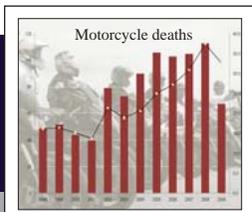




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MEDICAL SURVEILLANCE MONTHLY REPORT

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Motor Vehicle-related Deaths, U.S. Armed Forces, January 1998-September 2009

Motor vehicle accidents are the leading cause of death among U.S. military members during peacetime. During the four years prior to operations in Iraq and Afghanistan, one-third of service member deaths were caused by motor vehicle accidents. Since the beginning of those operations, there have been nearly as many deaths of service members due to “transportation accidents” as war-related injuries.¹

Many military members are young, single, male, and high-school educated; these characteristics are associated with high risk of dying in motor vehicle crashes.^{2,3} Compared to their older counterparts, young military members have less driving experience and are more likely to take risks while driving (such as to drive without seatbelts or while under the influence of alcohol).³ However, because military service is inherently dangerous, and because all U.S. military members are volunteers, they may be more willing to take risks, independently of age.

Motorcycles are used by many U.S. military members for transportation and recreation; of note, motorcyclists are 37 times more likely than passenger car occupants to die in road accidents.⁴ Also, driving and riding in military motor vehicles during training and operational missions can be hazardous — particularly, in unfamiliar and intrinsically unsafe settings (e.g., blackout conditions; inclement weather; narrow roadways, bridges, and overpasses).^{5,6}

This report summarizes numbers, rates, trends and correlates of risk of fatal motor vehicle accidents among U.S. military members.

Table 1. Motor vehicle deaths by “underlying cause of death” category, January 1998-September 2009

Underlying cause of death	Total service members	
	No.	%
Motorcyclist involved in any accident except collision with railway train	921	22.8
Other and unspecified motor vehicle accidents	918	22.8
Occupant of car pickup truck or van in collision with other motor vehicle	571	14.2
Occupant of motor vehicle in collision with non-motorized vehicle, pedestrian, fixed object	498	12.4
Occupant of motor vehicle in noncollision accident	466	11.6
Occupant of special-use motor vehicle in any accident (include military vehicle)	392	9.7
Pedestrian in collision with motor vehicle	223	5.5
Pedal cyclist in collision with motor vehicle	17	0.4
Other motor vehicle accident involving collision with railway train	10	0.2
Other and unspecified land transport accidents	10	0.2
Occupant of heavy transport vehicle or bus in collision with other motor vehicle	5	0.1
Total	4,031	100

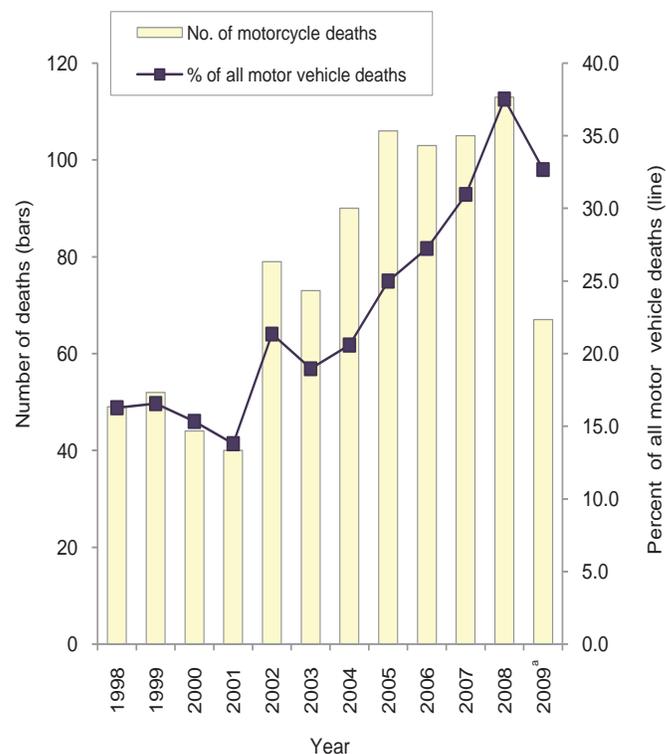
Methods:

The surveillance period was 1 January 1998 to 30 September 2009. The surveillance population included all individuals who served on active duty as a member of the active or Reserve component of the Army, Navy, Air Force, or Marine Corps any time during the surveillance period.

Motor vehicle-related deaths of service members while on active duty were ascertained from records maintained in the DoD Medical Mortality Registry of the Armed Forces Medical Examiner System and routinely provided to the Armed Forces Health Surveillance Center for integration in the Defense Medical Surveillance System (DMSS). For this analysis, a motor vehicle-related death was defined by a casualty record with an “underlying cause of death” code (**Table 1**) corresponding to a collision or non-collision motor vehicle accident. Motor vehicle deaths that were considered “intentional” (i.e., suicide, homicide, war-related) were excluded.

Summary measures were numbers of motor vehicle deaths in the surveillance population overall (i.e., active and Reserve component members who died while on active duty) and mortality rates. For members of the active component, mortality rates were calculated as deaths per 100,000 person-

Figure 1. Number and percent (of all motor vehicle deaths) of motorcycle-related deaths, active and Reserve component, U.S. Armed Forces, January 1998-September 2009



*Through September

Table 2. Demographic and military characteristics of individuals who died in motor vehicle accidents, active and Reserve components, with rates (per 100,000 person-years of service) for active component only, U.S. Armed Forces, January 1998-September 2009

	Active and Reserve components	Active component	
	No.	No.	Rate ^a
Total	4,031	3,414	21.1
Service			
Army	1,820	1,380	23.9
Navy	797	754	17.9
Air Force	671	589	14.3
Marine Corps	743	691	33.0
Sex			
Male	3,732	3,183	23.0
Female	297	229	9.7
Race ethnicity			
White, non-hispanic	484	2,001	19.7
Black, non-hispanic	1,878	720	24.1
Other	739	693	22.4
Age			
<20	484	420	32.8
20-24	1,878	1,685	31.5
25-29	739	641	18.8
30-39	678	534	11.8
40+	251	133	8.1
Military occupation			
Combat	1,038	899	27.1
Health	194	166	12.2
Admin/supply	904	697	18.4
Other	1,895	1,652	21.3

^aDeath rate per 100,000 person-years of service

years of active military service during the surveillance period. Mortality rates were summarized using person-years at risk (rather than individuals at risk) because the U.S. military is a dynamic cohort — each day, many individuals enter and many others leave service. Thus, in a given 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 for service members. Reserve component members were not included in rate calculations because the start and end dates of their active duty service periods were not available.

Results:

From 1998 through September 2009, 4,031 service members died from motor vehicle accidents (MVAs) while on active duty (Table 1). Nearly one-fourth (n=921; 23%) of all service members who died in motor vehicle accidents were riding motorcycles. Remarkably, the proportion of all MVA-related deaths that were due to motorcycle accidents increased from 14% (n=40) in 2001 to 38% (n=113) in 2008 (Figure 1).

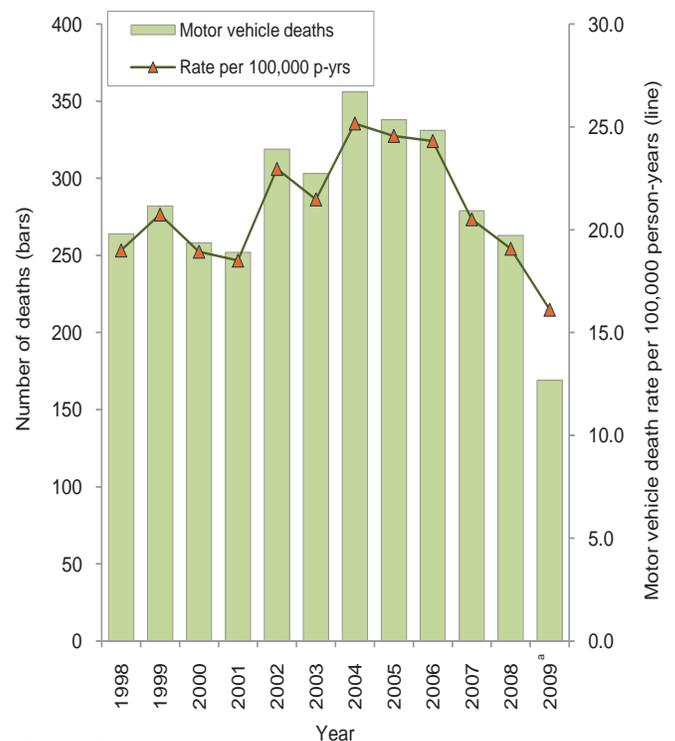
Of all non-motorcycle-related deaths from MVAs, approximately 15% (n=466) were related to “non-collision” accidents (e.g., rollovers, fires, loss of control); 13% (n=392) affected occupants of special-use (including military) vehicles; and 8% affected pedestrians (n=223) or bicyclists (n=17) who were hit by motor vehicles (Table 1).

Of all military members who died in motor vehicle accidents during the period, 85% (n=3,414) were in the active component (Table 2). Among active component members, the crude MVA-related fatality rate was 21.1 per 100,000 person-years (p-yrs). The highest MVA-related death rates affected service members who were in the Marine Corps (33.0 per 100,000 p-yrs), younger than 20 years (32.8 per 100,000 p-yrs), and in combat occupations (27.1 per 100,000 p-yrs). The MVA-related death rate declined with increasing age and was 2.4-times higher among males than females (Table 2).

Among active component members, numbers and rates of MVA-related deaths were generally stable from 1998 to 2001, increased from 2001 to 2004, slightly declined from 2004 to 2006, and sharply declined from 2006 through 2009 (Figure 2). The mean of MVA-related deaths per year during the period was 285; however, the range was wide. The most MVA-related deaths in a year were in 2004 (n=356; rate: 25.2 per 100,000 p-yrs) and the fewest in 2009 (through September) (n=169; rate: 16.1 per 100,000 p-yrs) (Figure 2).

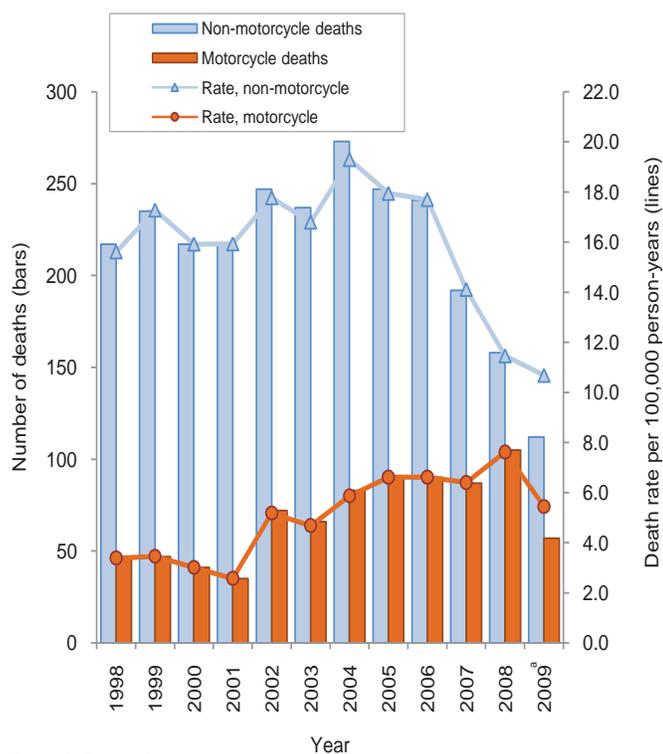
Among active component members, trends of motorcycle- and other motor vehicle-related deaths differed substantially over the period (Figure 3). Motorcycle-related death rates

Figure 2. Motor vehicle deaths per year among members of the active component, U.S. Armed Forces, January 1998-September 2009



^aThrough September

Figure 3. Motor vehicle deaths, by year and underlying cause (motorcycle vs. non-motorcycle accidents), active component, U.S. Armed Forces, January 1998-September 2009



^aThrough September

doubled from 2001 (2.6 per 100,000 p-yrs) to 2002 (5.2 per 100,000 p-yrs) and increased by nearly 50% from 2002 to 2008 (7.6 per 100,000 p-yrs). In sharp contrast, MVA-related deaths not involving motorcycles declined by 42% from 2004 (n=273) to 2008 (n=158) (Figure 3). In 1998, motorcycle accidents accounted for 16% of all fatal MVAs among U.S. military members of all components; in 2008, they accounted for 38% of all fatal MVAs among U.S. military members (Figure 1).

Of the services, the Marine Corps had the highest rates of MVA-related deaths overall (33.0 per 100,000 p-yrs) and motorcycle-related deaths specifically (6.8 per 100,000 p-yrs) during the entire period. The MVA-related death rate overall was higher in the Army (23.9 per 100,000 p-yrs) than the Navy (17.9 per 100,000 p-yrs); however, the motorcycle-related death rate was higher in the Navy (5.3 per 100,000 p-yrs) than the Army (4.8 per 100,000 p-yrs). Of note, in 2008 (the year with the most motorcycle-related deaths), motorcycle-related death rates were 11.3, 9.2, 7.3 and 4.3 per 100,000 person-years in the Marine Corps, Navy, Army and Air Force, respectively (data not shown).

Alcohol was reported as a factor in 9.5% of all MVA-related deaths overall and 7.8% of all fatal motorcycle accidents (data not shown). Forty-three percent (n=1,728) of service members who died from motor vehicle accidents had documented medical encounters (hospitalizations: 20%; ambulatory visits: 23%) within 7 days before the dates of their

deaths; of these individuals, 530 (31%) had primary (first-listed) diagnoses of serious injuries to the head. Head injuries (including skull fracture, intracranial injury and cerebral hemorrhage) accounted for five of the six most frequent injuries (at the 3-digit level of the ICD-9-CM) documented during medical encounters preceding MVA-related deaths (data not shown).

Data summaries by Stephen B. Taubman, PhD, Data Analysis Group, AFHSC.

Editorial comment:

This report reiterates the importance of motor vehicle accidents as a significant cause of deaths of U.S. service members. The most striking finding, however, is the sharp increase in the proportion of all MVA-related deaths that are due to motorcycle accidents. In 2008, 38% of all U.S. service members in active service (and 40% of all active component members) who were killed in motor vehicle accidents were riding motorcycles; in 2001, only 14% of all MVA-related deaths of service members were due to motorcycle accidents.

The recent sharp increase in motorcycle-related deaths has been noted and aggressively countered by the Services. For example, Service and local safety centers highlight vehicle safety in publications, messages, educational, and training materials; installations require training and proficiency testing before issuing permits for on-post motorcycle use; and some installations provide controlled, supervised venues for high performance uses of motorcycles and other vehicles. The effects of such efforts should be closely tracked; effective interventions should be identified and documented to enable broader implementation.

There are limitations to the analysis that should be considered when interpreting the results. For example, at the time of the analysis, records of deaths of U.S. service members were available only through September 2009; also, final determinations of underlying causes were pending for approximately 8% of deaths in 2009. Hence, numbers of MVA-related deaths, overall and by causes, during the most recent calendar year of interest for the analysis are incomplete. Also, this analysis did not include MVA-related deaths of Reserve component members who were not "on active duty" at the times of their accidents or deaths secondary to but long after motor vehicle accidents that occurred during active service (e.g., medically retired service members). Because such deaths were not included, the mortality impact of motor vehicle accidents on the total force is significantly higher than documented here.

Finally, this overview summarizes numbers, rates, trends, and demographic and military characteristics of U.S. military members who died from motor vehicle accidents. A future MSMR report will document temporal

characteristics of fatal motor vehicles accidents of military members (e.g., seasons of the year, days of the week, relationships to federal holidays).

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Update: Heat Injuries, Active Component, U.S. Armed Forces, 2009

Heat-related injuries are significant threats to the health and operational effectiveness of military members and their units.^{1,2} Lessons learned during training and operations in hot environments and findings of numerous research studies have resulted in doctrine, equipment, and methods that can significantly reduce the adverse effects of military activities in heat.¹⁻³ Although numerous and effective countermeasures are available, physical exertion in hot environments still causes hundreds of injuries — some life threatening — among U.S. military members each year.^{4,5}

In June 2009, the Armed Forces Health Surveillance Center issued revised Tri-Service Reportable Event Guidelines⁶ in which definitions of notifiable heat injuries were modified. Effective 31 July 2009, a notifiable case of “heat stroke” (ICD-9-CM: 992.0) is clinically defined as “a severe heat stress injury, specifically including injury to the central nervous system, characterized by central nervous system dysfunction and often accompanied by heat injury to other organs and tissue.” Notifiable cases of heat injuries

other than heat stroke (“unspecified effects of heat” [ICD-9-CM: 992.9]) are “moderate to severe heat injuries associated with strenuous exercise and environmental heat stress ... that require medical intervention or result in lost duty time.” All heat injuries that require medical intervention or result in lost duty are reportable. Cases of “heat exhaustion” (ICD-9-CM: 992.3) that do not require medical intervention or result in lost duty are not reportable.

This report summarizes heat injury-related hospitalizations, ambulatory visits and reportable medical events among members of active components during 2009 and compares them to recent years. Heat stroke (reportable during all of 2009) is summarized separately from “other heat injuries” which includes “heat exhaustion” reportable prior to 31 July 2009) and “unspecified effects of heat” (reportable since 31 July 2009).

Methods:

The surveillance population included all individuals who served in an active component of the Army, Navy, Air Force, Marine Corps or Coast Guard any time from 1 January 2005 through 31 December 2009. The Defense Medical Surveillance System (DMSS) was searched to identify all

Table 1. Incident cases and rates^a of heat injury, active component, U.S. Armed Forces, 2009

	Heat stroke ICD-9-CM: 992.0		Other heat injury 992.3-5,992.9	
	No.	Rate ^a	No.	Rate ^a
Total	323	0.22	2,038	1.41
Sex				
Male	293	0.24	1,673	1.35
Female	30	0.15	365	1.78
Age group				
< 20	44	0.44	428	4.32
20-24	147	0.31	876	1.82
25-29	63	0.19	358	1.05
30-34	30	0.14	189	0.91
35-39	28	0.16	128	0.75
40+	11	0.08	59	0.40
Race/ethnicity				
White, non-Hispanic	210	0.23	1,358	1.48
Black, non-Hispanic	51	0.22	332	1.43
Other	62	0.21	348	1.19
Service				
Army	209	0.38	1,160	2.12
Navy	18	0.06	122	0.37
Air Force	14	0.04	250	0.76
Marine Corps	81	0.40	484	2.39
Coast Guard	1	0.02	22	0.52
Military status				
Enlisted	283	0.23	1,895	1.57
Officer	40	0.17	143	0.61
Military occupation				
Combat	123	0.42	536	1.83
Health care	22	0.19	145	1.24
Other	178	0.17	1,357	1.31

^aRate per 1,000 person-years

Figure 1. Incident cases and rates of “heat stroke”, by source of report and year of diagnosis, active component, U.S. Armed Forces, 2005-2009

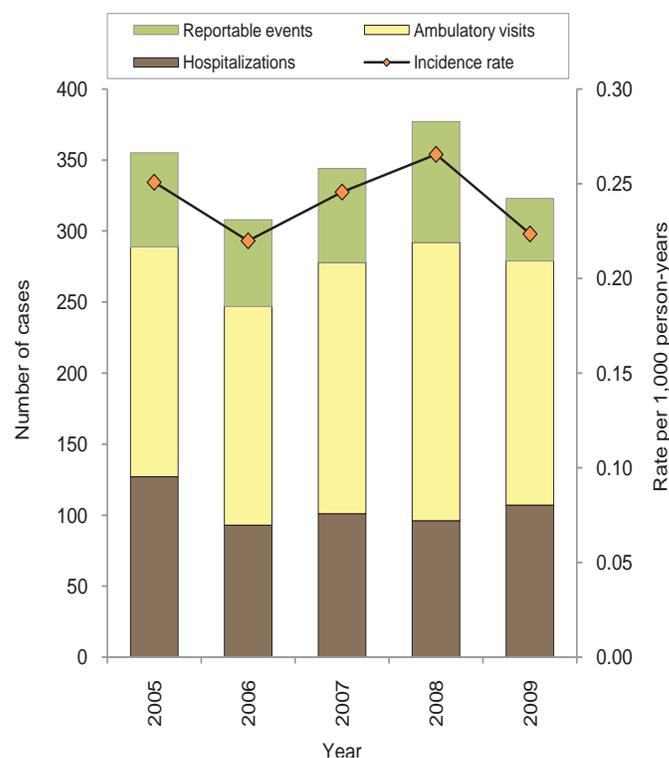
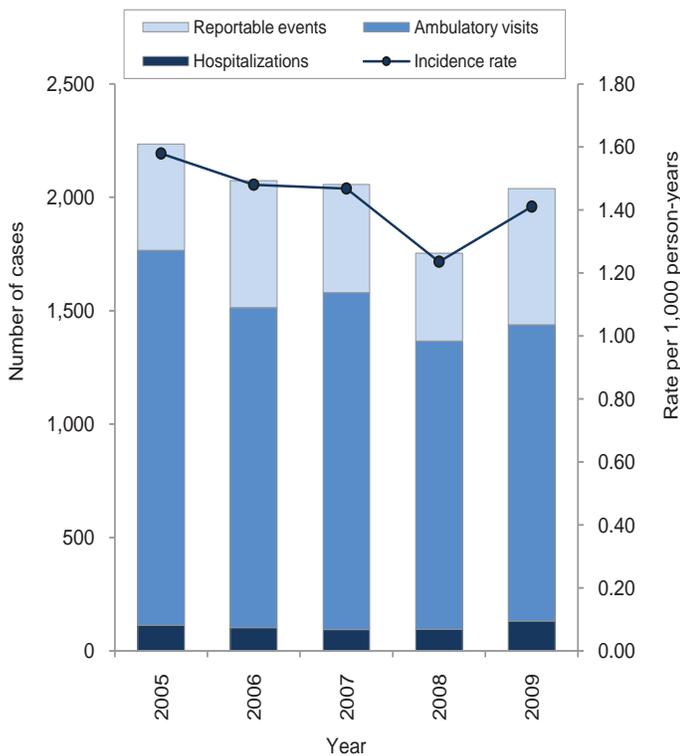


Figure 2. Incident cases and rates of “other heat injury”, by source of report and year of diagnosis, active component, U.S. Armed Forces, 2005-2009



medical encounters and notifiable medical event reports that included either primary (first listed) or secondary (second listed) diagnoses of “heat stroke” (ICD-9-CM: 992.0) or “other heat injury” (“heat exhaustion” [ICD-9-CM: 992.3-992.5 and “unspecified effects of heat” [ICD-9-CM:992.0]).

The analytic methods used to summarize heat injuries in this report are different from those used in previous heat injury updates. First, this report estimates annual numbers of both individuals affected by heat injury and heat injury events. Individuals were counted as an “incident case” only once per calendar year. When counting heat injury events, individuals were allowed one event every 60 days. Second, for individuals with more than one documented heat injury in a calendar year, information for summary purposes was derived from hospitalization records (if available) or reportable event records. Ambulatory records were used only if they were the sole source of information documenting a case. For individuals with more than one heat injury diagnosis in a calendar year, diagnoses of heat stroke were prioritized over other heat injury diagnoses.

In previous heat injury summaries published in the *MSMR*, multiple medical events of heat injury for an individual were prioritized by clinical setting and type of heat injury diagnosis only if such events occurred on the same day. Also, once a heat injury event was documented, the affected individual was removed from follow-up until six months after the last encounter for the previous injury. These methods limited the ability to detect recurrent heat injuries

and to accurately assess the severity of heat injury encounters among service members. As expected, the revised methods resulted in modest increases in numbers of heat-related hospitalizations/notifiable events (relative to ambulatory visits) and heat stroke cases (relative to other heat injury cases) in this update as compared to those previously published.

Results:

In 2009, there were 323 incident cases of heat stroke and 2,038 incident cases of “other heat injury” among active component members. Overall crude incidence rates of heat stroke and other heat injury were 0.22 and 1.41 per 1,000 person-years (p-yrs), respectively (Table 1).

The incidence rate (unadjusted) of heat stroke in 2009 was the same as the rate in 2006 and lower than in other prior years of the surveillance period (Figure 1). In 2009 compared to recent prior years, there were similar numbers of hospitalizations and ambulatory visits for, but fewer notifiable medical event reports of, heat stroke (perhaps reflecting the mid-year revision of the clinical definition of a notifiable heat stroke case) (Figure 1).

The overall incidence rate (unadjusted) of “other heat injury” in 2009 was slightly higher than in 2008; in general, however, the rate in 2009 was not remarkably different from the rates in recent prior years (Figure 2).

In 2009, absolute and relative (compared to their respective counterparts) rates of heat stroke were sharply higher among those younger than 20 years old (0.44 per 1000 p-yrs), in combat-specific occupations (0.42 per 1000 p-yrs), and in the Marine Corps (0.40 per 1000 p-yrs) and Army (0.38 per 1000 p-yrs). Heat stroke rates were higher among enlisted members (0.23 per 1000 p-yrs) and males (0.24 per 1000 p-yrs) than officers and females, respectively.

Table 2. Heat injuries by location of diagnosis/report, active component, U.S. Armed Forces, 2005-2009

Medical facility location	2005-2009	
	No.	% of total
Fort Bragg, NC	1,598	12.9
Fort Benning, GA	1,227	9.9
MCRD Parris Island/Beaufort, SC	1,152	9.3
MCB Camp Lejeune/Cherry Point, NC	531	4.3
Fort Polk, LA	453	3.6
Fort Jackson, SC	442	3.6
Fort Campbell, KY	397	3.2
Fort Hood, TX	359	2.9
Fort Stewart, GA	262	2.1
Fort Sill, OK	260	2.1
MCB Camp Pendleton, CA	251	2.0
MCRD San Diego, CA	230	1.9
NH Okinawa, Japan	208	1.7
MCB Quantico, VA	199	1.6
MCB Twentynine Palms, CA	185	1.5
NH Pensacola, FL	180	1.4
Fort Shafter, HI	162	1.3
NH Portsmouth, VA	152	1.2
All other locations	4,168	33.6
Total	12,416	100.0

Of note, crude rates of heat stroke were very similar across race-ethnicity-defined subgroups (Table 1).

There were generally similar relationships of crude rates of “other heat injuries” across military and demographic subgroups. In contrast to heat stroke, however, the rate of “other heat injuries” was higher among females than males and more than 2.5-times higher among enlisted members than officers (Table 1).

The 323 individuals affected by heat stroke in 2009 experienced a total of 369 separate heat stroke events. The 2,038 individuals with other heat injury diagnoses or reports had a total of 2,100 events. The number of individuals with more than one heat stroke event in 2009 (n=34) was lower than the average during the previous 4 years (2005-2008 average number of individuals with more than one heat stroke event: 58), while the average number of individuals with multiple events of other heat injuries (n=52) was higher than the average during the previous 4 years (2005-2008 average number of individuals with multiple “other heat injury” events: 33) (data not shown).

During the five-year surveillance period, heat-related injuries were diagnosed at more than 200 military medical facilities worldwide. However, six Army and two Marine Corps installations accounted for approximately one-half of all heat injury events: Fort Bragg, NC (n=1,598), Fort Benning, GA (n=1,227), MCRD Parris Island/Beaufort, SC (n=1,152), MCB Camp Lejeune/Cherry Point, NC (n=531), Fort Polk, LA (n=453) Fort Jackson, SC (n=442), Fort Campbell, KY (n=397) and Fort Hood, TX (n=359) (Table 2). Navy/Marine Corps installations represented one-half of the locations with more than 150 incident heat injury reports/diagnoses during the period (Table 2).

Editorial comment:

This update indicates that, over the last four years, incidence rates of heat injuries (both heat stroke and other clinically significant heat-related injuries) have been fairly stable among active component members of the U.S. military. However, there are limitations to the report that should be considered when interpreting the results. For example, the report is based on records of medical encounters at fixed (e.g., not deployed, at sea) medical facilities. In turn, heat injuries during training exercises and deployments that are treated in field/deployed medical facilities are not ascertained as cases for this report.

In spite of surveillance limitations, it is clear that heat injuries remain a significant threat to the health of U.S. military members and the effectiveness of military operations. Of all military members, the youngest and most inexperienced Marines and soldiers are at highest risk of heat injuries — including heat stroke, exertional hyponatremia, and exertional rhabdomyolysis (see pages 9-16). Commanders, small unit leaders, training cadre, and supporting medical personnel, particularly at recruit training centers and installations with large combat troop populations, must ensure that military members whom they supervise and support are informed regarding risks, preventive countermeasures (e.g., water consumption), early signs and symptoms, and first responder actions related to heat injuries.¹⁻³ Leaders should be aware of the dangers of insufficient hydration on the one hand and excessive water intake on the other; they must have detailed knowledge of and rigidly enforce countermeasures against all types of heat injuries.

Policies, guidance, and other information related to heat injury prevention and treatment among U.S. military members are available on-line at: <<http://chppm-www.apgea.army.mil/heat/#PM>> and <<http://www.marines.mil/news/publications/Documents/MCO%206200.1E%20W%20CH%201.pdf>>.

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Update: Exertional Rhabdomyolysis among U.S. Military Members, 2009

Rhabdomyolysis is the breakdown of striated muscle cells with release into the bloodstream of their potentially toxic contents. In U.S. military members, rhabdomyolysis is a significant threat during physical exertion, particularly under heat stress. Each year, the *MSMR* summarizes numbers, rates, trends, risk factors and locations of occurrences of exertional heat injuries, including exertional rhabdomyolysis. Information regarding the definition, causes and prevention of exertional rhabdomyolysis can be found in previous issues of the *MSMR*.¹

Methods:

The surveillance period was 1 January 2005 to 31 December 2009. The surveillance population included all individuals who served in an active component of the U.S. Armed Forces any time during the surveillance period. For surveillance purposes, a case of “exertional rhabdomyolysis” was defined as a hospitalization or ambulatory visit with

a discharge diagnosis in any position of: “rhabdomyolysis” (ICD-9-CM: 728.88) and/or “myoglobinuria” (ICD-9-CM: 791.3); plus a diagnosis in any position of “volume depletion (dehydration)” (ICD-9-CM: 276.5), “effects of heat” (ICD-9-CM: 992.0-992.9), “effects of thirst (deprivation of water),” “exhaustion due to exposure,” or “exhaustion due to excessive exertion (overexertion)” (ICD-9-CM: 994.3-994.5). Each individual could be included as a case only once per calendar year.

To exclude cases of rhabdomyolysis that were secondary to traumatic injuries, intoxications, or adverse drug reactions, medical encounters with diagnoses in any position of ICD-9-CM: 800-999 “injury, poisoning, toxic effects” (except ICD-9-CM: 992.0-992.9, 994.3-994.5, and 840-848 “sprains and strains of joints and adjacent muscles”) were excluded from consideration as “exertional rhabdomyolysis” case defining encounters.

Results:

In 2009, there were 315 incident episodes of rhabdomyolysis likely due to physical exertion and/or heat

Table 1. Incident diagnoses and incidence rates^a of exertional rhabdomyolysis, active component, U.S. Armed Forces, 2009

	Hospitalized		Ambulatory		Total	
	No.	Rate ^a	No.	Rate	No.	Rate
Total	144	10.0	171	11.8	315	21.8
Service						
Army	65	11.9	85	15.5	150	27.4
Navy	16	4.9	23	7.1	39	12.0
Air Force	19	5.8	12	3.7	31	9.5
Marine Corps	41	20.2	46	22.7	87	42.9
Coast Guard	3	7.1	5	11.9	8	19.0
Sex						
Male	135	10.9	162	13.1	297	24.0
Female	9	4.4	9	4.4	18	8.8
Race/ethnicity						
White, non-Hispanic	85	9.2	107	11.6	192	20.9
Black, non-Hispanic	32	13.8	40	17.2	72	31.0
Other	27	9.2	24	8.2	51	17.4
Age						
<20	20	20.6	28	28.9	48	49.5
20-24	53	11.2	73	15.4	126	26.5
25-29	25	7.3	31	9.1	56	16.4
30-34	20	9.6	15	7.2	35	16.8
35-39	18	10.5	17	9.9	35	20.4
40+	8	5.3	7	4.6	15	9.9
Rank						
Enlisted	126	10.4	162	13.4	288	23.8
Officer	18	7.6	9	3.8	27	11.4
Military occupation						
Combat	37	12.7	36	12.3	73	25.0
Health care	9	7.7	9	7.7	18	15.4
Other	98	9.5	126	12.2	224	21.6

^aRate per 100,000 person-years

Figure 1. Corrected version (posted 02 May 2011) Incident diagnoses of presumed exertional rhabdomyolysis, by type of medical encounter and calendar year, active component, U.S. Armed Forces, 2005-2009

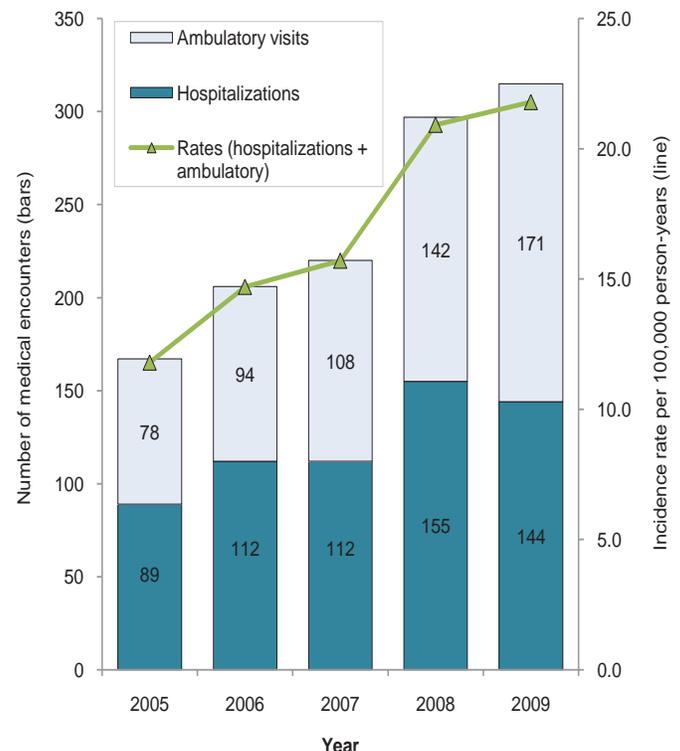


Table 2. Exertional rhabdomyolysis, by installation (among installations with at least 20 cases during the period), active component, U.S. Armed Forces, 2005-2009

Location of diagnosis	Total 2005-2009	
	No.	%
Fort Bragg, NC	157	13.0
MCRD Parris Island/Beaufort, SC	131	10.9
Camp Pendleton, CA	58	4.8
Lackland AFB, TX	49	4.1
Fort Benning, GA	46	3.8
Camp Lejeune/Cherry Pt, NC	41	3.4
MCRD San Diego, CA	38	3.2
Fort Jackson, SC	35	2.9
Fort Shafter, HI	32	2.7
NMC Portsmouth, VA	30	2.5
Fort Knox, KY	27	2.2
Fort Campbell, KY	26	2.2
Fort Belvoir, VA	23	1.9
Other locations	512	5.1
Total	1,205	100.0

stress (“exertional rhabdomyolysis”) (Table 1). The crude incidence rate was 21.8 per 100,000 person-years (p-yrs).

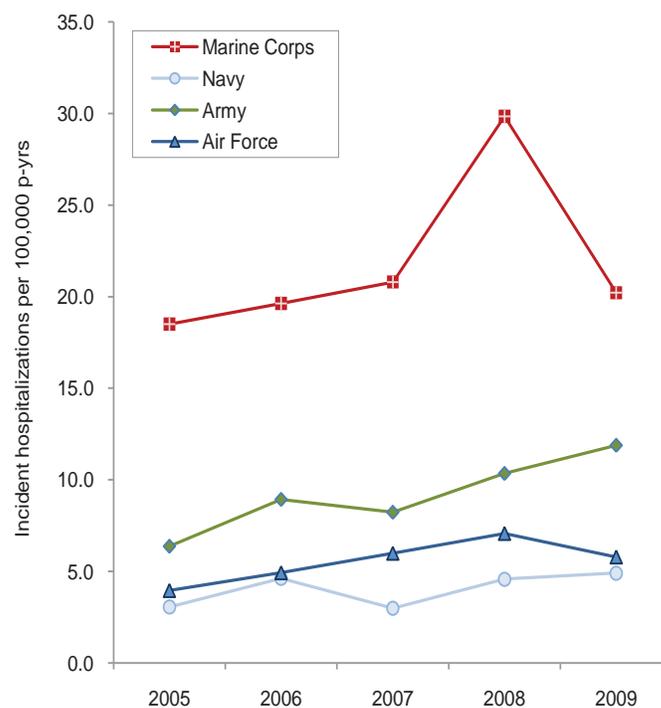
In 2009, relative to their respective counterparts, the highest incidence rates of exertional rhabdomyolysis were among service members who were in the Marine Corps (42.9 per 100,000 p-yrs) or Army (27.4 per 100,000 p-yrs), younger than 20 years old (49.5 per 100,000 p-yrs), Black non-Hispanic (31.0 per 100,000 p-yrs), enlisted (23.8 per 100,000 p-yrs), and in a combat-specific occupation (25.0 per 100,000 p-yrs) (Table 1).

There were more incident diagnoses of exertional rhabdomyolysis in 2009 than in any previous year of the period (Figure 1). From 2008 to 2009, the number of hospitalized cases declined slightly while the number of cases diagnosed in outpatient settings increased; 2009 was the first year since 2005 in which there were more outpatient than inpatient cases (Figure 1). During the five-year period, the rate of incident diagnoses of exertional rhabdomyolysis nearly doubled (2005: 11.8 per 100,000 p-yrs; 2009: 21.8 per 100,000 p-yrs) (Figure 1).

Approximately three-fourths (73%) of all service members hospitalized with exertional rhabdomyolysis in 2009 were in the Army (n=65) or Marine Corps (n=41) (Table 1). In 2009, the rate of hospitalized cases continued to generally increase among soldiers but decreased to 2005-2007-like rates among Marines (Figure 2).

During the period, the medical treatment facilities at ten installations accounted for at least 30 cases each and more than one-half of all cases; of these installations, five support recruit/basic combat training centers (Fort Benning, GA, and Fort Jackson, SC; Lackland AFB, TX; MCRD Parris

Figure 2. Hospitalization rates of presumed exertional rhabdomyolysis, by service and calendar year, active component, U.S. Armed Forces, 2005-2009



Island, SC and MCRD San Diego, CA) and three support large combat troop populations (Fort Bragg, NC; Camp Lejeune, NC; Camp Pendleton, CA) (Table 2). The most cases overall (accounting for nearly one-fourth of the total) were reported from Fort Bragg, NC (n=157) and Beaufort, SC (which supports the Marine Corps Recruit Depot Parris Island) (n=131) (Table 2).

Editorial comment:

This report documents a continuing increase in incident diagnoses of presumably exertional rhabdomyolysis among active component members of the U.S. military. Most cases are diagnosed at installations that support basic combat/recruit training centers or major Army and Marine Corps combat units. Individuals who suddenly increase overall levels of physical activity and/or increase stress on weight bearing muscles – particularly in high heat and humidity – are at increased risk of exertional rhabdomyolysis. Recruits who are not physically fit when they begin training have relatively high risks of training-related (including exertional heat) injuries, in general. Also, recruits from relatively cool and dry climates may not be acclimated to the high heat and humidity at training camps in mid-summer. Soldiers and Marines in combat units often conduct rigorous unit physical training, personal fitness training, and field training exercises regardless of weather conditions. It is not surprising, therefore, that recruit camps and installations

with large combat units account for most exertional rhabdomyolysis cases.

The findings of this report should be interpreted with consideration of several limitations. For example, because the diagnostic code specific for “rhabdomyolysis” was not added to the International Classification of Diseases, 9th revision, clinical modifications [ICD-9-CM] until 2004, a complete and consistent record of recent experience is not available. The recency of implementation of a specific diagnostic code makes it difficult to determine if the steady increase in diagnoses of “rhabdomyolysis” from 2005 through 2009 reflects increasing awareness and use of the indicator code in standardized reporting, an actual increase in case incidence, or both. Also, the diagnosis of “rhabdomyolysis” does not indicate the cause; hence, it is difficult to discern cases that are “exertional” and/or heat-related from those with other precipitating causes.

The measures that are effective at preventing exertional heat injuries in general are indicated for preventing exertional rhabdomyolysis. Work-rest cycles should be adapted not only to ambient weather conditions but also to the fitness levels of participants in strenuous activities. Of particular note, the strenuous physical activities of overweight and/or previously sedentary new recruits – especially in hot, humid weather – should increase

gradually and be closely monitored. Water intake should comply with current guidelines (see page 15) and be closely supervised. Strenuous activities during relatively cool mornings following days of high heat stress should be closely monitored; in the past, such situations have been associated with increased risk of exertional heat injuries (including rhabdomyolysis).² Commanders and supervisors at all levels should be aware of and alert for early signs of exertional heat injuries – including rhabdomyolysis – and should aggressively intervene when dangerous conditions, activities, or suspicious illnesses are detected.

Finally, medical care providers should consider exertional rhabdomyolysis in the differential diagnosis when service members – particularly recruits – present with muscular pain, swelling, and limited range of motion after strenuous physical activity, particularly in hot, humid weather. Brown colored urine from increased concentrations of myoglobin in urine is a distinctive clinical sign of rhabdomyolysis.

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1. Armed Forces Health Surveillance Center. Update: Exertional rhabdomyolysis among active component members. *MSMR*. 2009 Mar;16(3):10-13.
2. Kark JA, Burr PQ, Wenger CB, Gastaldo E, Gardner JW. Exertional heat illness in Marine Corps recruit training. *Aviat Space Environ Med*. 1996 Apr;67(4):354-60.

Update: Exertional Hyponatremia, Active Component, U.S. Armed Forces, 1999-2009

Hypnatremia is defined as abnormally low concentrations of sodium in the blood (serum sodium concentration <135 mEq/L); hyponatremia can have serious and sometimes fatal clinical effects.^{1,2} In otherwise healthy, physically active young adults (e.g., long distance runners, military recruits), hyponatremia is often associated with excessive water consumption during prolonged physical exertion (“exertional hyponatremia”), particularly during heat stress.¹⁻³

Acute hyponatremia creates an osmotic imbalance between fluids outside and inside of cells. The osmotic gradient causes water to flow from outside to inside the cells of vital organs, including the lungs (“pulmonary edema”) and brain (“cerebral edema”). Swelling of the brain increases intracranial pressure which can decrease cerebral blood flow and disrupt brain function (i.e., hypotonic encephalopathy, seizures, coma). Without rapid and definitive treatment to relieve increasing intracranial pressure, the brain stem can herniate through the base of the skull, compromising life sustaining functions controlled by the cardio-respiratory centers of the brain stem.¹⁻³

In the summer of 1997, multiple hospitalizations of soldiers for hyponatremia secondary to excessive water consumption during military training in hot weather were reported from Army training centers — one case was fatal and several others required intensive medical care.⁴ In April 1998, the U.S. Army Research Institute of Environmental Medicine (USARIEM), Natick, Massachusetts, published new guidelines for fluid replacement during military training in heat. The new guidelines were designed to protect service members not only from heat injury but also from hyponatremia due to excessive water consumption. The guidelines limited fluid intake regardless of heat category or work level to no more than 1½ quarts hourly and 12 quarts daily.⁵ There were fewer hospitalizations of soldiers for hyponatremia due to excessive water consumption during the year after compared to before implementation of the new guidelines.⁵

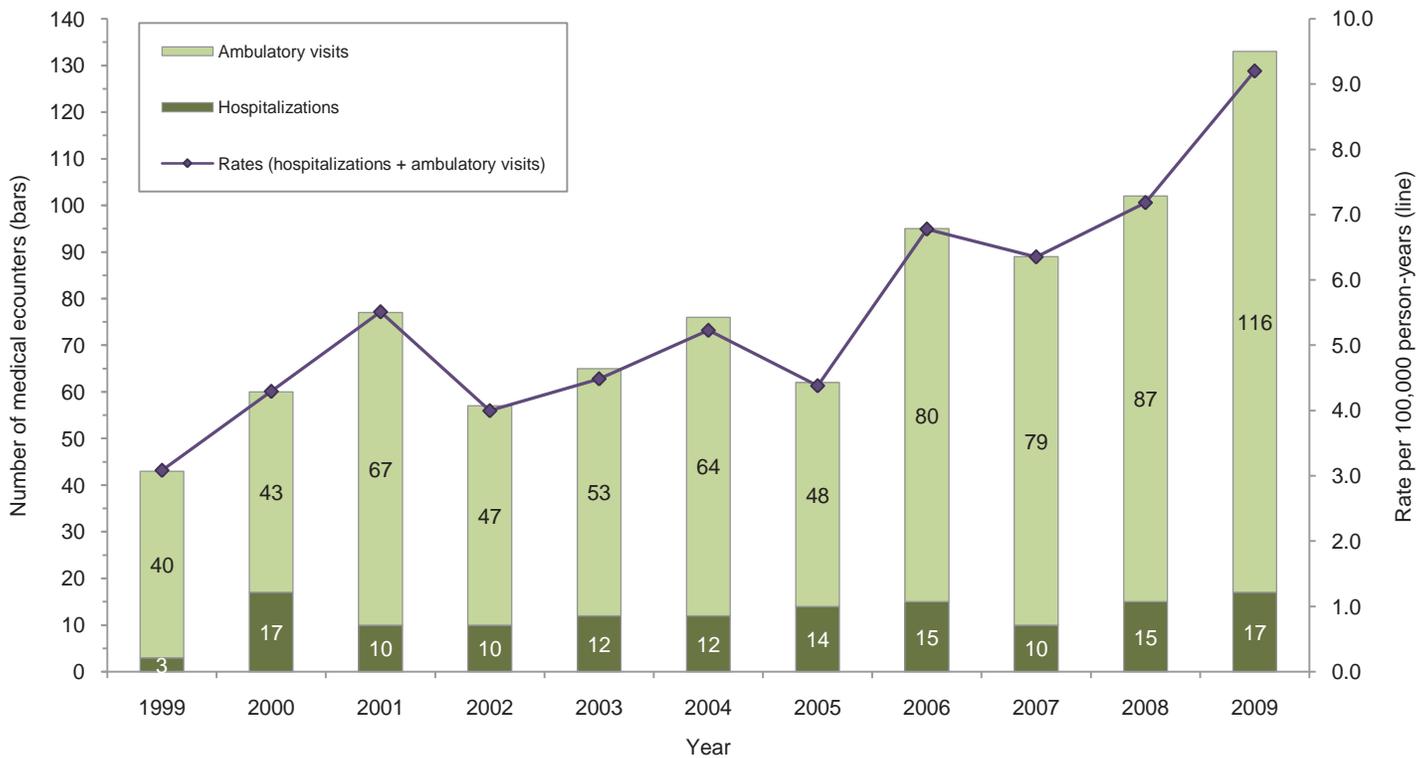
This report uses a surveillance case definition for exertional hyponatremia (slightly modified from that used previously) to estimate frequencies, rates, trends, geographic locations, and demographic and military characteristics of exertional

Table 1. Incident cases and rates^a of hyponatremia/overhydration, active component, U.S. Armed Forces, January 1999-December 2009

	Total 1999-2009		1999		2000		2001		2002		2003		2004		2005		2006		2007		2008		2009	
	No.	Rate ^a	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	859	5.5	43	3.1	60	4.3	77	5.5	57	4.0	65	4.5	76	5.2	62	4.4	95	6.8	89	6.4	102	7.2	133	9.2
<i>Service</i>																								
Army	310	5.7	17	3.6	25	5.3	37	7.8	19	4.0	22	4.5	29	5.9	25	5.1	37	7.5	29	5.7	26	4.9	44	8.0
Navy	122	3.1	4	1.1	7	1.9	5	1.4	12	3.2	13	3.5	13	3.5	7	2.0	17	4.9	12	3.6	15	4.6	17	5.2
Air Force	172	4.5	17	4.8	14	4.0	9	2.6	14	3.9	17	4.6	16	4.3	13	3.7	16	4.6	14	4.2	22	6.8	20	6.1
Marine Corps	243	12.3	5	2.9	11	6.4	26	15.2	12	7.0	13	7.4	17	9.6	17	9.5	23	12.9	32	17.5	37	19.0	50	24.7
Coast Guard	12	2.9	0	0.0	3	8.6	0	0.0	0	0.0	0	0.0	1	2.6	0	0.0	2	5.0	2	4.9	2	4.8	2	4.7
<i>Sex</i>																								
Male	700	5.2	31	2.6	48	4.0	58	4.9	45	3.7	51	4.1	62	5.0	51	4.2	84	7.0	68	5.7	89	7.3	113	9.1
Female	159	7.0	12	6.1	12	6.0	19	9.3	12	5.7	14	6.5	14	6.5	11	5.3	11	5.4	21	10.5	13	6.5	20	9.7
<i>Race/ethnicity</i>																								
White, non-Hispanic	596	6.1	26	3.0	39	4.4	51	5.8	37	4.1	44	4.8	57	6.2	40	4.5	69	7.8	65	7.3	75	8.3	93	10.1
Black, non-Hispanic	108	3.9	3	1.1	8	2.9	11	4.0	10	3.7	12	4.5	5	1.9	12	4.9	12	5.1	12	5.2	10	4.3	13	5.6
Other	155	5.3	14	5.4	13	5.4	15	6.2	10	3.9	9	3.4	14	5.1	10	3.6	14	5.0	12	4.3	17	6.0	27	9.2
<i>Age</i>																								
<20	137	11.3	6	5.1	11	8.8	20	15.8	9	7.3	15	13.0	14	12.5	8	8.1	8	8.4	11	11.3	14	14.0	21	21.2
20-24	277	5.4	11	2.6	17	3.9	18	4.0	18	3.8	16	3.2	26	5.2	20	4.2	31	6.5	42	9.0	34	7.2	44	9.1
25-29	150	4.5	10	3.5	14	5.0	16	5.9	10	3.6	6	2.1	9	3.0	8	2.6	20	6.5	9	2.9	20	6.1	28	8.2
30-34	85	3.7	4	1.8	5	2.3	9	4.3	6	2.9	7	3.4	10	4.8	6	2.9	12	6.0	8	4.0	7	3.5	11	5.3
35-39	90	4.4	8	3.8	4	1.9	6	3.0	7	3.6	9	4.8	8	4.4	9	5.2	10	5.8	7	4.1	9	5.2	13	7.6
40+	120	7.4	4	2.9	9	6.6	8	5.6	7	4.7	12	7.9	9	5.8	11	7.2	14	9.3	12	8.2	18	12.3	16	10.9
<i>Military occupation</i>																								
Combat	196	6.2	10	3.5	21	7.5	20	7.1	14	5.0	10	3.5	18	6.1	15	5.0	21	7.2	19	6.5	18	6.0	30	10.3
Health care	76	5.9	7	6.0	3	2.6	7	6.0	11	9.4	9	7.6	4	3.4	7	6.0	5	4.3	3	2.6	11	9.6	9	7.7
Other	587	5.3	26	2.6	36	3.6	50	5.0	32	3.1	46	4.4	54	5.2	40	4.0	69	6.9	67	6.8	73	7.3	94	9.1

^aRate per 100,000 person-years

Figure 1. Incident diagnoses of hyponatremia (presumably caused by excessive water consumption during physical exertion/heat stress), active component, U.S. service members, 1999-2009



hyponatremia cases among U.S. military members from 1999 through 2009.

Table 2. Hyponatremia/overhydration by location of diagnosis, active component, U.S. Armed Forces, 1999-2009

Medical facility location	1999-2009	
	No.	% of total
MCRD Parris Island/Beaufort, SC	113	13.2
Fort Benning, GA	63	7.3
MCB Camp Lejeune/Cherry Point, NC	33	3.8
San Diego, CA	27	3.1
Fort Bragg, NC	26	3.0
NMC Portsmouth, VA	24	2.8
MCB Camp Pendleton, CA	20	2.3
MCB Quantico, VA	19	2.2
Lackland AFB, TX	18	2.1
NNMC Bethesda, MD	16	1.9
Fort Shafter, HI	15	1.7
Fort Sam Houston, TX	15	1.7
Fort Leonard Wood, MO	15	1.7
Walter Reed AMC et al/Washington, DC	14	1.6
Fort Knox, KY	12	1.4
Fort Lewis, WA	12	1.4
Fort Jackson, SC	12	1.4
All other locations	405	47.1
Total	859	100.0

Methods:

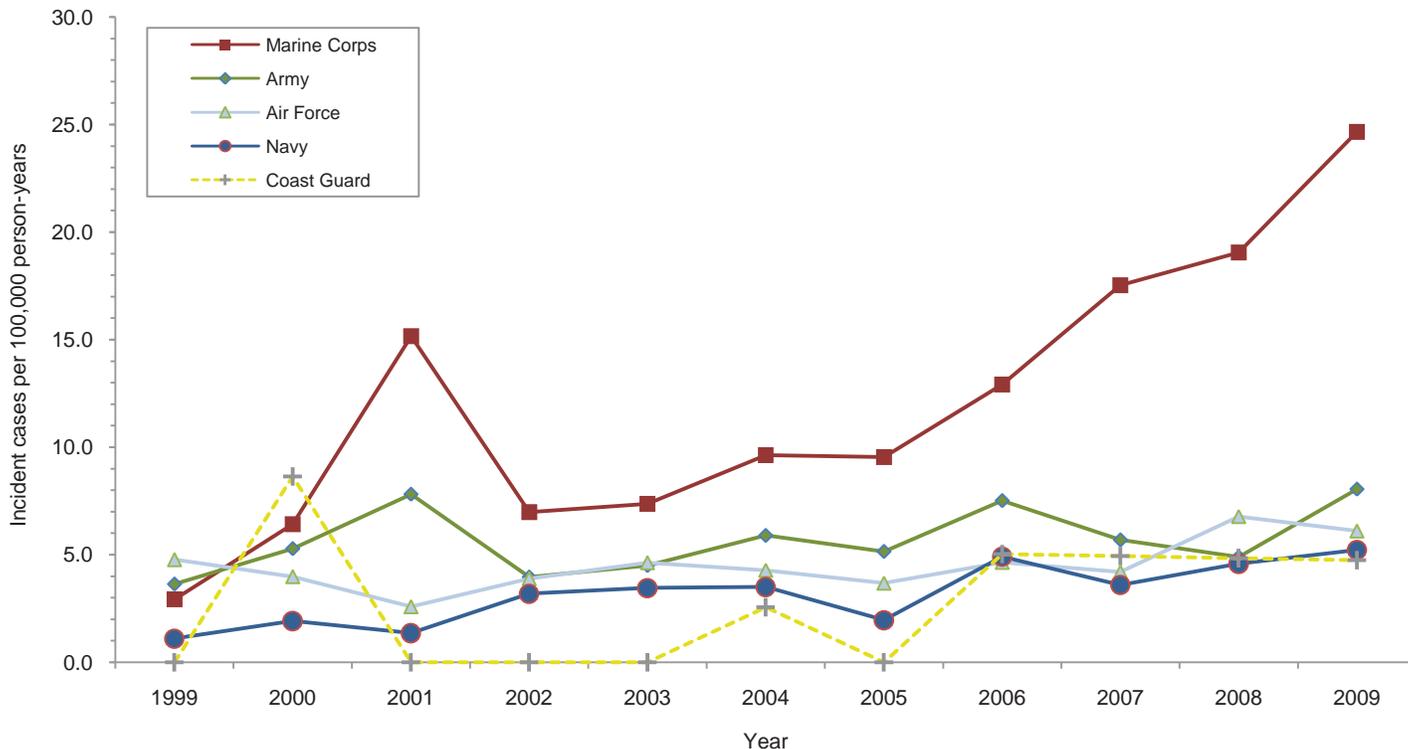
The surveillance period was 1 January 1999 to 31 December 2009. The surveillance population included all individuals who served in an active component of the U.S. Armed Forces any time during the surveillance period.

For surveillance purposes, a possible case of exertional hyponatremia was defined as a hospitalization or ambulatory visit with a primary (first-listed) diagnosis of “hyposmolality and/or hyponatremia” (ICD-9-CM: 276.1) without other illness or injury-specific diagnoses (ICD-9-CM: 001-999) in any position; or both “hyposmolality and/or hyponatremia” (ICD-9-CM: 276.1) and at least one of the following within the first three diagnostic positions (dx1-dx3): “fluid overload” (ICD-9-CM: 276.6), “alteration of consciousness” (ICD-9-CM: 780.0), “convulsions” (ICD-9-CM: 780.39), “altered mental status” (ICD-9-CM: 780.97), “effects of heat/light” (ICD-9-CM: 992.0-992.9) or “rhabdomyolysis” (ICD-9-CM: 728.88).

Medical encounters were not considered case-defining events if they included complicating diagnoses such as alcohol/illicit drug abuse; psychosis, depression, other major mental disorders; endocrine (e.g., pituitary, adrenal) disorders; kidney diseases; intestinal infectious diseases, cancers; major traumatic injuries; and complications of medical care.

Each individual could be included as a case only once per calendar year.

Figure 2. Incident rates of hyponatremia (presumably caused by excessive water consumption during physical exertion/heat stress), by Service, active component, U.S. service members, 1999-2009



Results:

From 1999 through 2009, there were 859 incident diagnoses of exertional hyponatremia among active component members. During the 11-year period, the average number of incident cases per year was 78 and the range was 43 (1999) to 133 (2009) (Table 1).

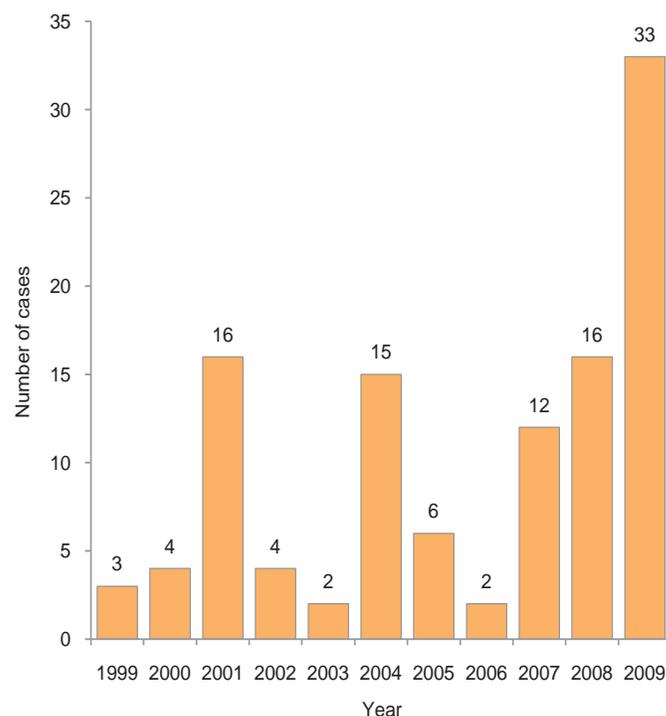
In 2009, there were 133 incident diagnoses (incidence rate: 9.2 per 100,000 person-years [p-yrs]) of exertional hyponatremia among active component members. The number and rate in 2009 were higher than in any other year of the period (Table 1, Figure 1).

In 2009, the incidence rate was highest in the Marine Corps (24.7 per 100,000 p-yrs), lowest in the Navy and Coast Guard (5.2 and 4.7 per 100,000 p-yrs, respectively), and intermediate in the Army and Air Force (8.0 and 6.1 per 100,000 p-yrs, respectively) (Table 1, Figure 2). In the Marine Corps and Army, the numbers and rates of hyponatremia cases were higher in 2009 than any other year of the period. During the past 5 years, rates of exertional hyponatremia increased more than 2.5-fold in the Marine Corps but were relatively stable in the Army (Figure 2).

In 2009, 85% of exertional hyponatremia cases affected males, but the rate was slightly higher among females (female-to-male incidence rate ratio, 2009: 1.07) (Table 1). In every year from 2002 through 2009, the incidence rate has been higher among white non-Hispanic than black non-Hispanic or other racial/ethnic subgroup members (Table 1).

In every year of the period (including 2009), the highest rates affected the youngest (2009, incidence rate, <20 years old: 21.2 per 100,000 p-yrs) and the oldest (2009, incidence rate, >39 years old: 10.9 per 100,000 p-yrs) service members.

Figure 3. Hyponatremia cases reported by Marine Corps Recruit Depot Parris Island/Beaufort, South Carolina, active component, U.S. Armed Forces, 1999-2009



Also, in 2009, service members in combat occupations had slightly higher rates of exertional hyponatremia than those in non-combat-specific occupations (Table 1).

During the 11-year period, exertional hyponatremia cases were diagnosed at more than 150 medical facilities; however, five locations reported more than 25 cases each and accounted for nearly one-third (31%) of all cases. The locations with the most cases overall were MCRD Parris Island/Beaufort, SC (n=113), Fort Benning, GA (n=63), MCB Camp Lejeune/Cherry Point, NC (n=33), San Diego, CA (n=27) and Fort Bragg, NC (n=26) (Table 2). Of note, MCRD Parris Island/Beaufort, SC reported 33 cases in 2009 — 25% of all cases in 2009 and more than twice as many than at Parris Island or any other location in any other year (Figure 3).

Editorial comment:

This report documents a sharp increase in the incidence of exertional hyponatremia among active component U.S. military members in 2009. The increased incidence in the U.S. military overall reflects sharply increasing rates in the Marine Corps since 2005. Of note, two-thirds of all cases in the Marine Corps in 2009 were reported from the Marine Corps Recruit Depot at Parris Island or its supporting Navy hospital at Beaufort, SC. The results suggest that a serious and potentially life threatening training-related condition — that is preventable — is increasing in incidence among Marine recruits at Parris Island. If so, policies and practices related to water consumption — particularly limits per hour and day — during physically rigorous training in hot, humid weather should be reviewed and enforced at Parris Island and all other recruit training sites.

The results of this report should be interpreted with consideration of several limitations. For example, there is not a diagnostic code specific for “exertional hyponatremia.” Thus, for surveillance purposes, cases are ascertained by identifying medical encounter records that include diagnoses of “hyposmolality and/or hyponatremia” without concurrent diagnoses indicative of medical conditions that increase risk of hyponatremia (e.g., metabolic, renal, psychiatric, iatrogenic). The results should be considered estimates of the actual incidence of symptomatic exertional hyponatremia from excessive water consumption among U.S. military members. The accuracy of estimated numbers and trends of cases depends on the completeness and accuracy of diagnoses that are reported on standardized records of relevant medical encounters. In turn, an increase in reporting of diagnoses indicative of exertional hyponatremia may not indicate an actual increase in the incidence of such cases.

In the past, concerns regarding hyponatremia from excessive water consumption were focused at training — particularly basic combat training — installations. Not surprisingly, in this analysis, the highest rates were among

the youngest — hence, the most junior — service members; and the most cases were diagnosed at medical facilities that support large training centers and combat units: Parris Island, SC; Fort Benning, GA; Fort Bragg, NC; San Diego, CA; Camp Lejeune/Cherry Point, NC. In many circumstances (e.g., recruit training, Ranger School), military trainees rigorously adhere to their training schedules — regardless of the weather conditions. In hot, humid weather, commanders, supervisors, instructors, and medical support staffs must be aware of and enforce guidelines for work-rest cycles and water consumption.

With regard to hyponatremia, service members and their supervisors must be knowledgeable of the dangers of excessive water consumption and the prescribed limits for water intake (Figure 4) during prolonged physical activity in hot, humid weather — during military activities, personal

Figure 4. Fluid replacement guidelines for warm weather training (applies to average acclimated soldier wearing BDU, hot weather)

Heat Category	WBGT Index, °F	Easy Work		Moderate Work		Hard Work	
		Work / Rest	Water Intake, Qt/hr	Work / Rest	Water Intake, Qt/hr	Work / Rest	Water Intake, Qt/hr
1	78-81.9	NL	1/2	NL	3/4	40/20 min	3/4
2 (Green)	82-84.9	NL	1/2	50/10 min	3/4	30/30 min	1
3 (Yellow)	85-87.9	NL	3/4	40/20 min	3/4	30/30 min	1
4 (Red)	88-89.9	NL	3/4	30/30 min	3/4	20/40 min	1
5 (Black)	> 90	50/10 min	1	20/40 min	1	10/50 min	1

- The work:rest times and fluid replacement volumes will sustain performance and hydration for at least 4 hours of work in the specified heat category. Individual water needs will vary ± ¼ qt/hour.
- NL= no limit to work time per hour.
- Rest means minimal physical activity (sitting or standing), accomplished in shade if possible.
- **CAUTION: Hourly fluid intake should not exceed 1½ quarts.**
- **Daily fluid intake should not exceed 12 quarts.**
- Wearing body armor add 5°F to WBGT Index
- Wearing MOPP overgarment add 10°F to WBGT Index.

Easy Work	Moderate Work	Hard Work
<ul style="list-style-type: none"> • Walking Hard Surface at 2.5 mph, ≤ 30 lb Load • Weapon Maintenance • Manual of Arms • Marksmanship Training • Drill and Ceremony 	<ul style="list-style-type: none"> • Walking Hard Surface at 3.5 mph < 40 lb Load • Walking Loose Sand at 2.5 mph no Load • Calisthenics • Patrolling • Individual Movement Techniques. i.e. low crawl, high crawl • Defensive Position Construction • Field Assaults 	<ul style="list-style-type: none"> • Walking Hard Surface at 3.5 mph, ≥ 40 lb Load • Walking Loose Sand at 2.5 mph with Load

fitness training, and recreational activities. Service members – particularly trainees – and their supervisors must be vigilant for early signs of heat-related illnesses and immediately and appropriately intervene in such cases.

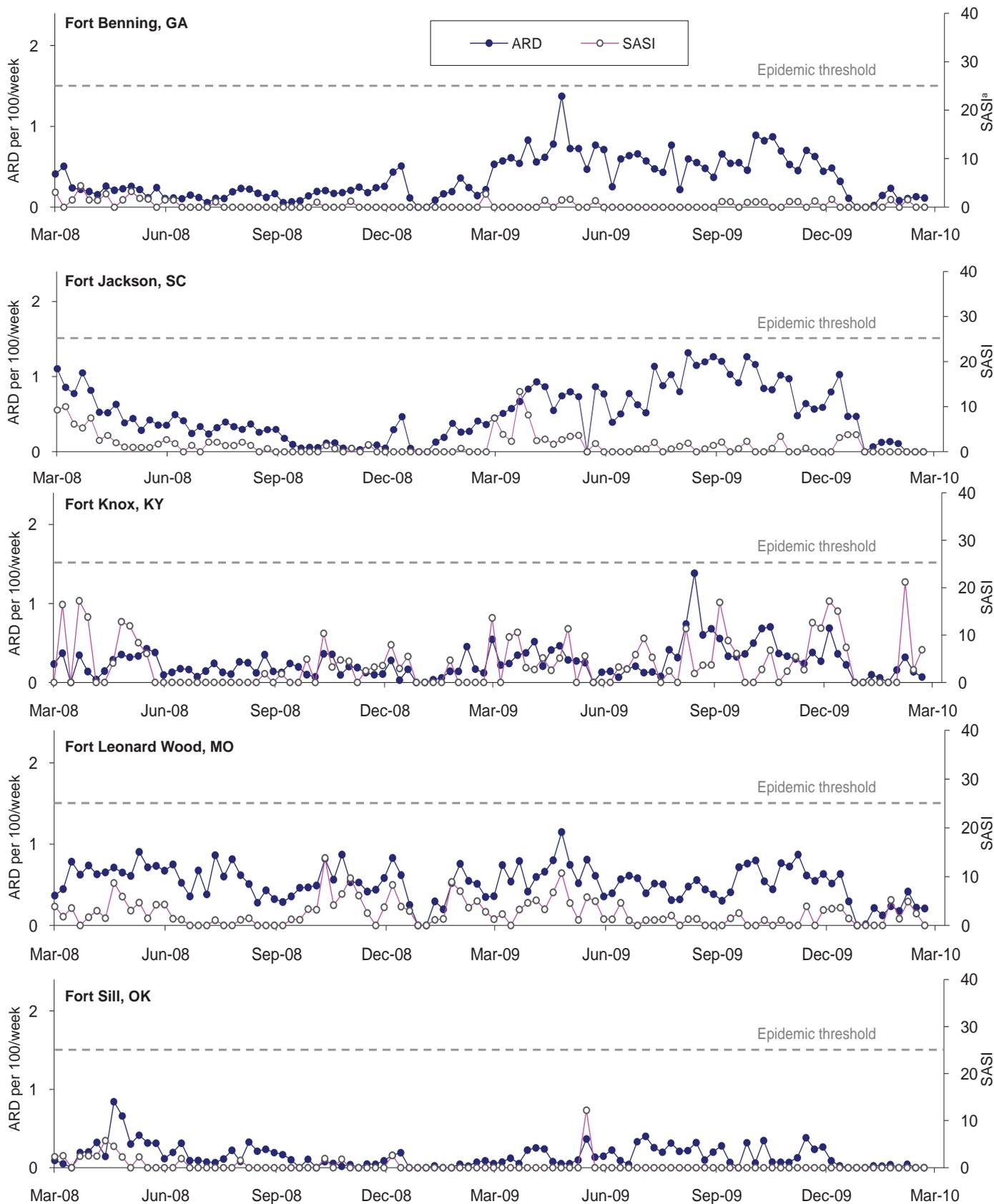
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Acute respiratory disease (ARD) and streptococcal pharyngitis rates (SASI^a), basic combat training centers, U.S. Army, by week, March 2008-March 2010



^aStreptococcal-ARD surveillance index (SASI) = ARD rate x % positive culture for group A streptococcus
 ARD rate = cases per 100 trainees per week
 ARD rate \geq 1.5 or SASI \geq 25.0 for 2 consecutive weeks are surveillance indicators of epidemics

Update: Deployment Health Assessments, U.S. Armed Forces, February 2010

Since January 2003, peaks and troughs in the numbers of pre- and post-deployment health assessment forms transmitted to the Armed Forces Health Surveillance Center generally corresponded to times of departure and return of large numbers of deployers. Since April 2006, numbers of post-deployment health reassessments (PDHRA) transmitted per month have ranged from 17,000 to 43,000 (Table 1, Figure 1).

During the past 12 months, the proportions of returned deployers who rated their health as “fair” or “poor” were 8-11% on post-deployment health assessment questionnaires and 11-14% on PDHRA questionnaires (Figure 2).

In general, on post-deployment assessments and reassessments, deployers in the Army and in reserve components were more likely than their respective counterparts to report health and exposure-related concerns (Table 2, Figure 2). Both active and reserve component members were more likely to report exposure concerns three to six months after compared to the time of return from deployment (Figure 3).

At the time of return from deployment, soldiers serving in the active component were the most likely of all deployers to receive mental health referrals; however, three to six months after returning, active component soldiers were less likely than Army and Marine Corps Reservists to receive mental health referrals (Table 2).

Finally, during the past three years, reserve component members have been more likely than active to report “exposure concerns” on post-deployment assessments and reassessments (Figure 3).

Table 1. Deployment-related health assessment forms, by month, U.S. Armed Forces, March 2009-February 2010

	Pre-deployment assessment DD2795		Post-deployment assessment DD2796		Post-deployment reassessment DD2900	
	No.	%	No.	%	No.	%
Total	457,143	100	377,223	100	303,798	100
2009						
March	40,673	8.9	26,562	7.0	32,213	10.6
April	43,513	9.5	20,024	5.3	31,363	10.3
May	36,276	7.9	28,321	7.5	25,039	8.2
June	44,431	9.7	28,766	7.6	26,950	8.9
July	39,917	8.7	28,714	7.6	22,665	7.5
August	39,013	8.5	46,694	12.4	21,689	7.1
September	30,506	6.7	39,408	10.4	26,175	8.6
October	36,380	8.0	32,267	8.6	23,972	7.9
November	32,140	7.0	32,731	8.7	20,463	6.7
December	30,505	6.7	36,277	9.6	28,778	9.5
2010						
January	54,231	11.9	33,588	8.9	25,157	8.3
February	29,558	6.5	23,871	6.3	19,334	6.4

Figure 2. Proportion of deployment health assessment forms with self-assessed health status as “fair” or “poor”, U.S. Armed Forces, March 2009-February 2010

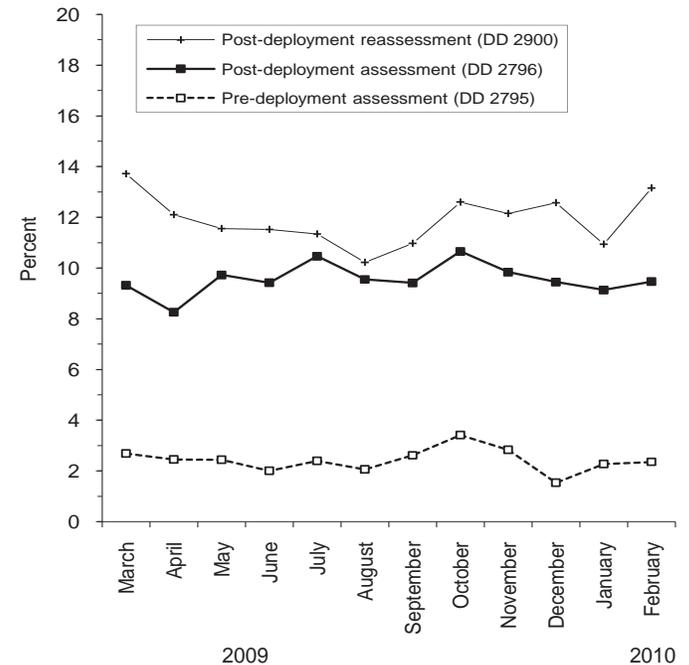


Figure 1. Total deployment health assessment and reassessment forms, by month, U.S. Armed Forces, January 2003-February 2010

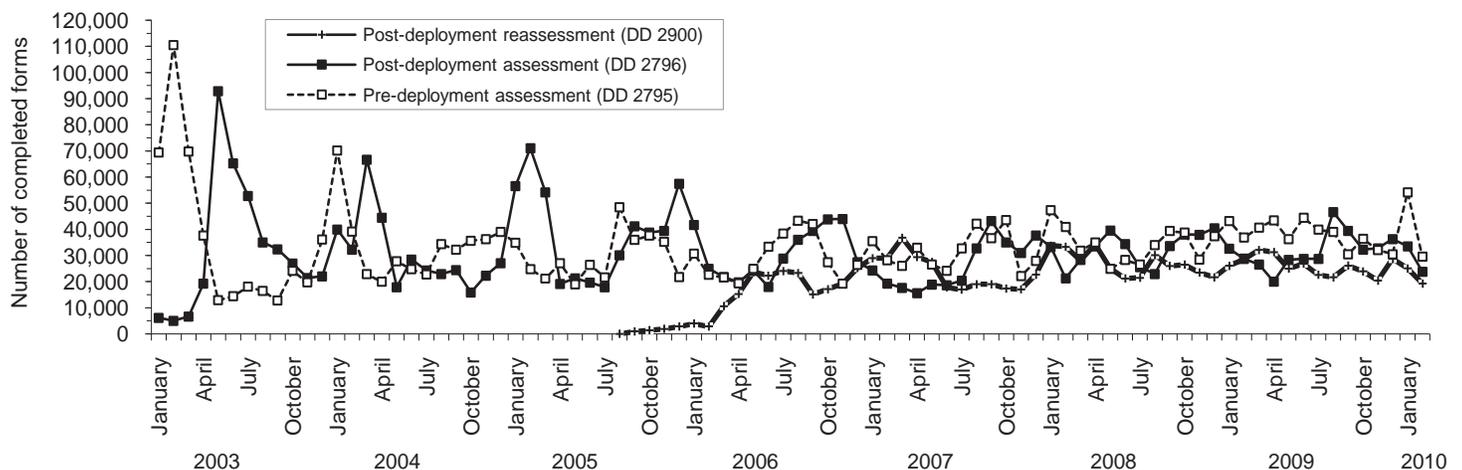


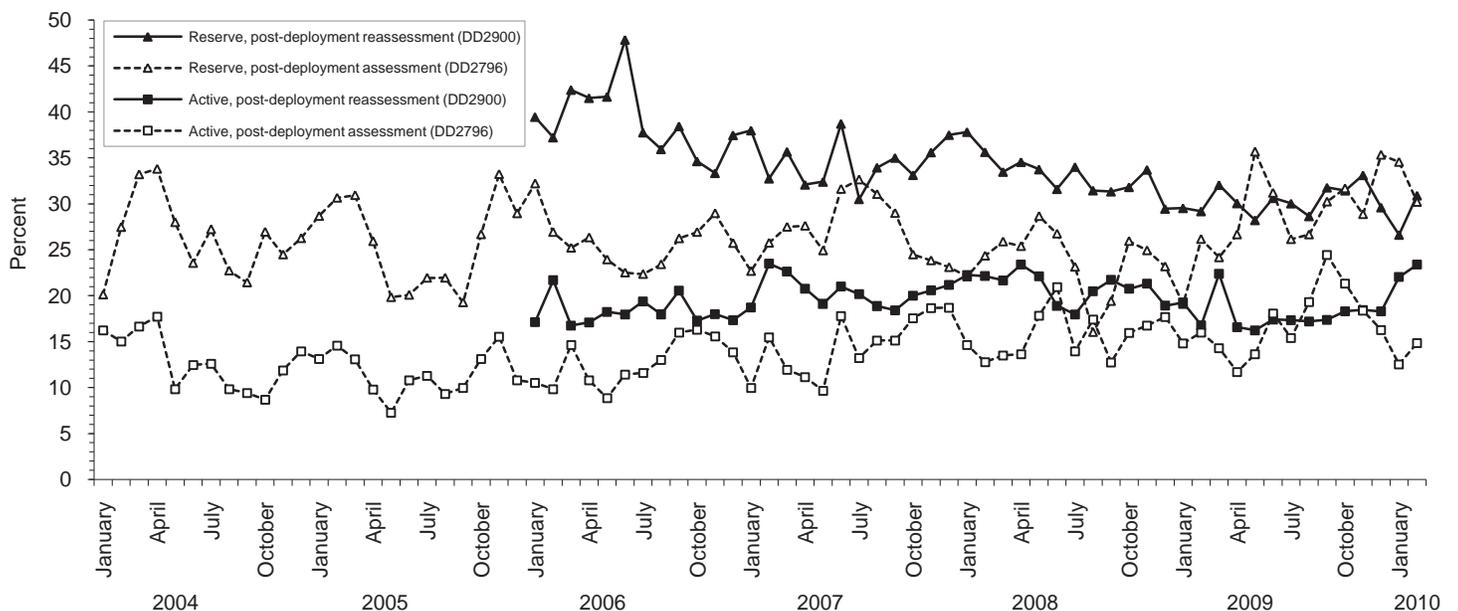
Table 2. Percentage of service members who endorsed selected questions/received referrals on health assessment forms, U.S. Armed Forces, March 2009 - February 2010

	Army			Navy			Air Force			Marine Corps			All service members		
	Pre-deploy DD2795	Post-deploy DD2796	Reassess DD2900	Pre-deploy DD2795	Post-deploy DD2796	Reassess DD2900	Pre-deploy DD2795	Post-deploy DD2796	Reassess DD2900	Pre-deploy DD2795	Post-deploy DD2796	Reassess DD2900	Pre-deploy DD2795	Post-deploy DD2796	Reassess DD2900
Active component	n=153,961	n=127,194	n=118,372	n=19,829	n=10,201	n=13,792	n=59,391	n=52,312	n=51,453	n=32,468	n=21,519	n=35,074	n=265,649	n=211,226	n=218,691
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
General health "fair" or "poor"	3.9	10.4	14.8	1.3	4.8	5.8	0.4	3.4	4.1	1.6	6.9	9.5	2.6	8.1	10.9
Health concerns, not wound or injury	21.4	26.1	24.8	3.5	12.5	13.5	1.3	5.7	10.5	3.0	12.2	17.4	13.3	19.0	19.5
Health worse now than before deployed	na	22.7	26.2	na	12.3	12.7	na	8.3	8.5	na	14.6	18.2	na	17.8	19.9
Exposure concerns	na	18.2	19.6	na	19.5	18.7	na	11.6	14.8	na	14.1	21.1	na	16.2	18.7
PTSD symptoms (2 or more)	na	9.1	12.3	na	4.6	6.2	na	2.3	2.4	na	5.3	8.2	na	6.9	8.9
Depression symptoms (any)	na	30.9	32.3	na	20.9	22.6	na	13.0	13.9	na	25.2	29.7	na	25.4	26.9
Referral indicated by provider (any)	5.1	33.7	23.0	5.0	20.4	16.1	1.7	10.9	6.9	4.1	18.7	26.1	4.2	25.9	19.3
Mental health referral indicated*	1.1	6.8	8.6	0.7	2.7	5.8	0.5	1.3	1.8	0.3	1.6	4.7	0.8	4.7	6.2
Medical visit following referral†	95.8	99.5	98.8	90.4	90.1	91.1	81.9	97.0	98.4	47.6	80.8	91.3	87.4	97.7	96.5
Reserve component	n=82,993	n=69,538	n=54,064	n=5,731	n=2,793	n=4,897	n=16,245	n=15,034	n=16,393	n=3,881	n=4,057	n=6,318	n=108,850	n=91,422	n=81,672
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
General health "fair" or "poor"	1.5	11.9	17.2	0.6	9.6	8.2	0.3	4.9	4.8	0.8	7.4	11.0	1.2	10.5	13.7
Health concerns, not wound or injury	16.9	33.8	43.5	1.4	35.5	30.4	0.6	8.7	14.8	3.2	22.7	35.7	13.1	29.2	36.3
Health worse now than before deployed	na	26.7	32.7	na	20.9	20.1	na	12.8	11.0	na	19.2	26.3	na	23.9	27.1
Exposure concerns	na	31.5	32.0	na	36.7	33.5	na	21.2	22.7	na	12.9	31.2	na	29.2	30.2
PTSD symptoms (2 or more)	na	8.6	19.1	na	6.4	11.2	na	2.1	3.0	na	3.0	14.3	na	7.2	15.0
Depression symptoms (any)	na	31.4	35.1	na	25.0	24.5	na	13.7	13.5	na	28.6	27.2	na	28.2	29.5
Referral indicated by provider (any)	3.5	36.7	34.3	3.2	28.0	18.5	0.4	13.6	6.0	3.8	27.2	27.4	3.1	32.2	27.1
Mental health referral indicated*	0.4	4.9	12.6	0.2	3.2	5.1	0.0	0.8	0.9	0.2	1.9	8.8	0.3	4.0	9.5
Medical visit following referral†	94.4	98.5	37.5	93.7	95.7	41.6	51.3	64.8	42.2	36.5	63.6	28.4	89.8	95.0	37.2

*Includes behavioral health, combat stress and substance abuse referrals.

†Record of inpatient or outpatient visit within 6 months after referral.

Figure 3. Proportion of service members who endorsed exposure concerns on post-deployment health assessments, U.S. Armed Forces, January 2004-February 2010



Sentinel reportable events among service members and beneficiaries at U.S. Army medical facilities, cumulative numbers^a for calendar years through 28 February 2009 and 28 February 2010



Army

Reporting locations	Number of reports all events ^b		Food-borne						Vaccine preventable					
			Campylobacter		Salmonella		Shigella		Hepatitis A		Hepatitis B		Varicella ^c	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
NORTHERN														
Aberdeen Proving Ground, MD	3	0	.	.	.	.	.	.	.	.	.	.	.	.
Fort Belvoir, VA	47	0	2	.	.	.	.	.	.	.	.	.	.	.
Fort Bragg, NC	276	226	.	.	3	1	.	.	.	.	2	.	.	.
Fort Dix, NJ	0	0	.	.	.	.	.	.	.	.	.	.	.	.
Fort Drum, NY	5	0	.	.	.	.	.	.	.	.	.	.	.	.
Fort Eustis, VA	35	39	.	.	.	.	.	.	.	.	.	.	.	.
Fort George G Meade, MD	11	0	.	.	.	.	.	.	.	.	.	.	.	.
Fort Knox, TN	28	56	.	.	.	.	.	1	.	.	.	.	.	.
Fort Lee, VA	131	36	.	.	.	.	.	.	.	.	.	.	.	.
Fort Monmouth, NJ	10	4	.	.	.	.	.	.	.	.	.	.	.	.
Walter Reed AMC, DC	27	0	.	.	.	.	.	.	.	.	.	.	.	.
West Point Military Reservation, NY	7	5	.	.	.	.	.	.	.	.	.	.	.	.
SOUTHERN														
Fort Benning, GA	26	0	.	.	.	.	.	.	.	.	.	.	.	.
Fort Campbell, KY	0	137	.	.	.	.	.	.	.	.	.	.	.	.
Fort Gordon, GA	115	130	.	.	.	1	.	1	.	.	.	.	.	.
Fort Hood, TX	259	306	1	2	2	.	1	12	.	.	.	1	.	.
Fort Jackson, SC	0	46	.	.	.	.	.	.	.	.	.	.	.	.
Fort Polk, LA	58	66	.	.	.	.	.	.	.	.	.	.	.	.
Fort Rucker, AL	13	21	.	.	.	.	.	.	.	.	.	.	.	.
Fort Sam Houston, TX	94	87	.	.	.	.	.	.	.	.	.	.	.	.
Fort Sill, OK	49	57	.	.	.	.	1	.	.	.	.	.	.	.
Fort Stewart, GA	163	87	.	1	.	2	.	.	.	.	.	1	.	.
WESTERN														
Fort Bliss, TX	84	65	.	.	.	1	1	.	1	.	4	.	.	.
Fort Carson, CO	102	124	1	3	.	1	.	.	.	.	.	.	.	.
Fort Huachuca, AZ	9	10	.	.	.	1	.	.	.	.	.	.	.	.
Fort Leavenworth, KS	12	5	.	.	.	.	.	.	.	.	.	.	.	.
Fort Leonard Wood, MO	65	75	.	.	.	1	.	.	1	.	.	.	.	.
Fort Lewis, WA	196	138	.	1	.	1	.	.	.	.	.	.	.	.
Fort Riley, KS	69	18	.	.	1	.	.	.	.	.	.	.	.	.
Fort Wainwright, AK	41	40	.	.	.	.	.	.	.	.	.	.	.	.
NTC and Fort Irwin, CA	14	18	.	.	.	.	1	.	.	.	.	.	.	.
PACIFIC														
Hawaii	107	165	3	2	.	.	.	3	.	1	.	.	.	.
Japan	3	0	.	.	.	.	.	.	.	.	.	.	.	.
Korea	92	31	.	.	.	.	.	.	.	.	.	.	.	.
EUROPEAN														
Heidelberg	23	21	2	3	1	.	.	.	.	.	.	.	.	.
Landstuhl	135	114	.	1	.	.	.	.	.	.	1	1	.	.
Bavaria	56	64	1	1	.	.	.	.	.	.	.	.	.	.
OTHER LOCATIONS														
Other	0	0	.	.	.	.	.	.	.	.	.	.	.	.
Total	2,365	2,191	10	14	7	9	4	17	2	1	6	3	1	0

^aEvents reported by Mar 8, 2009 and 2010

^bSixty-seven medical events/conditions specified by Tri-Service Reportable Events Guidelines and Case Definitions, June 2009.

^cService member cases only.

Note: Completeness and timeliness of reporting vary by facility.

Sentinel reportable events among service members and beneficiaries at U.S. Army medical facilities, cumulative numbers^a for calendar years through 28 February 2009 and 28 February 2010



Reporting location	Arthropod-borne				Sexually transmitted						Environmental				Travel associated			
	Lyme disease		Malaria		Chlamydia		Gonorrhea		Syphilis		Cold ^c		Heat ^c		Q Fever		Tuberculosis	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
NORTHERN																		
Aberdeen Proving Ground, MD	.	.	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.
Fort Belvoir, VA	.	.	.	.	39	.	6	.	.	.	.	.	.	.	.	.	.	.
Fort Bragg, NC	.	.	.	.	232	181	39	42	.	1	.	1	.	.	.	.	.	.
Fort Dix, NJ	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fort Drum, NY	.	.	.	.	3	.	2	.	.	.	.	.	.	.	.	.	.	.
Fort Eustis, VA	.	.	.	.	30	34	5	4	.	1	.	.	.	.	.	.	.	.
Fort George G Meade, MD	.	.	.	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.
Fort Knox, TN	.	.	.	.	24	52	4	3	.	.	.	.	.	.	.	.	.	.
Fort Lee, VA	1	.	.	.	114	29	16	7	.	.	.	.	.	.	.	.	.	.
Fort Monmouth, NJ	1	2	.	.	9	2	.	.	.	.	.	.	.	.	.	.	.	.
Walter Reed AMC, DC	1	.	.	.	18	.	3	.	4	.	.	.	.	.	.	.	1	.
West Point Military Reservation, NY	2	1	.	.	5	3	.	1	.	.	.	.	.	.	.	.	.	.
SOUTHERN																		
Fort Benning, GA	.	.	2	.	21	.	3	.	.	.	.	.	.	.	.	.	.	.
Fort Campbell, KY	.	.	.	.	.	129	.	8	.	.	.	.	.	.	.	.	.	.
Fort Gordon, GA	.	.	.	.	96	106	19	22	.	.	.	.	.	.	.	.	.	.
Fort Hood, TX	.	.	.	1	201	242	53	48	1	.	.	.	.	.	.	.	.	.
Fort Jackson, SC	.	.	.	.	.	40	.	6	.	.	.	.	.	.	.	.	.	.
Fort Polk, LA	.	.	.	.	56	57	2	9	.	.	.	.	.	.	.	.	.	.
Fort Rucker, AL	.	.	.	.	11	21	2	.	.	.	.	.	.	.	.	.	.	.
Fort Sam Houston, TX	.	.	.	.	77	78	16	9	1	.	.	.	.	.	.	.	.	.
Fort Sill, OK	.	.	.	.	37	51	11	5	.	1	.	.	.	.	.	.	.	.
Fort Stewart, GA	.	.	.	.	136	76	25	7	2	.	.	.	.	.	.	.	.	.
WESTERN																		
Fort Bliss, TX	.	.	.	.	67	52	10	11	1	1	.	.	.	.	.	.	.	.
Fort Carson, CO	.	.	.	.	94	115	7	5	.	.	.	.	.	.	.	.	.	.
Fort Huachuca, AZ	.	.	.	.	9	9	.	.	.	.	.	.	.	.	.	.	.	.
Fort Leavenworth, KS	.	.	.	.	8	5	3	.	1	.	.	.	.	.	.	.	.	.
Fort Leonard Wood, MO	.	.	.	.	54	65	9	8	.	1	1	.	.	.	.	.	.	.
Fort Lewis, WA	.	.	.	.	174	127	22	9	.	.	.	.	.	.	.	.	.	.
Fort Riley, KS	.	.	.	.	54	17	13	1	.	.	1	.	.	.	.	.	.	.
Fort Wainwright, AK	.	.	.	.	36	31	5	1	.	.	.	8	.	.	.	.	.	.
NTC and Fort Irwin, CA	.	.	.	.	12	17	1	1	.	.	.	.	.	.	.	.	.	.
PACIFIC																		
Hawaii	.	.	.	.	98	143	5	16	.	.	.	.	.	.	1	.	.	.
Japan	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.
Korea	.	.	.	.	88	23	2	1	1	.	1	7	.	.	.	.	.	.
EUROPEAN																		
Heidelberg	2	.	.	.	17	15	1	3	.	.	.	.	.	.	.	.	.	.
Landstuhl	4	.	.	2	111	93	16	17	1	.	.	.	.	.	.	.	2	.
Bavaria	2	1	.	.	48	53	4	9	.	.	1	.	.	.	.	.	.	.
OTHER LOCATIONS																		
Other	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	13	4	2	3	1,995	1,866	305	253	12	5	4	16	0	0	1	0	3	0

Sentinel reportable events among service members and beneficiaries at U.S. Navy medical facilities, cumulative numbers^a for calendar years through 28 February 2009 and 28 February 2010



Navy

Reporting locations	Number of reports all events ^b		Food-borne						Vaccine preventable					
			Campylobacter		Salmonella		Shigella		Hepatitis A		Hepatitis B		Varicella ^c	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
NATIONAL CAPITOL AREA														
NNMC Bethesda, MD	29	20	.	3	1	.	.	1	.	.	.	2	.	.
NHC Annapolis, MD	2	5	.	.	.	.	.	.	.	.	.	.	.	.
NHC Patuxent River, MD	1	0	.	.	.	.	.	.	.	.	.	.	.	.
NHC Quantico, VA	26	6	.	.	1	.	2	.	.	.	1	.	.	
NAVY MEDICINE EAST														
NH Beaufort, SC	188	63	.	.	.	.	.	.	.	.	.	.	.	.
NH Camp Lejeune, NC	73	74	.	.	2	.	.	.	.	.	.	.	.	.
NH Charleston, SC	3	0	.	.	.	.	.	.	.	.	.	.	.	.
NH Cherry Point, NC	3	0	.	.	.	.	.	.	.	.	.	.	.	.
NH Corpus Christi, TX	0	1	.	.	.	.	.	.	.	.	.	.	.	.
NHC Great Lakes, IL	6	137	.	.	.	.	.	.	.	.	.	.	.	.
NH Guantanamo Bay, Cuba	0	0	.	.	.	.	.	.	.	.	.	.	.	.
NH Jacksonville, FL	47	23	.	.	1	2	.	.	.	.	.	.	.	.
NH Naples, Italy	1	0	.	.	.	.	.	.	.	.	.	.	.	.
NHC New England, RI	0	0	.	.	.	.	.	.	.	.	.	.	.	.
NH Pensacola, FL	41	26	.	.	.	2	1	.	.	.	.	.	.	.
NMC Portsmouth, VA	49	49	.	.	.	.	.	.	.	.	.	.	.	.
NH Rota, Spain	0	0	.	.	.	.	.	.	.	.	.	.	.	.
NH Sigonella, Italy	1	0	.	.	.	.	.	.	.	.	.	.	1	.
NAVY MEDICINE WEST														
NH Bremerton, WA	2	1	.	.	.	.	.	.	.	.	.	1	.	.
NH Camp Pendleton, CA	6	0	.	.	.	.	.	.	.	.	.	.	.	.
NH Guam-Agana, Guam	14	0	.	.	.	.	.	.	.	.	.	.	.	.
NHC Hawaii, HI	0	211	.	.	.	.	.	.	.	.	.	.	.	.
NH Lemoore, CA	8	1	.	.	.	.	.	.	.	.	.	.	.	.
NH Oak Harbor, WA	34	13	3	.	2	.	.	.	.	.	1	1	.	.
NH Okinawa, Japan	38	0	.	.	.	.	.	.	.	.	.	.	.	.
NMC San Diego, CA	152	124	.	1	3	.	.	1	.	.	11	5	1	.
NH Twentynine Palms, CA	1	0	.	.	.	.	.	.	.	.	.	.	.	.
NH Yokosuka, Japan	15	12	.	.	.	.	.	.	.	.	1	1	.	.
NAVAL SHIPS														
COMNAVAIRLANT/CINCLANTFLEET	14	3	.	.	.	.	.	.	.	.	.	.	.	.
COMNAVSURFPAC/CINCPACFLEET	10	9	.	.	.	.	.	.	.	.	.	.	.	.
OTHER LOCATIONS														
Other	814	527	4	3	5	1	.	1	.	.	1	5	1	.
Total	1,578	1,305	7	7	15	5	3	3	0	0	14	16	3	0

^aEvents reported by Mar 8, 2010^bSixty-seven medical events/conditions specified by Tri-Service Reportable Events Guidelines and Case Definitions, June 2009.^cService member cases only.

Note: Completeness and timeliness of reporting vary by facility.

Sentinel reportable events among service members and beneficiaries at U.S. Navy medical facilities, cumulative numbers^a for calendar years through 28 February 2009 and 28 February 2010



Navy

Reporting location	Arthropod-borne				Sexually transmitted						Environmental				Travel associated			
	Lyme disease		Malaria		Chlamydia		Gonorrhea		Syphilis		Cold ^c		Heat ^c		Q Fever		Tuberculosis	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
NATIONAL CAPITOL AREA																		
NNMC Bethesda, MD	.	1	.	.	23	7	4	1	1	5	.	.	.	.	.	.	.	.
NHC Annapolis, MD	2	5	.	.	.	.	.	.	.	.	.	.	.	.
NHC Patuxent River, MD	1	.	.	.	.	.	.	.	.	.	.	.	.	.
NHC Quantico, VA	21	5	2	.	.	.	.	.	.	.	.	.	.	.
NAVY MEDICINE EAST																		
NH Beaufort, SC	178	57	9	6	1	.	.	.	.	.	.	.	.	.
NH Camp Lejeune, NC	.	1	1	.	57	61	12	9	.	.	.	2	1	1	.	.	.	.
NH Charleston, SC	2	.	1	.	.	.	.	.	.	.	.	.	.	.
NH Cherry Point, NC	3	.	.	.	.	.	.	.	.	.	.	.	.	.
NH Corpus Christi, TX	1	.	.	.	.	.	.	.	.	.	.	.	.
NHC Great Lakes, IL	6	120	.	17	.	.	.	.	.	.	.	.	.	.
NH Guantanamo Bay, Cuba
NH Jacksonville, FL	44	20	2	1	.	.	.	.	.	.	.	.	.	.
NH Naples, Italy	1	.	.	.	.	.	.	.	.	.	.	.	.	.
NHC New England, RI
NH Pensacola, FL	38	19	.	3	.	2	.	.	.	.	2	.	.	.
NMC Portsmouth, VA	.	.	.	1	37	40	11	7	.	1	.	.	.	.	.	.	1	.
NH Rota, Spain
NH Sigonella, Italy
NAVY MEDICINE WEST																		
NH Bremerton, WA	2	.	.	.	.	.	.	.	.	.	.	.	.	.
NH Camp Pendleton, CA	6	.	.	.	.	.	.	.	.	.	.	.	.	.
NH Guam-Agana, Guam	12	.	2	.	.	.	.	.	.	.	.	.	.	.
NHC Hawaii, HI	190	.	21	.	.	.	.	.	.	.	.	.	.
NH Lemoore, CA	8	.	.	1	.	.	.	.	.	.	.	.	.	.
NH Oak Harbor, WA	1	.	.	.	27	11	.	.	.	1	.	.	.	.	.	.	.	.
NH Okinawa, Japan	38	.	.	.	.	.	.	.	.	.	.	.	.	.
NMC San Diego, CA	.	.	3	1	108	99	20	15	4	2	.	.	2	.	.	.	.	.
NH Twentynine Palms, CA	1	.	.	.	.	.	.	.	.	.
NH Yokosuka, Japan	1	.	.	.	13	11	.	.	.	.	.	.	.	.	.	.	.	.
NAVAL SHIPS																		
COMNAVAIRLANT/CINCLANTFLEET	14	3	.	.	.	.	.	.	.	.	.	.	.	.
COMNAVSURFPAC/CINCPACFLEET	10	9	.	.	.	.	.	.	.	.	.	.	.	.
OTHER LOCATIONS																		
Other	5	6	3	3	703	451	78	53	4	2	3	1	6	1	.	.	1	.
Total	7	8	7	5	1,354	1,109	141	134	11	13	3	3	9	2	2	0	2	0

Sentinel reportable events among service members and beneficiaries at U.S. Air Force medical facilities, cumulative numbers^a for calendar years through 28 February 2009 and 28 February 2010



Air Force

Reporting locations	Number of reports all events ^b		Food-borne						Vaccine preventable						
			Campylobacter		Salmonella		Shigella		Hepatitis A		Hepatitis B		Varicella ^c		
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	
Air Combat Cmd	196	183	1	2	3	1	1	.	.	.	1	1	4	2	1
Air Education & Training Cmd	267	230	.	.	4	1	.	.	1	2	3	4	.	.	.
Air Force Dist. of Washington	42	15	.	.	1	.	.	.	.	.	1	1	.	.	.
Air Force Materiel Cmd	86	78	.	.	.	.	.	.	.	.	.	.	.	.	.
Air Force Special Ops Cmd	33	31	1	.	.	.	.	1	.	.	.	1	.	.	.
Air Force Space Cmd	64	46	1	.	1	2	.	.	.	1	.	.	.	.	.
Air Mobility Cmd	145	84	1	.	2	.	.	.	.	1	1	.	1	.	.
Pacific Air Forces	86	96	.	.	.	.	.	.	.	.	2	1	1	.	.
U.S. Air Forces in Europe	101	78	1	.	.	1	.	.	.	.	1	.	.	.	.
U.S. Air Force Academy	6	9	.	.	1	.	.	.	.	.	.	2	.	1	.
Other	5	14	.	.	.	2	.	.	.	.	.	.	.	.	.
Total	1,031	864	5	2	12	7	1	1	1	5	9	13	4	2	

^aEvents reported by Mar 8, 2010

^bSixty-seven medical events/conditions specified by Tri-Service Reportable Events Guidelines and Case Definitions, June 2009.

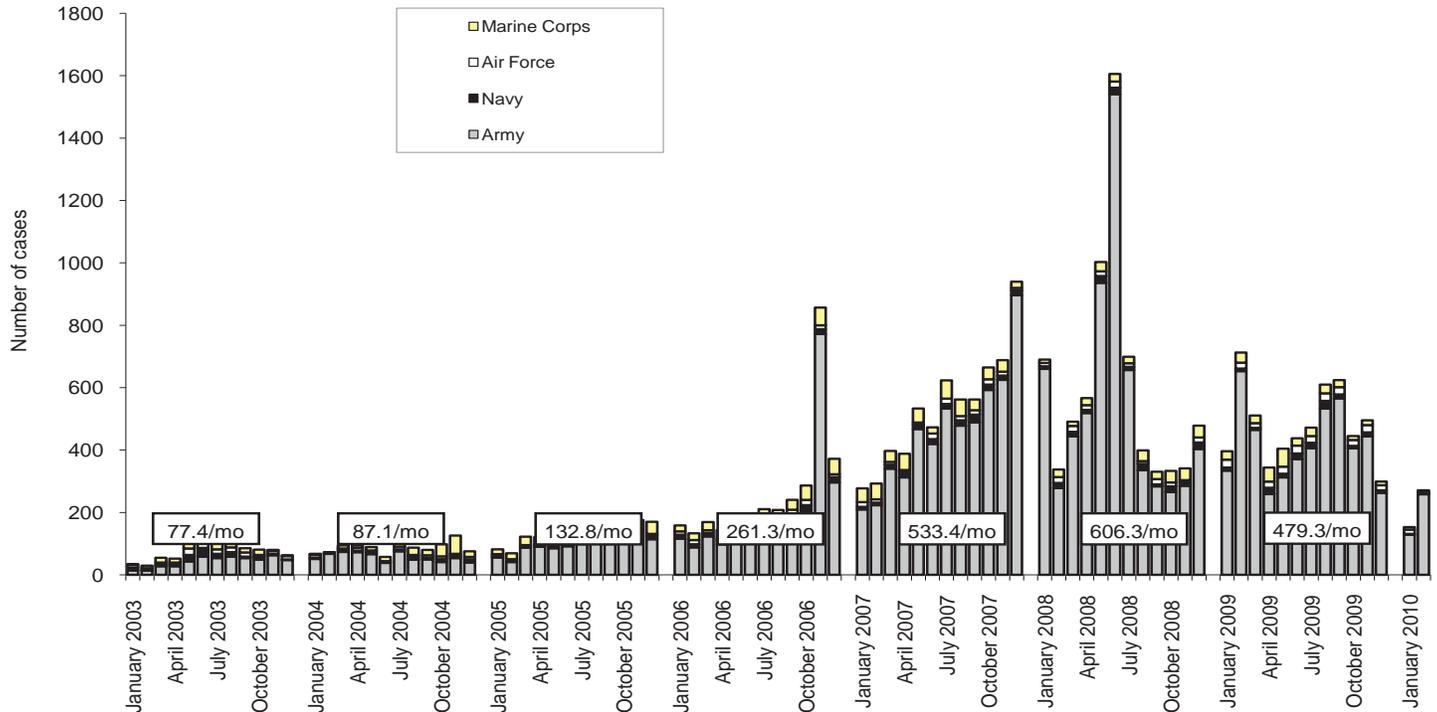
^cService member cases only.

Note: Completeness and timeliness of reporting vary by facility.

Reporting location	Arthropod-borne				Sexually transmitted						Environmental				Travel associated			
	Lyme disease		Malaria		Chlamydia		Gonorrhea		Syphilis		Cold ^c		Heat ^c		Q Fever		Tuberculosis	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Air Combat Cmd	.	.	.	.	165	147	19	22	1	2	3	3	.	.	.	.	.	.
Air Education & Training Cmd	.	.	.	.	228	198	29	24	2	1	.	.	.	.	.	.	.	.
Air Force Dist. of Washington	2	1	.	.	35	10	3	3	.	.	.	.	.	.	.	.	.	.
Air Force Materiel Cmd	1	.	.	.	75	68	8	10	2	.	.	.	.	.	.	.	.	.
Air Force Special Ops Cmd	.	.	.	.	30	25	1	2	1	1	.	1	.	.	.	.	.	.
Air Force Space Cmd	.	.	.	1	61	39	1	3	.	.	.	.	.	.	.	.	.	.
Air Mobility Cmd	4	.	.	.	107	78	16	5	.	.	13	.	.	.	.	.	.	.
Pacific Air Forces	.	.	.	.	64	87	10	7	.	1	9	.	.	.	.	.	.	.
U.S. Air Forces in Europe	1	.	.	.	86	70	9	7	1	.	1	.	.	.	.	.	1	.
U.S. Air Force Academy	.	.	.	.	5	6	.	.	.	.	.	.	.	.	.	.	.	.
Other	.	.	.	.	3	10	1	1	.	.	.	1	.	.	1	.	.	.
Total	8	1	0	1	859	738	97	84	7	5	26	5	0	0	1	0	1	0

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - February 2010 (data as of 26 March 2010)

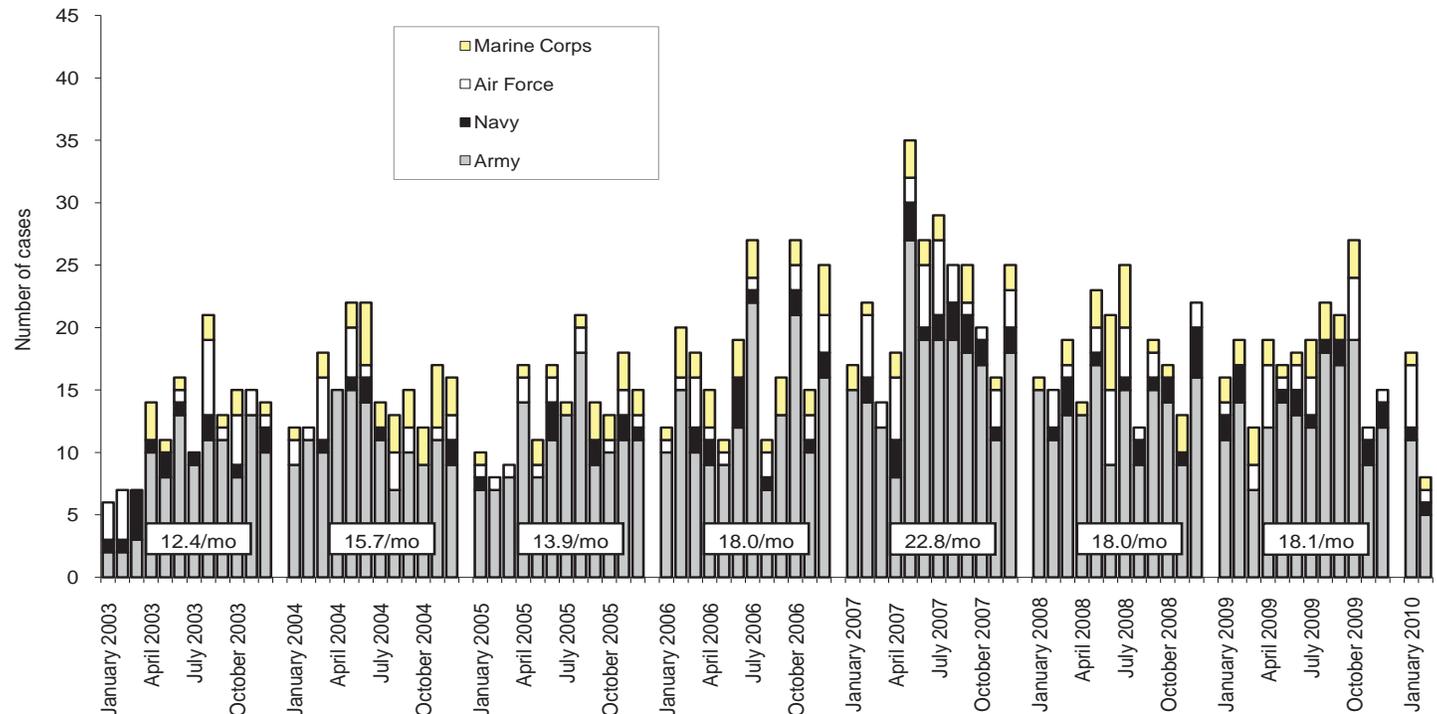
Traumatic brain injury (ICD-9: 310.2, 800-801, 803-804, 850-854, 907.0, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F, V15.59_1-9, V15.59_A-F)^a



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.

^aIndicator diagnosis (one per individual) during a hospitalization or ambulatory visit while deployed to/within 30 days of returning from OEF/OIF. (Includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 1,981 deployers who had at least one TBI-related medical encounter any time prior to OEF/OIF).

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

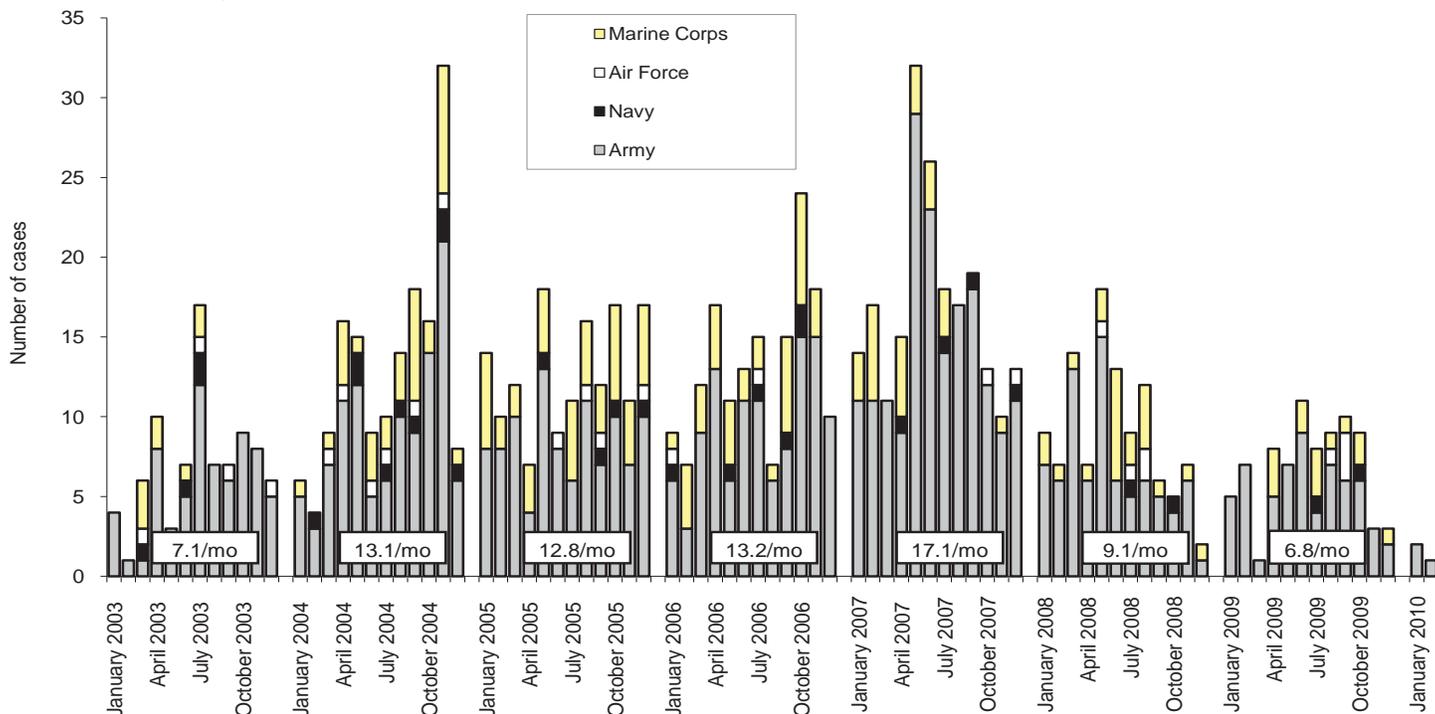


Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379-83.

^bOne 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.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - February 2010 (data as of 26 March 2010)

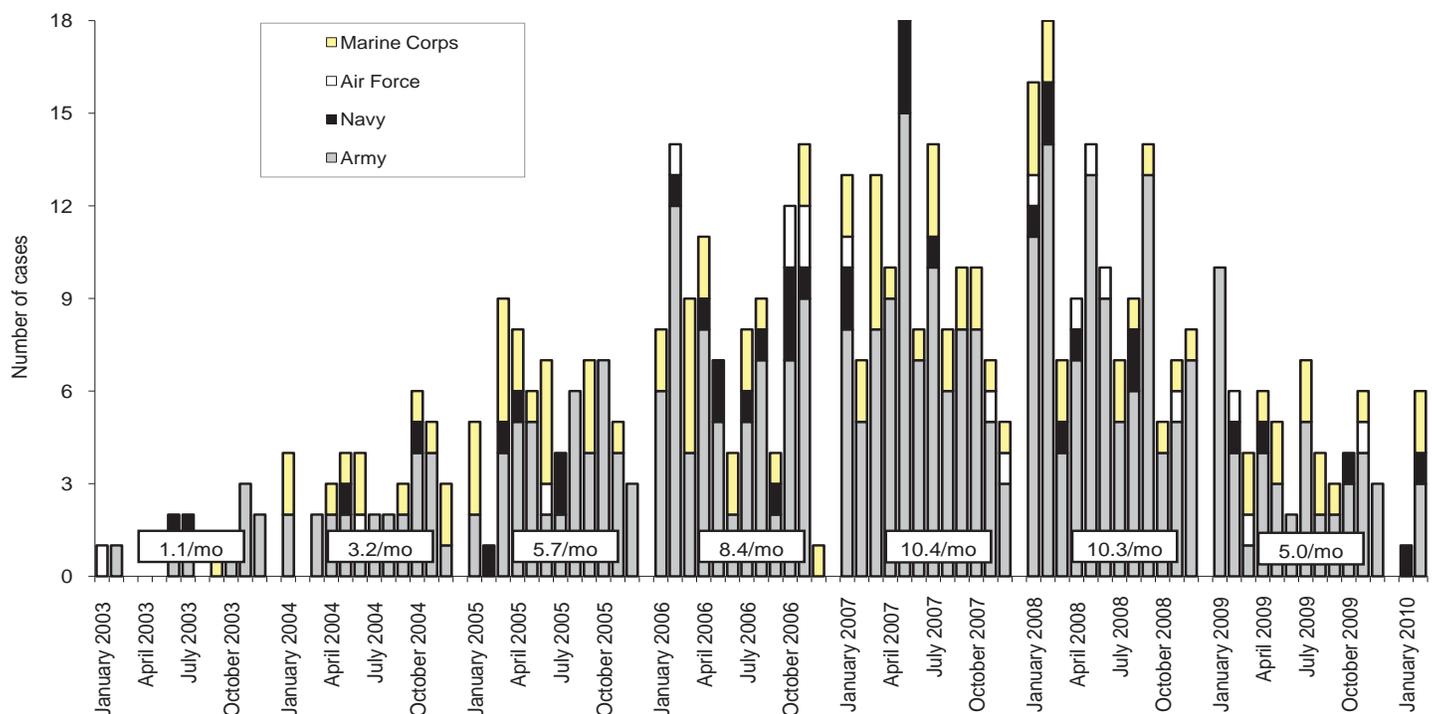
Amputations (ICD-9: 887, 896, 897, V49.6 except V49.61-V49.62, V49.7 except V49.71-V49.72, PR 84.0-PR 84.1, except PR 84.01-PR 84.02 and PR 84.11)^a



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.

^aIndicator diagnosis (one per individual) during a hospitalization while deployed to/within 365 days of returning from OEF/OIF.

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

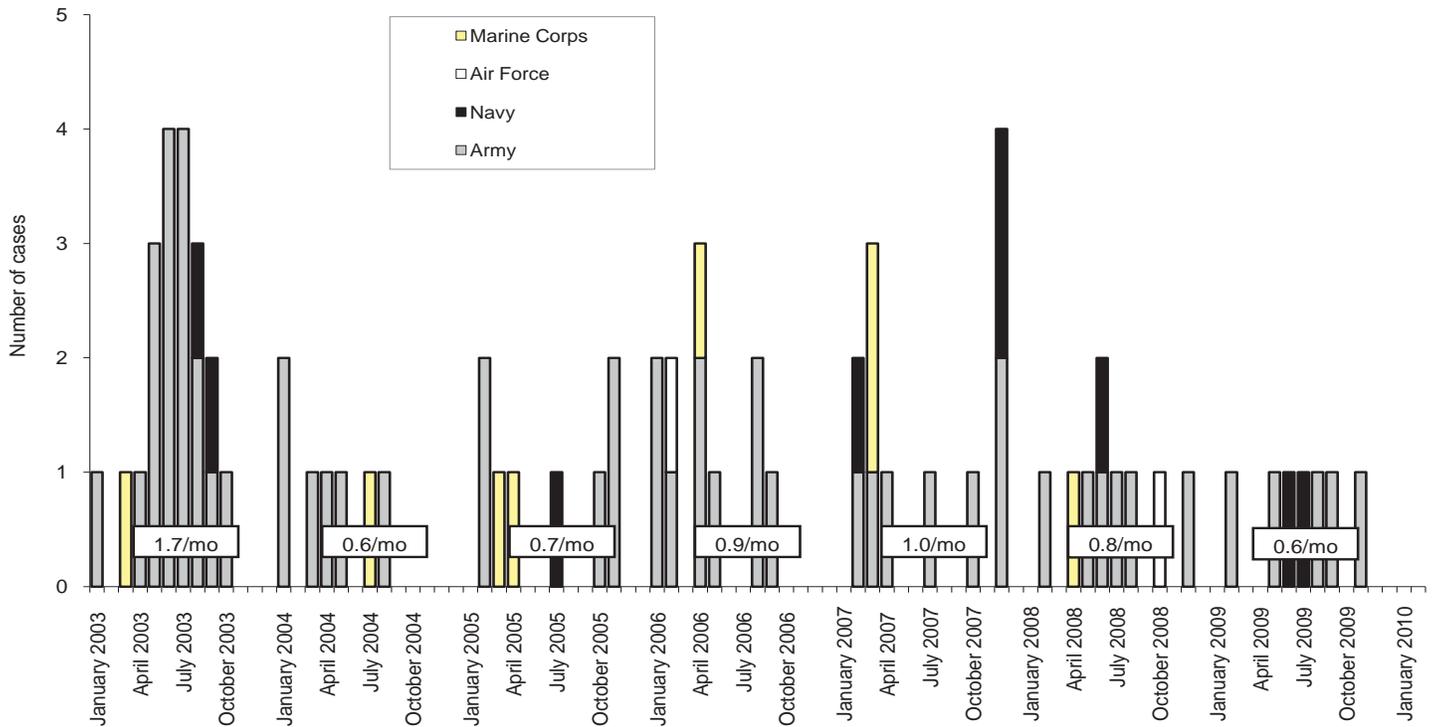


Reference: Army Medical Surveillance Activity. Heterotopic ossification, active components, U.S. Armed Forces, 2002-2007. *MSMR*. Aug 2007; 14(5):7-9.

^bOne 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.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - February 2010 (data as of 26 March 2010)

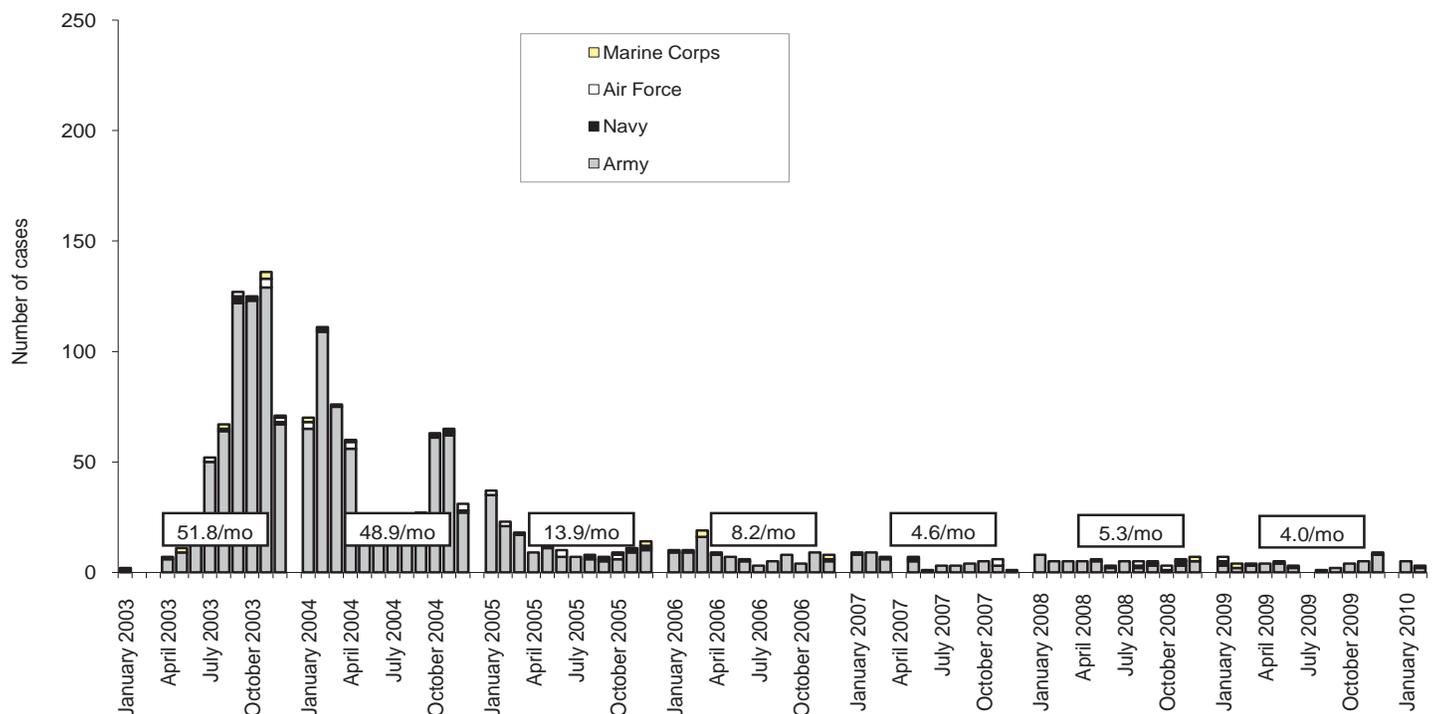
Severe acute pneumonia (ICD-9: 518.81, 518.82, 480-487, 786.09)^a



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.

^aIndicator diagnosis (one per individual) during a hospitalization while deployed to/within 30 days of returning from OEF/OIF.

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.

^bIndicator diagnosis (one per individual) during a hospitalization, ambulatory visit, and/or from a notifiable medical event during/after service in OEF/OIF.

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