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SUMMARY TABLES AND FIGURES

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Urinary Tract Infections During Deployment, Active Component, U.S. Armed Forces, 2008–2013

Austere living conditions during deployment may put service members at greater risk for urinary tract infections (UTIs). During the 6-year surveillance period, 6.5 percent of females (n=7,214) and 0.3 percent of males (n=2,412) who were ever deployed had at least one UTI diagnosed while deployed to Southwest Asia and the Middle East. The incidence rate of first-time UTIs while deployed was 86.7 per 1,000 person-years (p-yrs) in females and 3.3 per 1,000 p-yrs in males. Of service members with at least one UTI during deployment, 13.6 percent of females and 3.6 percent of males had an additional (recurrent) UTI during the same or a follow-up deployment period. Among both females and males, rates of UTIs were highest among those who were the youngest, in armor/motor transport occupations, and "other" (e.g., separated, divorced) marital status. Throughout the surveillance period, annual overall rates of UTIs were 26–55 percent higher among non-deployed than deployed females and 130–250 percent higher among non-deployed than deployed males. Among those diagnosed with UTIs during deployment, 53.6 percent of females and 13.9 percent of males had at least one UTI diagnosed during a medical encounter in a fixed medical treatment facility any time prior to deployment.

Urinary tract infections (UTIs) are common among service members, particularly service women. During deployment to overseas locations for combat or peacekeeping operations, service members may be at greater risk for developing UTIs.[1,2] Living conditions often experienced during deployment (e.g., extreme temperatures, lack of privacy, and unavailability of showers and latrines) make adequate personal hygiene difficult for many service members. In addition, the unavailability of privacy and inconveniences associated with removing bulky clothing and gear in austere environments have led service members, particularly females, to hold large volumes of urine for long periods of time or intentionally dehydrate to decrease the frequency of urination.[1-3] Inadequate personal hygiene, dehydration, infrequent and incomplete emptying of the bladder, and use of unsanitary urination devices (e.g., bottles, bags, funnels) can increase the risk for UTIs.[1,2,4,5]

This report estimates rates and trends of, and describes demographic and military characteristics of service members diagnosed with, UTIs during deployment to a theater of operations in Southwest Asia and the Middle East. In addition, annual crude rates of UTI diagnoses were compared among deployed and non-deployed service members during the same 6-year surveillance period.

METHODS

The surveillance period was 1 January 2008 through 31 December 2013. The surveillance population included active component service members of the Army, Navy, Air Force, Marine Corps, and Coast Guard who served at least one day in a theater of operations in Southwest Asia or the Middle East during the surveillance period. A case of urinary tract infection was defined as an individual with a case-defining ICD-9-CM code (as described in a previous *MSMR*[6]) recorded in any diagnostic position of a hospitalization or ambulatory care encounter.

For "first-time" incidence rate calculations, each individual could be counted as a case only once during the surveillance period. To calculate the rate of UTIs overall (first-time and recurrent infections), each affected individual was considered a new UTI case if at least 30 days had passed since any previous UTI-specific encounter. A recurrent case was defined as an individual who met the case definition more than once during the surveillance period. Cases of acute pyelonephritis (ICD-9: 590.1x) were analyzed separately using the same case definitions and incidence rules.

Diagnoses associated with deployment were derived from records of medical encounters of service members deployed to Southwest Asia/Middle East that were documented in the Theater Medical Data Store (TMDS). Denominators for rates of UTIs during deployment were calculated by determining the length of each individual's deployment and summing the person-time of all deployers. If the deployment end date was missing, the end date was imputed based on the average deployment time for each of the Services and by operation. For service members in the Navy, deployments on ships ("at sea") were excluded from this analysis.

UTI rates among members of the active components of the U.S. Armed Services overall were published in the February 2014 *MSMR*.[6] These rates were used for comparisons of the experiences of non-deployed and deployed service members during the period of interest for this report.

RESULTS

During the 6-year surveillance period from 2008 to 2013, a total of 7,214 females and 2,412 males were diagnosed with at least one UTI during a deployment **(Table 1)**. Of all females who deployed during the period, 6.5 percent had at least one UTI; of all men who deployed during the period, 0.3 percent had at least one UTI **(data not shown)**. Incidence rates of UTI diagnoses (first-ever diagnoses per person during the surveillance period) among females and males were 86.7 and 3.3 per 1,000

TABLE 1. Incidence counts and incidence rates of urinary tract infections (UTIs) diagnosed during deployment by demographic and military characteristics, active component, U.S. Armed Forces, 2008–2013

	Females				Males			
	Incident UTI[a]		Recurrent cases[b]		Incident UTI[a]		Recurrent cases[b]	
	No.	Rate[c]	No.	%	No.	Rate[c]	No.	%
Total	7,214	86.7	978	13.6	2,412	3.3	87	3.6
Race/ethnicity								
White, non-Hispanic	3,243	85.4	406	12.5	1,335	2.7	45	3.4
Black, non-Hispanic	2,382	93.8	338	14.2	718	6.7	30	4.2
Hispanic	924	89.5	139	15.0	219	2.7	7	3.2
Asian/Pacific Islander	274	62.7	37	13.5	58	2.1	1	1.7
Other/unknown	391	76.5	58	14.8	82	2.6	4	4.9
Age								
<20	304	128.8	42	13.8	87	4.0	6	6.9
20–24	2,997	102.7	418	13.9	948	3.4	28	3.0
25–29	1,908	82.3	244	12.8	654	3.4	27	4.1
30–34	967	77.3	147	15.2	333	3.1	14	4.2
35–39	617	70.6	80	13.0	218	2.8	9	4.1
40–44	317	64.5	39	12.3	115	2.7	2	1.7
45–49	83	47.2	7	8.4	50	3.5	1	2.0
50+	21	38.0	1	4.8	7	2.2	0	0.0
Service								
Army	5,342	101.0	800	15.0	1,762	3.7	68	3.9
Navy	335	45.5	27	8.1	151	2.7	2	1.3
Air Force	1,356	73.5	131	9.7	359	3.5	14	3.9
Marine Corps	180	40.8	20	11.1	138	1.3	3	2.2
Coast Guard	1	9.8	0	0.0	2	1.7	0	0.0
Rank								
Junior enlisted	3,892	100.5	554	14.2	1,256	3.4	42	3.3
Senior enlisted	2,450	84.9	308	12.6	919	3.6	36	3.9
Junior officer	701	59.1	97	13.8	165	2.2	7	4.2
Senior officer	171	45.8	19	11.1	72	2.1	2	2.8
Occupation								
Combat-specific[a]	145	89.2	10	6.9	459	2.4	14	3.1
Armor/motor transport	396	108.2	45	11.4	202	4.8	6	3.0
Pilot/aircrew	54	37.3	6	11.1	60	2.2	1	1.7
Repair/engineering	1,137	85.3	153	13.5	650	3.5	25	3.8
Communications/intelligence	3,216	92.7	490	15.2	591	3.9	21	3.6
Health care	880	75.1	90	10.2	85	2.2	2	2.4
Other	1,386	82.8	184	13.3	365	3.7	18	4.9
Marital status								
Married	3,389	92.4	474	14.0	1,286	3.1	40	3.1
Single	2,726	75.6	358	13.1	982	3.3	39	4.0
Other	1,099	105.0	146	13.3	144	4.9	8	5.6

[a]Incident UTI = first per person per surveillance period
[b]Recurrent cases = individuals who had more than one UTI encounter during the surveillance period
[c]Rate per 1,000 person-years

person-years (p-yrs), respectively **(Table 1)**. Of service members with at least one UTI during deployment, 13.6 percent of females and 3.6 percent of males had an additional (recurrent) UTI during the same or a subsequent deployment.

Approximately half (53.6%) of all females diagnosed with a UTI during deployment had at least one UTI diagnosed during a medical encounter in a fixed medical treatment facility prior to deployment (non-deployed) **(data not shown)**. Nearly one-third (29%) of females diagnosed with a UTI during deployment had recurrent UTI episodes (i.e., more than one UTI diagnosis) in the non-deployed setting. Among males diagnosed during deployment, 13.9 percent had at least one UTI diagnosis prior to deployment and 2.8 percent had recurrent UTI episodes.

Among both females and males, incidence rates of UTIs were higher among black, non-Hispanics than any other racial/ethnic group members; however, recurrence percentages were higher among Hispanics among females (15.0%) and "other/unknown" racial/ethnic group members among males (4.9%) **(Table 1)**. Among both males and females, incidence rates were markedly lower among Asian/Pacific Islanders than any other racial/ethnic group members.

Among females, incidence rates were highest among the youngest (<20 years of age) and decreased with advancing age **(Table 1, Figure 1)**. Among males, rates also generally declined with increasing age; however, rates were higher among males 45–49 years old than in any other age group except teenagers **(Table 1, Figure 1)**.

Among both males and females, incidence rates of UTI were higher among those in the Army, enlisted service members, and those with armor/motor transport occupations **(Table 1)**. Rates were lower among pilots and air crew members compared to those in any other military occupational groups. Among both males and females, rates of UTIs were higher among those who had been, but were not currently, married than those currently or never married.

TABLE 2. Incident counts (first-ever) and percentages of urinary tract infections by diagnosis and gender, active component, U.S. Armed Forces, 2008–2013

	Females		Males	
Diagnosis	No.	% total	No.	% total
Urinary tract infection, unspecified (599.0)	4,821	66.8	945	39.2
Acute cystitis (595.0)	1,734	24.0	215	8.9
Urethritis, unspecified (597.80)	36	0.5	1,117	46.3
Cystitis, unspecified (595.9)	623	8.6	135	5.6

Diagnoses by gender

For men, 46.3 percent of the UTI cases had the case-defining diagnosis of "urethritis, unspecified," but only 0.5 percent of cases among women received this diagnosis **(Table 2)**. Among females, the most frequent case-defining diagnosis was "urinary tract infection, unspecified."

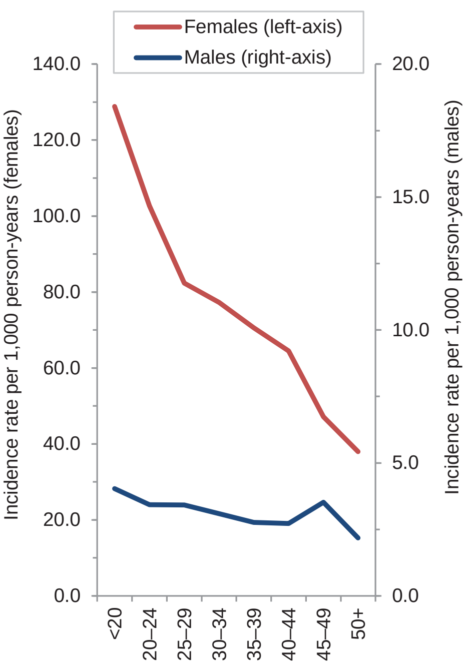
Counts and rates of UTIs

During the surveillance period, 7,214 service women had 8,418 UTIs (first infections and recurrent cases) diagnosed during deployment; 2,412 males had 2,504 UTIs during deployment **(data not shown)**.

The overall rate of UTIs (first and recurrent cases) among deployed females was 101.2 per 1,000 p-yrs; during the same period, the rate of UTIs among non-deployed females was 136.5 per 1,000 p-yrs **(Figure 2)**. Over the period, annual rates were 26–55 percent higher among non-deployed than deployed females; and in both cohorts, rates generally declined. During the last compared to the first year of the period, rates were 27.4 percent lower among deployed and 17.7 percent lower among non-deployed females.

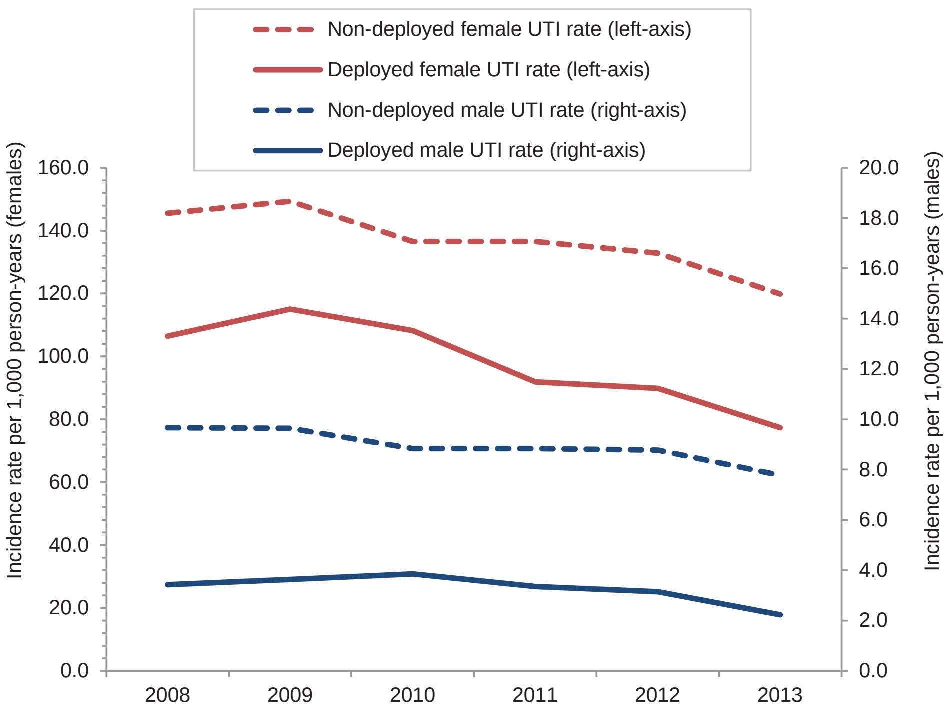
The UTI rates among deployed and non-deployed males were 3.4 and 8.9 per 1,000 p-yrs, respectively **(Figure 2)**. Over the period, annual rates were 130–250 percent

FIGURE 1. Incidence rates (first-time)[a] of urinary tract infections by gender and age group, active component, U.S. Armed Forces, 2008–2013



[a]Incidence rate=one per person per surveillance period

FIGURE 2. Incidence rates (first and recurrent cases)[a] of urinary tract infections (UTIs) by gender and deployment status, active component, U.S. Armed Forces, 2008–2013



[a]Incidence rate=one per person per 30-day period free of UTI encounters

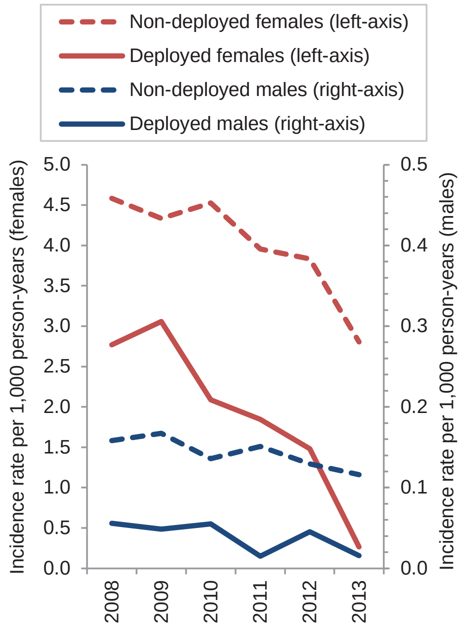
higher among non-deployed than deployed males. During the last compared to the first year of the period, rates were 35.0 percent lower among deployed and 19.6 percent lower among non-deployed males.

Acute pyelonephritis during deployment

During the 6-year period, among deployed service members, 178 and 31 cases of acute pyelonephritis affected 175 females and 31 males, respectively **(data not shown)**. Rates of acute pyelonephritis diagnoses were 2.1 and 4.0 per 1,000 p-yrs among deployed and non-deployed females, respectively **(Figure 3)**. Among both deployed and non-deployed females, annual rates of pyelonephritis markedly decreased during the period (90% and 39%, respectively).

Rates of acute pyelonephritis diagnoses were 0.04 and 0.14 per 1,000 p-yrs among deployed and non-deployed males, respectively **(Figure 3)**. Among both deployed and non-deployed males, annual rates of pyelonephritis markedly decreased during the period (72% and 27%, respectively).

FIGURE 3. Rates of acute pyelonephritis[a] by gender and deployment status, active component, U.S. Armed Forces, 2008–2013



[a]A individual was counted as a case once every 30 days without an encounter for acute pyelonephritis.

EDITORIAL COMMENT

Among all deployed active component service members during 2008–2013, 6.5 percent of females and 0.3 percent of males were diagnosed at least once with a UTI. Similar to the findings in the non-deployed setting, the incidence rate of first-time UTI among females was strikingly higher than the rate among males, and recurrent UTIs among females were common (13.6%). Likewise, incidence rates were highest among the youngest and most junior enlisted service members. Service members in armor/motor transport occupations had higher incidence rates of UTIs. This occupation may be more likely to participate in lengthy convoys with limited opportunity to urinate and may be more likely to resort to behavior that puts them at a greater risk for UTIs, (e.g., purposeful dehydration, holding urine for prolonged periods, using unsanitary containers for collection, or using incontinence briefs).[1-5]

Despite the findings of earlier studies and concerns about an increased risk of UTIs during deployment, the overall incidence rate of UTIs (first-time plus recurrent cases) was 35 percent less among deployed than non-deployed females. Throughout the period, annual rates were markedly lower among deployed than non-deployed females; of note, rates declined throughout the period in both cohorts. However, the lower rates among deployed females compared to non-deployed females should be considered in light of several limitations. For example, the analysis was limited in its ability to capture UTIs that were unreported, self-treated, resolved without medical treatment, or were treated outside of a medical unit/field hospital in more remote settings. Therefore, the numbers and rates documented in this report are likely to be underestimates of the true incidence of UTIs in the deployed setting. Several studies regarding deployed women have documented barriers to care and an unwillingness to seek care for genitourinary symptoms,[7–10] factors that corroborate the likelihood that not all UTIs during deployment were ascertained as cases for this report.

Although ascertainment of UTI cases while deployed may have underestimated counts and rates, it should be noted that the incidence rates of acute pyelonephritis while deployed were also lower in deployed service members than non-deployed. Acute pyelonephritis would be much more difficult to ignore, self-treat, or treat in field settings, suggesting that rates of acute pyelonephritis are not likely to be underestimated in the same way as UTIs. Clearly, further investigation of the counts and rates of UTI while deployed are warranted to clarify the limitations reported here.

Half of females who were diagnosed with UTIs during deployment had histories of UTIs in the non-deployed setting. Future analysis to determine the relative risks of UTI in relation to history of UTI will be presented in a future issue of *MSMR*. Service women with histories of UTIs should be advised of the risks—particularly deployment-specific behavioral risks—prior to deploying; in addition, all female service members should be advised of and encouraged to practice measures to prevent UTIs while serving in austere settings.

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Legionellosis in Military Health System Beneficiaries, 1998–2013

Legionellosis is an infection caused by exposure to mist or vapor contaminated with *Legionella* bacteria. During the 16-year surveillance period, 73 cases of legionellosis were identified in active component service members; 37 were identified among the reserve component; and 1,044 were identified among all other beneficiaries of the Military Health System (MHS). Of the total 1,154 cases of legionellosis, 11 percent (n=126) were confirmed cases (i.e., reportable medical events); 52 percent (n=599) were probable cases (i.e., hospitalizations); and 37 percent (n=429) were suspected cases (i.e., ambulatory visits). Most of the cases (59%) were identified in individuals aged 60 years and older. The annual number of cases increased during the surveillance period and demonstrated a seasonal trend with more cases occurring in the summer and early fall. Recent trends in the incidence of legionellosis among MHS beneficiaries and civilian populations in the United States highlight the importance of correctly identifying the etiologic agents of bacterial pneumonia and submitting reports of cases of legionellosis through the appropriate reporting system.

Legionella bacteria are present in the natural environment, especially in warm water. When introduced into man-made water systems, such as hot tubs, hot water tanks, fountains, or cooling towers (which are used for heating, ventilating, and air conditioning large buildings), *Legionella* bacteria can proliferate.[1] Without proper disinfection and maintenance, high concentrations of *Legionella* bacteria can occur in such water systems, increasing the risk of dissemination and human exposure.

When the mist or vapor of water contaminated with *Legionella* bacteria is inhaled into the lungs, the bacteria can cause infection (i.e., legionellosis). Legionellosis can present in a mild form, Pontiac fever, which causes flu-like symptoms and is self-limiting.[1] The hallmark manifestation of the severe form, Legionnaires' disease, is pneumonia; symptoms include high fever, cough, shortness of breath, and muscle aches. Individuals at greatest risk for developing legionellosis and of having more severe outcomes are people aged 50 years and older, former or current smokers, individuals with chronic lung disease, or the immunocompromised. *Legionella* is not transmitted from person to person.

Reported cases of legionellosis are often associated with outbreaks where several individuals become ill from a common exposure. Individuals may be exposed to a single environmental point source (e.g., hot tubs/swimming pools,[2–4] fountains,[5–7] and air conditioning cooling towers[8,9]). The bacterium was first identified as the causative agent of Legionnaires' disease by the Centers for Disease Control and Prevention after an outbreak of pneumonia among attendees at a Pennsylvania State American Legion convention in Philadelphia in 1976, thus leading to the names for the disease and the genus of the causative agent.[1] In 2004, a cluster of *Legionella*-associated pneumonia cases was identified among Marine recruits.[10] Investigation suggested the common exposure to be a shared training facility outside the barracks. Recruits are generally young, healthy, and not likely to develop legionellosis when exposed; however, acute respiratory disease is common among recruits and may have pre-disposed this group to the infection.

The objective of this report is to describe the counts, rates (in the active component only), and trends of legionellosis among beneficiaries of the Military Health System (MHS). Furthermore, the demographic characteristics of cases of legionellosis will be summarized.

METHODS

The surveillance period was 1 January 1998 through 31 January 2013. The surveillance population consisted of all MHS beneficiaries, including active and reserve component service members of the U.S. Armed Forces, family members of active and reserve component service members, and retirees and their eligible family members.

Cases of legionellosis were defined as one of the following: *confirmed*: a confirmed or pending reportable medical event (RME) for legionellosis; *probable*: a hospitalization for Legionnaires' disease with a case-defining code (ICD-9: 482.84) in the primary or secondary diagnostic position; or *suspected*: an outpatient visit for Legionnaires' disease with a defining code (ICD-9: 482.84) in the primary diagnostic position. An individual was considered a case only once during the surveillance period; incident cases were categorized on the basis of the above hierarchy of cases (e.g., if an individual had both an RME and a hospitalization, he or she was considered a confirmed case because of the RME).

RESULTS

Active component

During the 16-year surveillance period, 73 cases of legionellosis were identified in active component service members

(Table 1, Figure 1). Approximately one-third were confirmed cases (n=24), one-third were probable cases (n=23), and one-third were suspected cases (n=26) **(Figure 1)**. The overall crude incidence rate among active component service members was 0.32 per 100,000 person-years (p-yrs). The annual incidence varied during the surveillance period; the incidence rate peaked in 2001 (0.50 per 100,000 p-yrs) and again in 2011. The most cases (n=10) and highest rate (0.69 per 100,000 p-yrs) were reported in 2011.

Incidence rates of legionellosis were highest among males; among those in the youngest (<20 years) and oldest (≥40 years) age groups; and in white, non-Hispanic service members **(Table 1)**. Service members in the Army, senior officers, and those in "other" occupational categories had the highest rates of legionellosis compared to their respective counterparts.

Reserve component

Among reserve component service members, there were 37 cases of legionellosis identified during the surveillance period **(Table 1, Figure 2)**. Approximately one-fifth were confirmed cases (n=8; 22%), one-third were probable cases (n=12; 32%), and the remainder were suspected cases (n=17; 46%). The greatest annual number of cases occurred in 2005 (n=8); however, more cases were identified during the second half of the surveillance period (2006–2013, n=21) than during the first half (1998–2005, n=16).

In the reserve component, a majority of the cases were among males (n=31; 83.8%), among those 40 years or older (n=22; 59.5%), and among white, non-Hispanic service members (n=24; 64.9%) **(Table 1)**. Most cases involved Army members (n=25; 67.6%), and senior enlisted (n=21; 56.8%). In the reserve component, those in "other" occupations (n=12; 32.4%) had the highest number of cases.

TABLE 1. Incident counts and incidence rates (active only) of legionellosis by demographic/military characteristics, MHS beneficiaries, U.S. Armed Forces, 1998–2013

	Active component		Reserve component		All other beneficiaries[a]	
	No.	Rate[b]	No.	%	No.	%
Total	73	0.32	37	100.0	1,044	100.0
Sex						
Male	64	0.33	31	83.8	573	54.9
Female	9	0.27	6	16.2	471	45.1
Age						
0–9	n/a	n/a	n/a	n/a	7	0.7
10–19[c]	7	0.42	0	0.0	19	1.8
20–29	33	0.27	8	21.6	20	1.9
30–39	21	0.33	7	18.9	27	2.6
40–49	11	0.50	14	37.8	90	8.6
50–59	1	0.54	8	21.6	198	19.0
60–69	n/a	n/a	n/a	n/a	296	28.4
70+	n/a	n/a	n/a	n/a	387	37.1
Race/ethnicity						
White, non-Hispanic	53	0.37	24	64.9	n/a	n/a
Black, non-Hispanic	10	0.25	9	24.3	n/a	n/a
Other	10	0.22	4	10.8	n/a	n/a
Service						
Army	33	0.41	25	67.6	n/a	n/a
Navy	14	0.25	1	2.7	n/a	n/a
Air Force	18	0.33	9	24.3	n/a	n/a
Marine Corps	7	0.24	2	5.4	n/a	n/a
Coast Guard	1	0.16	0	0.0	n/a	n/a
Rank						
Junior enlisted	33	0.33	7	18.9	n/a	n/a
Senior enlisted	29	0.32	21	56.8	n/a	n/a
Junior officer	6	0.26	4	10.8	n/a	n/a
Senior officer	5	0.34	5	13.5	n/a	n/a
Occupation						
Combat-specific	17	0.36	8	21.6	n/a	n/a
Armor/motor transport	1	0.23	3	8.1	n/a	n/a
Repair/engineering	17	0.25	8	21.6	n/a	n/a
Communications/intelligence	16	0.31	4	10.8	n/a	n/a
Health care	6	0.32	2	5.4	n/a	n/a
Other	16	0.41	12	32.4	n/a	n/a

[a]Retired service members and dependents of service members and retirees
[b]Rate per 100,000 person-years
[c]Age range for active and reserve components is 17–19 years
n/a = not applicable

All other beneficiaries

There were 1,044 diagnosed cases of legionellosis among all other beneficiaries of the MHS (i.e., family members of active and reserve component service members, and retirees and their family members) **(Table 1, Figure 3)**. The number of confirmed cases (n=94) was 9 percent of the total number of cases; probable cases (n=564) accounted for 54 percent; and suspected cases (n=386) made up 37 percent. The annual number of cases ranged from 23 to 30 during the first 4 years (1998–2001); 37 to 69 during the next 5 years (2002–2006); and 82 to 105 during the final 7 years of

FIGURE 1. Incident cases and incidence rates of legionellosis among active component service members, U.S. Armed Forces, 1998–2013

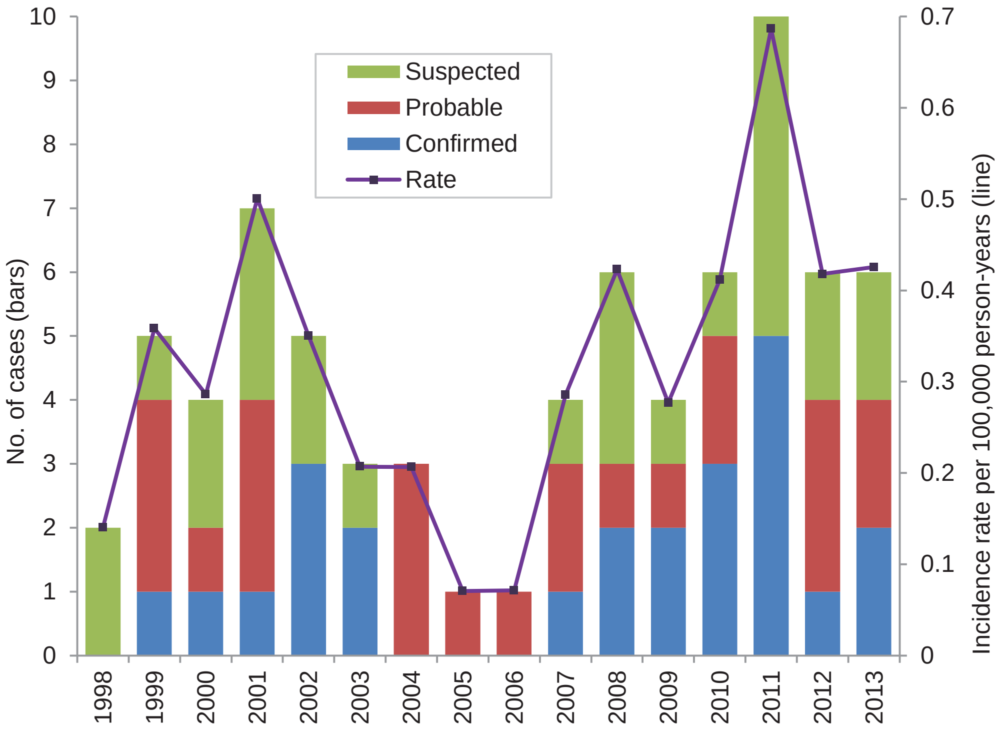
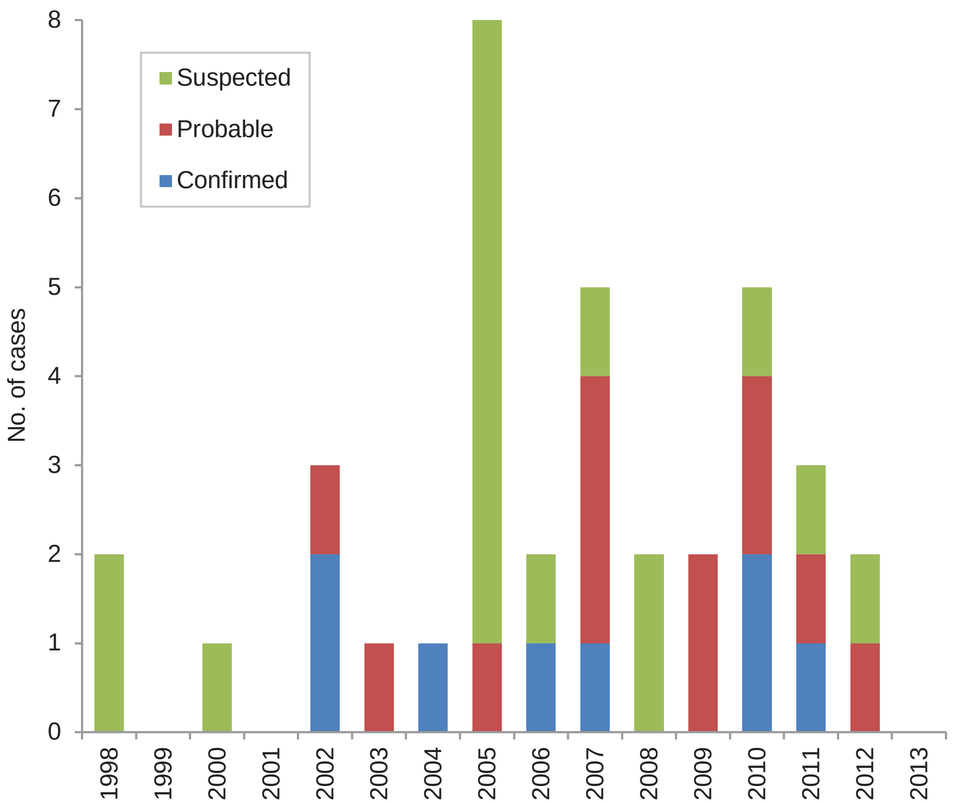


FIGURE 2. Incident cases of legionellosis among reserve component service members, U.S. Armed Forces, 1998–2013



the surveillance period (2007–2013). The annual number of cases increased nearly 300 percent during 1998–2013.

Among all other beneficiaries, cases were identified more frequently in males than females with approximately 10 percent more cases in males than in females **(Table 1)**. A majority of cases were in beneficiaries aged 50 years and older (n=881; 84.4%); 37.1 percent (n=387) were in beneficiaries aged 70 and older.

Distribution by month

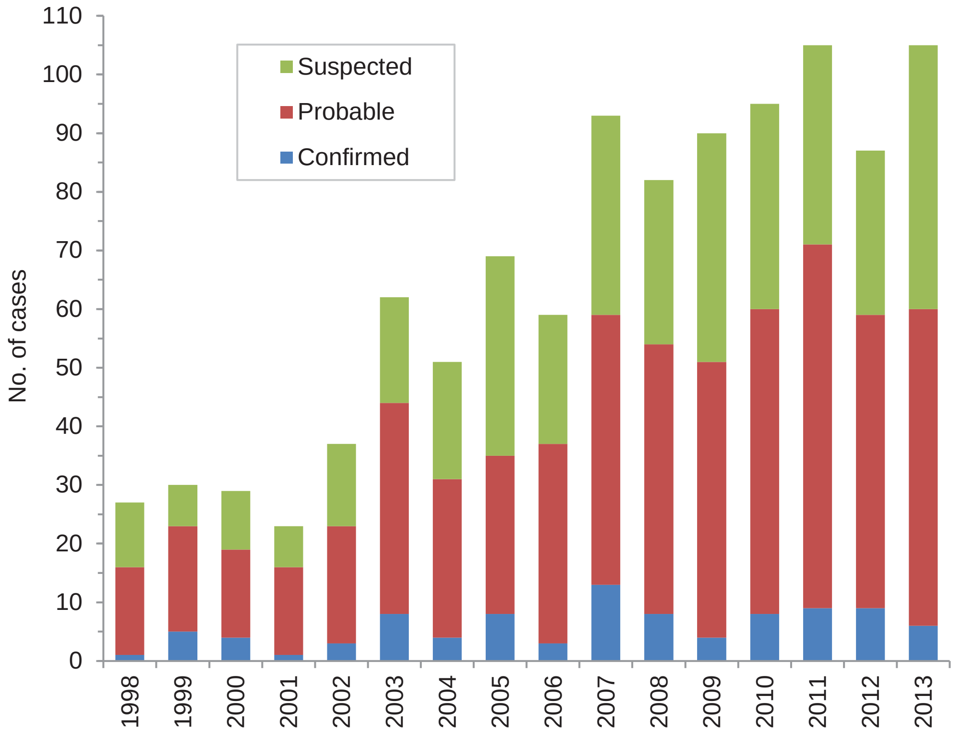
Among all 1,154 cases identified in MHS beneficiaries, approximately half (52.9%; n=694) occurred from June to October **(data not shown)**. The greatest number of cases occurred in September (n=133) and July (n=130). The months with the fewest cases were March (n=55), February (n=67), and January (n=77).

EDITORIAL COMMENT

During the 16-year surveillance period, 1,154 cases of legionellosis were identified in individuals who receive care from the MHS. Eleven percent of all cases (n=126) were confirmed cases (RMEs), 52 percent (n=599) were probable cases (hospitalizations), and 37 percent (n=429) were suspected cases (ambulatory visits). The stratification of cases into these categories must be considered in light of several limitations. Most cases in this report were categorized as probable or suspected cases. In the MHS, legionellosis is an RME; therefore, "true" cases (i.e., cases that meet the case definition) should be reported through the system. However, many cases may not be properly reported, or may be reported elsewhere (e.g., state health department), particularly if associated with care given outside the MHS ("outsourced" care) or if laboratory or pertinent patient history is unavailable or pending.

Most of the cases (59%) were identified in individuals aged 60 years and older. Advancing age has been shown to be a significant risk factor for developing legionellosis after exposure to *Legionella* bacteria.[1,11] However, it should be noted that cases still occur in young, healthy individuals, and

FIGURE 3. Incident cases of legionellosis among all other beneficiaries[a] of the Military Health System, 1998–2013



[a]Retired service members and dependents of service members and retirees

increases were demonstrated among the active and reserve components during the surveillance period. This, as well as other studies, demonstrates the importance of considering *Legionella* species as a cause of pneumonia in all age groups.[10–12]

The trend of increasing numbers of legionellosis cases identified over time demonstrated in each beneficiary type has also been observed in the civilian population.[2,11,12] This trend may be attributed to improved diagnosis and reporting of legionellosis; increased use of urine antigen tests, which provide timely and accurate results (particularly after the test's endorsement by the Council of State and Territorial Epidemiologists in 2005); and an increasing population of older individuals (i.e., increase in the population at the highest risk of infection).

The counts and rates of legionellosis reported here are most likely an underestimation of the true number of cases. Because of the less severe symptoms and self-limiting nature of Pontiac fever, the mild form of legionellosis, many cases of mild *Legionella* infection may go undetected, misdiagnosed, or unreported. Also, Pontiac fever is not associated with an ICD-9-CM code and is not an RME in the MHS. Some cases of the severe form of legionellosis that include pneumonia (i.e., Legionnaires' disease) may also go undetected, misdiagnosed, or unreported. For example, the cluster of *Legionella*-associated pneumonia cases among military recruits was not identified as Legionnaires' disease at the time of diagnosis and the patients were treated empirically for bacterial pneumonia.[10] Because these cases were not identified with legionellosis at the time of diagnosis, they were not reported to the electronic record-keeping systems as such, and were not identified as cases by the methodology used in this report.

Legionellosis is often associated with travel and with outbreaks. This report was limited in its ability to identify travel-associated risk factors and cases that may have been part of a larger outbreak. The results did demonstrate a seasonal trend with more cases occurring in the summer and early fall—a factor that may be related to increased travel, use of air conditioning, and other recreational activities that increase risk of exposure to *Legionella* bacteria (e.g., use of hot tubs, pools, spas). Recent trends in the incidence of legionellosis among MHS beneficiaries and civilian populations in the United States highlight the importance of correctly identifying the etiologic agents of bacterial pneumonia and submitting reports of cases of legionellosis through the appropriate reporting system.

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Update: Heat Injuries, Active Component, U.S. Armed Forces, 2013

The number of active component service members treated for heat stroke in 2013 (n=324) was the lowest since 2010 (n=321). Incidence rates of heat stroke were higher among males, those younger than 20 years of age, Asian/Pacific Islanders, Marine Corps and Army members, recruit trainees, and service members in combat-specific occupations, compared to their respective counterparts. Fewer service members were treated for "other heat injuries" in 2013 (n=1,701) than in any other year of the 5-year surveillance period. In addition, there were fewer reportable medical events, ambulatory encounters, and hospitalizations for "other heat injuries" in 2013 than in any of the prior 4 years. The incidence rate of "other heat injuries" was higher among females than males and 304 percent higher among recruit trainees than among other enlisted members or officers. During 2009–2013, a total of 909 heat injury events occurred in Iraq/Afghanistan; 6.4 percent (n=58) of those events were due to heat stroke.

Heat-related injuries are a significant threat to the health and operational effectiveness of military members and their units.[1,2] Lessons learned during training and operations in hot environments plus the findings of numerous research studies have resulted in doctrine, equipment, and preventive measures that can significantly reduce the adverse health effects of military activities in heat.[1–3] Although numerous 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 the U.S. Military Health System (MHS), the most serious heat-related injuries are considered notifiable medical events. Since 31 July 2009, a notifiable case of "heat stroke" (ICD-9-CM: 992.0) has been 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."[6] Notifiable cases of heat injuries other than heat stroke ("unspecified effects of heat" [ICD-9-CM: 992.9]) include "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: 992.3–992.5) that do not require medical intervention or result in lost duty time are not reportable.[6]

This report summarizes heat injury–related hospitalizations, ambulatory visits, and reportable medical events among active component members during 2013 and compares them to the previous 4 years. Episodes of heat stroke and "other heat injuries" are summarized separately; for this analysis, "other heat injuries" includes "heat exhaustion" (which was reportable prior to 31 July 2009) and "unspecified effects of heat" (reportable since 31 July 2009).

METHODS

The surveillance period was 1 January 2009 through 31 December 2013. The surveillance population included all individuals who served in the active components of the Army, Navy, Air Force, Marine Corps, or Coast Guard at any time during the surveillance period. The Defense Medical Surveillance System (DMSS) maintains electronic records of all actively serving U.S. military members' hospitalizations and ambulatory visits in U.S. military and civilian (contracted or purchased care through the MHS) medical facilities worldwide; the DMSS also maintains records of medical encounters of service members deployed to Southwest Asia/Middle East (as documented in the Theater Medical Data Store [TMDS]). Because heat injuries represent a threat to the health of individual service members and to military training and operations, the Armed Forces require expeditious reporting of these reportable medical events through one of the service-specific electronic reporting systems; these reports are routinely transmitted and incorporated into the DMSS.

For this analysis, DMSS was searched to identify all records of medical encounters and notifiable medical event reports that included 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: 992.9]).

This report summarizes numbers of individuals affected by documented heat injuries (incident cases) and "heat injury events" during each calendar year. To estimate numbers of incident cases per year, each individual who was affected by a heat injury event (one or more) during a year accounted for one incident case during the respective year. To classify the severity of incident cases per year, those that were associated with any heat stroke diagnosis were classified as heat stroke cases; all others were classified as "other heat injury" cases.

To estimate total numbers of heat injury events per year, affected individuals could account for multiple events during a year. To distinguish encounters for follow-up care from new heat injury events, affected service members were not considered at risk of new heat injury events within 60 days of prior events. Annual numbers of heat stroke and "other heat injury"–related events were estimated separately. To categorize the clinical management of heat injury events, those that were documented with hospitalization records were classified as hospitalization cases; among the others, those documented with reportable event records were prioritized over those documented by ambulatory records only.

For surveillance purposes, a "recruit trainee" was defined as an active component service member (grades E1–E4) who was assigned to one of the services' 10 recruit training locations (per the individual's initial military personnel record). For this report, each service member was considered a recruit trainee for the period of time corresponding to the usual length of recruit training in his or her service. Recruit trainees were considered a separate category of enlisted service members in summaries of heat injuries by military status overall.

Records of medical evacuations from the U.S. Central Command (CENTCOM) area of responsibility (AOR) (i.e., Iraq, Afghanistan) to a medical treatment facility outside the CENTCOM AOR were analyzed separately. Evacuations were considered case-defining if affected service members had at least one inpatient or outpatient heat injury medical encounter in a permanent military medical facility in the United States or Europe from 5 days before to 10 days after their evacuation dates.

RESULTS

In 2013, there were 324 incident cases of heat stroke and 1,701 incident cases of "other heat injury" among active component service members **(Table 1)**. The overall crude incidence rates of heat stroke and "other heat injury" were 0.23 and 1.21 per 1,000 person-years (p-yrs), respectively.

The annual incidence rate (unadjusted) of heat stroke in 2013 was lower

TABLE 1. Incident cases and incidence rates[a] of heat injury, active component, U.S. Armed Forces, 2013

	Heat stroke		Other heat injury		Total heat injury diagnoses	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total	324	0.23	1,701	1.21	2,025	1.44
Sex						
Male	293	0.24	1,429	1.19	1,722	1.43
Female	31	0.15	272	1.30	303	1.45
Age group						
<20	41	0.46	332	3.73	373	4.19
20–24	134	0.31	731	1.68	865	1.98
25–29	82	0.24	341	0.99	423	1.23
30–34	35	0.15	148	0.65	183	0.80
35–39	25	0.16	90	0.57	115	0.72
40+	7	0.05	59	0.39	66	0.43
Race/ethnicity						
White, non-Hispanic	200	0.23	1,037	1.19	1,237	1.42
Black, non-Hispanic	51	0.23	321	1.44	372	1.66
Hispanic	36	0.22	179	1.10	215	1.32
Asian/Pacific Islander	25	0.44	86	1.51	111	1.96
Other/unknown	12	0.12	78	0.79	90	0.91
Service						
Army	210	0.40	1,032	1.95	1,242	2.34
Navy	19	0.06	95	0.30	114	0.36
Air Force	9	0.03	167	0.51	176	0.54
Marine	86	0.44	393	2.02	479	2.46
Coast Guard	0	0.00	14	0.34	14	0.34
Military status						
Recruit trainee	11	0.38	146	5.01	157	5.39
Enlisted	262	0.23	1,405	1.24	1,667	1.47
Officer	51	0.21	150	0.61	201	0.81
Military occupation						
Combat-specific	142	0.74	449	2.35	591	3.10
Armor/motor transport	8	0.15	65	1.20	73	1.35
Pilot/air crew	3	0.06	8	0.15	11	0.21
Repair/engineering	39	0.10	311	0.76	350	0.86
Communications/intelligence	48	0.16	317	1.04	365	1.19
Health care	28	0.23	100	0.81	128	1.04
Other	56	0.20	451	1.64	507	1.84
Home of record[b]						
Midwest	70	0.28	317	1.26	387	1.54
Northeast	47	0.26	204	1.13	251	1.39
South	123	0.21	773	1.34	896	1.55
West	80	0.25	363	1.15	443	1.41
Other/unknown	4	0.04	44	0.52	48	0.56

[a]Rate per 1,000 person-years
[b]Home of record self-reported at entry into service

FIGURE 1. Incident cases and incidence rates of heat stroke, by source and year of diagnosis, active component, U.S. Armed Forces, 2009–2013

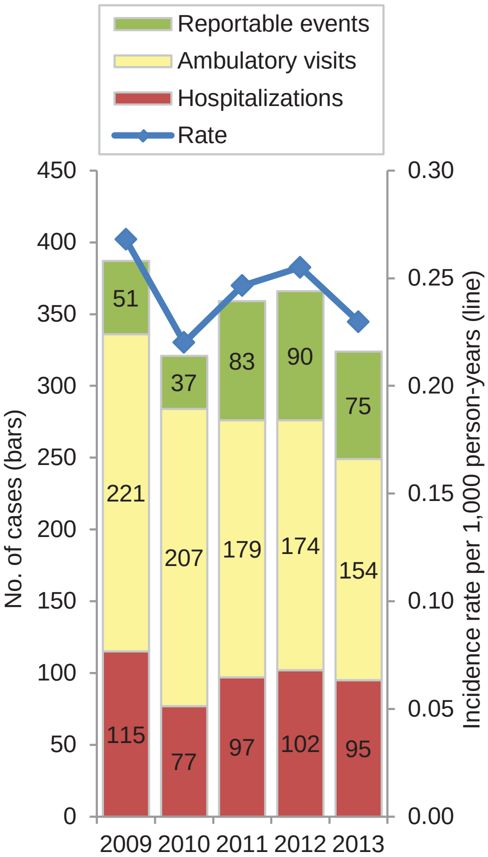
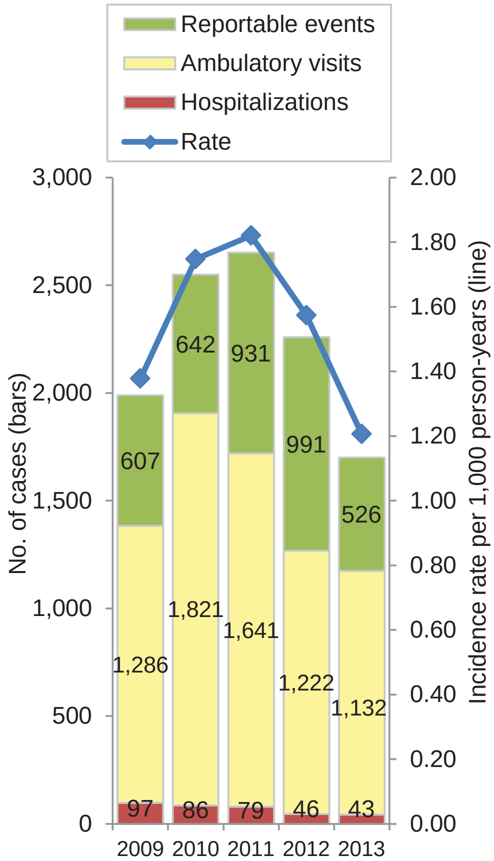


FIGURE 2. Incident cases and incidence rates of "other heat injury," by source and year of diagnosis, active component, U.S. Armed Forces, 2009–2013



than in 2012, 2011, and 2009, but higher than in 2010 **(Figure 1)**. There were fewer heat stroke–related reportable events in 2013 than in 2012 or 2011. In addition, there were fewer ambulatory visits and hospitalizations (combined) for heat stroke in 2013 than in any other year of the period.

The annual incidence rate (unadjusted) of "other heat injury" was lower in 2013 than in any other year of the surveillance period. In 2013, compared to 2012, there were markedly fewer reportable events (−47%) and slightly fewer hospitalizations (−7%) and ambulatory visits (−7%) for "other heat injuries" **(Figure 2)**.

In 2013, subgroup-specific incidence rates of heat stroke were highest among service members younger than 20 years of age, Asian/Pacific Islanders, Marine Corps and Army members, recruit trainees, and combat-specific occupations **(Table 1)**. Heat stroke rates in the Marine Corps and Army were more than 6-fold those in the other services; the rate was 60 percent higher among males than females and 65 percent higher among recruit trainees than other enlisted members and officers.

In contrast to the heat stroke experience, the crude incidence rate of "other heat injuries" was higher among females than males **(Table 1)**. In 2013, subgroup-specific incidence rates of "other heat injuries" were highest by far among service members younger than 20 years of age, Army and Marine Corps members, recruit trainees, and service members in combat-specific occupations.

In 2013, a total of 386 heat stroke events affected 324 individuals (average number of heat stroke events per affected individual: 1.2); 60 individuals experienced more than one heat stroke event during the year **(data not shown)**. The number of service members affected by more than one heat stroke event in 2013 was lower than the average per year (n=69) during the prior years of the period. Also, in 2013, 1,927 "other heat injury" events affected 1,854 individuals; these numbers included some individuals who were also diagnosed with heat stroke during 2013. The average number of "other heat injury" events per affected individual was 1.04; 69 individuals experienced more than one "other heat injury" event during the year. The number of service members affected by more than one "other heat injury" event in 2013 was higher than all other years except 2009 (n=79).

Heat injuries by location

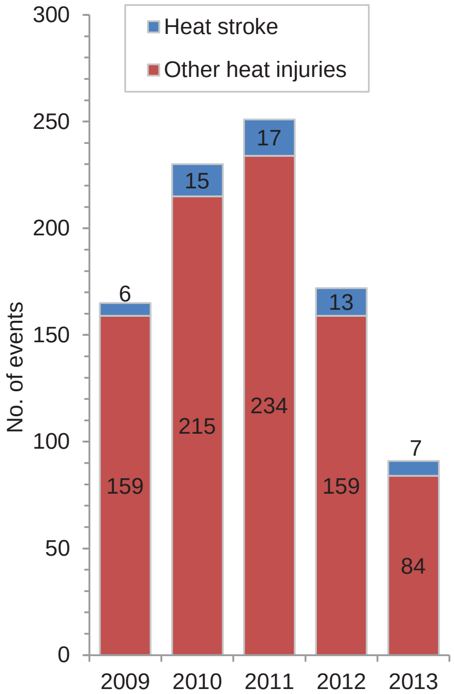
During the 5-year surveillance period, heat-related injuries were diagnosed at more than 100 military installations and

TABLE 2. Heat injury events[a] by location of diagnosis/report, active component, U.S. Armed Forces, 2009–2013

Location of diagnosis	No.	% total
Fort Bragg, NC	1,380	10.7
Fort Benning, GA	1,270	9.8
Fort Jackson, SC	1,144	8.9
MCB Camp Lejeune/ Cherry Point, NC	561	4.3
MCRD Parris Island/ Beaufort, SC	503	3.9
Fort Polk, LA	484	3.7
Fort Campbell, KY	452	3.5
Fort Hood, TX	254	2.0
MCB Quantico, VA	250	1.9
Fort Stewart, GA	235	1.8
MCB Camp Pendleton, CA	225	1.7
Fort Sill, OK	220	1.7
NMC San Diego, CA	214	1.7
JBSA Lackland, TX	204	1.6
Okinawa, Japan	162	1.3
All other locations	5,349	41.4
Total	12,907	100.0

[a]One heat injury per person per year

FIGURE 3. Numbers of heat injury events[a] reported from Iraq/Afghanistan, by year and type of heat injury, 2009–2013



[a]One per person per 60 days

geographic locations worldwide. Three Army installations accounted for nearly 30 percent of all heat injury events during the period (Fort Bragg, NC [n=1,380], Fort Benning, GA [n=1,270], and Fort Jackson, SC [n=1,144]); four other installations accounted for an additional 16 percent of heat injury events (Marine Corps Base [MCB] Camp Lejeune/Cherry Point, NC [n=561], Marine Corps Recruit Depot [MCRD] Parris Island/Beaufort, SC [n=503], Fort Polk, LA [n=484], and Fort Campbell, KY [n=452]). Of the 10 installations with the most heat injury events, eight are in the southeastern United States **(Table 2)**.

Heat injuries in Iraq and Afghanistan

During the 5-year surveillance period, 909 heat injuries were diagnosed and treated in Iraq and Afghanistan **(Figure 3)**. Of these, 6.4 percent (n=58) were heat stroke. Deployed service members who were affected by heat injuries were most frequently male (n=728; 80.1%), white, non-Hispanic (n=567: 62.4%), aged 20–24 years (n=554; 52.3%), in the Army (n=570; 62.7%), enlisted (n=861; 95.7%), and in combat-specific (n=235; 25.9%) or repair/engineering (n=229; 25.2%) occupations **(data not shown)**. During the surveillance period, 23 service members were medically evacuated for heat injuries from Iraq or Afghanistan; 61 percent of the evacuations (n=14) took place in July or August.

EDITORIAL COMMENT

In 2013, there were fewer reportable events for heat stroke than in 2012, and fewer hospitalizations and ambulatory visits (combined) than in any other year during the period. In 2013, the incidence rate of heat stroke was lower than in the previous 2 years. Rates of other clinically significant heat-related injuries increased from 2009 through 2011, but declined in 2012 and 2013 to the lowest rate during the surveillance period.

The results of this update should be interpreted with consideration of its limitations. Similar heat-related clinical illnesses are likely managed differently and reported with different diagnostic codes at different locations and in different clinical settings. Such differences undermine the validity of direct comparisons of rates of nominal heat stroke and “other heat injury” events across locations and settings. Also, heat injuries during training exercises and deployments that are treated in field medical facilities are not completely ascertained as cases for this report.

In spite of its limitations, this report documents that heat injuries are still 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 (particularly those training at installations in the southeastern United States) are at highest risk of heat injuries—including heat stroke, exertional hyponatremia, and exertional rhabdomyolysis (see the other articles in this issue of the *MSMR*).

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 online at: http://phc.amedd.army.mil/topics/discond/hipss/Pages/HeatinjuryPrevention.aspx and http://www.marines.mil/Portals/59/Publications/MCO%206200.1E%20W%20CH%201.pdf.

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Update: Exertional Rhabdomyolysis, Active Component, U.S. Armed Forces, 2009–2013

Among active component U.S. service members in 2013, there were 378 incident episodes of rhabdomyolysis likely due to physical exertion or heat stress (exertional rhabdomyolysis). The annual incidence rates of exertional rhabdomyolysis increased 33 percent during 2009–2013. In 2013, the highest incidence rates occurred in service members who were male; younger than 20 years of age; either Asian/Pacific Islander or black, non-Hispanic; members of the Marine Corps and Army; recruit trainees; and in combat-specific occupations. Incidence rates were higher among service members with homes of record from the Northeast compared to other regions of the United States. Most cases of exertional rhabdomyolysis were diagnosed at installations that support basic combat/recruit training or major ground combat units of the Army or Marine Corps. Medical care providers should consider exertional rhabdomyolysis in the differential diagnosis when service members (particularly recruits) present with muscular pain and swelling, limited range of motion, or the excretion of dark urine (e.g., myoglobinuria) after strenuous physical activity, particularly in hot, humid weather.

Rhabdomyolysis refers to the rapid breakdown of skeletal muscle cells, a process most often recognized by the appearance in the urine of brown-colored myoglobin following its release from damaged muscle cells into the bloodstream. Myoglobin is toxic to the tubular cells of the kidney and can induce renal failure. 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. This report includes the data for the years 2009–2013. More detailed information about 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 2009 to 31 December 2013. The surveillance population included all individuals who served in an active component of the U.S. Armed Forces at any time during the surveillance period. The Defense Medical Surveillance System (DMSS) maintains electronic records of all actively serving U.S. military members' hospitalizations and ambulatory visits in U.S. military and civilian (contracted or purchased care through the Military Health System) medical facilities worldwide. The DMSS also maintains records of medical encounters of service members deployed to Southwest Asia/Middle East (as documented in the Theater Medical Data Store).

For this analysis, the DMSS was searched for records of healthcare encounters (inpatient or outpatient) associated with diagnoses related to the occurrence of exertional rhabdomyolysis. For surveillance purposes, a case of exertional rhabdomyolysis was defined as a hospitalization or ambulatory visit with a discharge diagnosis in any position of either "rhabdomyolysis" (ICD-9-CM: 728.88) or "myoglobinuria" (ICD-9-CM: 791.3) plus a diagnosis in any position of one of the following: "volume depletion (dehydration)" (ICD-9-CM: 276.5x), "effects of heat" (ICD-9-CM: 992.0–992.9), "effects of thirst (deprivation of water)" (ICD-9-CM: 994.3), "exhaustion due to exposure" (ICD-9-CM: 994.4), or "exhaustion due to excessive exertion (overexertion)" (ICD-9-CM: 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 "injury, poisoning, toxic effects" (ICD-9-CM: 800–999, except "sprains and strains of joints and adjacent muscles" [ICD-9-CM: 992.0–992.9, 994.3–994.5, and 840–848]) were not considered indicative of "exertional rhabdomyolysis."

For surveillance purposes, a "recruit trainee" was defined as an active component member in an enlisted grade of E1–E4 who was assigned to one of the services' 10 recruit training locations (per the individual's initial military personnel record). For this report, each service member was considered a recruit trainee for the period of time corresponding to the usual length of recruit training in his or her service. Recruit trainees were considered a separate category of enlisted service members in summaries of rhabdomyolysis cases by military status overall.

Records of medical evacuations from the U.S. Central Command (CENTCOM) area of responsibility (AOR) (e.g., Iraq, Afghanistan) to a medical treatment facility outside the CENTCOM AOR were analyzed separately. Evacuations were considered case-defining if affected service members met the above criteria in a permanent military medical facility in the United States or Europe from 5 days before to 10 days after their evacuation dates.

RESULTS

In 2013, there were 378 incident diagnoses of rhabdomyolysis likely associated with physical exertion and/or heat stress (exertional rhabdomyolysis) **(Table 1)**. The crude incidence rate was 26.8 per 100,000 person-years (p-yrs).

In 2013, relative to their respective counterparts, the highest incidence rates of exertional rhabdomyolysis affected service members who were male, younger than 20 years of age, and either Asian/Pacific Islander or black, non-Hispanic **(Table 1)**. Subgroup-specific incidence rates were highest among service members in the Marine Corps and Army, in combat-specific occupations, and those with homes of record from the Northeast region of the United States. Of note, incidence rates among recruit trainees were five times those among other enlisted members and officers.

The annual rates of exertional rhabdomyolysis increased more than 46 percent from 2009 to 2011 (20.2 and 29.5 per 100,000 p-yrs, respectively) **(Figure 1)**. However, after peaking in 2011, the annual numbers and rates of incident diagnoses of exertional rhabdomyolysis decreased slightly in 2012 and 2013. The overall increase during the surveillance period was 33 percent.

In 2013, 77 percent of all service members who were diagnosed with exertional rhabdomyolysis were in either the Army (n=177) or the Marine Corps (n=115) **(Table 1)**. Annual incidence rates were much higher in the Marine Corps than in any of the other Services during every year of the surveillance period **(Figure 2)**. The Marine Corps was the only service to experience an increase in the incidence rate from 2012 to 2013. During the 5-year surveillance period, most cases (71%) occurred from May through September **(Figure 3)**.

Rhabdomyolysis by location

During the 5-year surveillance period, the medical treatment facilities at eight installations accounted for at least 50 cases each and, together, for 46.6 percent of all diagnosed cases **(Table 2)**. Of these installations, four provide support to recruit/basic combat training centers (Marine Corps Recruit Depot [MCRD] Parris Island/Beaufort, SC; Fort Jackson, SC; Joint Base San Antonio [JBSA]

TABLE 1. Incident diagnoses and incidence rates[a] of exertional rhabdomyolysis, active component, U.S. Armed Forces, 2013

	Hospitalizations		Ambulatory visits		Total	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total	168	11.9	210	14.9	378	26.8
Gender						
Male	158	13.2	190	15.8	348	29.0
Female	10	4.8	20	9.6	30	14.4
Age group						
<20	19	17.9	51	48.1	70	66.0
20–24	54	12.2	73	16.5	127	28.8
25–29	46	13.6	44	13.0	90	26.6
30–34	26	11.6	19	8.5	45	20.1
35–39	21	13.5	13	8.3	34	21.8
40+	2	1.4	10	6.9	12	8.3
Race/ethnicity						
White, non-Hispanic	101	11.6	110	12.7	211	24.3
Black, non-Hispanic	26	11.6	56	25.1	82	36.7
Hispanic	16	9.8	24	14.7	40	24.5
Asian/Pacific Islander	13	22.9	13	22.9	26	45.8
Other/unknown	12	12.2	7	7.1	19	19.2
Service						
Army	85	16.0	92	17.4	177	33.4
Navy	17	5.4	18	5.7	35	11.0
Air Force	22	6.7	28	8.5	50	15.2
Marine Corps	43	22.1	72	37.0	115	59.1
Coast Guard	1	2.5	0	0.0	1	2.5
Military status						
Recruit trainee	12	41.2	27	92.7	39	133.9
Enlisted	132	11.6	158	13.9	290	25.6
Officer	24	9.7	25	10.1	49	19.9
Military occupation						
Combat-specific	46	24.1	47	24.6	93	48.8
Armor/motor transport	6	11.1	6	11.1	12	22.2
Pilot/air crew	3	5.7	4	7.6	7	13.3
Repair/engineering	25	6.1	35	8.6	60	14.7
Communications/intelligence	32	10.5	27	8.8	59	19.3
Health care	18	14.6	14	11.4	32	26.0
Other	38	13.8	77	28.0	115	41.8
Home of record[b]						
Midwest	30	11.9	39	15.5	69	27.4
Northeast	25	13.9	29	16.1	54	30.0
South	66	11.4	88	15.2	154	26.6
West	41	13.0	46	14.6	87	27.6
Other/unknown	6	7.1	8	9.4	14	16.5

[a]Rate per 100,000 person-years
[b]Home of record self-reported at entry into service

FIGURE 1. Incident diagnoses of exertional rhabdomyolysis by clinical setting, active component, U.S. Armed Forces, 2009–2013

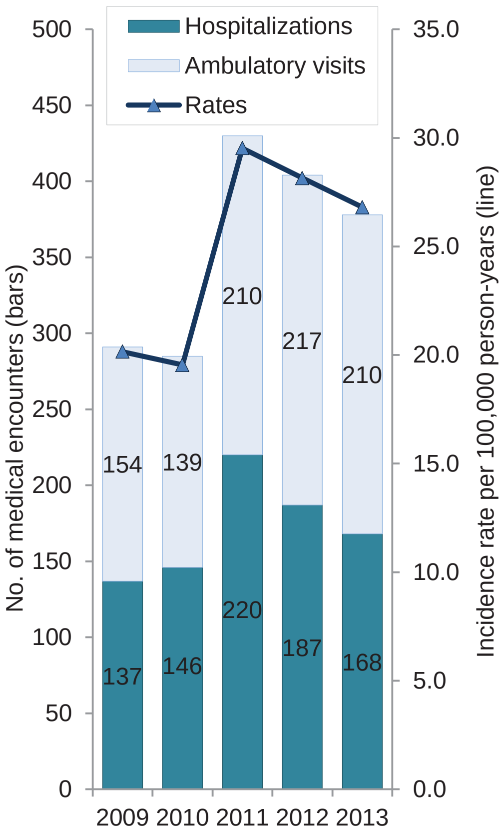


FIGURE 2. Annual incidence rates of exertional rhabdomyolysis by service, active component, U.S. Armed Forces, 2009–2013

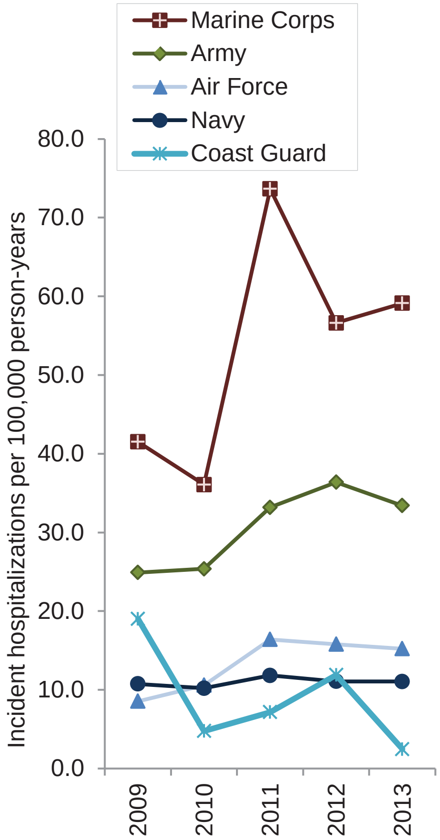
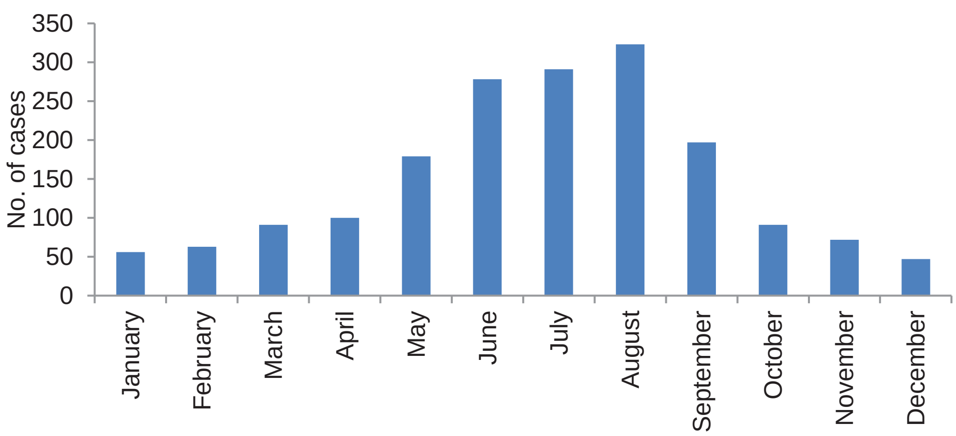


FIGURE 3. Incident cases of exertional rhabdomyolysis by month, active component, U.S. Armed Forces, 2009–2013



Lackland Air Force Base; and Fort Benning, GA) and four support large combat troop populations (Fort Bragg, NC; Marine Corps Base [MCB] Camp Pendleton, CA; MCB Camp Lejeune/Cherry Point, NC; and Fort Hood, TX). The most cases overall (together accounting for 27% of all cases) were diagnosed at Fort Bragg, NC, (n=276) and MCRD Parris Island/Beaufort, SC (n=206).

Rhabdomyolysis in Iraq and Afghanistan

During the 5-year surveillance period, there were 22 incident cases of exertional rhabdomyolysis diagnosed and treated in Iraq/Afghanistan **(data not shown).** Deployed service members who were affected by exertional rhabdomyolysis were most frequently male (n=21; 95.5%); black, non-Hispanic (n=9; 40.9%); aged 20–24 years (n=8; 36.4%); in the Army (n=17; 77.3%); enlisted (n=19; 86.4%); and in combat-specific occupations (n=11; 50.0%). Four active component service members were medically evacuated from Iraq/Afghanistan for exertional rhabdomyolysis; all of these cases occurred from May through September **(data not shown)**.

EDITORIAL COMMENT

This report documents a modest decline in the annual rates of diagnoses of exertional rhabdomyolysis among active component members of the U.S. military in the past 2 years. Exertional rhabdomyolysis continued to occur most frequently from late spring through early fall at installations that support basic combat/recruit training or major Army or Marine Corps combat units.

The risks of heat injuries, including exertional rhabdomyolysis, are increased among individuals who suddenly increase overall levels of physical activity, recruits who are not physically fit when they begin training, and recruits from relatively cool and dry climates who may not be acclimated to the high heat and humidity at training camps in the summer.[2,3] Soldiers and Marines in combat units often conduct rigorous unit physical training, personal fitness training, and field training exercises regardless of weather conditions. Thus, it is not surprising that incidence rates of exertional rhabdomyolysis are highest among recruit trainees and service members from the Northeast region of the United States and that recruit camps and installations with large ground combat units account for most of these cases.

TABLE 2. Incident cases of exertional rhabdomyolysis by installation (with at least 20 cases during the period), active component, U.S. Armed Forces, 2009–2013

Location of diagnosis	No.	% total
Fort Bragg, NC	276	15.4
MCRD Parris Island/ Beaufort, SC	206	11.5
MCB Camp Lejeune/ Cherry Pt, NC	70	3.9
MCB Camp Pendleton, CA	65	3.6
Fort Jackson, SC	64	3.6
JBSA Lackland, TX	51	2.9
Fort Hood, TX	51	2.9
Fort Benning, GA	50	2.8
Fort Shafter, HI	43	2.4
NMC San Diego, CA	39	2.2
MCB Quantico, VA	37	2.1
Fort Bliss, TX	34	1.9
Fort Belvoir, VA	32	1.8
Fort Campbell, KY	29	1.6
Fort Stewart, GA	27	1.5
NMC Portsmouth, VA	25	1.4
Fort Carson, CO	24	1.3
Eglin AFB, FL	22	1.2
Fort Riley, KS	20	1.1
Other locations	623	34.8
Total	1,788	100.0

Prior to 2013, the annual incidence rates in black, non-Hispanic service members were consistently higher than the rates among members of other racial/ethnic subgroups. This observation has been attributed, at least in part, to an increased risk of exertional rhabdomyolysis among individuals with sickle cell trait (SCT).[4-6] Although the association between SCT and exertional rhabdomyolysis has a high relative risk, the population attributable risk remains low given the low prevalence of SCT in this population. In 2013, however, the rate among Asian/Pacific Islanders was the highest of all racial/ethnic groups. Although the annual incidence rates for this group have been on the increase since 2009, the reasons for such a trend are unknown. Supervisors at all levels should assure that guidelines to prevent heat injuries are consistently implemented and should be vigilant for early signs of exertional heat injuries, including rhabdomyolysis, among all service members.

The findings of this report should be interpreted with consideration of its limitations. A diagnosis of "rhabdomyolysis" alone does not indicate the cause. Ascertainment of the probable causes of cases of exertional rhabdomyolysis was attempted by using a combination of ICD-9 diagnostic codes related to rhabdomyolysis with additional codes indicative of the effects of exertion, heat, or dehydration. Furthermore, other ICD-9 codes were used to exclude cases of rhabdomyolysis that were secondary to trauma, intoxication, or adverse drug reactions.

The measures that are effective at preventing exertional heat injuries in general apply to the prevention of exertional rhabdomyolysis. In the military training setting, the intensity and duration of exercise and adherence to prescribed work-rest cycles during strenuous physical activities should be adapted not only to ambient weather conditions but also to the fitness levels of participants in strenuous activities. The physical activities of overweight and/or previously sedentary new recruits should increase gradually and be closely monitored. Water intake should comply with current guidelines and be closely supervised. Strenuous activities during relatively cool mornings following days of high heat stress should be particularly closely monitored; in the past, such situations have been associated with increased risk of exertional heat injuries (including rhabdomyolysis).[7] Commanders and supervisors at all levels should be aware of and alert for early signs of exertional heat injuries 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 or swelling, limited range of motion, or the excretion of dark urine (possibly due to myoglobinuria) after strenuous physical activity, particularly in hot, humid weather. Clinical practice guidelines for managing exertional rhabdomyolysis can be found at: http://champ.usuhs.mil/hpl/ExertionalRhabdomyolysis.pdf.

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Update: Exertional Hyponatremia, Active Component, U.S. Armed Forces, 1999–2013

From 1999 through 2013, there were 1,406 incident diagnoses of exertional hyponatremia among active component members of the U.S. Armed Forces. Annual incidence rates rose sharply from 2008 to 2010 but decreased by 59 percent from 2010 to 2013. In 2013, there were fewer incident cases (n=73) than in any of the previous 9 years. The recent decrease in overall rates reflects sharply declining rates in the Marine Corps and slight decreases in the other Services. Relative to their respective counterparts, crude incidence rates of exertional hyponatremia for the entire 15-year surveillance period were higher among females, those in the youngest age group, Marines, recruit trainees, and "other" military occupations. Service members (particularly recruit trainees) and their supervisors must be vigilant for early signs of heat-related illnesses and must be knowledgeable of the dangers of excessive water consumption and the prescribed limits for water intake during prolonged physical activity (e.g., field training exercises, personal fitness training, recreational activities) in hot, humid weather.

Hyponatremia, which is defined as an abnormally low concentration of sodium in the blood (i.e., serum sodium concentration <135 mEq/L), 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, excessive sodium losses in sweat, and inadequate sodium intake during prolonged physical exertion (exertional hyponatremia), particularly during heat stress.[1–4]

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 various 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 (e.g., 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 and compromise life-sustaining functions that are controlled by the cardiorespiratory centers of the brain stem.[1–3]

During the summer of 1997, Army training centers reported five hospitalizations of soldiers for hyponatremia secondary to excessive water consumption during military training in hot weather—one case was fatal and several others required intensive medical care.[5] In April 1998, the U.S. Army revised the guidelines for fluid replacement during military training in heat so as to protect service members from not only heat injury, but also 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.[6] During the unusually hot summer of 1998 that followed, even though rates of heat injuries among soldiers were 45 percent higher than in 1997, rates of overhydration/hyponatremia declined slightly overall and by nearly two-thirds among the subgroups of historically highest risk—the youngest and most junior soldiers.[6]

This report uses a surveillance case definition for exertional hyponatremia to estimate frequencies, rates, trends, geographic locations, and demographic and military characteristics of exertional hyponatremia cases among U.S. military members from 1999 through 2013.

METHODS

The surveillance period was 1 January 1999 through 31 December 2013. The surveillance population included all individuals who served in an active component of the U.S. Armed Forces at any time during the surveillance period. The Defense Medical Surveillance System (DMSS) maintains electronic records of all actively serving U.S. military members' hospitalizations and ambulatory visits in U.S. military and civilian (contracted or purchased care through the Military Health System) medical facilities worldwide; the DMSS also maintains records of medical encounters of service members deployed to Southwest Asia/Middle East (as documented in the Theater Medical Data Store).

For surveillance purposes, a 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) and no other illness or injury-specific diagnoses (ICD-9-CM: 001–999) in any diagnostic position; or both a diagnosis of "hyposmolality and/or hyponatremia" (ICD-9-CM: 276.1) and at least one of the following within the first three diagnostic positions: "fluid overload" (ICD-9-CM: 276.6), "alteration of consciousness" (ICD-9-CM: 780.0x), "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, or other major mental disorders; endocrine (e.g., pituitary, adrenal) disorders; kidney diseases; intestinal infectious diseases; cancers; major traumatic injuries; or complications of medical care in any diagnostic position. Each individual could be included as a case only once per calendar year.

For surveillance purposes, a "recruit trainee" was defined as an enlisted active component member (grades E1–E4) who was assigned to one of the services' 10 recruit training locations (per the individual's initial military personnel record). For this report, each service member was considered a recruit trainee for the period of time corresponding to the usual length of recruit training in his or her service. Recruit trainees were considered a separate category of enlisted service members in summaries of exertional hyponatremia by military status overall.

Records of medical evacuations from the U.S. Central Command (CENTCOM) area of responsibility (AOR) (e.g., Iraq, Afghanistan) to a medical treatment facility outside the CENTCOM AOR were analyzed separately. Evacuations were considered case-defining if the affected service members met the above criteria in a permanent military medical facility in the U.S. or Europe from 5 days before to 10 days after their evacuation dates.

RESULTS

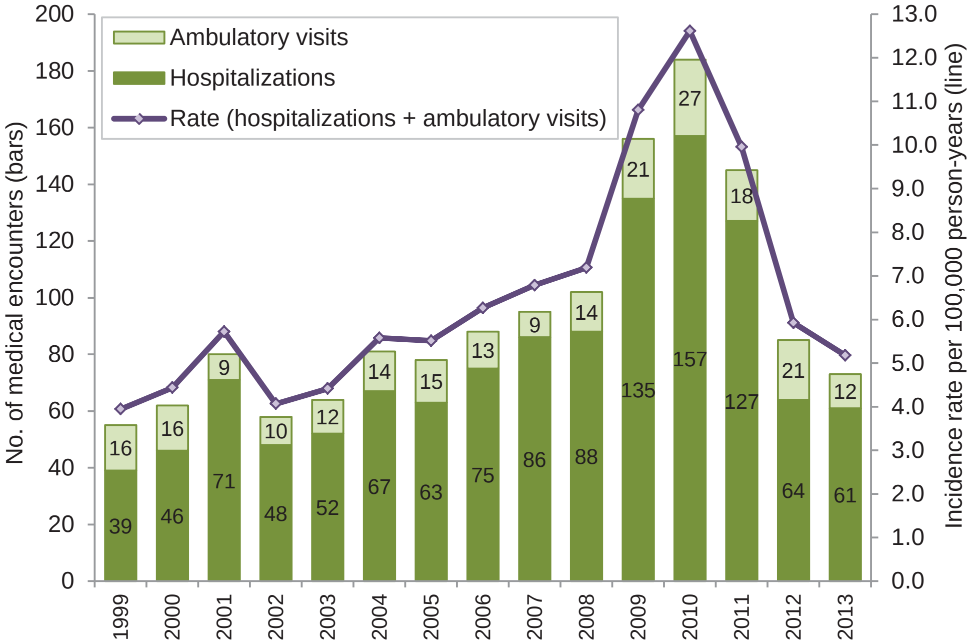
From 1999 through 2013, permanent medical facilities reported 1,406 incident diagnoses of exertional hyponatremia among active component service members (incidence rate: 6.6 per 100,000 person-years [p-yrs]) **(Table 1)**. From 2008 to 2010, annual incident cases and incidence rates increased by 80 percent and 75 percent, respectively **(Figure 1)**. However, since the peak in 2010 (12.6 per 100,000 p-yrs), incidence rates have decreased by 59 percent. The 73 diagnoses of exertional hyponatremia (incidence rate: 5.2 per 100,000 p-yrs)

TABLE 1. Incident diagnoses and incidence rates[a] of exertional hyponatremia, active component, U.S. Armed Forces, 1999–2013

	2013		Total 1999–2013	
	No.	Rate[a]	No.	Rate[a]
Total	73	5.2	1,406	6.6
Sex				
Male	61	5.1	1,167	6.4
Female	12	5.7	239	7.7
Age group				
<20	10	11.2	205	13.3
20–24	18	4.1	431	6.2
25–29	12	3.5	259	5.5
30–34	11	4.8	142	4.5
35–39	10	6.3	162	6.0
40+	12	7.8	207	9.2
Race/ethnicity				
White, non-Hispanic	49	5.6	967	7.2
Black, non-Hispanic	8	3.6	168	4.6
Hispanic	6	3.7	137	6.3
Asian/Pacific Islander	4	7.0	55	6.6
Other/unknown	6	6.1	79	6.1
Service				
Army	26	4.9	495	6.5
Navy	16	5.1	204	3.9
Air Force	8	2.4	293	5.7
Marine Corps	21	10.8	391	14.1
Coast Guard	2	4.9	23	3.9
Military Status				
Recruit trainee	6	20.6	125	29.0
Enlisted	47	4.1	1,032	5.9
Officer	20	8.1	249	7.1
Military occupation				
Combat-specific	12	6.3	206	7.7
Armor/motor transport	2	3.7	51	5.5
Pilot/air crew	2	3.8	41	5.1
Repair/engineering	15	3.7	261	4.2
Communications/intelligence	15	4.9	235	4.9
Health care	4	3.3	113	6.5
Other	23	8.4	499	12.1
Home of record[b]				
Midwest	13	5.2	223	6.5
Northeast	8	4.4	177	6.9
South	34	5.9	547	6.9
West	11	3.5	228	5.5
Other/unknown	7	8.2	231	7.0

[a]Rate per 100,000 person-years
[b]Home of record self-reported at entry into service

FIGURE 1. Incident diagnoses and incidence rates of exertional hyponatremia, active component, U.S. Armed Forces, 1999–2013



among active component members in 2013 represented the lowest annual number of cases and incidence rate since 2003 (64 cases; incidence rate: 4.4 per 100,000 p-yrs).

In 2013, the Army had the highest number of cases (n=26) among the Services, but the highest incidence rate was in the Marine Corps (10.8 per 100,000 p-yrs) **(Table 1)**. During the 15-year surveillance period, the overall crude incidence rate was highest in the Marine Corps (14.1 per 100,000 p-yrs), intermediate in the Army and Air Force (6.5 and 5.7 per 100,000 p-yrs, respectively), and lowest in the Navy and Coast Guard (3.9 and 3.9 per 100,000 p-yrs, respectively) **(Table 1, Figure 2)**. In the Marine Corps, the annual crude rate increased by more than 3-fold between 2002 and 2010, but then decreased 62 percent from 2010 to 2013. In each service, annual incidence rates decreased between 2010 and 2013.

In 2013, 84 percent of exertional hyponatremia cases (n=61) affected males, but the rate during the year was higher among females (5.7 per 100,000 p-yrs) than males (5.1 per 100,000 p-yrs) **(Table 1)**. During the entire surveillance period, the incidence rate was higher among females than males.

In 2013 and during the surveillance period overall, the highest age group–specific incidence rates affected the youngest (<20 years) and oldest (40+ years) service members **(Table 1)**. Also, during the surveillance period overall, rates were higher among white, non-Hispanic service members than other racial/ethnic groups. Although recruit trainees accounted for only 9 percent (n=125) of all cases of hyponatremia overall (n=1,406), the annual and overall rates among trainees were considerably higher than among other enlisted members and officers. Among categories of military occupations, service members in "other" occupations had the highest rates. No consistent relationships were found between exertional hyponatremia rates and home of record.

Exertional hyponatremia by location

During the 15-year surveillance period, exertional hyponatremia cases were diagnosed at U.S. military medical facilities at more than 200 locations; however, six locations experienced 40 or more cases each and accounted for nearly one-third of all cases **(Table 2)**. The location with the most cases overall was the Marine Corps Recruit Depot (MCRD) Parris Island/Beaufort, SC (n=185); however, the counts of cases at this location in recent years (2012, n=6; 2013, n=10) were the lowest since 2006 (n=2) **(data not shown)**.

Exertional hyponatremia in Iraq and Afghanistan

Between 2005 and 2013, 105 cases of exertional hyponatremia were diagnosed and treated in Iraq and Afghanistan. Deployed service members who were affected by exertional hyponatremia were most frequently male (n=74; 70%); white, non-Hispanic (n=63; 60%); aged 20–24 years (n=41; 39%); in the Army (n=70; 67%); enlisted (n=90; 86%); and in communications/intelligence (n=25; 24%) and

FIGURE 2. Incidence rates of exertional hyponatremia by service, active component, U.S. Armed Forces, 1999–2013

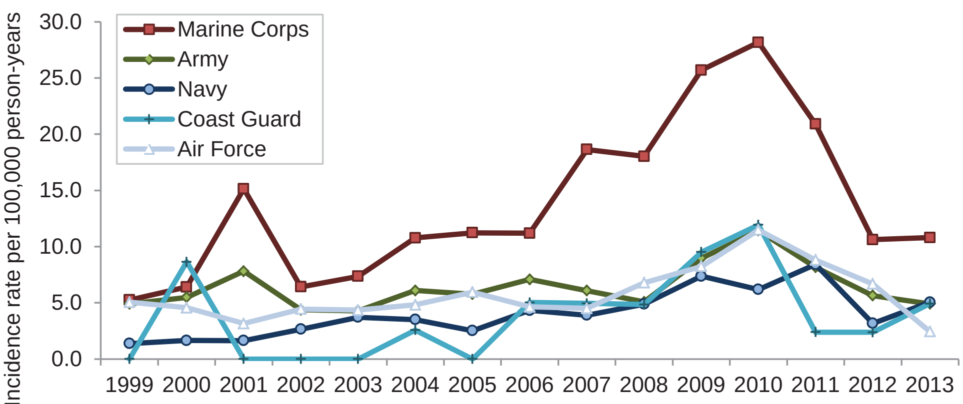


TABLE 2. Incident cases of exertional hyponatremia by installation (with at least 20 cases during the period), active component, U.S. Armed Forces, 1999–2013

Location of diagnosis	No.	%
MCRD Parris Island/ Beaufort, SC	185	13.2
Fort Benning, GA	89	6.3
JBSA Lackland, TX	49	3.5
MCB Camp Lejeune/ Cherry Point, NC	46	3.3
Walter Reed NMMC, MD[a]	44	3.1
Fort Bragg, NC	42	3.0
NMC Portsmouth, VA	36	2.6
MCB Camp Pendleton, CA	35	2.5
NMC San Diego, CA	34	2.4
Fort Jackson, SC	30	2.1
MCB Quantico, VA	29	2.1
Fort Leonard Wood, MO	25	1.8
Other locations	762	54.2
Total	1,406	100.0

[a]Walter Reed National Military Medical Center (NMMC) is a consolidation of National Naval Medical Center (Bethesda, MD) and Walter Reed Army Medical Center (Washington, DC). This number represents the sum of the two sites prior to the consolidation (November 2011) and the number reported at the consolidated location.

repair/engineering (n=24; 23%) occupations **(data not shown)**. During the 9-year period, nine service members were medically evacuated from Iraq or Afghanistan for exertional hyponatremia **(data not shown)**.

EDITORIAL COMMENT

This report documents that, after a long period of increasing numbers and rates of exertional hyponatremia diagnoses among active component U.S. military members, numbers and rates of diagnoses have declined sharply since 2010. In the past 3 years, rates have declined in all of the Services, but particularly in the Marine Corps.

The results of this report should be interpreted with consideration of several limitations. For example, there is no diagnostic code specific for "exertional hyponatremia." Thus, for surveillance purposes, cases of presumed exertional hyponatremia were ascertained from records of medical encounters that included diagnoses of "hyposmolality and/or hyponatremia," but not of other conditions (e.g., metabolic, renal, psychiatric, or iatrogenic disorders) that increase the risk of hyponatremia in the absence of physical exertion or heat stress. As such, the results of this analysis 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, rates, trends, and correlates of risk depends on the completeness and accuracy of diagnoses that are reported on standardized records of relevant medical encounters. As a result, an increase in reporting of diagnoses indicative of exertional hyponatremia may reflect, at least in part, increasing awareness of, concern regarding, and aggressive management of incipient cases by military supervisors and primary healthcare providers.

In the past, concerns about hyponatremia from excessive water consumption were focused at training installations (particularly recruit training). In this analysis, rates were relatively high among the youngest—hence, the most junior—service members, and the most cases were diagnosed at medical facilities that support large recruit training centers and large Army and Marine Corps combat units (e.g., MCRD Parris Island/Beaufort, SC; Fort Benning, GA; Camp Lejeune/Cherry Point, NC; Fort Bragg, NC). In many circumstances (e.g., recruit training, Ranger School), military trainees rigorously adhere to standardized training schedules, regardless of weather conditions. In hot, humid weather, commanders, supervisors, instructors, and medical support staff must be aware of and enforce guidelines for work-rest cycles and water consumption.

In 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 during prolonged physical activity (e.g., field training exercises, personal fitness training, and recreational activities) in hot, humid weather. The current U.S. Military Fluid Replacement Guidelines can be found at: http://hprc-online.org/nutrition/hprc-articles/files/current-u-s-military-fluid-replacement.

Female service members had higher rates of hyponatremia in 2013 and overall during the surveillance period. Females may be at greater risk because of lower fluid requirements and longer periods of exposure to risk during some training exercises (e.g., land navigation courses, load-bearing marches).[4] Service members (particularly recruit trainees and females) and their supervisors must be vigilant for early signs of heat-related illnesses, and immediately and appropriately (but not excessively) intervene in such cases.

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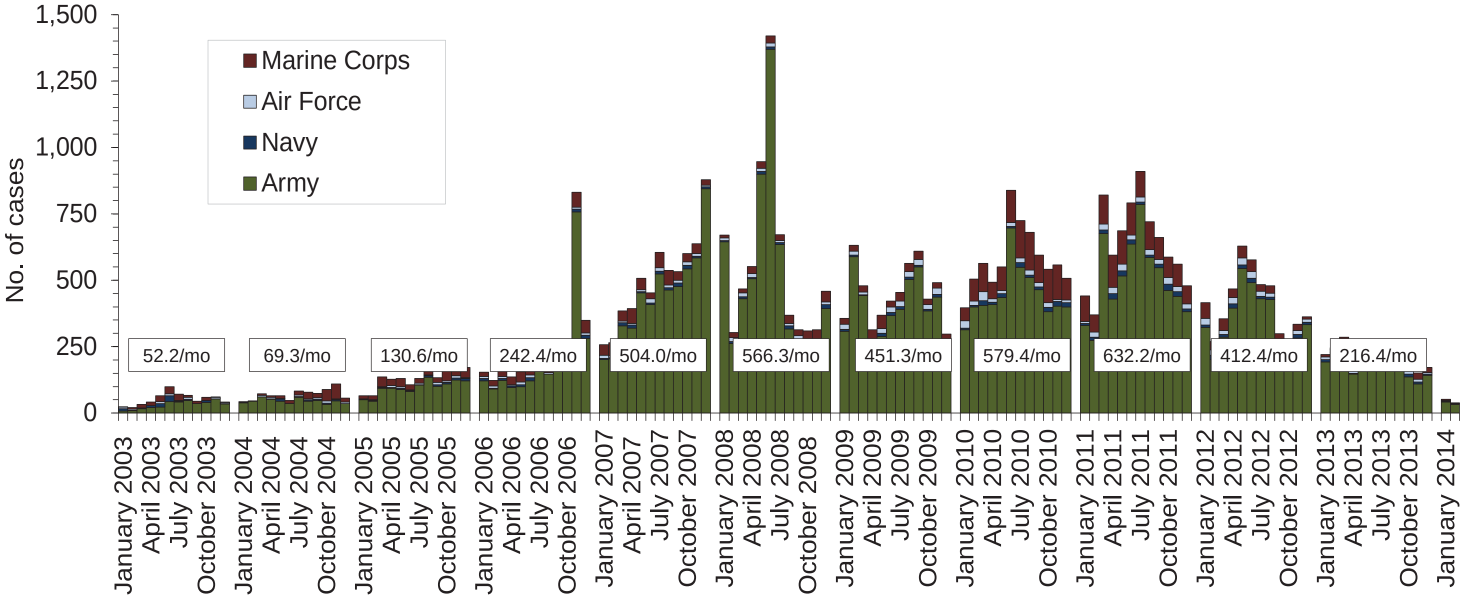
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–February 2014 (data as of 20 March 2014)

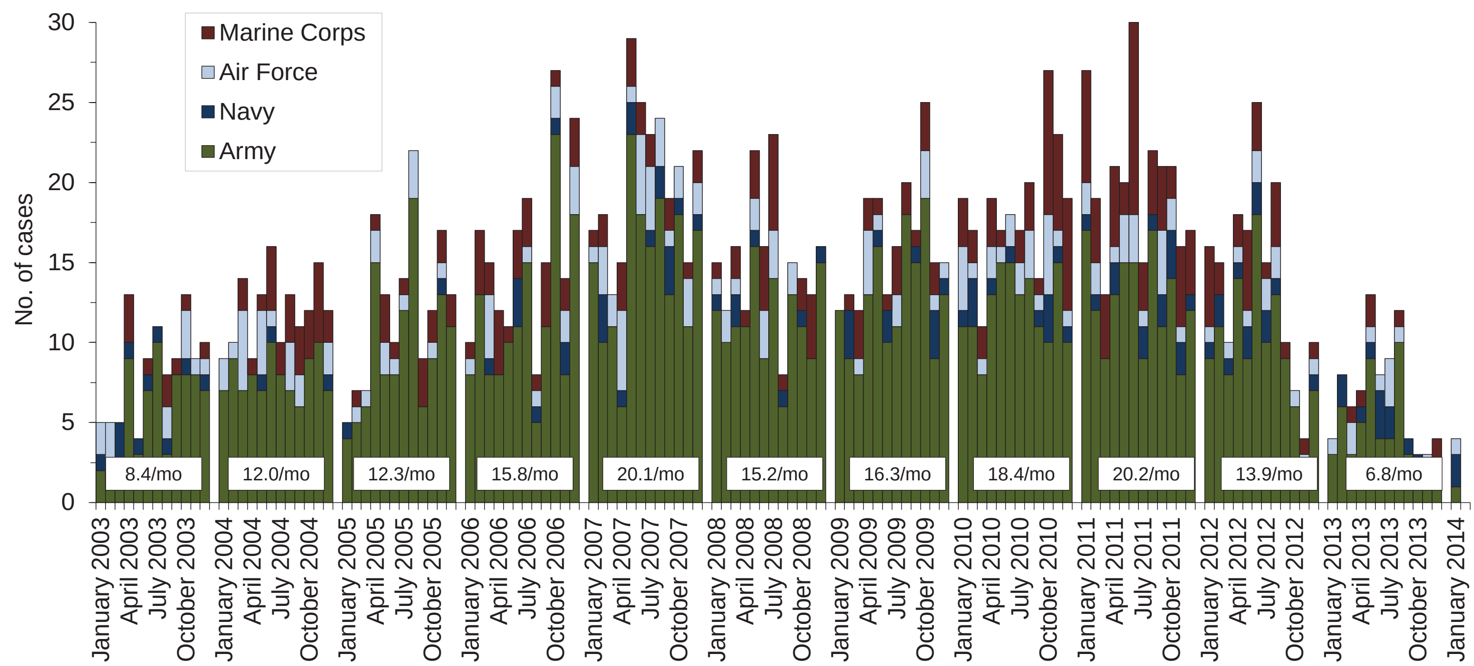
Traumatic brain injury (TBI) (ICD-9: 310.2, 800–801, 803-804, 850–854, 907.0, 950.1–950.3, 959.01, V15.5_1–9, V15.5_A–F, V15.52_0–9, V15.52_A–F, V15.59_1–9, V15.59_A–F)[a]



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 deployment (Includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 4,439 deployers who had at least one TBI-related medical encounter any time prior to deployment).

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]

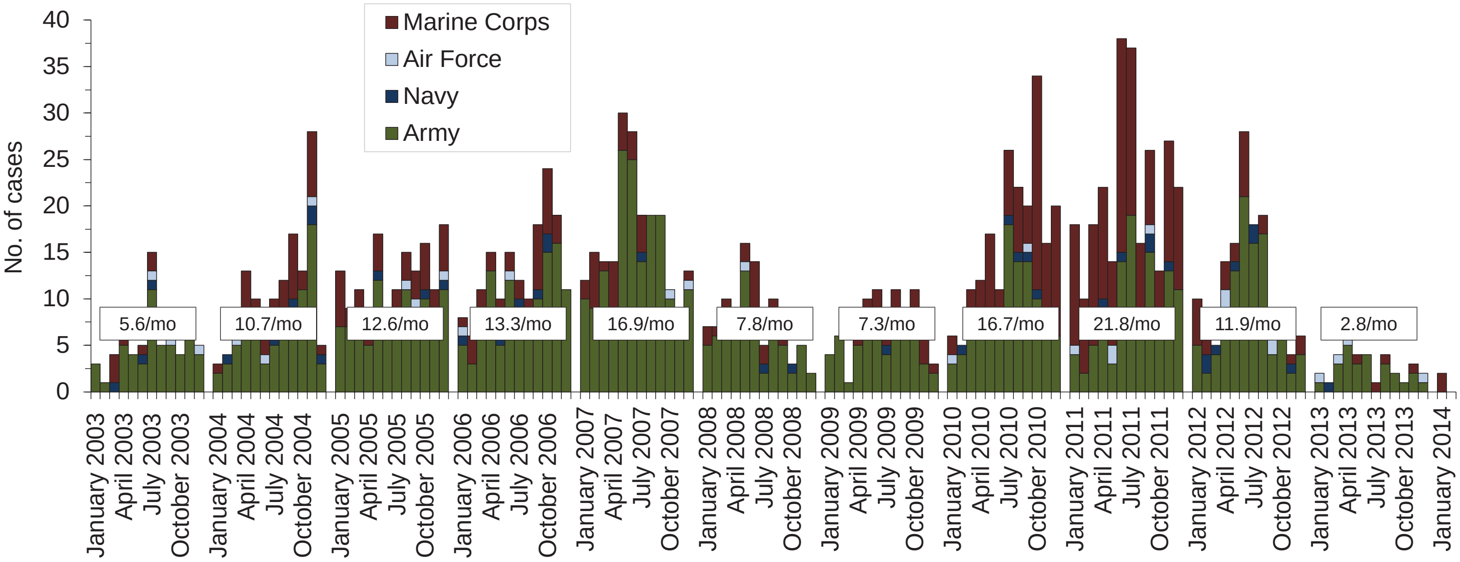


Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379–383.

[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 deployment.

Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–February 2014 (data as of 20 March 2014)

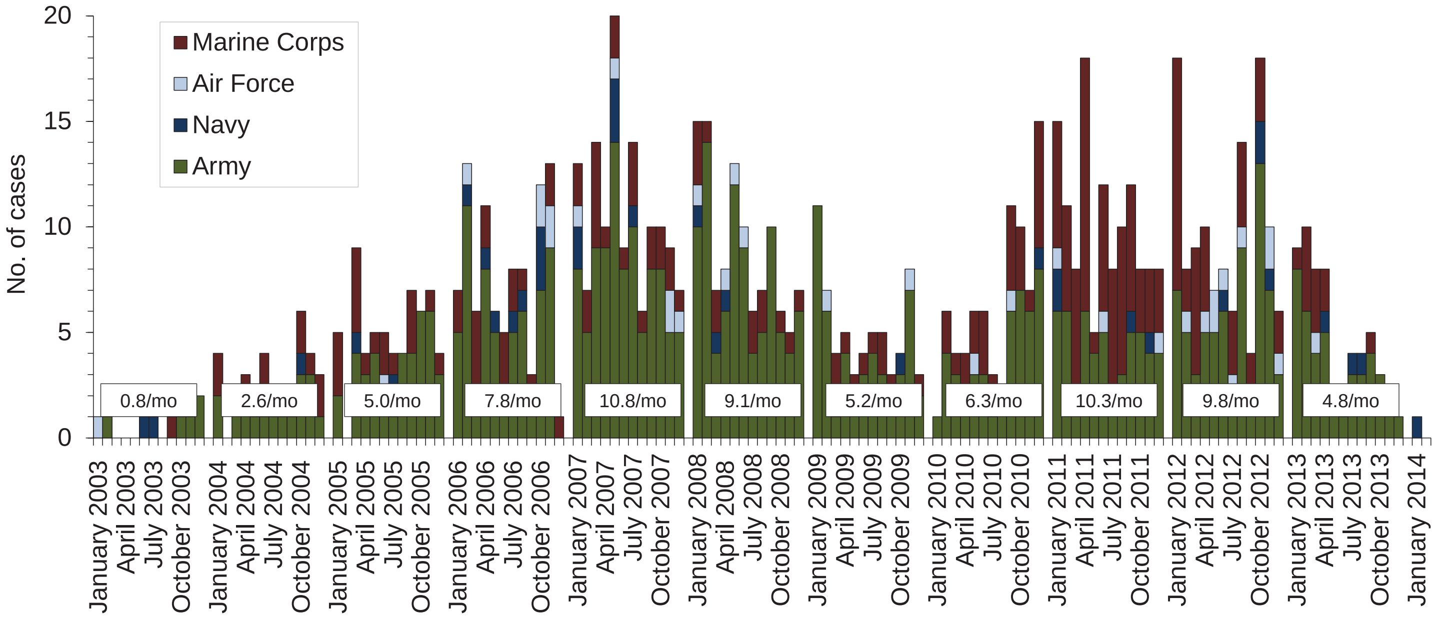
Amputations (ICD-9-CM: 887, 896, 897, V49.6 except V49.61–V49.62, V49.7 except V49.71–V49.72, PR 84.0–PR 84.1, except PR 84.01–PR 84.02 and PR 84.11)[a]



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 deployment.

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 deployment.

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