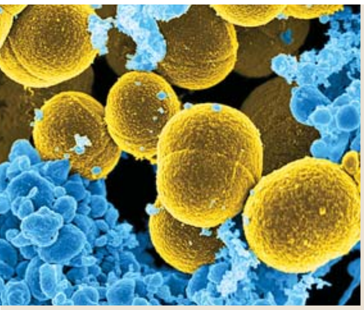
JULY 2015

Volume 22
Number 7

MSMR

MEDICAL SURVEILLANCE MONTHLY REPORT



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A publication of the Armed Forces Health Surveillance Center

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Form Approved
OMB No. 0704-0188

1. REPORT DATE **JUL 2015**	2. REPORT TYPE	3. DATES COVERED **00-00-2015 to 00-00-2015**

4. TITLE AND SUBTITLE **Medical Surveillane Monthly Report,Volume 22,Number 7**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Armed Forces Health Surveillance Center,,11800 Tech Road, Suite 220 (MCAF-CS),,Silver Spring,,MD,20904**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**25**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

Epidemiology, Microbiology, and Antibiotic Susceptibility Patterns of Skin and Soft Tissue Infections, Joint Base San Antonio–Lackland, Texas, 2012–2014

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Skin and soft tissue infections (SSTIs), including those caused by methicillin-resistant *Staphylococcus aureus* (MRSA), are common in military training environments. In 2014, the healthcare providers for trainees at Joint Base San Antonio (JBSA)–Lackland, TX, notified the surveillance unit of increased antibiotic resistance reported on wound cultures of purulent SSTIs. To provide updated clinical guidance to local providers, the surveillance unit conducted a review of all SSTIs diagnosed among trainees at JBSA-Lackland between 1 October 2012 and 31 December 2014. SSTI cumulative incidence during the surveillance period was 0.81%, with similar rates between males (0.80%) and females (0.84%) and between basic (0.82%) and technical (0.79%) trainees. Of 772 total cases, 254 were cultured; 196 resulted in growth of one or more pathogens: MRSA (n=110); methicillin-sensitive *S. aureus* (n=68); other gram-positive cocci (n=5); and gram-negative rods (n=18). In vitro activity of commonly used antibiotics against *S. aureus* isolates dropped slightly from the previous surveillance period. In addition to novel antibiotic research and development, these trends warrant enhanced local preventive efforts and close adherence to evidence-based treatment algorithms.

Military training is considered a high-risk setting for the transmission of methicillin-resistant *Staphylococcus aureus* (MRSA),[1] a gram-positive bacterium that has emerged as a leading cause of skin abscess around the world.[2] Approximately one in 500 persons who entered U.S. Air Force basic military training (BMT) between October 2008 and September 2012 was diagnosed with a skin and soft tissue infection (SSTI). Fifty-five percent of the cases cultured grew MRSA, and most strains were sensitive to the commonly prescribed oral antibiotics: trimethoprim-sulfamethoxazole (100%); tetracycline (96%); and clindamycin (92%).[3] The investigators used these data and the clinical practice guidelines from the Infectious Diseases Society of America[4] to make the following recommendations to trainees' health providers at Joint Base San Antonio (JBSA)–Lackland, TX, for treating purulent SSTIs (i.e., those SSTIs that contain or exude pus, such as abscess): perform incision and drainage as mainstay therapy; treat all abscesses as MRSA unless a wound culture proves otherwise; and use trimethoprim-sulfamethoxazole as the first-line agent in sulfa non-allergic patients.

However, in 2014, providers notified the trainee health surveillance unit of increased antibiotic resistance among cultured abscesses, including the first case of trimethoprim-sulfamethoxazole resistance. To provide clinical guidance based on updated local data, the surveillance unit began gathering information on SSTIs among trainees since October 2012. This report presents the findings of the outbreak investigation, including the current epidemiology, microbiology, and antibiotic susceptibilities of SSTIs in military trainees at JBSA-Lackland.

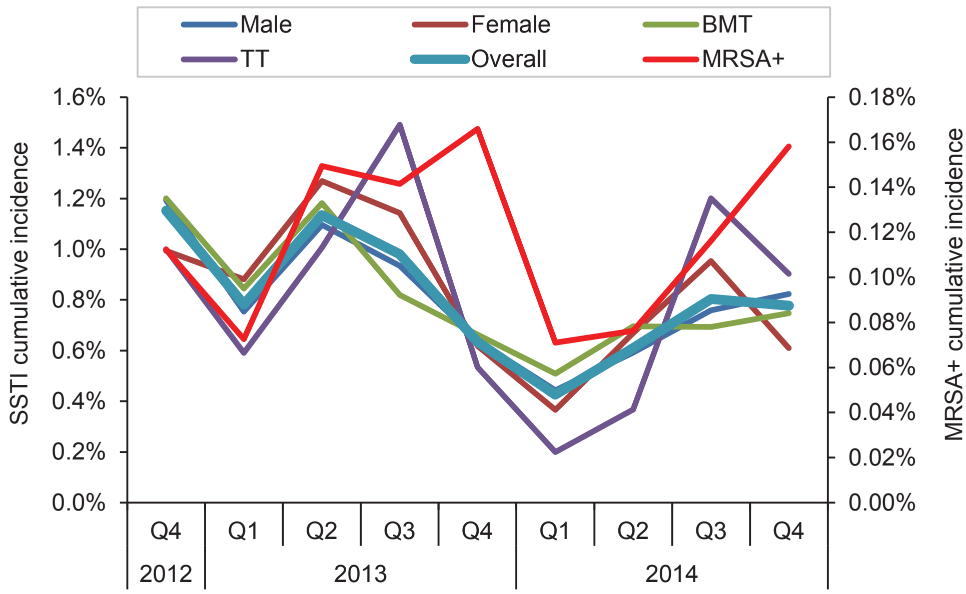
METHODS

SSTI cases were ascertained from the local disease and non-battle injury database, which contains demographic and training information on all trainees assigned to JBSA-Lackland, as well as all diagnoses recorded during their outpatient and inpatient medical encounters. The database was queried for ICD-9 diagnostic codes commonly associated with SSTI: 680.x (carbuncle and furuncle), 681.x (cellulitis and abscess of finger and toe), and 682.x (other cellulitis and abscess) between 1 October 2012 and 31 December 2014. To avoid duplicate counting, cases were limited to one per trainee during the surveillance period. Chart reviews were performed on all identified cases to determine whether SSTIs were cultured and, if so, the microbiologic and antibiotic sensitivity results. Post hoc chart reviews were also performed on all cases (n=66) with follow-up encounters 14 or more days after the initial encounter, to explore possible patterns and frequency of relapse. Follow-up encounters before 14 days were assumed to likely represent repacking of abscesses after incision and drainage.

Cases were classified by sex, body location (per ICD-9 code), training status (basic military training [BMT] or technical training [TT]), quarter in which they were first diagnosed, and week of training, if BMT. Training status was considered BMT if the encounter date preceded either the BMT graduation or TT start date, or, when these dates were missing, if the encounter date occurred within 9 weeks of the BMT start date. Cultured cases were stratified by the bacterial pathogen(s) grown, if any, and the antibiotic(s) to which the pathogens were shown to be resistant during in vitro testing. By using the total counts of males and females who began BMT and TT during each quarter, cumulative and quarterly incidence proportions of SSTI and MRSA infections were calculated. Proportions of cultured cases by pathogen, antibiotic sensitivity, and week of BMT were also calculated.

Analyses were performed using online statistical software (http://www.openepi.com and http://www.socscistatistics.com/tests) and included Mann-Whitney U test for non-parametric continuous variables and chi-square test for categorical variables. P-values less than 0.05 were considered statistically significant, with all p-values based on two-sided tests.

FIGURE 1. Quarterly incidence of methicillin-resistant *Staphylococcus aureus* (MRSA) cases of skin and soft tissue infection (SSTI), and of all SSTI by sex and training status



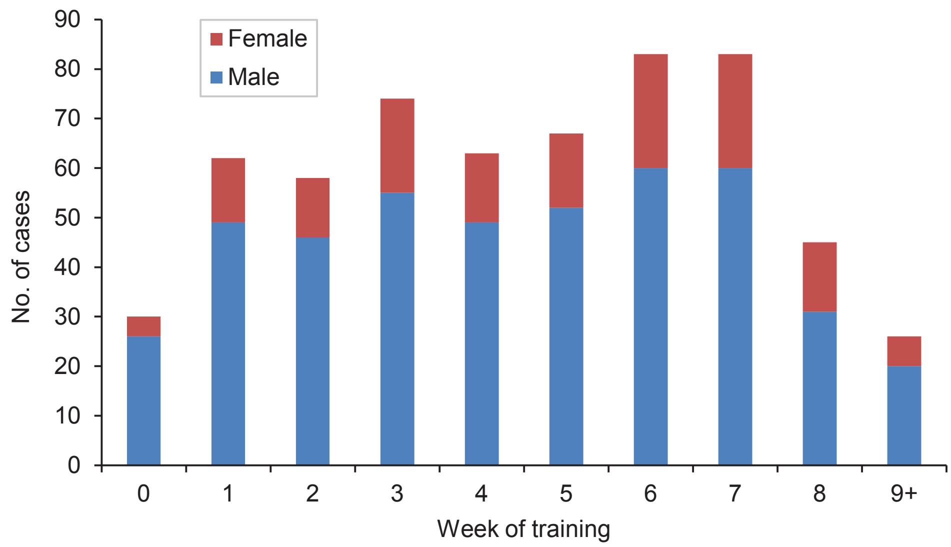
BMT=basic military training; TT=technical training

RESULTS

During the 27-month surveillance period, 772 trainees were diagnosed with at least one SSTI, for an overall cumulative incidence of 0.81%. Incidence was similar between males (0.80%) and females (0.84%), as well as between trainees in BMT (0.82%) and TT (0.79%) **(data not shown)**. Incidence trends over time were similar among all subpopulations **(Figure 1)**. In BMT, nearly 30% of cases occurred during weeks 6 and 7 of training **(Figure 2)**.

Of the 772 cases included in the analysis, 254 (32.9%) were cultured, and at least one pathogen was identified in 196 (77.2%) of these cases **(Table 1)**. Among all cultures, 178 (70.1%) grew *S. aureus*, 110 (61.8%) of which were classified as MRSA. The cumulative incidence of MRSA was 0.12% overall and ranged from 0.07% to 0.17% per quarter **(Figure 1)**. The proportions of *S. aureus* cases that were MRSA positive were highest during the fourth quarters (October–December) of 2013 and 2014 **(Figure 3)**. The remaining positive cultures grew various other gram-positive cocci and gram-negative rods **(Table 1)**. Culture-confirmed MRSA and methicillin-sensitive *S. aureus* (MSSA) cases were similar by age (p=0.56), training status (p=0.38), and SSTI location (p=0.66), but the proportion of cases growing MRSA was higher in females (81%) than in males (58%) (p=0.02) **(Table 2)**. Antibiotic susceptibilities of *S. aureus* isolates ranged from 29% (erythromycin-azithromycin) to 100% (vancomycin); these results are presented in an antibiogram **(Table 3)**.

FIGURE 2. Count of skin and soft tissue infections by week of basic training, stratified by sex



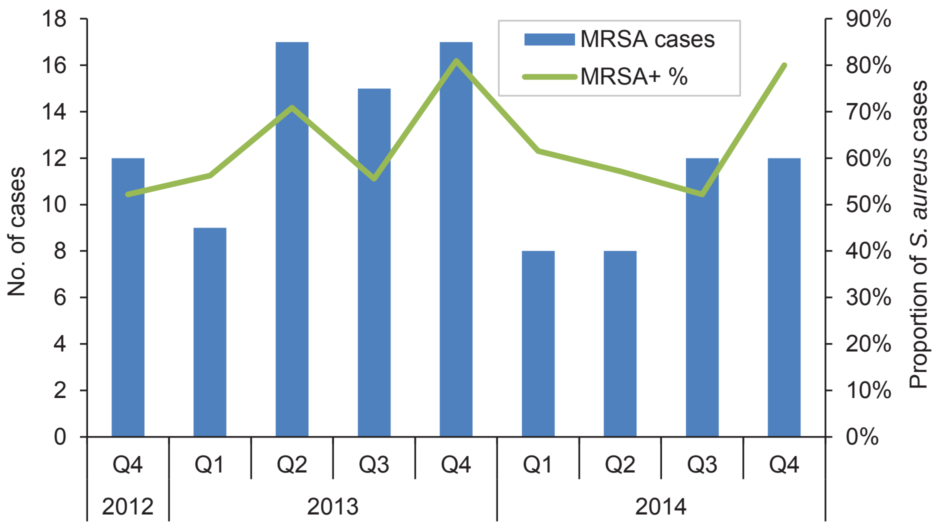
Relapses were rare, affecting just 0.8% of trainees with a diagnosed SSTI. All six cases were initially treated with incision and drainage and trimethoprim-sulfamethoxazole (two double-strength [160–800 mg] tablets every 12 hours for 10 days). Wound culture results varied: MRSA (n=2); MSSA (n=2); *E. coli* (n=1); and no growth (n=1). Three cases required repeat incision, and five were treated with another course of oral antibiotics: clindamycin (n=2); doxycycline (n=1); levofloxacin (n=1); and a second course of trimethoprim-sulfamethoxazole (n=1).

TABLE 1. Results of skin and soft tissue infections cultured

Result	Cultured cases (n=254)[a]	% of total
Staphylococcus aureus		
Methicillin-resistant *S. aureus* (MRSA)	110	43.3
Methicillin-sensitive *S. aureus* (MSSA)	68	26.8
Other gram-positive cocci		
Enterococcus sp.	1	0.4
Group B *Streptococcus*	3	1.2
Group D *Streptococcus*	1	0.4
Gram-negative rods		
Acinetobacter baumannii	1	0.4
Escherichia coli	6	2.4
Eikenella corrodens	1	0.4
Haemophilus influenzae	1	0.4
Haemophilus parainfluenzae	1	0.4
Klebsiella pneumoniae	1	0.4
Proteus mirabilis	2	0.8
Pseudomonas aeruginosa	3	1.2
Serratia marcescens	2	0.8
Usual skin flora	42	16.6
No growth	16	6.3

[a]Some cultures grew out multiple organisms, so column total exceeds number of cultured cases.

FIGURE 3. Quarterly count of methicillin-resistant *Staphylococcus aureus* (MRSA) cases and proportion of all *S. aureus* cases that were MRSA positive



methodology was largely identical between the two surveillance periods, in the previous study more thorough chart reviews allowed the investigators to exclude a few cases that were obviously miscoded. However, these explanations are unlikely to account for such a dramatic increase. Rather, the increased numbers more likely reflect a true increased incidence, consistent with trends in some other populations.[5,6] Nonetheless, the cumulative incidence remains much lower than that reported in a similar time period at U.S. Army Infantry One Station Unit Training at Fort Benning, GA, during which 4.2% of soldiers developed an SSTI over a 14-week training period.[7]

The pathogen profile also shifted. Among wounds cultured during the two periods, a decreased percentage grew *S. aureus* (from 82.8% to 70.1%) and MRSA (from 55.2% to 43.3%). This is partly explained by an increase in cultures showing usual skin flora or no bacteriologic growth (from 14.9% to 22.8%), but it also reflects the expanding prevalence (from 1.1% to 7.1%) and diversity (from one pathogen to nine pathogens) of gram-negative rods. Because culture rates were similar in the two periods (30.1% vs. 32.9%), increased culturing is unlikely to account for this change.

Whereas the rate of community-associated MRSA among the entire U.S. Military Health System has moderately declined in recent years,[8] the cumulative incidence among trainees at JBSA-Lackland increased from 0.03% in the previous period to 0.12% in the current period. MRSA epidemiology among trainees otherwise mirrored other non-military populations. Among cultures growing *S. aureus*, MRSA was more likely among females than males. Although a slightly increased risk was also demonstrated among women in a large Northern California population,[9] an explanation for this finding has not been offered. If this discrepancy is validated in other military training populations, it may warrant increased hygiene education for female recruits. The seasonal pattern demonstrated here, in which MRSA rates peaked during October–December, after the summer surge of SSTIs, has been demonstrated in some[10,11] but not all[7] populations.

EDITORIAL COMMENT

SSTI epidemiology in the military training population at JBSA-Lackland has changed. Among basic trainees, the cumulative incidence rose from 0.19% in the previous surveillance period (October 2008–September 2012)[3] to 0.82% in the current period (October 2012–December 2014). This may reflect increased reporting of infections by trainees, increased surveillance by medical providers, or increased miscoding of lesions. Although the

TABLE 2. Methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-sensitive *S. aureus* (MSSA) comparison

Characteristic	MRSA (n=110)	MSSA (n=68)	p-value
Age, median (IQR)	20 (19–22.75)	20 (19–23.25)	0.56
Sex			
Male	84	62	0.02
Female	26	6	
Training status			
Basic training	85	48	0.38
Technical training	25	20	
SSTI location			
Lower extremity	19	13	0.66
Upper extremity	16	12	
Trunk, neck, face	10	8	
Buttock, groin	18	6	
Other/unspecified	47	29	

IQR=interquartile range; SSTI=skin and soft tissue infection

In addition to the higher rate and wider microbiologic diversity of SSTIs, drug resistance has also increased. In the prior analysis, in vitro testing of antibiotic activity against *S. aureus* isolates showed 100% susceptibility to trimethoprim-sulfamethoxazole, 98% to tetracyclines, and 94% to clindamycin. In this analysis, the respective susceptibilities dropped slightly to 98%, 96%, and 91%. These trends, along with the general concern regarding increased antibiotic resistance, support enhanced antibiotic research and development. Moreover, they reinforce the local practice of obtaining wound cultures and susceptibilities on purulent SSTIs for surveillance purposes (but not necessarily for treatment, as relapse rates in this population are low).

Incision and drainage remains the front-line treatment for purulent SSTIs. For certain trainees (e.g., TT students working in a classroom setting and not living in barracks), mild, purulent SSTIs may be treated with incision and drainage only.[12] In randomized trials, the use of trimethoprim-sulfamethoxazole following incision and drainage has not been shown to reduce treatment failure, although it has prevented future infections.[13] However, an antibiotic should be provided in moderate or severe cases, or when trainees are unable to ensure adequate covering of the infection site. Despite emerging resistance, trimethoprim-sulfamethoxazole and clindamycin should remain the primary outpatient antimicrobial therapies for purulent and non-purulent SSTIs in non-allergic patients.[14] For mild, non-purulent SSTIs, cephalexin alone without the addition of trimethoprim-sulfamethoxazole is an effective outpatient treatment.[12,15]

Although total prevention of SSTIs in a military training environment is difficult, limiting transmission is possible through basic preventive measures. First, and most importantly, all trainees should be repeatedly encouraged to maintain good hygiene and avoid contact with other persons' draining wounds and SSTIs. Opportunities and supplies for hand washing should be maximized, and hand sanitizer should be readily available in settings without running water.[16,17] Daily showering and frequent hand washing—typically defined as at least five times daily[17]—should be mandated, if possible. Additional measures beyond these standard hygiene practices, such as weekly use of chlorhexidine-based body wash, have not been shown to be effective in further reducing SSTIs or MRSA-positive SSTIs in randomized controlled trials, and thus are not recommended.[7] Second, protective gear should be worn during activities that pose an increased risk of skin trauma, such as obstacle courses. Third, the sharing of towels, grooming items, and other equipment should be minimized to the greatest extent possible. Equipment that must be shared, such as helmets and pugil sticks, should be cleansed between uses with an appropriate antiseptic.[16,17] Although a 1:10 dilution of ordinary bleach is commonly and appropriately used,[17] other disinfectants effective against MRSA are available; the U.S. Environmental Protection Agency has published a list of such alternatives.[18]

TABLE 3. Antibiogram (antibiotic susceptibilities) of *Staphylococcus aureus* isolates (% susceptible)

	Oxacillin/ dicloxacillin	Erythromycin/ azithromycin	Clindamycin[b]	Ciprofloxacin	Tetracycline	Trimethoprim/ sulfamethoxazole	Vancomycin	Moxifloxacin
MRSA (n=110)	0[a]	13	92	54	97	99	100	58
MSSA (n=68)	100[a]	56	88	82	94	96	100	82
S. aureus (n=178)	38	29	91	65	96	98	100	67

[a]By definition

[b]Among the 15 cases with clindamycin resistance, eight were inducible resistance.

MRSA=methicillin-resistant *S. aureus*; MSSA=methicillin-sensitive *S. aureus*

This study should be interpreted in light of its limitations. First, ascertainment of cases relied on ICD-9 codes entered by a variety of medical providers. Although these codes correspond to those used in other epidemiologic investigations,[19] providers may have coded SSTI diagnoses in another fashion. Second, pathogen and antibiotic sensitivity results are based only on SSTIs that were cultured. Because the decision to culture is based on provider preference, the data presented here reflect only SSTIs that were cultured. However, the data likely captured most purulent SSTIs, because the providers who perform all procedures on trainees during normal clinic hours reported sending culture specimens from all SSTIs that they treated. Third, lack of molecular characterization of *S. aureus* isolates, such as by pulsed-field gel electrophoresis, Panton-Valentine leukocidin, or *mecA* gene testing, prohibited further classification of antibiotic susceptibilities by MRSA subtype, which may allow for more tailored selection of medication.[20]

Adequately addressing the increased incidence of SSTIs and MRSA-positive SSTIs among trainees at JBSA-Lackland will require a concerted response from all involved. Training leadership and the trainees themselves must commit to the preventive measures outlined in this report. Trainee health providers are obligated to employ evidence-based treatment that includes incision and drainage, when possible, and the use of antibiotics only when indicated. Finally, preventive medicine support staff must continue ongoing active and passive surveillance of SSTI epidemiology and microbiology.

Disclaimer: The views expressed are those of the authors and do not necessarily reflect the official views of the Uniformed Services University of the Health Sciences, the U.S. Air Force, or the Department of Defense.

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Post-Deployment Screening and Referral for Risky Alcohol Use and Subsequent Alcohol-Related and Injury Diagnoses, Active Component, U.S. Armed Forces, 2008–2014

Lee Hurt, DrPH, MS

Risky alcohol use among service members is a threat to both military readiness and the health of service members. This report describes an analysis using the Defense Medical Surveillance System (DMSS) to identify all active component service members who returned from deployment and completed the Alcohol Use Disorders Identification Test–Consumption (AUDIT-C) alcohol use screen as part of the Post Deployment Health Assessment (PDHA) and Post Deployment Health Reassessment (PDHRA) during 2008–2014. This analysis identified that 3.4% of PDHA forms and 4.8% of PDHRA forms completed indicated severe risk for alcohol abuse, defined as an AUDIT-C score of 8 or higher. Among those at severe risk on the PDHRA who were not already under care for alcohol abuse, only 37.7% received a referral for treatment: 21.7% to primary care, 13.4% to behavioral health in primary care, 7.5% to mental health specialty care, and 5.6% to a substance abuse program. Referrals for treatment for those at severe risk were lower than their respective counterparts among males, white non-Hispanics, members of the Air Force, junior officers, and pilots/air crew. There were significant trends of increasing frequencies of subsequent injury and alcohol-related conditions as alcohol use levels increased.

Heavy alcohol consumption is a well-known cause of numerous health problems, including increased risk for injuries, cardiovascular conditions, several types of cancer (breast, mouth, esophagus, liver, colon), alcohol dependence, and fetal alcohol spectrum disorders (among children born to women who drank during pregnancy).[1] Alcohol use levels are defined in various ways according to frequency and amount consumed. The 2010 Dietary Guidelines for Americans defines moderate drinking for men as having up to two drinks per day, and no more than one drink per day for women.[2] Anything above these levels, including binge drinking (which is usually defined as five or more drinks per occasion for men and four or more drinks per occasion for women) represents risky alcohol use.[3] Heavy drinking by military service members is a concern because it may affect military readiness as well as the short- and long-term health of service members.

According to a 2013 Institute of Medicine (IOM) report, "Substance Use Disorders in the U.S. Armed Forces," current levels of substance use and misuse among military personnel and their dependents "constitute a public health crisis."[4] Results from the 2011 Department of Defense (DoD) Health Related Behaviors Survey of Active Duty Military Personnel found that hazardous alcohol use (defined as an Alcohol Use Disorders Identification Test [AUDIT] score of 8 or higher) was self-reported among 11.3% of respondents, and was substantially higher than self-reports of illicit substance use (1.3%).[5] Risk factors for risky alcohol use include having a genetic predisposition, permissive parental attitudes toward alcohol use, and peer pressure. Military service members have additional factors that may increase their risk, such as experiences of trauma, separation from family, combat-related mental health conditions, and discounted prices for alcohol on military installations.[4]

As a result of the high prevalence of risky alcohol use in the military, and because service members face many risk factors for alcohol abuse, the IOM report recommended that the DoD should implement routine screening for risky alcohol use. The report also recommended that the DoD implement early intervention and treatment programs for those who screen positive for risky use.[4] One occasion when routine screening for alcohol use was already being performed was at the time service members return from a deployment. Within 30 days of the end of an overseas deployment, service members are required to complete a Post Deployment Health Assessment (PDHA) questionnaire, and they must complete a Post Deployment Health Reassessment (PDHRA) questionnaire approximately 90–180 days after return from deployment. Both of these assessments contain an alcohol use screening tool with known psychometric properties called the Alcohol Use Disorders Identification Test–Consumption (AUDIT-C).[6] The requirement that each completed assessment be reviewed by a healthcare provider provides an opportunity for intervention and referral for treatment if risky alcohol use has been identified. The analysis described in this report was designed to describe the results of the alcohol use screens and to assess whether appropriate treatment was being recommended by the healthcare providers reviewing these assessments.

METHODS

The Defense Medical Surveillance System (DMSS) was used to identify all active component service personnel (Army, Navy, Air Force, Marine Corps) who returned from a deployment of at least 30 days duration under Operations Iraqi Freedom, Enduring Freedom, New Dawn, or Inherent Resolve (Iraq, Syria) and completed a PDHA form (DD2796) or a PDHRA form (DD2900) between 1 January 2008 and 31 December 2014. In cases where an individual service member completed more than one PDHA or PDHRA form for a given deployment, the most recent healthcare provider–certified form was used for this analysis. There may have been multiple PDHA and PDHRA forms completed by an individual service member, if he or she deployed more than once. These multiple forms were included because the alcohol use risk may have changed over time, and because if the risk was elevated and persisted, then the review of each form represented additional opportunities for healthcare providers to assess the risk and to recommend referral for treatment.

Both the PDHA and PDHRA forms contain a three-question screen, AUDIT-C, which is used widely to assess risky alcohol use **(Box 1)**. Service members completing the AUDIT-C alcohol use screen were categorized into four levels of alcohol use risk **(Box 2)**. Responses by the service member to additional alcohol-related questions that appeared on certain versions of the forms were analyzed by alcohol risk level. Responses by the healthcare provider reviewing and certifying the form regarding recommended referrals for treatment were also analyzed relative to alcohol risk level, and by service member demographics.

The DMSS contains administrative records for all medical encounters of military service members who are hospitalized or receive ambulatory care at military treatment facilities or through civilian purchased care. Medical encounters occurring after completion of each PDHA/PDHRA form through 31 December 2014 were searched for diagnoses of alcohol-related conditions **(Table 1)** in any diagnostic position. Medical encounters occurring after form completion through 31 December 2014 containing diagnoses for injuries **(Table 1)** in the primary diagnostic position were also identified. The frequency of these encounters was analyzed by alcohol risk level.

All data were analyzed using SAS v9.4 (SAS Institute, Cary, NC). Tests for statistically significant differences between groups were performed using the chi-square test. The Cochran-Armitage test was used to identify statistically significant trends. All tests were two-tailed and an alpha level below 0.05 was considered significant.

BOX 1. Alcohol Use Disorders Identification Test–Consumption (AUDIT-C)[a] screen[b]

Question 1: How often do you have a drink containing alcohol?

Possible response	Points
Never	0
Monthly or less	1
2–4 times a month	2
2–3 times per week	3
4 or more times a week	4

Question 2: How many drinks containing alcohol do you have on a typical day when you are drinking?

Possible response	Points
1 or 2	0
3 or 4	1
5 or 6	2
7 to 9	3
10 or more	4

Question 3: How often do you have six or more drinks on one occasion?

Possible response	Points
Never	0
Less than monthly	1
Monthly	2
Weekly	3
Daily or almost daily	4

[a]The Audit-C is scored on a scale of 0 to 12 by summing the responses to the three questions.
[b]The Audit-C screen is available for use in the public domain.

BOX 2. Categorization of alcohol use risk by Alcohol Use Disorders Identification Test–Consumption (AUDIT-C) score and sex

	Males	Females
Risk level	AUDIT-C score	AUDIT-C score
Low	0–3	0–2
Moderate	4–5	3–5
High	6–7	6–7
Severe	8–12	8–12

TABLE 1. ICD-9 diagnostic codes used for alcohol-related and injury classification

Alcohol-related diagnoses	ICD-9 code
Alcohol dependence	303.x
Alcohol abuse	305.0x
Alcohol-induced mental disorders	291.x
Toxic effect of alcohol	980.x
Excessive blood level of alcohol	790.3
Accidental poisoning by alcohol	E860.x
Alcoholic fatty liver	571.0
Acute alcoholic hepatitis	571.1
Alcoholic cirrhosis of liver	571.2
Alcoholic liver damage, unspecified	571.3
Alcoholic cardiomyopathy	425.5
Alcoholic gastritis	535.3
Alcoholic polyneuropathy	357.5
Personal history of alcoholism	V11.3
Injury diagnoses	**ICD-9 code**
Fractures	800.x–829.x
Dislocations	830.x–839.x
Concussion	850.x–854.x
Internal injuries to thorax, abdomen, pelvis	860.x–869.x
Open wounds	870.x–897.x
Injuries to blood vessels	900.x–904.x
Contusions	920.x–924.x
Crushing injuries	925.x–929.x
Effects of foreign bodies	930.x–939.x
Burns	940.x–949.x
Injuries to nerves	950.x–957.x

RESULTS

Over the study period, 42,473 (3%) PDHA forms were missing AUDIT-C screen responses and were excluded from analysis, resulting in 1,073,840 PDHA forms used in the remaining analyses. Among the PDHRA forms, 37,726 (4%) were missing AUDIT-C screen responses and were excluded from analysis, resulting in 936,475 PDHRA forms used in the remaining analyses.

Risk for alcohol abuse

For service members who completed the AUDIT-C screening, the distributions of alcohol risk levels by their demographic and military characteristics and by form type (PDHA/PDHRA), are shown in **Table 2**. During the initial health assessment period, 8.2% of PDHA forms reflected AUDIT-C scores of 6 or higher, indicating high or severe risk for alcohol abuse. During the health reassessment period, the percentage of PDHRA forms indicating high or severe risk was notably higher at 12.9%. Compared to their respective counterparts, service members whose AUDIT-C responses indicated high or severe risk were more likely to be male, white non-Hispanic, Hispanic, or American Indian/Alaska Native, aged 20–24 years, Marines or soldiers, and working in combat-related or armor/motor transport occupations **(Table 2)**. The proportions with high or severe risk were notably lower among pilots and air crew. Proportions at high or severe risk were greater among

TABLE 2. Counts and percentages of deployers by alcohol use risk level and demographic and military characteristics, active component, U.S. Armed Forces, 2008–2014

	Post Deployment Health Assessment (DD2796)								Post Deployment Health Reassessment (DD2900)							
	Alcohol use risk level[a]								Alcohol use risk level[a]							
	Low		Moderate		High		Severe		Low		Moderate		High		Severe	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	846,498	78.8	139,248	13.0	51,910	4.8	36,184	3.4	603,592	64.5	212,362	22.7	75,771	8.1	44,750	4.8
Sex																
Male	755,227	78.5	121,465	12.6	50,037	5.2	35,350	3.7	535,749	63.8	187,714	22.3	73,134	8.7	43,708	5.2
Female	91,271	81.7	17,783	15.9	1,873	1.7	834	0.7	67,843	70.5	24,648	25.6	2,637	2.7	1,042	1.1
Race/ethnicity																
White, non-Hispanic	549,476	77.4	97,481	13.7	36,749	5.2	26,059	3.7	382,682	62.2	147,679	24.0	53,014	8.6	31,527	5.1
Black, non-Hispanic	136,317	83.9	16,744	10.3	5,641	3.5	3,684	2.3	103,725	72.6	25,793	18.1	8,468	5.9	4,862	3.4
Hispanic	86,985	78.4	14,172	12.8	5,814	5.2	4,046	3.6	64,189	63.8	22,333	22.2	8,739	8.7	5,309	5.3
Asian/Pacific Islander	32,843	81.0	4,728	11.7	1,801	4.4	1,157	2.9	24,467	68.1	7,374	20.5	2,619	7.3	1,474	4.1
American Indian/Alaskan Native	6,478	77.3	1,180	14.1	420	5.0	300	3.6	4,758	62.2	1,853	24.2	692	9.0	351	4.6
Other/unknown	34,399	82.4	4,943	11.8	1,485	3.6	938	2.2	23,771	68.8	7,330	21.2	2,239	6.5	1,227	3.5
Age																
<20	15,573	90.6	745	4.3	422	2.5	449	2.6	5,050	86.2	359	6.1	214	3.7	236	4.0
20–24	294,090	75.6	50,217	12.9	24,108	6.2	20,356	5.2	189,301	58.2	75,946	23.3	35,287	10.8	24,965	7.7
25–29	235,938	77.1	44,299	14.5	15,817	5.2	9,881	3.2	170,210	62.5	67,644	24.8	22,753	8.4	11,795	4.3
30–34	135,824	81.2	22,020	13.2	6,286	3.8	3,111	1.9	104,569	68.7	33,997	22.4	9,280	6.1	4,264	2.8
35–39	92,689	83.4	13,485	12.1	3,423	3.1	1,575	1.4	74,063	72.7	20,422	20.0	5,221	5.1	2,189	2.1
40–44	51,223	86.0	6,301	10.6	1,418	2.4	632	1.1	42,450	76.0	10,104	18.1	2,291	4.1	1,008	1.8
≥45	21,161	88.3	2,181	9.1	436	1.8	180	0.8	17,949	78.5	3,890	17.0	725	3.2	293	1.3
Service																
Army	459,427	75.7	86,045	14.2	36,330	6.0	25,119	4.1	360,291	62.5	134,445	23.3	51,409	8.9	30,087	5.2
Navy	37,505	77.7	7,867	16.3	2,008	4.2	920	1.9	32,761	64.9	13,040	25.8	3,328	6.6	1,358	2.7
Marine Corps	99,657	70.5	21,278	15.0	11,040	7.8	9,479	6.7	67,700	52.1	32,854	25.3	17,038	13.1	12,295	9.5
Air Force	249,909	90.2	24,058	8.7	2,532	0.9	666	0.2	142,840	79.4	32,023	17.8	3,996	2.2	1,010	0.6
Rank																
Junior Enlisted	376,351	77.3	59,864	12.3	27,689	5.7	23,142	4.8	247,563	61.0	89,424	22.0	40,279	9.9	28,567	7.0
Senior Enlisted	332,781	79.4	55,467	13.2	19,227	4.6	11,593	2.8	259,575	66.4	88,476	22.6	28,702	7.3	14,406	3.7
Junior Officer	97,960	80.3	18,450	15.1	4,289	3.5	1,282	1.1	66,926	66.7	26,128	26.0	5,713	5.7	1,543	1.5
Senior Officer	39,406	86.1	5,467	12.0	705	1.5	167	0.4	29,528	75.4	8,334	21.3	1,077	2.7	234	0.6
Occupation																
Combat-related	167,570	71.8	33,589	14.4	17,421	7.5	14,665	6.3	126,469	56.9	53,357	24.0	24,980	11.2	17,559	7.9
Armor/motor transport	39,087	74.5	6,970	13.3	3,553	6.8	2,845	5.4	30,349	61.0	10,869	21.9	5,036	10.1	3,482	7.0
Pilot/air crew	49,368	85.9	6,825	11.9	1,010	1.8	259	0.5	27,277	72.1	8,844	23.4	1,416	3.7	319	0.8
Repair/engineering	223,656	80.6	33,901	12.2	12,282	4.4	7,749	2.8	153,511	65.5	52,709	22.5	18,473	7.9	9,847	4.2
Communications/intelligence	186,401	80.2	30,588	13.2	9,670	4.2	5,796	2.5	133,751	66.8	45,115	22.5	13,887	6.9	7,454	3.7
Healthcare	55,025	80.7	9,112	13.4	2,529	3.7	1,521	2.2	43,657	68.7	14,200	22.3	3,792	6.0	1,915	3.0
Other	125,391	82.3	18,263	12.0	5,445	3.6	3,349	2.2	88,578	69.1	27,268	21.3	8,187	6.4	4,174	3.3
Year of form completion																
2008	84,216	71.7	18,371	15.6	7,993	6.8	6,942	5.9	42,518	52.5	21,527	26.6	9,624	11.9	7,352	9.1
2009	140,386	73.4	29,047	15.2	12,295	6.4	9,415	4.9	84,300	57.1	38,301	26.0	15,169	10.3	9,788	6.6
2010	145,368	75.6	27,950	14.5	11,073	5.8	7,891	4.1	88,591	58.4	38,459	25.4	15,162	10.0	9,434	6.2
2011	158,434	77.1	29,687	14.4	10,686	5.2	6,719	3.3	108,275	65.7	36,941	22.4	12,566	7.6	6,965	4.2
2012	121,561	79.8	20,435	13.4	6,571	4.3	3,843	2.5	115,139	68.5	35,101	20.9	11,713	7.0	6,157	3.7
2013	117,386	90.4	9,133	7.0	2,317	1.8	1,025	0.8	91,432	72.5	24,493	19.4	6,951	5.5	3,219	2.6
2014	79,147	93.0	4,625	5.4	975	1.1	349	0.4	73,337	75.4	17,540	18.0	4,586	4.7	1,835	1.9

[a]As determined by Alcohol Use Disorders Identification Test–Consumption (AUDIT-C) score

enlisted personnel than officers, and among junior rather than senior enlisted and officers. The annual percentages of PDHA and PDHRA forms that indicated high or severe risk for alcohol abuse decreased monotonically between 2008 and 2014. For example, 9.1% of PDHRA forms completed in 2008 indicated severe risk, but only 1.9% of forms in 2014 indicated severe risk **(Table 2)**.

Referrals

The PDHA/PDHRA forms were analyzed to identify service members who were already under care for alcohol abuse, as indicated by a positive response by the healthcare provider who reviewed and certified the form. Among forms indicating severe risk for alcohol abuse, only 1.7% of PDHA forms and 5.0% of PDHRA forms had provider annotations that service members were already under care **(Table 3)**. Among service members who were not already under care, the percentage provided with relevant referrals increased with increasing risk for alcohol abuse. For those in the severe risk category, 26.3% of PDHA forms and 21.7% of PDHRA forms indicated that the service member had been referred to primary care or family practice. Much lower percentages of service members in the severe risk category were referred for specific types of specialized care, such as behavioral health in primary care, mental health specialty care, or a substance abuse program **(Table 3)**. Overall, the forms indicated that among those not already under care but at severe risk, only about 37% received a relevant referral. Put another way, a majority of service members completing forms that indicated severe risk for alcohol abuse did not receive a relevant referral for follow-up care (PDHA: 63.3% and PDHRA: 62.3%).

Focusing on this group of severe- risk individuals not already under care, **Table 4** shows the frequencies of referral by demographic and military characteristics. Compared to their respective counterparts, the proportions of service members with documented referrals were lower for males, white non-Hispanics, younger service members, members of the Air Force, officers, particularly junior officers, and those working in pilot/air crew occupations. Service members working in armor/motor transport occupations were the most likely to have received a referral.

Referrals to primary care/family practice may have been for reasons other than for follow-up care for alcohol abuse. **Figure 1** compares the percentage of deployers at severe risk for alcohol abuse on the PDHRA who received a referral to primary care/family practice with the percentage who received a more specialized referral to behavioral health in primary care, to mental health specialty care, or to the substance abuse program. Overall, PDHRA respondents with severe risk scores and not already under care had a higher percentage of behavioral health referrals than primary care referrals. This was true across most demographic/military characteristics except for service members aged 45 years and older, Marines, senior officers, and pilots/air crew who were all more likely to receive a referral to primary care than to specialty care. Compared to their respective counterparts, the proportions of service members receiving referrals to behavioral specialty care were highest among females, black non-Hispanics, those younger than 20 years of age, sailors, junior enlisted personnel, and service members working in healthcare occupations **(Figure 1)**.

Select alcohol-related questions on the PDHA/PDHRA

The analysis included several additional alcohol use questions on the PDHA/PDHRA. On the 2008 version of the forms, one question asked deployers "Did you use alcohol more than you meant to?" Positive responses to this question increased monotonically from less than 1% among those categorized as low risk to 20.0% (PDHA) and

TABLE 3. Counts and percentages of deployers by alcohol use risk level and type of referral received, active component, U.S. Armed Forces, 2008–2014

	Post Deployment Health Assessment (DD2796)								Post Deployment Health Reassessment (DD2900)							
	Alcohol use risk level[a]								Alcohol use risk level[a]							
	Low		Moderate		High		Severe		Low		Moderate		High		Severe	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	846,498	78.8	139,248	13.0	51,910	4.8	36,184	3.4	603,592	64.5	212,362	22.7	75,771	8.1	44,750	4.8
Already under care[b]	697	0.1	554	0.4	412	0.8	626	1.7	1,522	0.3	1,700	0.8	1,373	1.8	2,237	5.0
Among those not under care																
Referral to primary care, family practice	147,306	17.4	28,701	20.7	11,893	23.1	9,360	26.3	70,086	11.6	27,801	13.2	12,897	17.3	9,241	21.7
Referral to behavioral health in primary care	24,252	2.9	5,850	4.2	3,084	6.0	3,042	8.6	25,597	4.3	12,455	5.9	6,523	8.8	5,703	13.4
Referral to mental health specialty care	19,028	2.2	4,362	3.1	2,310	4.5	2,509	7.1	13,935	2.3	6,316	3.0	3,302	4.4	3,193	7.5
Referral to substance abuse program	264	0.0	494	0.4	589	1.1	1,593	4.5	192	0.0	487	0.2	638	0.9	2,390	5.6
Referral to any of the above types	170,521	20.2	34,359	24.8	15,099	29.3	13,050	36.7	96,665	16.1	40,718	19.3	19,584	26.3	16,023	37.7

[a]As determined by Alcohol Use Disorders Identification Test–Consumption (AUDIT-C) score
[b]Defined as a healthcare provider's positive response to the "Already under care for alcohol use" question (2008 version of the forms) or to the "Already under care" or "Already has referral" reasons for why a referral is not indicated (2012 version of the forms)

38.7% (PDHRA) among those at severe risk for alcohol abuse. The next question (also on the 2008 version of the forms) asked "Have you felt that you wanted to or needed to cut down on your drinking?" Positive responses to this question also ranged from less than 1% among low-risk individuals to 18.5% (PDHA) and 33.8% (PDHRA) among those at severe risk **(data not shown)**.

On the 2012 version of the forms, if the healthcare provider reviewing/certifying the form stated that a referral was not indicated, he or she was asked to record, in cases where the AUDIT-C score was 8 or higher (categorized as severe risk), a reason why no referral was made. Among forms completed where the deployer responses indicated severe risk for alcohol abuse and where the provider did not recommend a referral for follow-up care, the healthcare provider gave "No significant impairment" as the reason for not recommending follow-up care for alcohol abuse on 37.1% of PDHA forms and 34.0% of PDHRA forms **(data not shown)**.

Alcohol-related medical encounters

Service members were categorized according to their highest AUDIT-C score on a qualifying PDHA/PDHRA form, and inpatient and outpatient medical encounters occurring after form completion were searched for an alcohol-related diagnosis **(Table 1)** in any diagnostic position. There was a statistically significant trend of increasing proportions of subsequent alcohol-related diagnoses as the risk level for alcohol abuse increased **(Table 5)**. Seven percent of service members whose highest risk level was categorized as moderate had a subsequent alcohol-related diagnosis during the study period. The percentages of subsequent alcohol-related diagnoses were significantly higher among high-risk individuals (11.7%) and severe-risk individuals (20.0%) **(Table 5)**.

Injury-related medical encounters

In a manner similar to the analysis described above for alcohol-related diagnoses, the health records of service members categorized according to their highest AUDIT-C risk levels were examined for subsequent diagnoses of injury in the first diagnostic position of inpatient and outpatient

TABLE 4. Counts and percentages of deployers at severe risk for alcohol abuse, and not already under care,[a] who received a referral[b] by demographic and military characteristics, active component, U.S. Armed Forces, 2008–2014

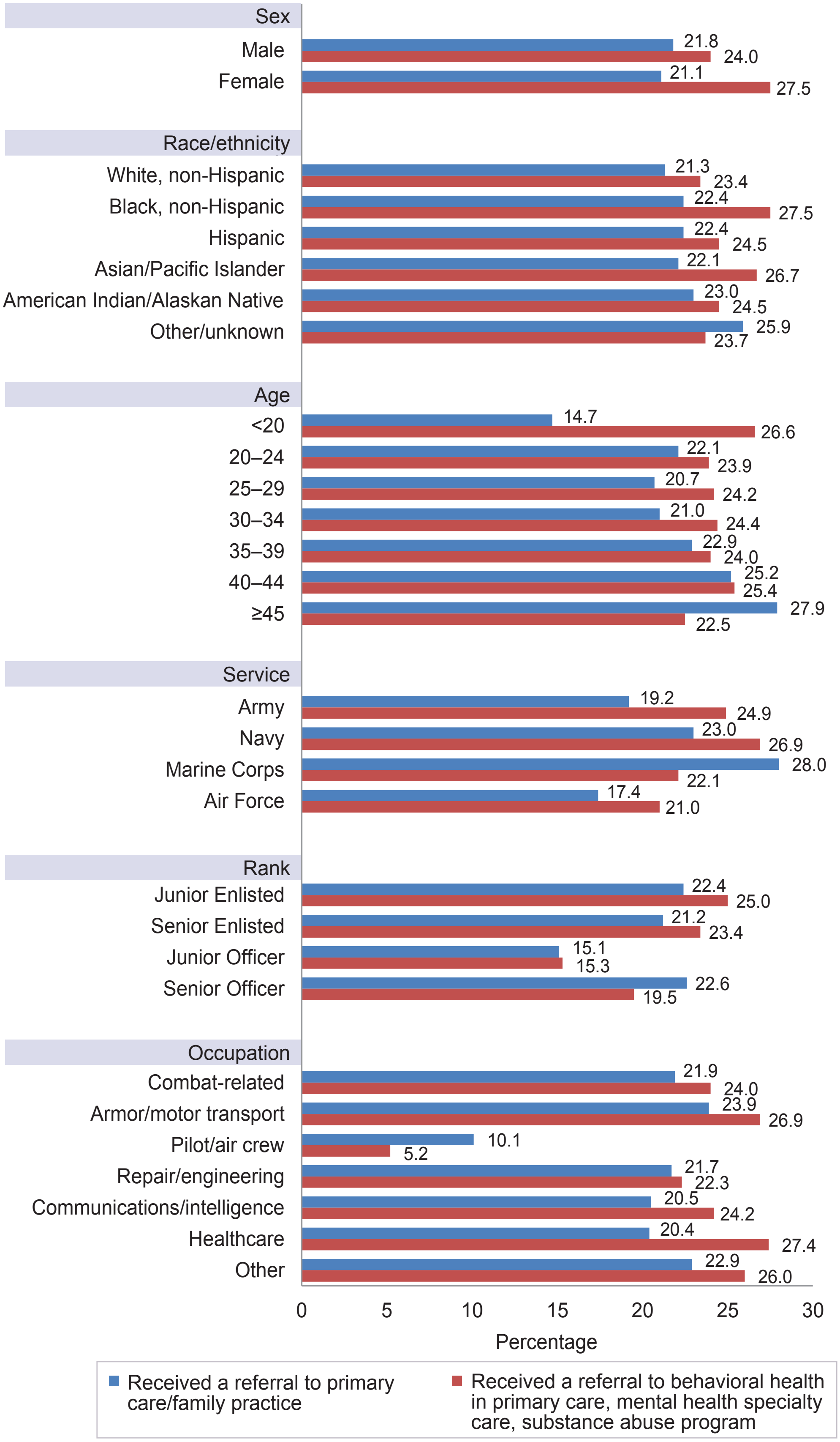
	Post Deployment Health Assessment (DD2796)			Post Deployment Health Reassessment (DD2900)		
	Severe risk and not already under care[a]			Severe risk and not already under care[a]		
	No.	%	p-value[c]	No.	%	p-value[c]
Total	35,558	100.0		42,513	100.0	
Received a referral[b]						
Total	13,050	36.7		16,023	37.7	
Sex			0.0004			0.4694
Male	12,704	36.6		15,647	37.7	
Female	346	42.6		376	38.8	
Race/ethnicity			<0.0001			0.0007
White, non-Hispanic	16,514	35.5		11,113	37.1	
Black, non-Hispanic	2,151	40.6		1,843	40.0	
Hispanic	2,379	40.1		1,907	37.9	
Asian/Pacific Islander	709	37.6		563	39.8	
American Indian/Alaskan Native	187	36.6		130	39.4	
Other/unknown	568	38.1		467	40.3	
Age			<0.0001			0.1375
<20	153	34.7		77	35.3	
20–24	6,835	34.2		9,048	38.1	
25–29	3,786	39.0		4,124	36.9	
30–34	1,242	40.5		1,497	36.8	
35–39	665	43.0		786	37.6	
40–44	284	45.7		379	39.9	
≥45	85	47.2		112	40.6	
Service			<0.0001			<0.0001
Army	9,642	38.9		10,350	36.2	
Navy	316	35.3		497	39.5	
Marine Corps	2,893	31.4		4,871	41.5	
Air Force	199	30.2		305	32.7	
Rank			<0.0001			<0.0001
Junior Enlisted	8,156	35.9		10,553	39.0	
Senior Enlisted	4,480	39.3		4,994	36.3	
Junior Officer	360	28.5		396	26.4	
Senior Officer	54	32.3		80	36.2	
Occupation			<0.0001			<0.0001
Combat-related	5,298	36.7		6,342	37.9	
Armor/motor transport	1,131	40.6		1,360	41.3	
Pilot/air crew	56	22.0		46	14.9	
Repair/engineering	2,673	35.2		3,405	36.3	
Communications/intelligence	2,032	35.6		2,604	36.7	
Healthcare	558	37.6		692	38.8	
Other	1,302	39.3		1,574	40.0	

[a]Defined as a healthcare provider's positive response to the "Already under care for alcohol use" question (2008 version of the forms) or a positive response to the "Already under care" or "Already has referral" reasons for why a referral is not indicated (2012 version of the forms)

[b]Referral to primary care/family practice, behavioral health in primary care, mental health specialty care, substance abuse program

[c]Chi-square test

FIGURE 1. Percentage of deployers completing a Post Deployment Health Reassessment (PDHRA) form categorized at severe risk for alcohol abuse, not already under care, who received a referrral, by referral type and demographic/military characteristics, active component, U.S. Armed Forces, 2008–2014



encounters **(Table 1)**. Once again, there was a statistically significant increasing trend of injury-related encounters as risk for alcohol use increased. Those service members experiencing one or more injury medical encounters increased from 25.3% among low-risk individuals to 29.9% among those with the most severe risk of alcohol abuse **(Table 5)**.

EDITORIAL COMMENT

The results of this analysis indicate that 51,910 (4.8%) PDHA forms were completed with AUDIT-C screens indicating high risk for alcohol abuse and 36,184 (3.4%) indicating severe risk. These numbers increased by the time the PDHRA forms were completed, with 75,771 (8.1%) forms reflecting high risk and 44,750 (4.8%) reflecting severe risk. The percentages of forms categorized as severe risk were highest among white non-Hispanic and Hispanic deployers, those aged 20–24 years, Marines, junior enlisted, and service members working in combat-related occupations, compared to their respective counterparts.

Among the forms completed by service members categorized at severe risk, only a small percentage were already under care at the time of PDHA completion, 1.7%. This percentage increased by the time of PDHRA completion to 5.0%. Despite the serious health and behavioral consequences of sustained alcohol abuse, only a small fraction of service members categorized as being at severe risk, and who were not already under care, received a referral for follow-up care, 36.7% (PDHA) and 37.7% (PDHRA). Even fewer service members received referrals to a substance abuse program, 4.5% (PDHA) and 5.6% (PDHRA). The IOM Report on Substance Abuse Disorders recommended increased integration of alcohol treatment into primary care as a way to decrease stigma.[4] Although it was not possible in this analysis to identify whether a service member was referred to primary care for alcohol abuse treatment or for some other condition, it may be that some of those referred to primary care were in locations where this integrated alcohol treatment capability exists.

There were significant disparities in the percentage of deployers at severe risk for alcohol abuse who received referrals. White non-Hispanic service members were less likely to receive a referral than other race/ethnicity groups. Younger service members

TABLE 5. Counts and percentages of deployers by highest alcohol use risk level[a] on Post Deployment Health Assessement/Post Deployment Health Reassessment (PDHA/PDHRA) forms completed and subsequent medical encounters with alcohol-related and injury diagnoses,[b] active component, U.S. Armed Forces, 2008–2014

	Highest alcohol use risk level[a] among PDHA/PDHRA forms completed by each deployer								
	Low		Moderate		High		Severe		
	No.	%	No.	%	No.	%	No.	%	p-value[c]
No. of alcohol-related diagnoses following form completion									<0.0001
0	490,585	95.2	202,426	93.0	81,438	88.3	53,886	80.0	
1 or more	24,901	4.8	15,237	7.0	10,830	11.7	13,466	20.0	
No. of injury diagnoses following form completion									<0.0001
0	384,820	74.7	160,132	73.6	66,212	71.8	47,247	70.1	
1 or more	130,666	25.3	57,531	26.4	26,056	28.2	20,105	29.9	

[a]As determined by Alcohol Use Disorders Identification Test–Consumption (AUDIT-C) score
[b]ICD-9 diagnostic codes listed in Table 1
[c]Cochran-Armitage Trend Test

completing the PDHA were also much less likely to receive a referral, compared with older personnel, although this disparity disappeared by the time of the reassessment. Officers were much less likely to receive a referral than enlisted service members. Finally, only 22.0% of PDHA and 14.9% of PDHRA forms completed by pilots and air crew received a referral, compared with the highest referral percentages of 40.6% of PDHA and 41.3% of PDHRA forms completed by personnel in armor/motor transport occupations who received a referral for treatment. These striking disparities may be due to the stigma and potential career impact associated with referral for treatment of alcohol abuse. However, it should be borne in mind that a score of 8 or higher on the PDHA/PDHRA AUDIT-C screen, categorized as severe risk, represents an individual who has self-reported an excessive use of alcohol. Combined with the 18.5% of PDHA forms and the 33.8% of PDHRA forms (2008 version) where the deployer at severe risk reported that he or she wanted or needed to cut down on drinking, these health assessment results may indicate a cry for help. When the healthcare provider reviewing these forms indicates that they are not recommending a referral for alcohol abuse treatment, despite the severe risk, because there was no significant impairment (37.1% PDHA, 34.0% PDHRA), they may be missing an opportunity to prevent long-term health consequences.

Some of these long-term health outcomes were subsequently clinically diagnosed in 20% of the deployers who completed the PDHA/PDHRA forms and were categorized as being at severe risk for alcohol abuse. Also troubling is the statistically significant trend of increased risk for diagnoses for injuries following completion of the PDHA/PDHRA among those categorized at increasing risk for alcohol abuse. Failure to address elevated alcohol use early on may affect service members' health and their ability to perform their duties, and may increase their risk of injury. It may also affect service members after they leave service. The Centers for Disease Control and Prevention reported that male veterans aged 25–74 years were significantly more likely to report being heavy drinkers, compared with nonveterans.[7]

One limitation of this analysis is that responses to the health assessment forms are self-reported. Given the stigma associated with alcohol abuse and the possible ramifications to a military career, many deployers may underreport their actual level of alcohol use, or may choose not to respond at all to the AUDIT-C screen. There are also many service members who fail to complete the assessments following redeployment. For these reasons, the percentage of service members returning from deployment who are at elevated risk for alcohol abuse is likely underestimated in this analysis. Another limitation is that there is insufficient information in the medical encounter data to allow determination of which, if any, encounters containing injury diagnoses were due to alcohol use. It is only possible to identify a trend of increased injury associated with increasing alcohol abuse risk.

The IOM report notes repeatedly that healthcare providers are required to notify unit commanders of service members identified with alcohol use problems, which may act to inhibit referrals for treatment.[4] It is possible that healthcare providers, rather than explicitly issuing a referral, may be encouraging at-risk service members to self-refer to confidential treatment programs such as the Army's Confidential Alcohol Treatment and Education Pilot (CATEP).

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Incidence of Gastroesophageal Reflux Disease (GERD), Active Component, U.S. Armed Forces, 2005–2014

Denise O. Daniele, MS; Gi-Taik Oh, MS; Francis L. O'Donnell, MD, MPH (COL, USA, Ret); Leslie L. Clark, PhD, MS

Gastroesophageal reflux disease (GERD) is a common condition among adults that can cause symptoms such as frequent heartburn, substernal chest pain, and regurgitation of food. During 2005–2014, a total of 137,081 active component service members had an incident (first-ever) diagnosis of GERD (incidence rate: 101.3 per 10,000 person-years). Incidence rates were higher than their respective counterparts among females, black and white non-Hispanics, service members in the Coast Guard and Air Force, officers, and those in healthcare occupations. Rates increased monotonically with increasing age groups. Most GERD cases (79.2%) were uncomplicated GERD; however, 20.8% were identified as having a symptom or complication linked to their GERD diagnosis. Lifestyle changes, medication, and prevention of serious complications should be emphasized among individuals diagnosed with GERD, particularly those at risk for severe disease.

Gastroesophageal reflux (GER), also called acid reflux, heartburn, or acid indigestion, occurs when acidic stomach contents flow backward from the stomach into the esophagus. GER causes sensations of minor burning and tightness in the substernal region of the chest where the lower esophageal sphincter is located. GER is a common occurrence in adults and often provokes symptoms after eating a large meal, consuming acidic food or beverages, or lying down too soon after eating. When GER reoccurs regularly or symptoms intensify, a clinician may diagnose gastroesophageal reflux disease (GERD).[1] Symptoms of GERD include frequent heartburn, chest pain, regurgitation of food, and difficulty swallowing. Non-esophageal symptoms, such as sore throat, coughing, hoarseness, asthma-like breathing difficulties, and dental erosion, can also be caused by GERD.

Risk factors for GERD include excess body weight, hiatal hernia, smoking, pregnancy, diabetes, and a family history of GERD. Changes in lifestyle (e.g., losing weight, avoiding acid-inducing food and drink, eating smaller meals) and medications can reduce the symptoms of GERD and prevent damage to esophageal tissues. Untreated GERD can cause scar tissue build-up in the esophagus and may lead to complications such as esophagitis (inflammation of the esophagus), esophageal ulcers, esophageal hemorrhage, esophageal narrowing, Barrett's esophagus (a precancerous condition), and less commonly, cancer of the esophagus.

GERD is common in Western countries with a prevalence of 10%–20% and an incidence rate of approximately 5 per 1,000 person-years (p-yrs).[2] Estimates of the incidence and prevalence of GERD among members of the active component of the U.S. Armed Forces have not been reported; however, diseases of the esophagus, of which GERD is one type, rank second in active component males and third in females in the numbers of ambulatory visits for digestive system disorders.[3] The objective of this report is to describe the counts, rates, trends, and demographic and military characteristics of GERD among active component service members.

METHODS

The surveillance population included all active component members of the Army, Navy, Air Force, Marine Corps, and Coast Guard. The surveillance period was 1 January 2005 through 31 December 2014. Medical encounters used for this report were derived from records maintained in the Defense Medical Surveillance System (DMSS), which document both ambulatory encounters and hospitalizations of active component members of the U.S. Armed Forces in fixed military and civilian treatment facilities (when reimbursed through the Military Health System). An incident case of GERD was defined by medical record documentation of 1) an inpatient or outpatient encounter with ICD-9 code: 530.81 (gastroesophageal reflux, gastroesophageal reflux disease) in the primary diagnostic position or; 2) an inpatient or outpatient encounter with an esophageal complication or extraesophageal symptom ICD-9 code in the primary diagnostic position and ICD-9: 530.81 in any other diagnostic position **(Table 1)**. Each individual could be counted as an incident case just once during the surveillance period.

Because there is a lack of consensus over the basic clinical definition of GERD, the ICD-9: 530.81 code remains ambiguous in regard to the severity of the reflux and whether or not it is transient reflux (GER) or chronic reflux disease (GERD).[2,4–6] For the purposes of this report, all cases of ICD-9: 530.81 identified using the aforementioned definition will be referred to as cases of GERD.

For all GERD cases, the frequencies of associated extraesophageal symptoms and esophageal complications that were diagnosed during or after the case-defining event were identified. For an extraesophageal symptom to be linked to a GERD case, the symptom ICD-9 code

TABLE 1. ICD-9 codes for gastroesophageal reflux (GER) and gastroesophageal reflux disease (GERD) and esophageal complications and extraesophageal symptoms associated with GERD

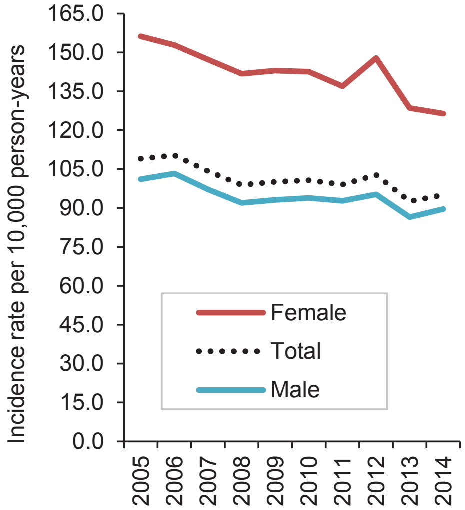
Description	ICD-9 code
GER/GERD	530.81
Esophageal symptoms	
Esophagitis	530.1, 530.10, 530.11, 530.12, 530.19
Esophageal hemorrhage	530.82
Esophageal narrowing	530.3
Barrett's esophagus	530.85
Esophageal leukoplakia	530.83
Ulcer of esophagus	530.2x
Cancer of esophagus	150.xx, 151.0, 230.1
Extraesophageal symptoms	
Cough	786.2
Hoarseness	784.42, 784.49
Laryngitis	476.xx
Asthma/bronchospasm	493.xx, 519.1x
Dental erosion	521.3x

TABLE 2. Incident counts and incidence rates of type of GERD by demographic characteristics, active component, U.S. Armed Forces, 2005–2014

	No.	Rate[a]
Total	137,081	101.3
Sex		
Male	109,660	94.5
Female	27,421	142.3
Race/ethnicity		
White, non-Hispanic	88,130	104.4
Black, non-Hispanic	22,855	105.2
Hispanic	13,583	90.7
Asian/Pacific Islander	4,423	80.0
American Indian/ Alaskan Native	1,008	63.2
Other/unknown	7,082	100.2
Age		
≤19	4,794	41.5
20–24	32,137	68.8
25–29	30,215	97.4
30–34	20,983	108.1
35–39	20,635	140.0
40–44	17,341	214.6
45+	10,976	288.2
Service		
Army	54,146	107.3
Navy	28,099	89.3
Air Force	38,213	123.9
Marine Corps	11,461	61.0
Coast Guard	5,162	135.9
Rank		
Enlisted	113,712	100.7
Officer	23,369	104.2
Occupation		
Combat-specific	12,682	68.5
Armor/motor transport	5,222	92.8
Pilot/air crew	3,997	79.9
Repair/engineer	39,458	100.1
Communications/ intelligence	33,980	115.0
Health care	16,380	149.2
Other/unknown	25,362	96.6

[a]Rate per 10,000 person-years
GERD=gastroesophageal reflux disease

FIGURE 1. Incidence rates of GERD by gender, active component, U.S. Armed Forces, 2005–2014



GERD=gastroesophageal reflux disease

(Table 1) had to be in any diagnostic position of an encounter record that also had ICD-9: 530.81 in the primary or secondary diagnostic position. For an esophageal complication to be linked to a GERD case, the complication ICD-9 code **(Table 1)** had to be in: 1) the primary diagnostic position of a medical encounter; or 2) any other diagnostic position when the primary diagnostic position contained ICD-9: 530.81. Each symptom or complication was counted only once per individual during the surveillance period.

RESULTS

During the 10-year surveillance period, 137,081 active component service members had an incident (first-ever) diagnosis of GERD **(Table 2)**. The crude overall incidence rate was 101.3 per 10,000 p-yrs. During 2005–2014, the incidence rate decreased 12.8% overall and in both males and females (11.4% and 19.1%, respectively) **(Figure 1)**. Crude incidence rates were higher than their respective counterparts among females, black and white non-Hispanics, service members in the Coast Guard and Air Force, officers, and those in healthcare occupations. Rates increased monotonically with increasing age groups.

Most GERD cases (n=108,635; 79.2%) were uncomplicated GERD (i.e., had no symptoms or complications linked to their GERD diagnosis) **(data not shown)**. However, 20.8% (n=28,446) were identified as having a symptom or complication linked to their GERD diagnosis. Among GERD cases, the most commonly diagnosed esophageal complication was esophagitis, which occurred among 14.5% of cases **(Table 3)**. Esophageal narrowing and Barrett's esophagus were each reported among 1.4% of GERD cases. Cancer of the esophagus was diagnosed in 0.03% of cases. Among GERD cases, the most commonly diagnosed extraesophageal symptoms were asthma (2.9%) and cough (2.0%).

The proportions of GERD cases that had esophageal complications were higher among males than females **(Figure 2)**. Of note, the proportions of Barrett's esophagus were highest among American Indian/Alaskan Natives and white non-Hispanics, compared to other race/ethnicity groups **(Figure 3)**.

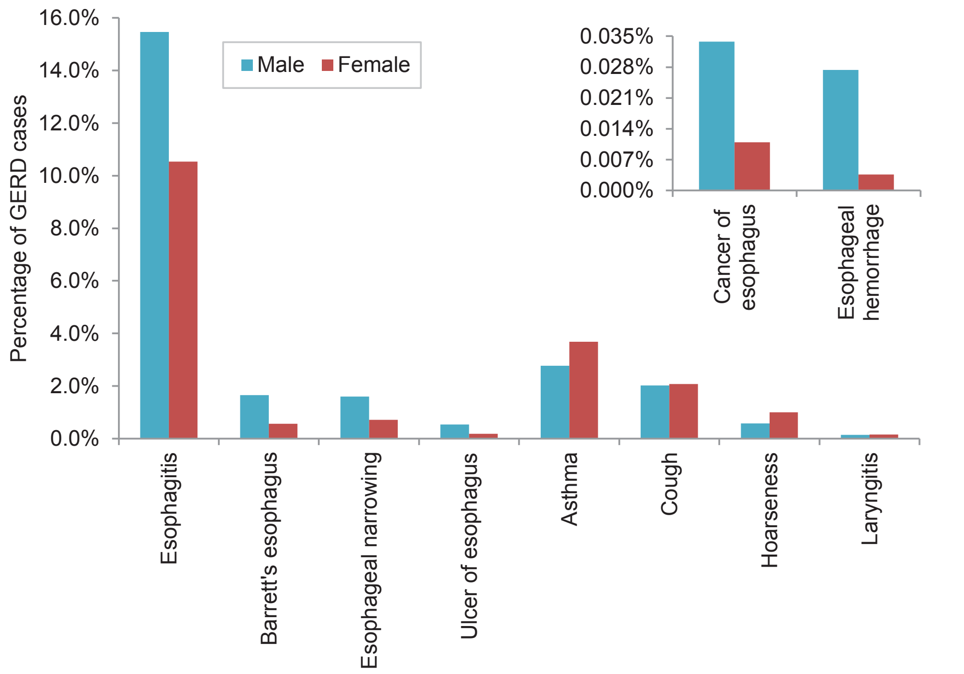
During the surveillance period, the numbers of medical encounters for GERD and of individuals affected decreased 17.0%

TABLE 3. Esophageal complications and extraesophageal symptoms among GERD cases, active component, U.S. Armed Forces, 2005–2014

	No.	% of GERD cases
Esophageal complications		
Esophagitis	19,845	14.5
Esophageal hemorrhage	31	>0.0
Esophageal narrowing	1,945	1.4
Barrett's esophagus	1,974	1.4
Esophageal leukoplakia	4	>0.0
Ulcer of esophagus	643	0.5
Cancer of esophagus	40	>0.0
Extraesophageal symptoms		
Cough	2,786	2.0
Hoarseness	906	0.7
Laryngitis	192	0.1
Asthma	4,040	2.9
Dental erosion	32	>0.0

GERD=gastroesophageal reflux disease

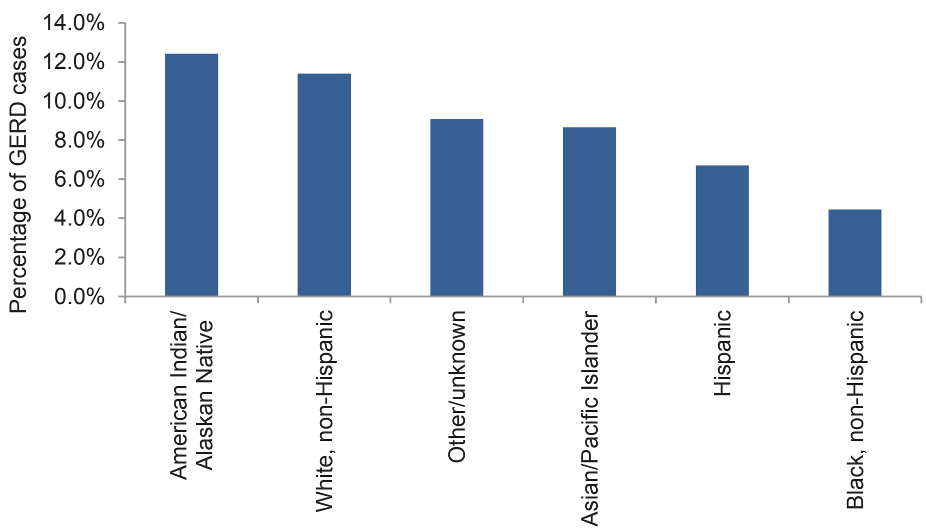
FIGURE 2. Proportions of esophageal complications and extraesophageal symptoms among GERD cases, by gender, active component, U.S. Armed Forces, 2005–2014



Data not shown: esophageal leukoplakia, dental erosion
GERD=gastroesophageal reflux disease

and 16.1%, respectively **(Figure 4)**; however, the ratio of medical encounters per individual remained stable at 1.4 **(data not shown)**. Annual numbers of hospital bed days associated with GERD decreased by 45.7% from 925 bed days in 2005 to 502 bed days in 2014.

FIGURE 3. Proportions of Barrett's esophagus by race/ethnicity among GERD cases, active component, U.S. Armed Forces, 2005–2014



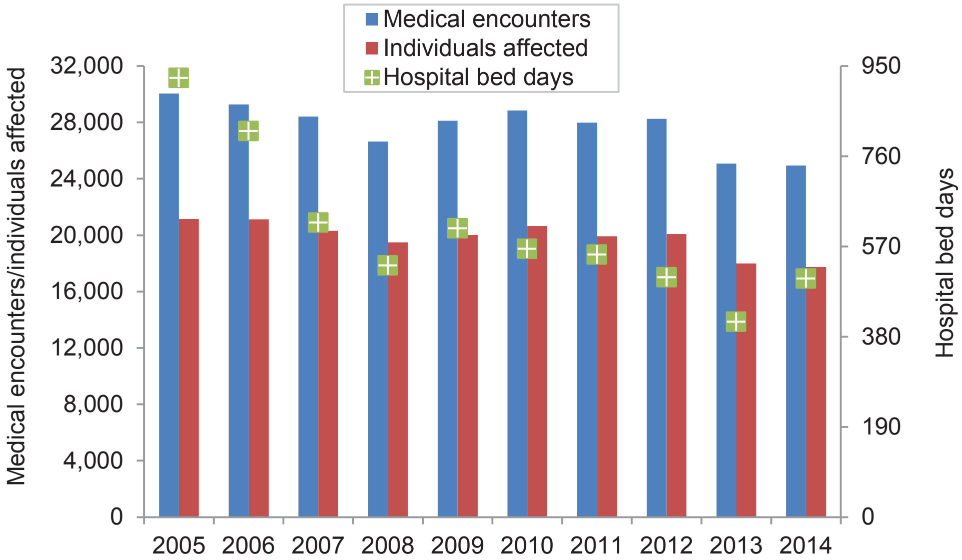
GERD=gastroesophageal reflux disease

EDITORIAL COMMENT

GERD was common among active component service members, affecting nearly 140,000 individuals in a 10-year period. Not surprisingly, advancing age was found to be the most impactful risk factor for GERD diagnosis. Because age markedly varies in relation to other factors considered here (e.g., rank, Service, occupation), the effects of age differences should be accounted for when assessing GERD rates in relation to such factors. For example, officers and individuals in healthcare occupations are relatively older compared to their respective counterparts; thus higher rates of GERD may be attributed to the greater proportions of older individuals within these groups.

A majority (79.2%) of GERD cases identified in this report had neither esophageal complications nor extraesophageal symptoms identified related to their GERD diagnosis. This finding may be a result of the ambiguity of the ICD-9 code used in this report and the continuum of symptoms and severity of reflux and reflux disease. For example, some of the cases identified by the case definition may have represented one-time diagnoses of simple GER and may not have ever been diagnosed with any of the

FIGURE 4. Medical encounters,[a] individuals affected,[b] and hospital bed days for GERD, active component, U.S. Armed Forces, 2005–2014



[a]Medical encounters: total hospitalizations and ambulatory visitis for the condition (with no more than one encounter per individual per day)
[b]Individuals with at least one hospitalization or ambulatory visit for the condition
GERD=gastroesophageal reflux disease

symptoms or complications associated with GERD. Many cases of GER and GERD are treated with dietary and lifestyle modifications that result in resolution of symptoms and lack of progression to more serious complications. Furthermore, for individuals diagnosed late in the surveillance period or shortly before the end of their time in service, there may not have been enough follow-up time for symptoms or complications to develop and to be documented in the DMSS.

Despite a majority of cases being classified as uncomplicated GERD, approximately 30,000 incident cases (20.8%) were identified with either extraesophageal symptoms or esophageal complications during the 10-year surveillance period. Females had higher rates of GERD compared to males, and had higher proportions of extraesophageal symptoms. In this report, females may have had higher rates of GERD because pregnancy is a well-known risk factor for GER/GERD. Males with GERD had higher proportions of all of the individual esophageal complications than females with GERD. These findings are consistent with findings among civilian populations that males and white non-Hispanics had higher rates of esophageal complications—particularly Barrett's esophagus—compared to their respective counterparts.[7,8] Explanations for the higher rates among males and white non-Hispanics are not readily apparent.

Several limitations should be considered when interpreting the results, particularly among GERD cases identified with symptoms and complications. It should also be noted that the extraesophageal symptoms reported as associated with GERD in this report are common in persons who do not have GERD. It is plausible that some of these symptoms in the GERD patients may have had other etiologies, so the recording of a symptom diagnosis and the GERD diagnosis during the same encounter may have been coincidental. Further analysis would be required to ascertain a true association between GERD and the extraesophageal symptoms reported here.

In addition, the esophagitis code set (ICD-9: 530.1) includes a code for reflux esophagitis (ICD-9: 530.11), which some clinicians may be using to define GERD instead of, or in addition to, ICD-9: 530.81. Some of the cases identified with esophagitis as a complication, therefore, may be less severe than inferred, particularly when compared to other types of esophagitis and other complications identified in the report.

In conclusion, although GERD diagnoses are common, in most cases the disease is not very serious and does not cause further complication. However, in a select group of individuals, GERD may progress and impair quality of life and fitness of the force. Lifestyle changes, medication, and prevention of serious complications should be emphasized among individuals at risk for severe disease.

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Surveillance Snapshot: Prevalence of Antibodies to Viral Causes of Vaccine-Preventable Illnesses by State Home of Record Among Air Force Recruits, 25 April 2013–24 April 2014

Paul E. Lewis, MD, MPH (Lt Col, USAF)

This snapshot displays the seroprevalence of antibodies to the viruses of six vaccine-preventable infections according to the state home of record for all 32,502 Air Force recruits arriving at Joint Base San Antonio–Lackland, TX, from 25 April 2013 through 24 April 2014. Serum antibody titers to measles, mumps, rubella, and varicella **(Figure 1),** and hepatitis A and B viruses **(Figure 2)** are measured for all incoming recruits. Recruits are subsequently vaccinated against those viruses for which they are seronegative. A positive antibody titer may indicate either previous vaccination or past natural infection. Further related information can be obtained in "Measles, Mumps, and Rubella Titers in Air Force Recruits: Below Herd Immunity Thresholds?" (Lewis PE, Burnett DG, Costello AA, Olsen CH, Tchandja JN, Webber BJ. *Am J Prev Med.* July 2015; in press).

FIGURE 1. Proportions of Air Force recruits with measurable serum antibody levels to measles, mumps, rubella, and varicella viruses, according to their state home of record, 25 April 2014–24 April 2014

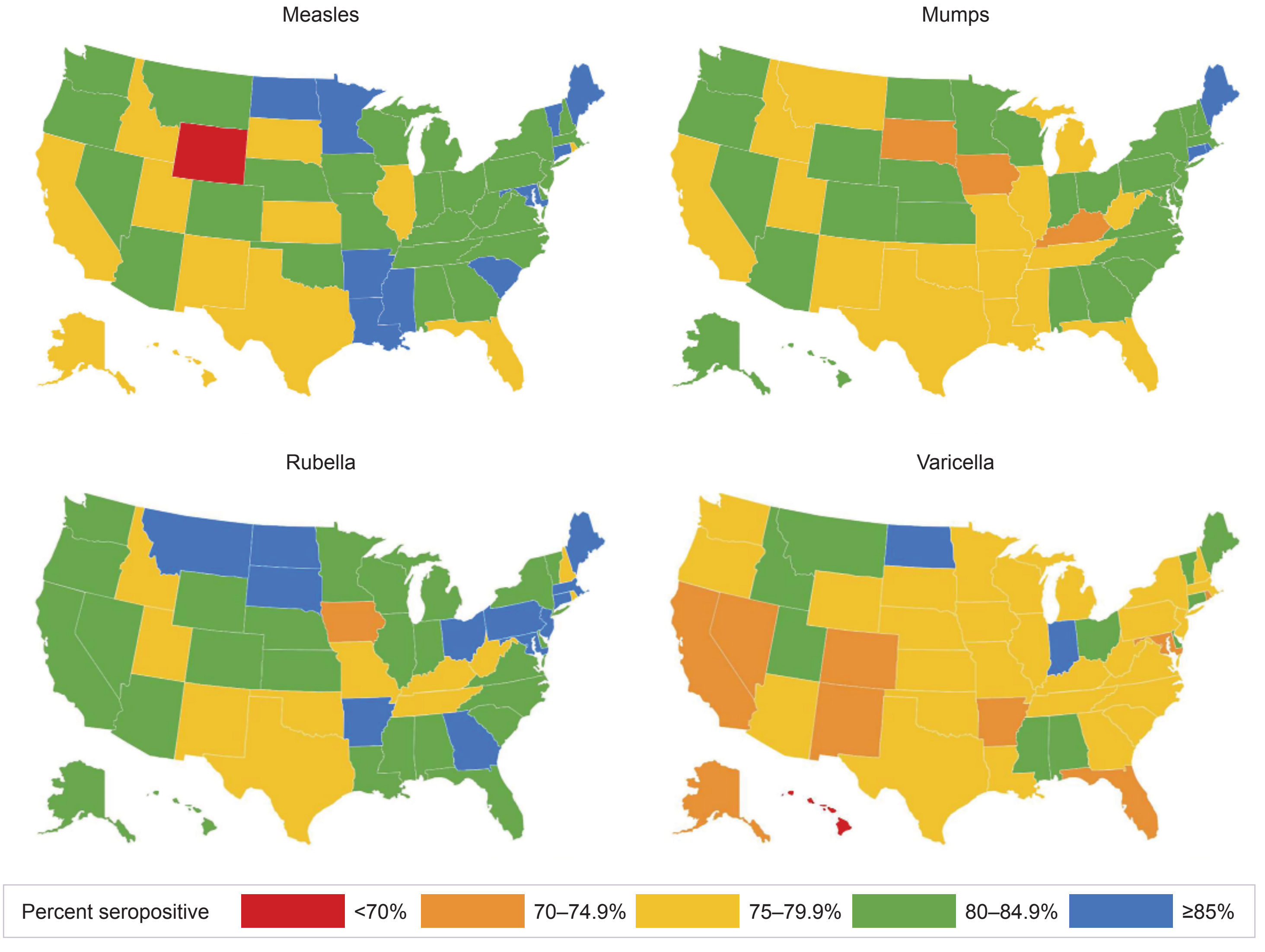
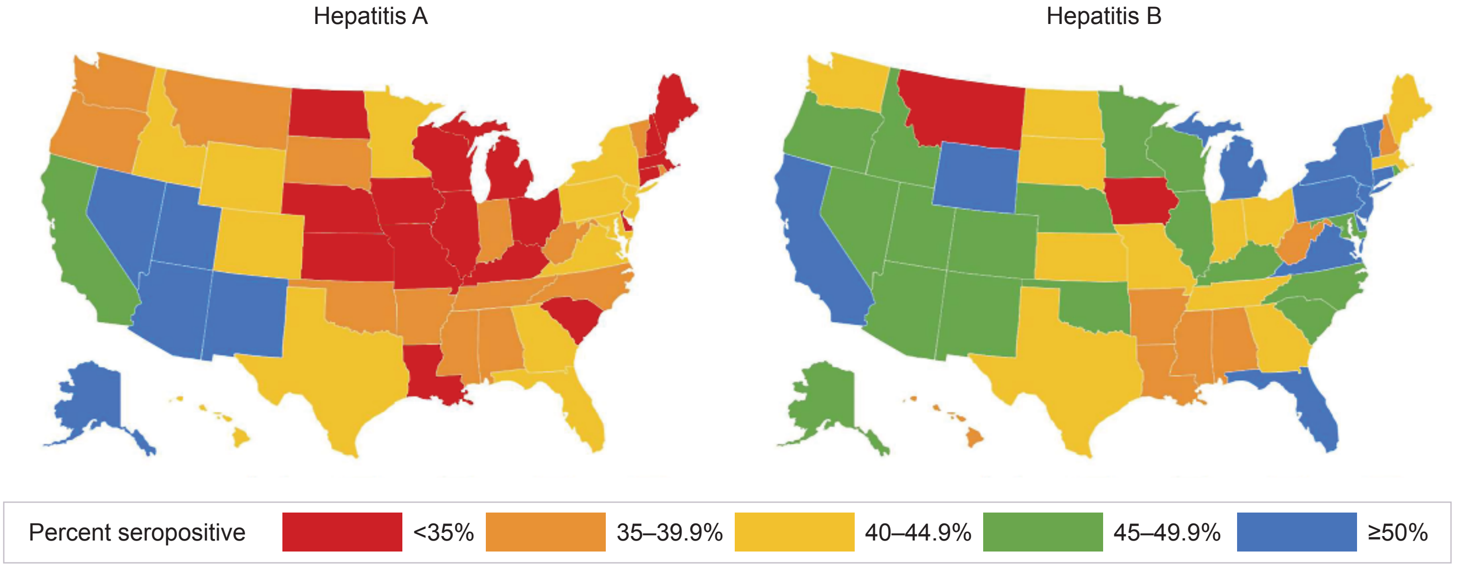


FIGURE 2. Proportions of Air Force recruits with measurable serum antibody levels to hepatitis A and B viruses, according to their state home of record, 25 April 2013–24 April 2014



MSMR's Invitation to Readers

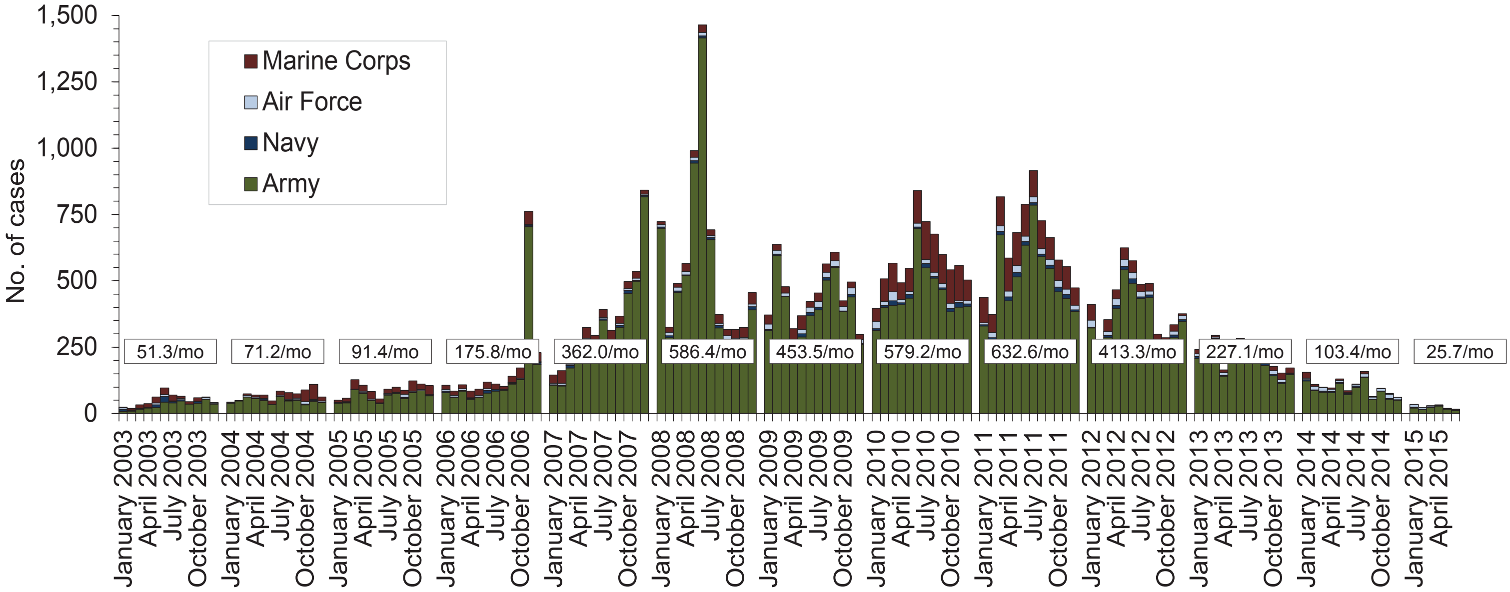
The *Medical Surveillance Monthly Report (MSMR)* invites readers to submit topics for consideration as the basis for future *MSMR* reports. The *MSMR* editorial staff will review suggested topics for feasibility and compatibility with the journal's health surveillance goals. As is the case with most of the analyses and reports produced by the Armed Forces Health Surveillance Center (AFHSC) staff, studies that would take advantage of the healthcare and personnel data contained in the Defense Medical Surveillance System would be the most plausible types. For each promising topic, AFHSC staff members will design and carry out the data analysis, interpret the results, and write a manuscript to report on the study. This invitation represents a willingness to consider good ideas from anyone who shares the *MSMR*'s objective to publish evidence-based reports on subjects relevant to the health, safety, and well-being of military service members and other beneficiaries of the Military Health System.

In addition, the *MSMR* encourages the submission for publication of reports on evidence-based estimates of the incidence, distribution, impact, or trends of illness and injuries among members of the U.S. Armed Forces and other beneficiaries of the Military Health System. Instructions for authors can be found on the *MSMR* page of the Armed Forces Health Surveillance Center website at: http://www.afhsc.mil/msmr/Instructions.

Please email your article ideas and suggestions to the *MSMR* editorial staff at: usarmy.ncr.medcom-afhsc.mbx.msmr@mail.mil.

Deployment-Related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–June 2015 (data as of 21 July 2015)

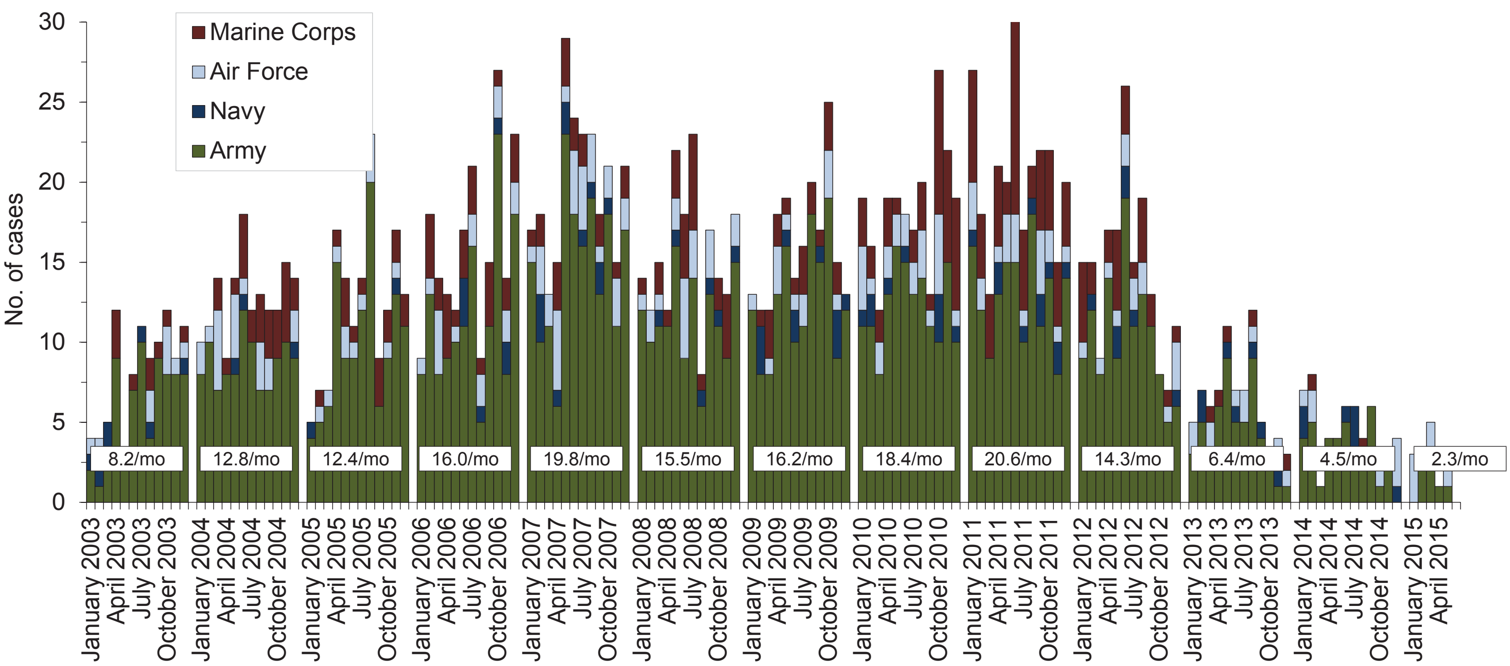
Traumatic brain injury (TBI) (ICD-9: 310.2, 800–801, 803-804, 850–854, 907.0, 950.1–950.3, 959.01, V15.5_1–9, V15.5_A–F, V15.52_0–9, V15.52_A–F, V15.59_1–9, V15.59_A–F)[a]



Reference: Armed Forces Health Surveillance Center. Deriving case counts from medical encounter data: considerations when interpreting health surveillance reports. *MSMR*. 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 4,599 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]

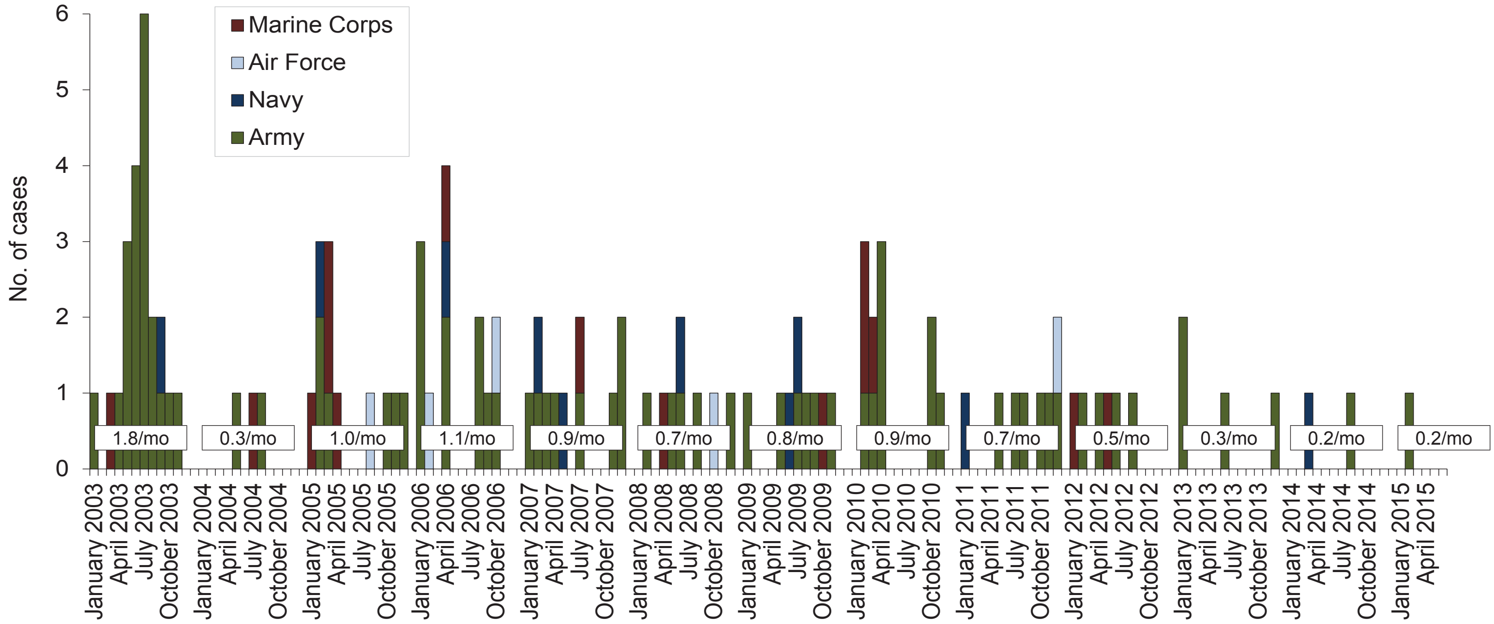


Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379–383.

[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–June 2015 (data as of 21 July 2015)

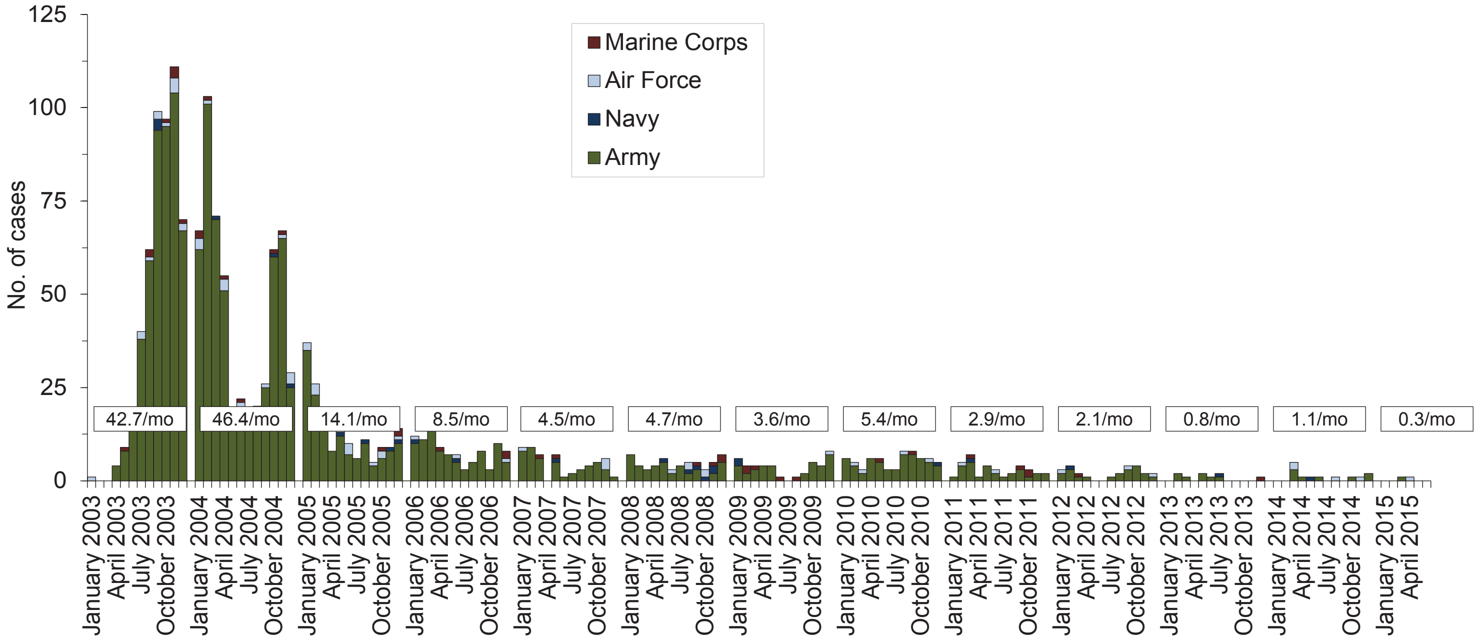
Severe acute pneumonia (ICD-9: 518.81, 518.82, 480–487, 786.09)[a]



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*. 2004;10(6):6–7.

[a]Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 30 days of returning from OEF/OIF/OND.

Leishmaniasis (ICD-9: 085.0–085.9)[b]

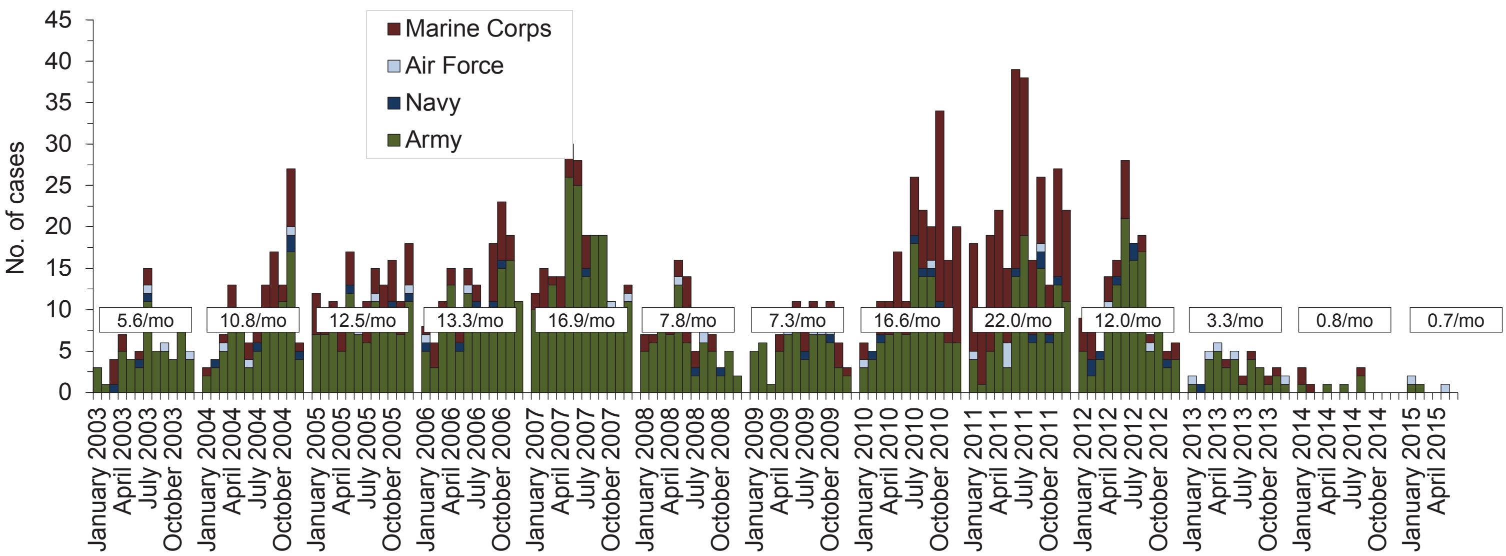


Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: leishmaniasis. Leishmaniasis among U.S. Armed Forces, January 2003–November 2004. *MSMR*. 2004;10(6):2–4.

[b]Indicator diagnosis (one per individual) during a hospitalization, ambulatory visit, and/or from a notifiable medical event during/after service in OEF/OIF/OND.

Deployment-Related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–June 2015 (data as of 21 July 2015)

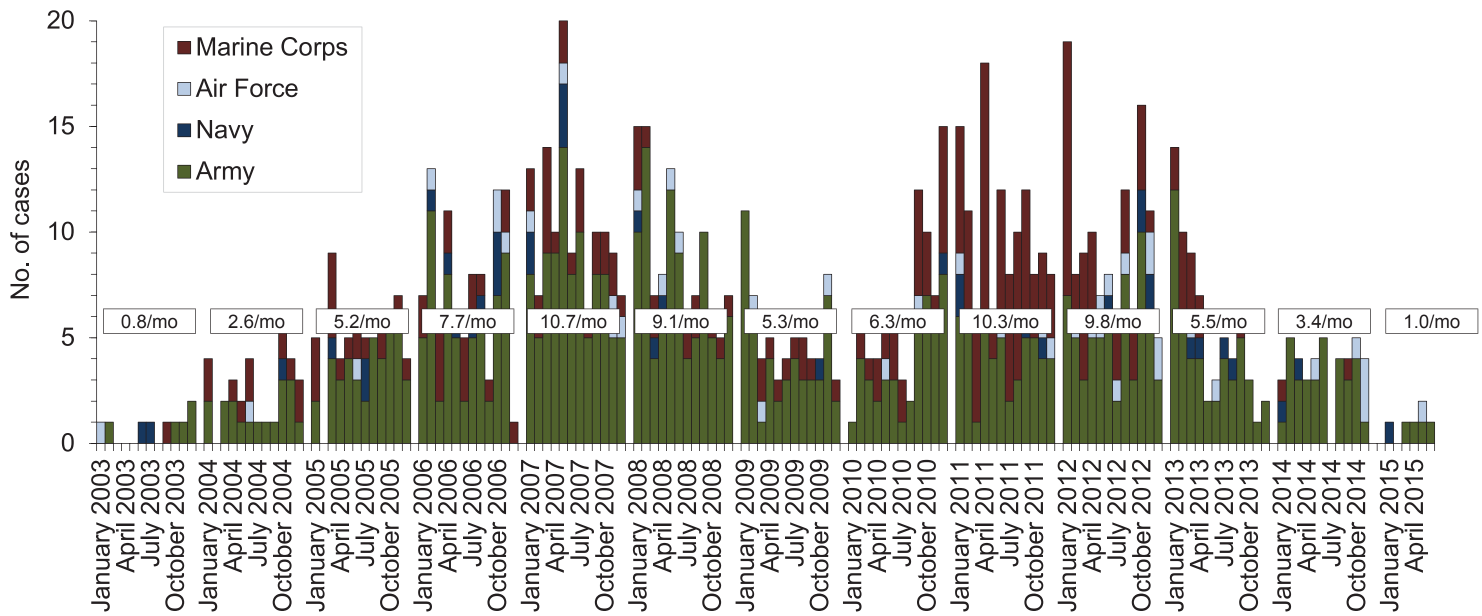
Amputations (ICD-9-CM: 887, 896, 897, V49.6 except V49.61–V49.62, V49.7 except V49.71–V49.72, PR 84.0–PR 84.1, except PR 84.01–PR 84.02 and PR 84.11)[a]



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*. 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]

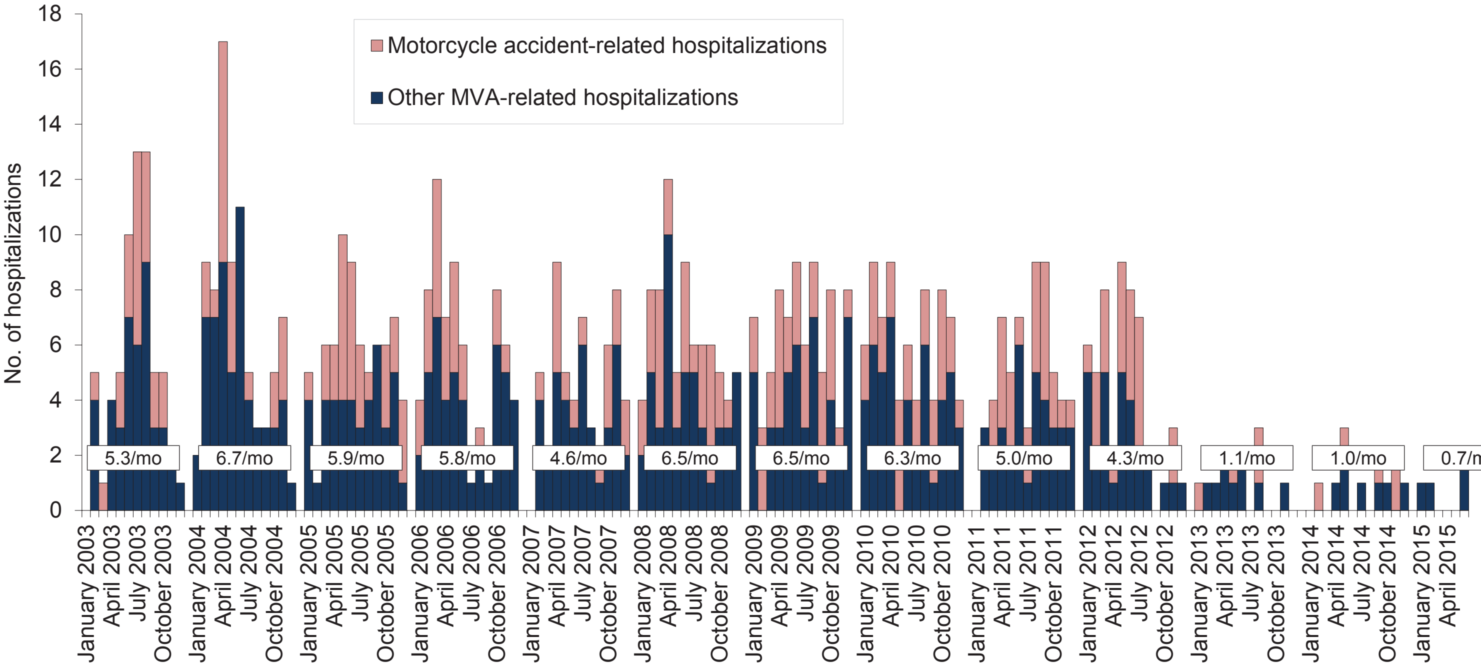


Reference: Army Medical Surveillance Activity. Heterotopic ossification, active components, U.S. Armed Forces, 2002–2007. *MSMR*. 2007;14(5):7–9.

[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

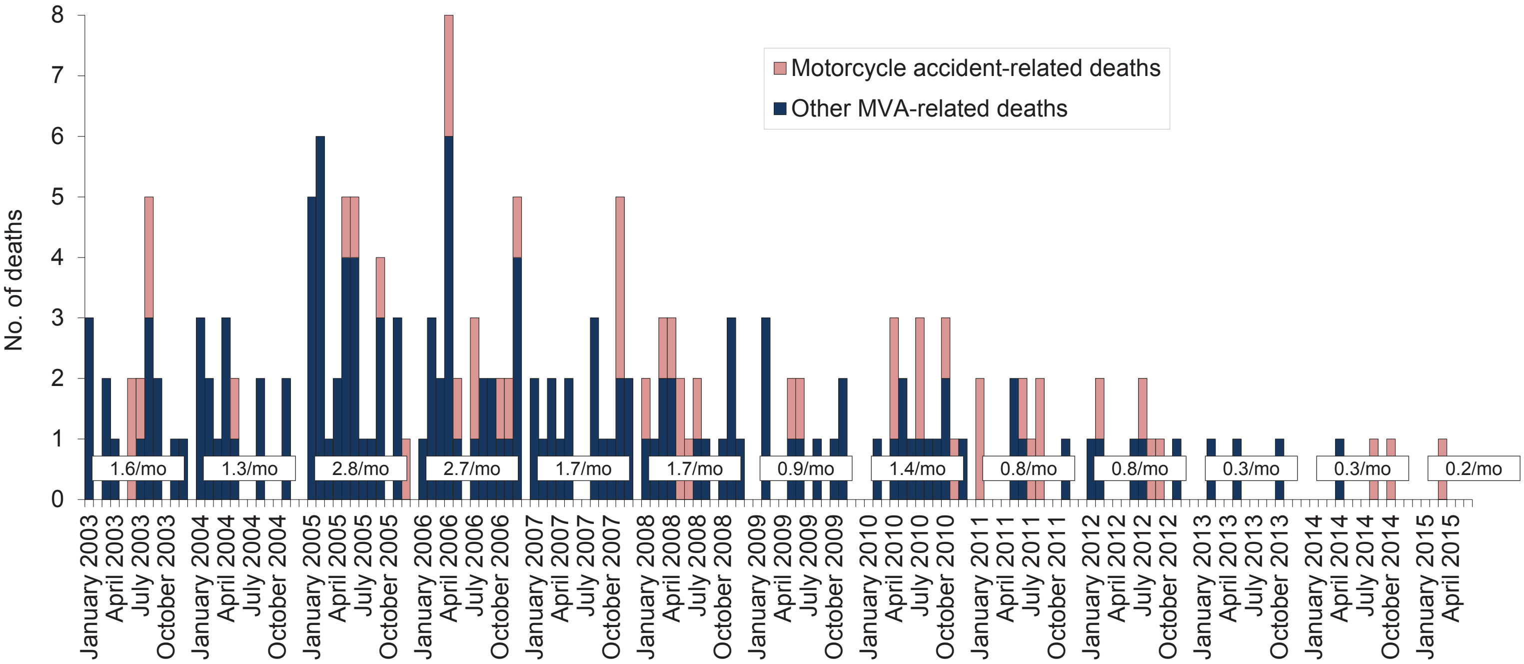
Deployment-Related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–June 2015 (data as of 20 July 2015)

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



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

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



Reference: Armed Forces Health Surveillance Center. Motor vehicle-related deaths, U.S. Armed Forces, 2010. *MSMR*. 2011;17(3):2–6.

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

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

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

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