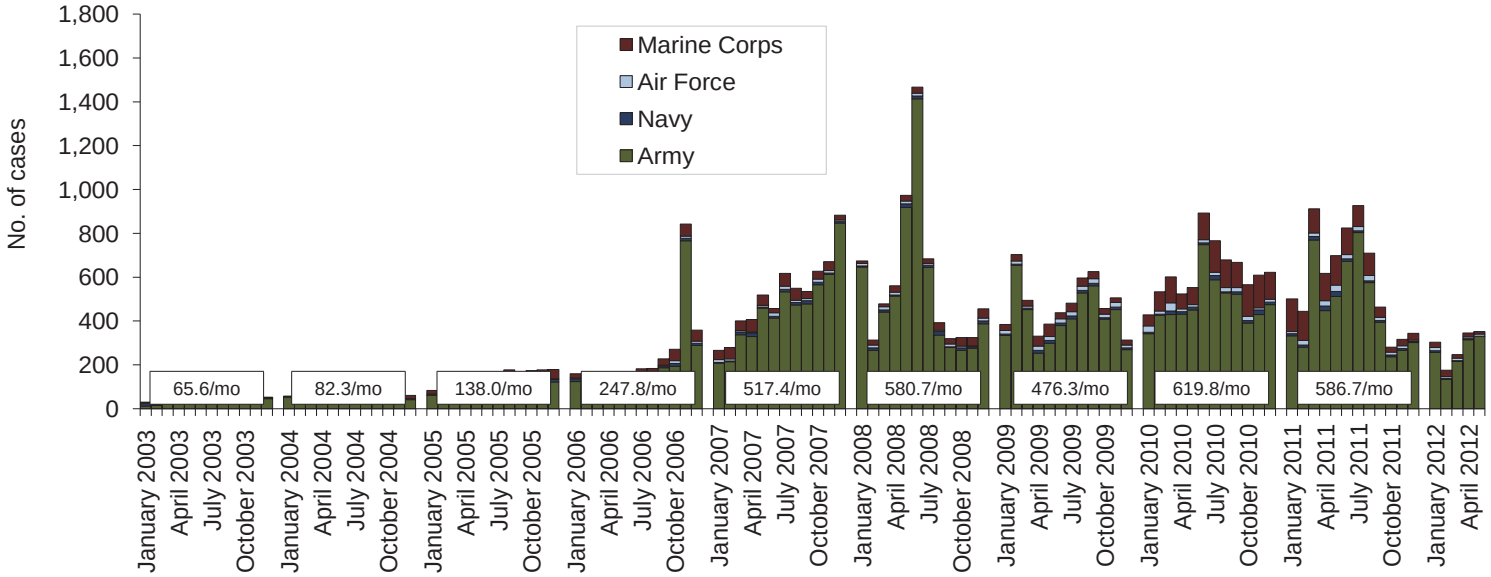
Deaths following motor vehicle accidents occurring in non-military vehicles and outside of the operational theater (per the DoD Medical Mortality Registry)



Reference: Armed Forces Health Surveillance Center. Motor vehicle-related deaths, U.S. Armed Forces, 2010. *Medical Surveillance Monthly Report (MSMR)*. Mar 11;17(3):2-6.
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-May 2012 (data as of 22 June 2012)

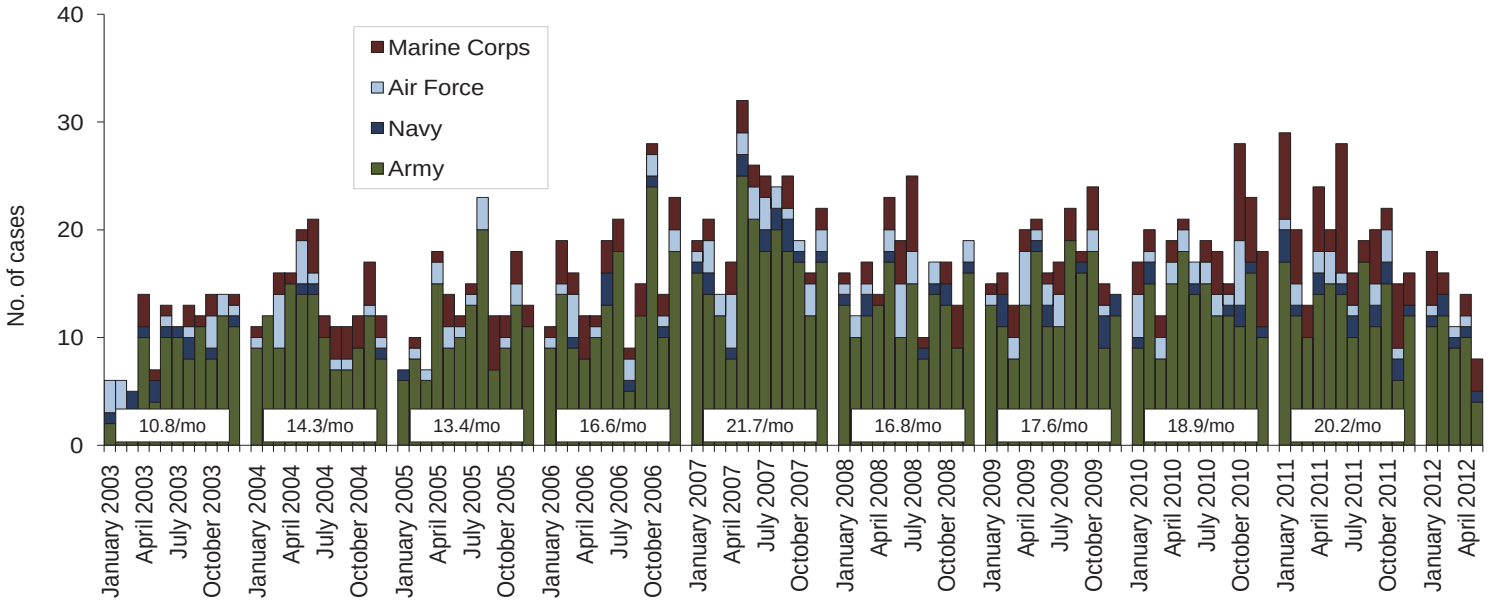
Traumatic brain injury (ICD-9: 310.2, 800-801, 803-804, 850-854, 907.0, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F, V15.52_0-9, V15.52_A-F, V15.59_1-9, V15.59_A-F)[a]



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 3,705 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]

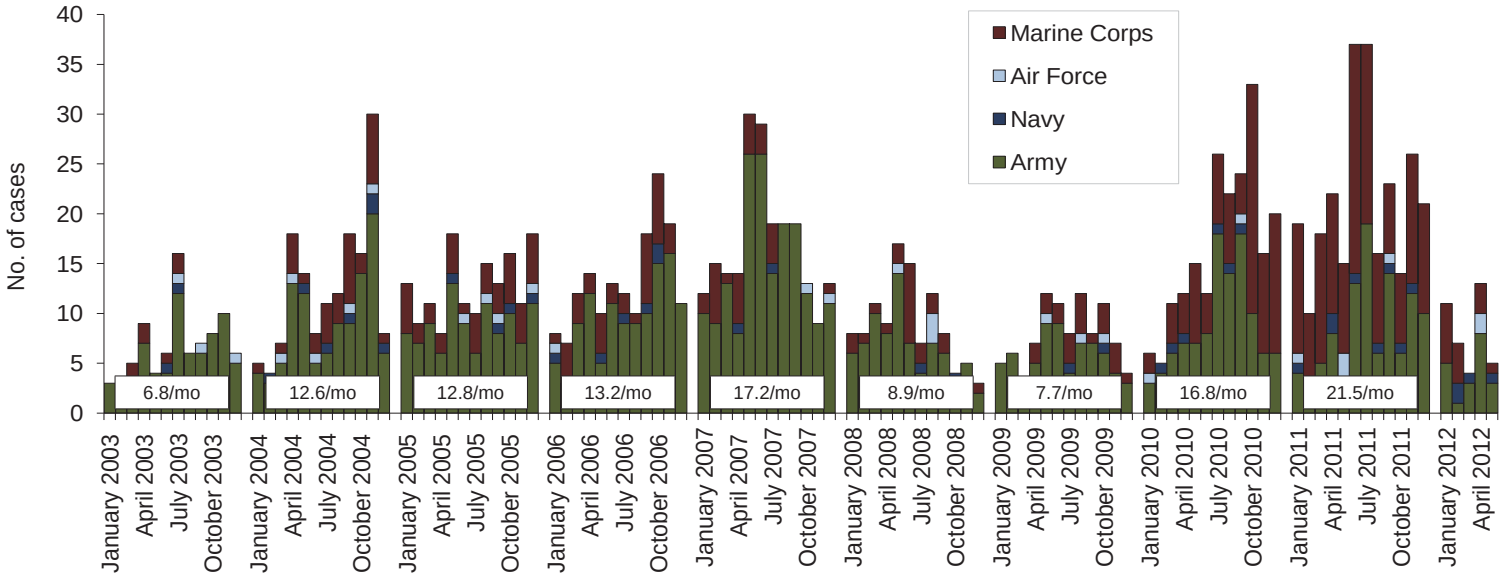


Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379-83.

[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.

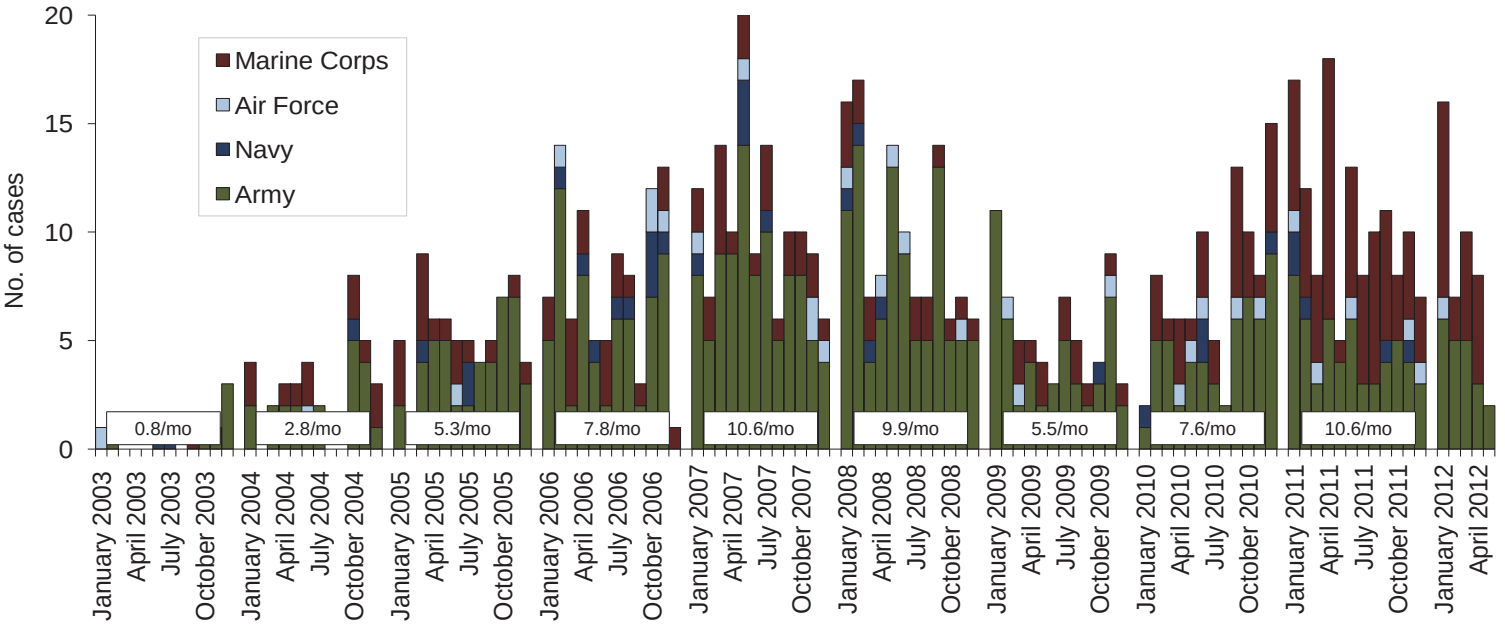
Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003-May 2012 (data as of 22 June 2012)

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.

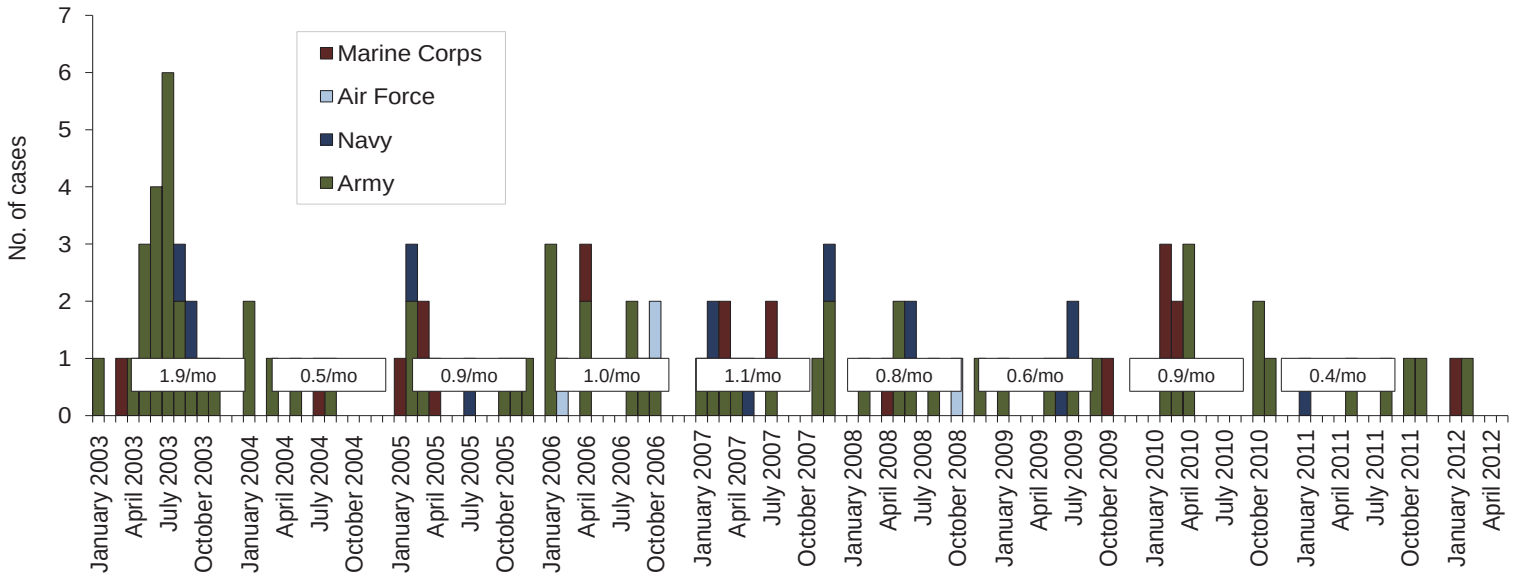
Heterotopic ossification (ICD-9: 728.12, 728.13, 728.19)[b]



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.

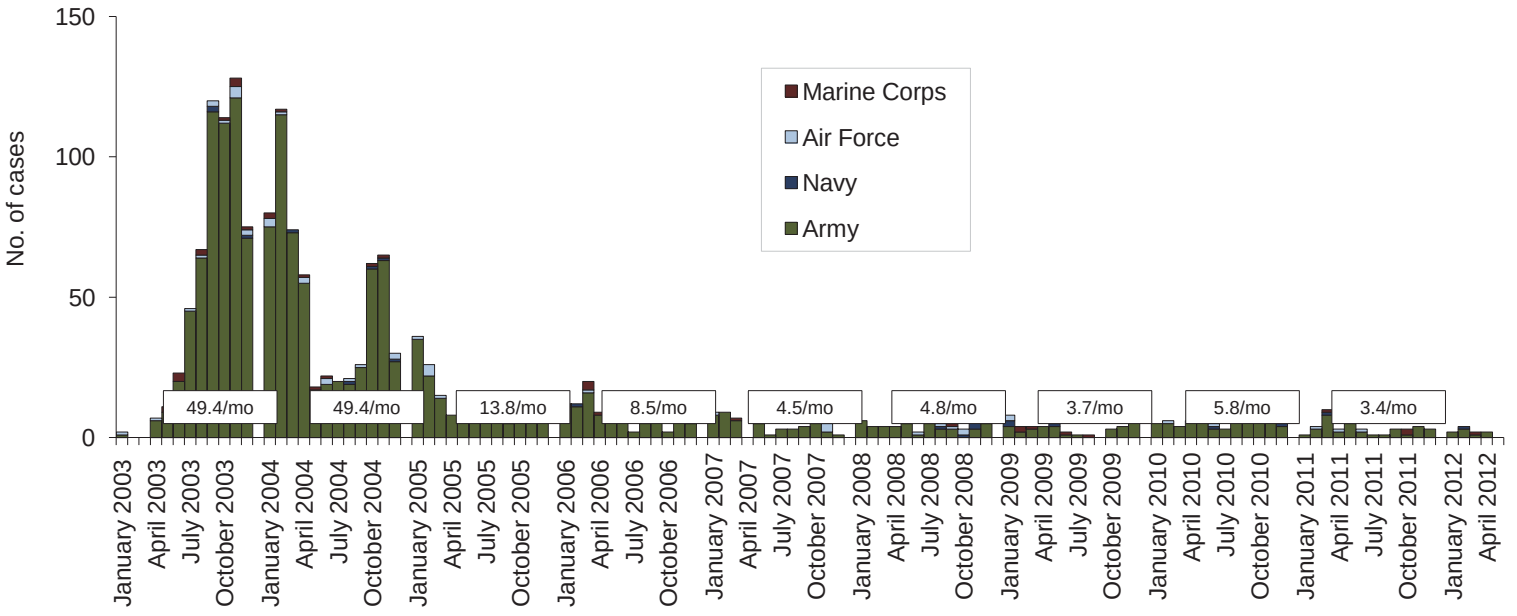
Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - May 2012 (data as of 22 June 2012)

Severe acute pneumonia (ICD-9: 518.81, 518.82, 480-487, 786.09)[a]



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: severe acute pneumonia. Hospitalizations for acute respiratory failure (ARF)/acute respiratory distress syndrome (ARDS) among participants in Operation Enduring Freedom/Operation Iraqi Freedom, active components, U.S. Armed Forces, January 2003-November 2004. *MSMR*. Nov/Dec 2004;10(6):6-7.
[a]Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 30 days of returning from OEF/OIF/OND.

Leishmaniasis (ICD-9: 085.0 to 085.9)[b]



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: leishmaniasis. Leishmaniasis among U.S. Armed Forces, January 2003-November 2004. *MSMR*. Nov/Dec 2004;10(6):2-4.
[b]Indicator diagnosis (one per individual) during a hospitalization, ambulatory visit, and/or from a notifiable medical event during/after service in OEF/OIF/OND.

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